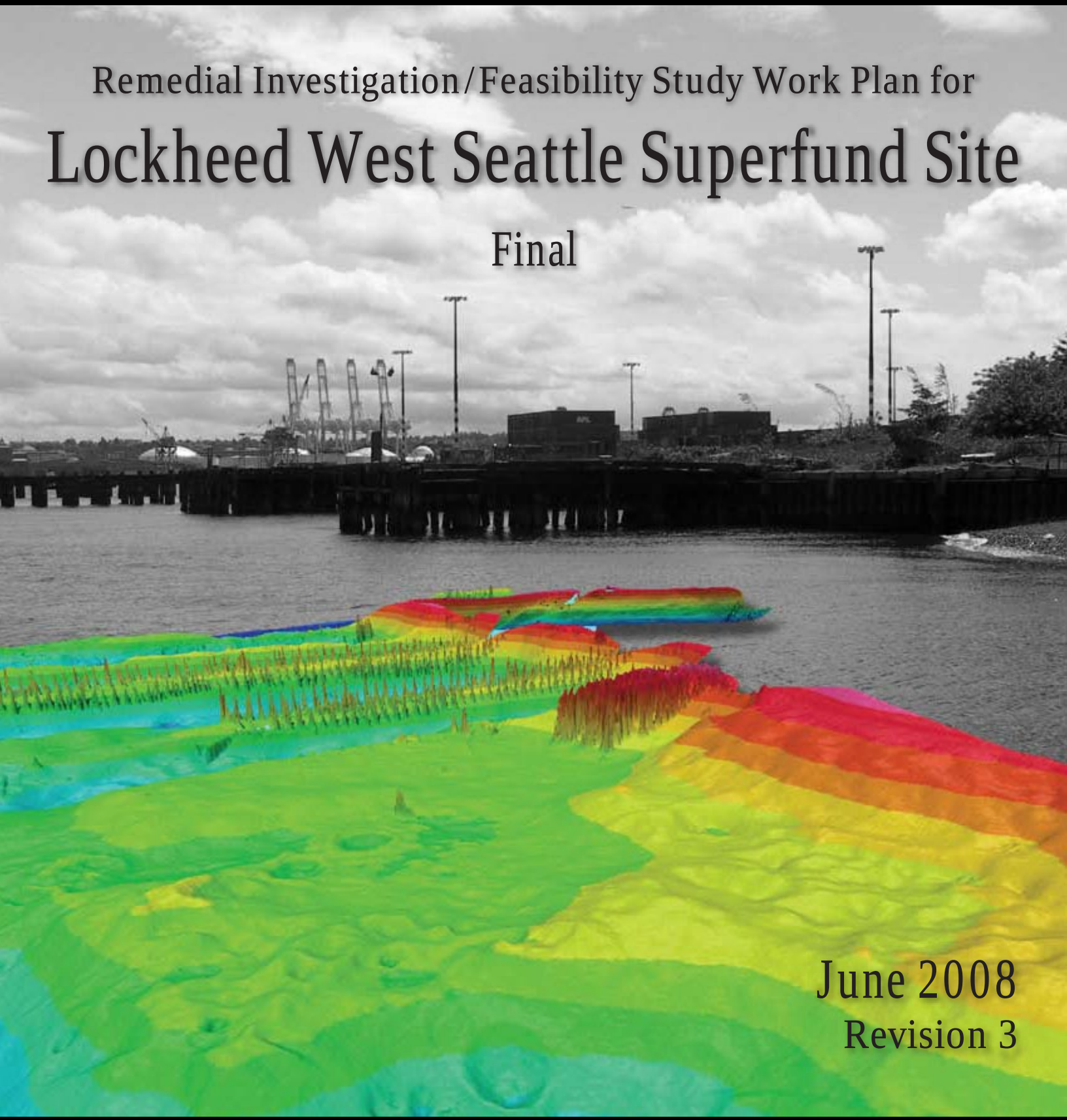
Remedial Investigation/Feasibility Study Work Plan for

Lockheed West Seattle Superfund Site

Final



June 2008
Revision 3

Prepared for LOCKHEED MARTIN

Prepared by TETRA TECH

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK PLAN FOR LOCKHEED WEST SEATTLE SUPERFUND SITE

Final

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Lockheed Martin Corporation

Prepared by

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ACRONYMS AND ABBREVIATIONS

AKART	all known, available, and reasonable technologies
ANSI	American National Standards Institute
ARAR	applicable or relevant and appropriate requirements
ASAOC	Administrative Settlement Agreement and Order on Consent
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWQC	Ambient Water Quality Criteria
BCF	bioconcentration factor
BEHP	bis(2-ethylhexyl)phthalate
BSAF	biota-sediment accumulation factor
BW	body weight
CAP	Cleanup Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFS	cubic feet per second
CHE	Coast and Harbor Engineering, Inc.
COC	chemical of concern
COI	chemical of interest
COPC	chemical of potential concern
CPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	cleanup screening level
CSM	Conceptual Site Model
CST	Column Settling Test
CWA	Clean Water Act
CY	cubic yard
DFC	daily food consumption
DMMP	Dredged Material Management Program
DNR	Washington State Department of Natural Resources
DQO	Data Quality Objective

ACRONYMS AND ABBREVIATIONS (CONTINUED)

DRET	Dredging Elutriate Test
DSC	daily sediment consumption
dw	dry weight
DW/HW	dangerous waste/hazardous waste
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ER	exceedance ratio
ERA	Ecological Risk Assessment
Framework	tribal framework
FWM	food web model
g/cm^3	grams per cubic centimeter
g/day	grams per day
GIS	Geographic Information System
GRA	general response actions
GWCMP	Groundwater Confirmation Monitoring Program
H	horizontal
HASP	Health and Safety Plan
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	hazard index
HPAH	high-molecular weight polycyclic aromatic hydrocarbon
HQ	hazard quotient
IRIS	Integrated Risk Information system
LAET	lowest apparent effects threshold
LDW	Lower Duwamish Waterway
LMC	Lockheed Martin Corporation
LOAEL	lowest-observed-adverse-effect-level
LPAH	low-molecular weight polycyclic aromatic hydrocarbon

ACRONYMS AND ABBREVIATIONS (CONTINUED)

LSSOU	Lockheed Shipyard Sediment Operable Unit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MCUL	minimum cleanup level
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
mg/kg-OC	milligrams per kilogram organic carbon normalized
mg/L	milligrams per liter
mL	milliliters
MLLW	mean lower low water
MNR	monitored natural recovery
MS/MSD	matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act
NAD	North American Datum
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
NOAA	National Oceanic Atmospheric Association
NOAEL	no-observed-adverse-effect-level
NPL	National Priorities List
O&M	operation and maintenance
OC	organic carbon
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polycyclic aromatic hydrocarbons
Pb	lead
PCB	polychlorinated biphenyls
Port	Port of Seattle
ppm	part per million
PRG	preliminary remediation goal
PROPWASH	propeller wash modeling

ACRONYMS AND ABBREVIATIONS (CONTINUED)

PSAMP	Puget Sound Ambient Monitoring Program
PSDDA	Puget Sound Dredge Disposal Analysis
PSEP	Puget Sound Estuary Program
PSR	Pacific Sound Resources
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSAR	Qualitative Structure Information System
RA	risk assessment
RAO	remedial action objective
RBACG	risk-based analytical concentration goal
RBC	risk-based concentration
RBG	risk-based goal
RBTC	risk-based threshold concentration
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RfD	reference dose
RG	remediation goal
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RM	river mile
RME	reasonable maximum exposure
ROC	receptor of concern
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SEDQUAL	Sediment Quality Information System
SHIPWAVE	ship-induced waves
Site	Lockheed West Seattle Superfund Site
SMS	Washington State Sediment Management Standards
SMU	sediment management unit

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SOW	statement of work
SQS	sediment quality standard
SRI	Supplemental Remedial Investigation
SVOC	semivolatile organic compound
SWAC	spatially weighted average concentration
SWH	Southwest Harbor
SWHCRP	Southwest Harbor Cleanup and Redevelopment Project
TBC	to be considered
TBT	tributyltin
TCLP	toxicity characteristic leaching procedure
TEQ	toxic equivalency quotient
TM	Technical Memorandum
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TRV	toxicity reference value
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code
WDFW	Washington Department of Wildlife
WDOH	Washington State Department of Health

1. INTRODUCTION

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan describes the procedures and activities that will be completed by the Lockheed Martin Corporation (LMC) for the RI/FS of sediment areas at the Former Lockheed Shipyard No. 2, located in Seattle, Washington (henceforth referred to as the Lockheed West Site or Site). This Work Plan was prepared as required by the Administrative Settlement Agreement and Order on Consent (ASAOC) (U.S. Environmental Protection Agency [EPA] Docket No. CERCLA-10-2006-0321/Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]) and accompanying Statement of Work (SOW) for the Lockheed West Seattle Superfund Site.

The RI/FS described in this Work Plan will be completed in accordance with the ASAOC. The RI/FS process for the Lockheed West Site described in this Work Plan and diagramed on Figure 1-1 is based on flexible and cooperative effort between EPA and LMC. This effort aims to produce a protective, timely, and cost-effective remediation strategy for the Site.

EPA approval of this Work Plan will fulfill the requirements specified in Section II, Task I of the SOW. During the development of this Work Plan, EPA approved the Site Characterization Sampling and Analysis Plan (Appendix C) and Quality Assurance Project Plan (Appendix D) in January 2007 to allow LMC to expedite investigation of the site, including: sediment sampling, site surveying, and reconnaissance activities. Sampling plans for these activities are referred to as proposed, including those that will have been completed by the time of EPA's final approval. Data resulting from implementation of these activities are described in the past tense in Chapter 8 of this Work Plan.

1.1 PURPOSE OF THE LOCKHEED WEST RI/FS

The purposes of completing an RI/FS for the Lockheed West Site are to (a) determine the nature and extent of contamination (i.e., define the site cleanup boundary) and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants or contaminants at or from the Site, by conducting an RI; and (b) identify and evaluate remedial alternatives to prevent, mitigate, or otherwise respond to or remedy any release or threatened release of hazardous substances, pollutants, or contaminants at or from the Site, by conducting a FS. The Lockheed West RI/FS will be conducted in accordance with the provisions of the ASAOC, SOW, CERCLA, National Contingency Plan (NCP), and EPA guidance, including, but not limited to, the "Interim

Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (Office of Solid Waste and Emergency Response [OSWER] Directive #9355.3-01, October 1988 or subsequently issued guidance), "Guidance for Data Usability in Risk Assessment" (OSWER Directive #9285.7-05, October 1990 or subsequently issued guidance) and guidance referenced therein, and guidance referenced in the SOW, as may be amended or modified by EPA. A project roadmap, diagramming the primary project phases, key considerations, and SOW is presented in Figure 1-1.

1.2 DESCRIPTION OF THE LOCKHEED WEST SEATTLE SUPERFUND SITE

The area of investigation for this RI/FS (henceforth referred to as the Site) is located in the southwest corner of Elliott Bay, and consists of the areal extent of sediment contamination (as determined by environmental sampling) and sources thereto from the former shipyard facility also known as Lockheed Shipyard No. 2, which was located at 2330 Southwest Florida Street in West Seattle, Washington. For purposes of illustration, the historical property boundaries are shown on the figures but are not intended to represent the cleanup boundary which will be determined following the completion of the RI/FS and based on extent of historical shipyard contamination. The area of investigation includes both the property occupied by the former shipyard and the areas of Elliott Bay and the West Waterway immediately adjacent to the former shipyard property.

The Site is bounded by Elliott Bay on the north, Harbor Island West Waterway on the east, and Pacific Sound Resources (PSR) Superfund Site on the west (Figure 1-2). It includes approximately 7 acres of aquatic land now owned by the Port of Seattle (Port) (formerly owned by LMC) and approximately 20 acres owned by Washington Department of Natural Resources (DNR) and historically leased to LMC.

LMC discontinued operations at Lockheed Shipyard Number 2 in 1987 after approximately 45 years of continuous operations by Lockheed and others that included shipbuilding, ship repair, and ship maintenance. Past industrial practices at or adjacent to the facility have resulted in contamination of aquatic sediments. The contaminants found in the aquatic area include hazardous substances associated with shipbuilding, repair, and maintenance activities, consistent with the historical uses of the facility. Other contaminants not directly associated with shipyard activities may be present at the Site.

Historical shipyard contaminants of potential concern (COPCs) include, but are not limited to, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), mercury, other metals, and other organic compounds.

Associated sediments are habitat to numerous fish and other aquatic species, and are within a migratory corridor for endangered, threatened, and other anadromous fish.

Pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, EPA proposed the Site for inclusion on the National Priorities List (NPL) on September 26, 2006. The Lockheed West Seattle Site was listed on the NPL on March 7, 2007.

1.3 WORK PLAN ORGANIZATION

This Work Plan is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Project Approach, Team, Deliverables, and Schedule
- Section 3 – Listing of Applicable Standards
- Section 4 – Summary of Existing Information
- Section 5 – Preliminary Identification of Remedial Action Objectives and Potential Remedial Alternatives
- Section 6 – Preliminary Remediation Goals
- Section 7 – Sediment Stability
- Section 8 – Sampling and Analysis
- Section 9 – Data Management
- Section 10 – Field Data Collection and Data Reporting
- Section 11 – Risk Assessment Work Plan
- Section 12 – Source Control Evaluation
- Section 13 – Remedial Investigation and Feasibility Study
- Section 14 – Community Involvement Activities
- Section 15 – References

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Project Phase

Key Considerations

- Risk assessments completed for the nearby Lower Duwamish Waterway Superfund Site indicate that No-Action and Natural Recovery remedial alternatives may not achieve an acceptable level of protectiveness at the Lockheed West Site.
- EPA and LMC have agreed to evaluate only capping and dredging alternatives to address historical shipyard contamination at the site.
- Extensive existing site data will be utilized to identify data gaps for investigation of the site. Only validated existing sediment quality data will be utilized for the RI/FS.
- Data collection will focus on delineation of the site boundary and fulfillment of data gaps for evaluation of capping and dredging alternatives for the site.
- Site-specific human health and ecological risk assessments will be streamlined given that active remediation will be completed throughout the site. Additionally, a range-finding study to identify potential background concentrations for the site COCs from within Elliott Bay will be completed. Other efforts to characterize background may be required.
- Site cleanup will consider the results of the streamlined human health and ecological risk assessments as well as the results of the background determination. Site sediment cleanup criteria will be based on the higher of either risk-based concentrations identified from the streamlined risk assessments or background concentrations.
- Source control evaluation will determine the status of potential souces of recontamination of the Site after remediation and make recommendations to EPA on how to address potential sources, if identified.

- Surface and subsurface sediment quality samples will be collected and analyzed for historical shipyard COCs to determine the nature and extent of contamination.
- Site bathymetric and shoreline inventory data will be collected to characterize the physical attributes of the site.
- Samples will be collected from within and adjacent to the property boundary of the former shipyard facility to delineate the site cleanup boundary.
- Range-finding samples will be collected from greater Elliott Bay to assist in determining background concentrations for Lockheed West COCs.
- Shoreline survey will be completed to identify nearshore site features.
- A clam reconnaissance survey and potential tissue analysis will be completed to identify the presence or absence of deposit feeding clams at the site and for BSAF calculations.

- Streamlined human health and ecological risk assessments will be completed using procedures established by the Lower Duwamish Waterway Superfund site and Tribal Risk Framework, as appropriate.
- Data collected during the site investigation will be utilized to calculate risk-based cleanup criteria.

- Site-specific cleanup levels for historical shipyard COCs will be risk-based concentrations derived from the streamlined risk assessments or based on background concentrations, whichever are higher.
- Site-specific cleanup levels will be used to delineate the extent of historical shipyard contamination and delineate site cleanup boundary.
- Remedial Action Objectives will include consideration of Port of Seattle, Department of Natural Resources and tribal fishery future site uses.
- Screening of remedial alternative technologies will be limited to capping and dredging technologies applicable to site conditions.
- Remedial alternatives will be assembled for capping, dredging and combinations of these remediation technologies. Only alternatives meeting the Remedial Action Objectives and the Applicable Standards will be carried forward for evaluation and ranking.
- The assembled site-specific remedial alternatives will be evaluated and ranked relative to CERCLA criteria.
- A preferred alternative will be identified based on the comparative evaluation and relative ranking of the assembled alternatives. The preferred alternative will be described in detail relative to the comparative criteria and will be recommended to EPA for consideration in the Preferred Plan for the Lockheed West Site.

Scope of Work

Summarize Existing Data

Develop Preliminary Conceptual Site Model

Identify Data Gaps

Remedial Investigation/Feasibility Study Work Plan

- Project Approach, Management, and Schedule
- Applicable Standards
- Summary of Existing Data
- Site Investigation SAP, QAPP, HSP
- Streamlined Human Health Risk Assessment
- Streamlined Ecological Risk Assessment
- Source Control Evaluation

Field Data Collection and Laboratory Analysis

Additional Data Collection (if necessary)

Site Investigation Data Report(s)

Refinement of Conceptual Site Model

Baseline Ecological Risk Assessment

Baseline Human Health Risk Assessment

Remedial Investigation and Feasibility Study Report

- Data Summary and Final Conceptual Site Model
- Identification of Remediation Goals (Cleanup Levels)
- Delineation of Cleanup Boundary
- Identification of Remedial Action Objectives
- Screening of Appropriate Remedial Technologies
- Develop Remediation Alternatives
- Remedial Alternatives Evaluation and Ranking
- Identification of Preferred Remedial Alternative

TETRA TECH

Lockheed West Shipyard No. 2 Seattle, WA

Figure 1-1
Project Roadmap:
Lockheed West Remedial Investigation and Feasibility Study



Figure 1-2 Site Vicinity Map

TETRA TECH EC, INC.

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2. PROJECT APPROACH, TEAM, DELIVERABLES, AND SCHEDULE

This section provides information on the project approach, team, deliverables, and schedule for completion of the Lockheed West RI/FS.

2.1 STREAMLINING THE RI/FS PROCESS

Authority for the cleanup of the Lockheed West Site was transferred from the Washington Department of Ecology (Ecology) to EPA Region 10 in September 2006. Since this time, EPA and LMC have held several planning meetings for the purposes of finding acceptable ways to streamline the RI/FS process. Given that a significant body of data is available for the Site, both EPA and LMC desire to expedite cleanup of the Site. The existing data and precedents at nearby EPA cleanup sites have allowed for efficiencies that will streamline the Lockheed West RI/FS and allow cleanup of the Site to be implemented in a protective and time-efficient manner.

Prior to the transfer of the Site, Lockheed West (then referred to as Lockheed Shipyard No. 2) was listed as a sediment cleanup priority by Ecology who had developed a Cleanup Action Plan (CAP) for the Site in 1996 after completion of a cleanup investigation. The Ecology CAP was never implemented. However, the studies supporting the Ecology CAP produced a significant amount of data that are useful in developing and understanding the nature and extent of sediment contamination at the Site prior to implementation of the investigation that is the subject of this Work Plan.

In addition to the Ecology CAP and supporting studies, other information relevant to completion of Lockheed West RI/FS is available from EPA Superfund sites nearby and adjacent to Lockheed West. To the immediate west of Lockheed West is the PSR Superfund Site. Sediment area remedial actions were implemented at the PSR Site in 2002. East of Lockheed West is the West Waterway Operable Unit (OU) of the Harbor Island Superfund Site. The West Waterway OU is subject to a No-Action Record of Decision (ROD). Upstream of the West Waterway OU is the Lower Duwamish Waterway (LDW) Superfund Site. The LDW Site is currently undergoing an RI/FS to address sediment contamination.

Sediment remediation goals will be established for the Lockheed West Site as part of the RI/FS. These numbers will be derived from baseline human health and ecological risk assessments (ERAs) that will identify sediment contaminants of concern (COCs) and from evaluation of background concentrations of COCs. Baseline risk assessments completed for

the nearby LDW Site have shown that the sediment cleanup criteria for aquatic organisms established by Ecology's Sediment Management Standards (WAC 173-204) may not meet cleanup levels based on EPA human health risk thresholds for PCBs and other COCs and site-specific exposures including the tribal framework for tribal seafood consumption (the Framework). Similarly, based on the risk assessments, it has been recognized that risk-based sediment cleanup levels for PCBs at the LDW Site may be below background concentrations for the LDW. LMC and EPA recognized, without completing baseline risk assessments for the Lockheed West Site, that similar risk assessment outcomes are likely to result for some of the historical shipyard COCs.

Because of the likelihood that the in-situ chemical concentrations in Lockheed West sediment will result in exceedances of human health or ecologically based thresholds, LMC recognized that No Action and Natural Recovery as primary remedial alternatives at the Site would not likely meet CERCLA criteria for remedy selection. LMC therefore committed to elimination of these non-active remedial technologies. At the minimum, remediation of the Site will consist of placing caps over all contaminated sediments. Dredging, capping or some combination of dredging and capping are the only remedial alternatives under consideration at this time.

Limiting the remediation technologies for the Lockheed West Site allows the RI/FS process to be streamlined in that:

- Data collection can be focused on delineation of the cleanup boundary and filling of data gaps for completion of risk assessments and evaluation of capping and dredging technologies;
- Baseline human health and ecological risk assessments will be completed as applicable, consistent with the procedures established at the LDW Superfund Site and the draft Framework (EPA 2007d), as appropriate, and will use data collected during the site investigation to identify COCs and to determine risk-based cleanup criteria;
- Risk-based cleanup criteria will be identified for COCs identified in the risk assessments, and will be derived largely from the upstream LDW site;
- Background concentrations for COCs (to be determined in coordination with EPA, Muckleshoot and Suquamish tribes, and other stakeholders) will be considered as cleanup criteria if risk-based cleanup criteria are lower and, therefore, not practically achievable; and
- Remedial alternatives will be assembled for capping, dredging, and combinations of these remediation technologies. Only alternatives meeting the cleanup criteria,

remedial action objectives (RAOs), and the applicable standards will be carried forward for evaluation and ranking.

2.2 LOCKHEED WEST RI/FS SCOPE OF WORK

The RI/FS process includes several steps. RI activities are any activities necessary to develop sufficient information to support the development of remedial options, assess the potential human health and ecological risks from site contamination, and assess the potential for sediment recontamination. FS activities are those activities that evaluate and assemble remedial alternatives in support of the selection of the preferred remedial option. To implement the Lockheed West RI/FS, the following SOW will be completed;

- Compile and assess existing site data to identify potential data gaps for evaluation of remedial alternatives;
- Identify chemicals of interest (COIs) resulting from historical shipyard activities;
- Characterize the nature and delineate the extent of historical shipyard COIs by collection and analysis of environmental samples (as identified by data gaps) and completion of physical surveys of the project area and shoreline;
- Delineate a cleanup boundary for the Lockheed West Site based on the Site investigation data;
- Refine the Conceptual Site Model (CSM) based on interpretation of the site investigation data;
- Complete baseline human health and ecological risk assessments to identify site COCs and risk-based cleanup criteria, and background sediment sampling to identify appropriate cleanup levels for remediation of the Site;
- Identify site-specific RAOs for remediation of the Site;
- Identify appropriate remedial technologies and assemble applicable remediation alternatives for cleanup of the Site;
- Evaluate assembled remedial alternatives against CERCLA criteria; and
- Recommend a preferred remedial alternative based on the comparative evaluation and relative ranking of the assembled alternatives. The preferred alternative will be recommended to EPA for consideration in the Preferred Plan for the Lockheed West Site.

Descriptions of the approaches and procedures for completion of each of these project steps are detailed in the following sections of this Work Plan.

2.3 EXPEDITED SITE CHARACTERIZATION SAMPLING AND ANALYSIS PLAN

Both EPA and LMC recognized that collection of site data early in the RI/FS would assist in streamlining the evaluation of remedial alternatives for the Site. Sampling and analysis was carried out in January 2007. To facilitate efficient review and approval by EPA, the Site Characterization Sampling and Analysis Plan (SAP) was submitted as a stand-alone document and is a component of this RI/FS Work Plan. The Site Characterization SAP describes a sampling and analysis plan approach for the Lockheed West Site and was prepared as a stand-alone document to expedite collection of site data. EPA comments on the site investigation approach were incorporated into the study design; however, rangefinding sampling locations were not approved by EPA. As agreed with EPA, collection of additional site data early in the site cleanup process will lead to better informed decision making and determination of appropriate cleanup measures.

2.4 PROJECT TEAM

Tetra Tech, Inc. (Tetra Tech) is the primary contractor to LMC represented by Gene Matsushita, Program Manager. Mr. Matsushita or his designee, Mr. Bill Bath (Project Coordinator), will be responsible for coordination with regulatory agencies and overall implementation of the ASAOC and SOW. Tetra Tech will be responsible for project management, and conducting RI and FS tasks. Tetra Tech will also be responsible for preparing project deliverables, team resources, project budget and financial controls, scheduling, coordination, and communications. Tetra Tech is supported by John Herzog (GeoEngineers) and Gary Pascoe (Pascoe Environmental Consulting), who will provide risk assessment support. In accordance with Section VIII of the ASAOC, project team qualifications were provided to EPA. The project team organization is presented in Table 2-1 and Figure 2-1.

2.5 PROJECT DELIVERABLES

Following is a description of the planned project deliverables that will be prepared in addition to this Work Plan. All documents will be prepared in accordance with EPA guidelines for conducting an RI/FS. Further, the quality of all reports and submittals to EPA will be ensured by strict adherence to the Tetra Tech Quality Assurance (QA) program, including, but not limited to, internal technical and editorial review, independent verification of all calculations used in the RI/FS, documentation of all reviews, and the process to be used to identify and correct problems. This program has been formatted and designed to meet the requirements of the latest versions of American National Standards Institute/American Society of Mechanical Engineers, Nuclear QA (ANSI/ASME NQA-1),

Ecology Order 5700.6, as well as applicable EPA QA requirements and other recognized and appropriate engineering codes, standards, requirements, and practices. Tetra Tech procedures and criteria applicable include, but are not limited to, the following:

- SCI-002 Technical Review of Scientific Documents,
- QA-3 Control of Work Process,
- QA-6 Document Control,
- ENG-7 Design Verification, and
- ENG-8 Record Drawings.

A full listing of Tetra Tech procedures will be provided to EPA upon request.

2.5.1 Progress Reports

LMC will submit monthly progress reports to the EPA Project Coordinator by the 10th of the month for the preceding reporting period. If this day is a weekend or holiday, progress reports will be submitted on the next business day. Progress reports will, at a minimum, contain the following information regarding the preceding reporting period:

- Description of actions that have been taken to comply with the ASAOC and SOW during the previous month,
- Summary of results of sampling and tests and all other data received by LMC,
- Description of all work planned for the next 2 months with schedules relating such work to the overall project schedule for RI/FS completion, and
- Description of all problems encountered and any anticipated problems, any actual or anticipated delays, and solutions developed and implemented to address any actual or anticipated problems or delays.

2.5.2 Data Collection Report

The Data Collection Report will present the results of the RI field investigation, including:

- Description of the field activities completed;
- Deviations from the approved Work Plan, SAP, Quality Assurance Project Plan (QAPP), or Health and Safety Plan (HASP);
- Tabulated chemical, physical, and biological data with comparisons to regulatory criteria (where applicable);
- Sample identification matrix;

- Sample location and sample identification information;
- Data validation reports;
- Field logs;
- Chain of custody forms; and
- Electronic data, submitted in accordance with EPA instructions for formatting digital data (EPA 1993a) and in a format compatible with software currently available within EPA Region 10 (Microsoft® Access format).

All data will be submitted to EPA in an acceptable electronic format.

2.5.3 Source Control Evaluation Report

The Source Control evaluation will identify and assess potential sources of contamination to the Lockheed West Site (Site). The purpose of the source control evaluation is to document the current status of source control and to determine whether there are sources with the potential to recontaminate the Site following its planned remediation.

The objectives of this Source Control Evaluation are to:

1. Identify potential sources and assess the potential pathways and the potential for recontamination of Lockheed West following its remediation.
2. Evaluate whether the resuspension, transport, and deposition of bottom sediments in the adjacent Elliott Bay and West Waterway are a potential ongoing source of chemical contamination that could result in recontamination of Lockheed West after remediation.
3. Qualitatively compare available source information to existing sediment quality data.
4. Identify data gaps that should be resolved so that the status of source control at Lockheed West can be confirmed.
5. Make recommendations to the EPA regarding the need for further investigation or control of identified potential sources.

The Source Control Evaluation approach will be further refined through technical workshops with EPA and the project stakeholders. Details of the Source Control Evaluation approach stemming from the technical workshops will be documented and submitted for review and approval.

2.5.4 Remedial Investigation and Feasibility Study Report

LMC will prepare and submit a draft and final Remedial Investigation/Feasibility Study (RI/FS) Report for EPA review and approval. This report will present an evaluation of the nature and extent of contamination at the Site and evaluate remedial alternatives for cleanup. The individual elements of the RI/FS Report are described below.

2.5.4.1 Remedial Investigation

The remedial investigation section will summarize all useable data into a complete evaluation of the nature and extent of contamination at and from the Site. It will also include discussions of historical data, chemical fate, sediment transport, and historical and potential ongoing sources of contamination. LMC will use EPA RI/FS guidance for an outline of the report format and required contents.

2.5.4.2 Baseline Ecological and Human Health Risk Assessments

The baseline risk assessments will be streamlined consistent with the RI approach described above. Because of the decision to actively remediate the entire Site, the no-action alternative and natural recovery alternatives will be evaluated to the extent required by CERCLA, however, these alternatives are not intended for serious consideration. Instead, the entire Site will be actively remediated to mitigate all assumed human health and ecological risks. The presence of Site contamination requires performance of a baseline risk assessment to indicate the potential extent of risk under present site conditions, and to support the remedy selection for the sediments that will mitigate the risk.

Risks to human health and ecological receptors from exposures to chemicals in Site sediments will be evaluated through streamlined approaches. The streamlined risk assessment (RA) will evaluate potential risk by structuring the assessments to use technical information from the risk assessments performed at the nearby LDW site.

The streamlined Human Health Risk Assessment (HHRA) will evaluate the potential for human health risks to adults and children from site sediments and consumption of fish/shellfish tissue. The baseline HHRA will include (at a minimum), with justification, the following exposure scenarios: 1) tribal seafood consumption and clam harvesting, 2) recreational child beach play, and 3) tribal netfishing. It will address risks to seafood-consuming tribal individuals by utilizing relevant material from the LDW HHRA, as appropriate, and applying the Framework on seafood consumption.

2.5.4.3 Remedial Action Objectives

Remedial Action Objectives (RAOs) will be identified to provide a framework for the evaluation of remedial alternatives as part of the feasibility study. The RAO section will include the following:

- List of final COCs as determined from the baseline risk assessments,
- Identification and rationale for goals and technical basis for cleanup level goals (preliminary remediation goals [PRGs], applicable or relevant and appropriate requirements [ARARs], risk assessments), and
- Identification of cleanup boundaries based on determined cleanup level goals.

2.5.4.4 Remedial Technologies Screening and Alternatives Assembly

The remedial technologies screening section will identify and screen remedial technologies and assemble representative alternatives to reduce the number of alternatives to be considered for detailed analysis in the FS. This process consists of the general steps described below.

- Develop general response actions (GRAs) for each medium of concern defining removal, containment, attenuation, or other actions, singly or in combination, which may be taken to satisfy the RAOs for the Site.
- Identify preliminary volumes or areas of media to which GRAs might be applied, taking into account the requirements for protectiveness as identified in the RAOs and the chemical and physical characterization of the Site.
- Identify and screen the technologies and process options (e.g., specific processes within each technology type) applicable to each GRA to ensure that only those technologies and process options applicable to the contaminants present, their physical matrix, and other site characteristics will be considered. Given the streamlined RI/FS approach for the Site, the technologies and process options to be screened will include:
  - In-place confinement (capping), and
  - Dredging with upland disposal in existing landfills.

  This screening will be based primarily on a technology's ability to effectively address the contaminants at the Site, but will also take into account a technology's implementability, constructability, and cost.
- Combine retained technologies and process options into media-specific or site-wide representative alternatives. The developed alternatives will be defined with respect to size and configuration of the representative process options, time for remediation,

rates of flow or treatment, spatial requirements, distances for disposal, and other factors necessary to evaluate the alternatives.

2.5.4.5 Feasibility Study

The FS section will summarize applicable results of the RI and risk assessments, and will include the results of the RAO identification and remedial alternatives screening. The results of the FS will provide the basis for remedy selection by EPA and will document the development and detailed analysis of remedial alternatives. This FS will apply CERCLA evaluation criteria to the remedial alternatives identified by the remedial alternatives screening to ensure the selected remedial alternative(s) will:

- Protect human health and the environment;
- Be in compliance with, or include a waiver of, ARARs;
- Be cost-effective;
- Utilize permanent solutions and alternative treatment technologies, or resource recovery technologies, to the maximum extent practicable; and
- Address the statutory preference for treatment as a principal element.

For each alternative described in the FS, the report will include: 1) a description of the alternative that outlines the sediment management strategy involved and identifies the degree of protectiveness and key ARARs associated with each alternative; and 2) an assessment of each alternative against each of the CERCLA criteria except Criteria 8 (state acceptance) and 9 (community acceptance) which will be addressed by EPA after the RI/FS report has been released to the public.

2.5.5 Meetings

Although not a specific project deliverable, several meetings are anticipated to ensure that planning and communication for the RI/FS is undertaken in a manner that is cost-effective and timely. LMC and EPA will hold meetings for the purpose of briefing EPA or responding to EPA comments or concerns. These meetings will be held as deemed necessary and appropriate by the parties, and may include a review of project deliverables and coordination with other agencies, such as:

- Coordination on sampling and data gap fulfillment approach,
- Coordination with EPA and other parties regarding baseline human health and ecological risk assessments,
- Coordination with EPA and other parties regarding habitat issues,

- Coordination with EPA and other parties regarding existing and future site use plans, and
- Coordination with EPA and Ecology to identify areas and activities that may require implementation of source control measures prior to remedial actions at the Site.

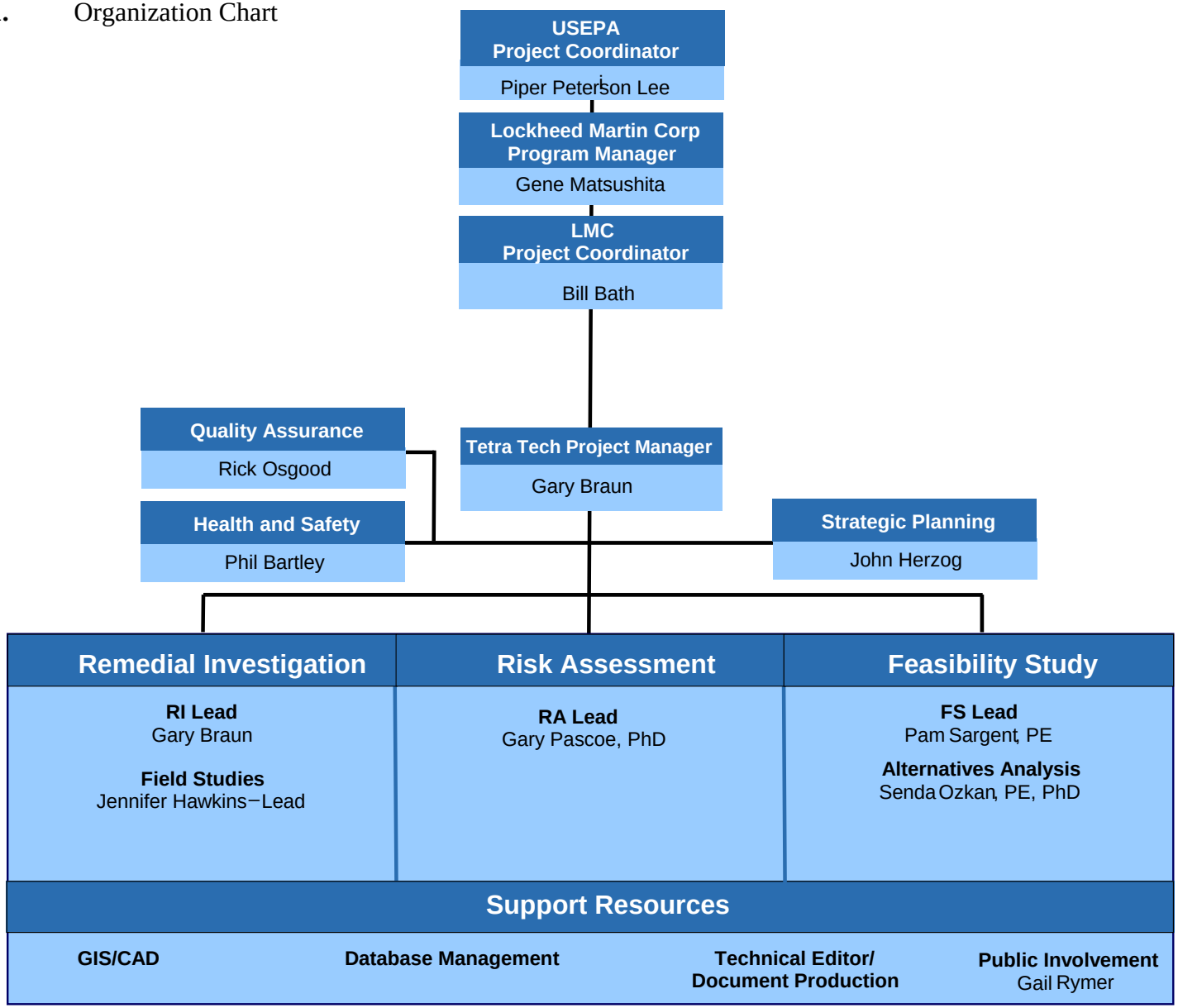
2.6 SCHEDULE OF ACTIVITIES

This section describes a schedule for the completion of the ASAOC/SOW tasks (in calendar days). The schedule for performing the RI/FS tasks, as set forth in Section III of the SOW, is presented in Figure 2-2. Initial draft deliverable due dates to EPA are listed in Section III of the SOW. Revised deliverables (including one redlined version) are due 30 days after receipt of EPA comments on the draft. Documents become final upon written approval by EPA. Days are calendar days; if due dates fall on a weekend or holiday, deliverables will be submitted to EPA on the next business day. Where the deliverable due date is triggered by notification, comments, or approval, the starting date for the period shown is the date LMC received notification, comments, or approval, unless otherwise shown. Where triggered by EPA receipt of a deliverable, the starting date for the period shown is based on the mail receipt date or EPA's signature on the hand delivered form. The completed RI/FS will be subject to public comment. After the public comment period, EPA will consider comments and select the final remediation plan. EPA will provide written notification of the final selection to LMC. EPA may modify the project schedule as necessary.

Table 2-1. Project Organization

Position	Name	Phone Number
EPA Project Coordinator/Remedial Program Manager	Piper Peterson Lee	206-553-4951
LMC Program Manager	Gene Matsushita	818-847-0197
LMC Project Coordinator	Bill Bath	303-977-3997
Project Manager	Gary Braun, Tetra Tech	425-482-7840
QA Manager	Rick Osgood, Tetra Tech	425-482-7819
Health and Safety Manager	Phil Bartley, Tetra Tech	509-372-5818
Quality Control (QC) Manager	Sheri Wunderlich, Tetra Tech	425-482-7849
RI Lead	Gary Braun, Tetra Tech	425-482-7840
RA Lead	Gary Pascoe, Pascoe Environmental	360-385-9977
FS Lead	Pamela Sargent, Tetra Tech	425-482-7615
Strategic RI/FS Consultant	John Herzog, GeoEngineers	206-406-6431
Field Operations Lead	Jennifer Hawkins, Tetra Tech	425-482-7678
Analytical Laboratory	Columbia Analytical Services	360-577-7222

Figure 2-1. Organization Chart



Lockheed West RI/FS Representative Project Schedule

ID	Task Name	Duration	Start	Finish
1	**AOC for Initial Data Review**	108 days	Tue 12/6/05	Thu 3/23/06
2	**ASAOC for Remedial Investigation/Feasibility Study**	**114 days**	**Thu 4/6/06**	**Fri 7/28/06**
3	Receive Special Notice Letter and Draft AOC/SOW	0 days	Thu 4/6/06	Thu 4/6/06
4	Good Faith Offer to EPA and Negotiation of Remedial Investigation/Feasibility Study AOC	60 days	Thu 4/6/06	Sun 6/4/06
5	ASAOC for RI/FS Effective Date	54 days	Mon 6/5/06	Fri 7/28/06
6	**Monthly Progress Reporting**	**2193 days**	**Mon 5/1/06**	**Tue 5/1/12**
80	**Remedial Investigation / Feasibility Study (RI/FS) Work Plan**	**703 days**	**Sat 7/29/06**	**Tue 7/8/08**
81	**Prepare RI/FS Work Plan**	**703 days**	**Sat 7/29/06**	**Tue 7/8/08**
82	Prepare Draft RI/FS Work Plan	30 days	Sat 7/29/06	Sun 8/27/06
83	Submit Draft Work Plan to EPA	1 day	Mon 8/28/06	Mon 8/28/06
84	EPA review of Draft RI/FS Work Plan	45 days	Tue 8/29/06	Thu 10/12/06
85	Prepare and Submit Site Characterization SAP	15 days	Wed 11/1/06	Wed 11/15/06
86	EPA review of Site Characterization SAP	6 days	Thu 11/16/06	Tue 11/21/06
87	EPA Approval of SC SAP	0 days	Mon 12/4/06	Mon 12/4/06
88	Revise and Prepare Revised Streamlined RI/FS Work Plan	78 days	Mon 12/25/06	Mon 3/12/07
89	Submit Final Streamlined RI/FS Work Plan to EPA	0 days	Mon 3/12/07	Mon 3/12/07
90	EPA Review of revised Streamlined RI/FS Work Plan	197 days	Tue 3/13/07	Tue 9/25/07
91	Resolve EPA comments	62 days	Wed 9/26/07	Tue 12/4/07
92	Revise and Prepare Draft Final Streamlined RI/FS Work Plan	51 days	Wed 12/5/07	Thu 1/24/08
93	Submit Draft Final RI/FSWork Plan to EPA	0 days	Thu 1/24/08	Thu 1/24/08
94	EPA review of Draft Final RI/FS Work Plan	53 days	Fri 1/25/08	Mon 3/17/08
95	Revise and Prepare Final Streamlined RI/FS Work Plan	99 days	Tue 3/18/08	Tue 6/24/08
96	EPA Review of Final Streamlined RI/FS Work Plan	14 days	Wed 6/25/08	Tue 7/8/08
97	EPA Approval of Final Streamlined RI/FS Work Plan	0 days	Tue 7/8/08	Tue 7/8/08
98	**Prepare Risk Assessment Work Plan**	**122 days**	**Mon 8/21/06**	**Wed 12/20/06**
107	**Remedial Investigation Field Work**	**144 days**	**Tue 12/5/06**	**Fri 4/27/07**
108	Field Work Planning	34 days	Tue 12/5/06	Sun 1/7/07
109	Field Work Implementation - Subtidal	25 days	Mon 1/8/07	Thu 2/1/07
110	Field Work Implementation - Intertidal	10 days	Wed 4/18/07	Fri 4/27/07
111	**Remedial Investigation Data Report**	**489 days**	**Fri 2/2/07**	**Thu 6/12/08**
112	Prepare Draft Remedial Investigation Data Report	100 days	Fri 2/2/07	Sat 5/12/07
113	EPA Comment on Draft Remedial Investigation Data Report	192 days	Sun 5/13/07	Tue 11/20/07
114	Prepare and Submit Addenda to Data Report for Intertidal work	60 days	Sat 4/28/07	Tue 6/26/07
115	Revise Remedial Investigation Data Report	66 days	Wed 11/21/07	Fri 1/25/08
116	EPA Review of Final Remedial Investigation Data Report	139 days	Sat 1/26/08	Thu 6/12/08
117	EPA Approval of Final Remedial Investigation Data Report	0 days	Thu 6/12/08	Thu 6/12/08
118	**Baseline Ecological and Human Health Risk Assessments**	**255 days**	**Thu 6/12/08**	**Sun 2/22/09**
119	Draft Baseline Ecological Risk Assessment	150 edays	Thu 6/12/08	Sun 11/9/08
120	Draft Baseline Human Health Risk Assessment	150 edays	Thu 6/12/08	Sun 11/9/08
121	EPA Comment on Draft Baseline ERA and HHRA	45 edays	Sun 11/9/08	Wed 12/24/08

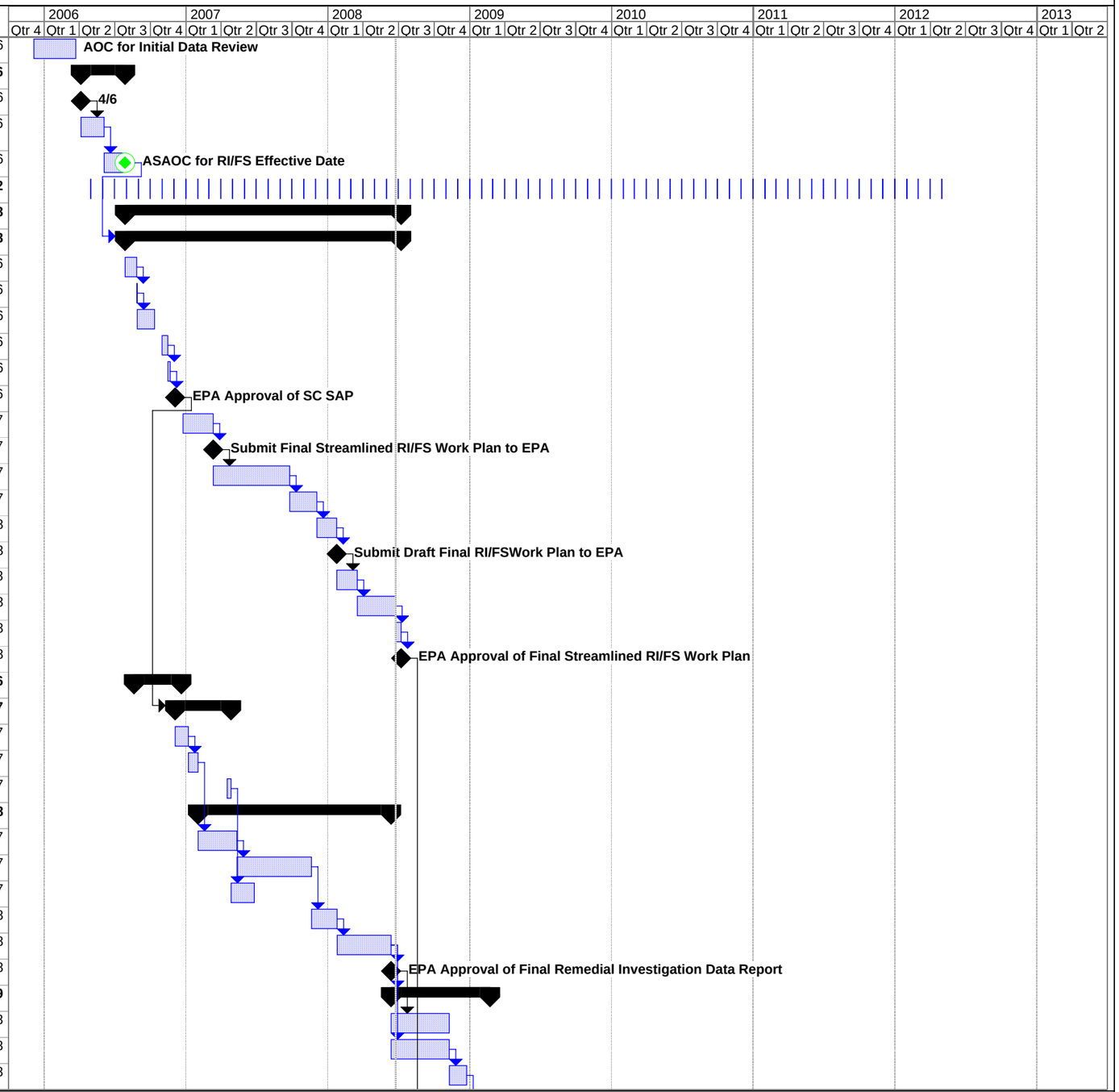


Figure 2-2 Representative Project Schedule
(6/24/08)

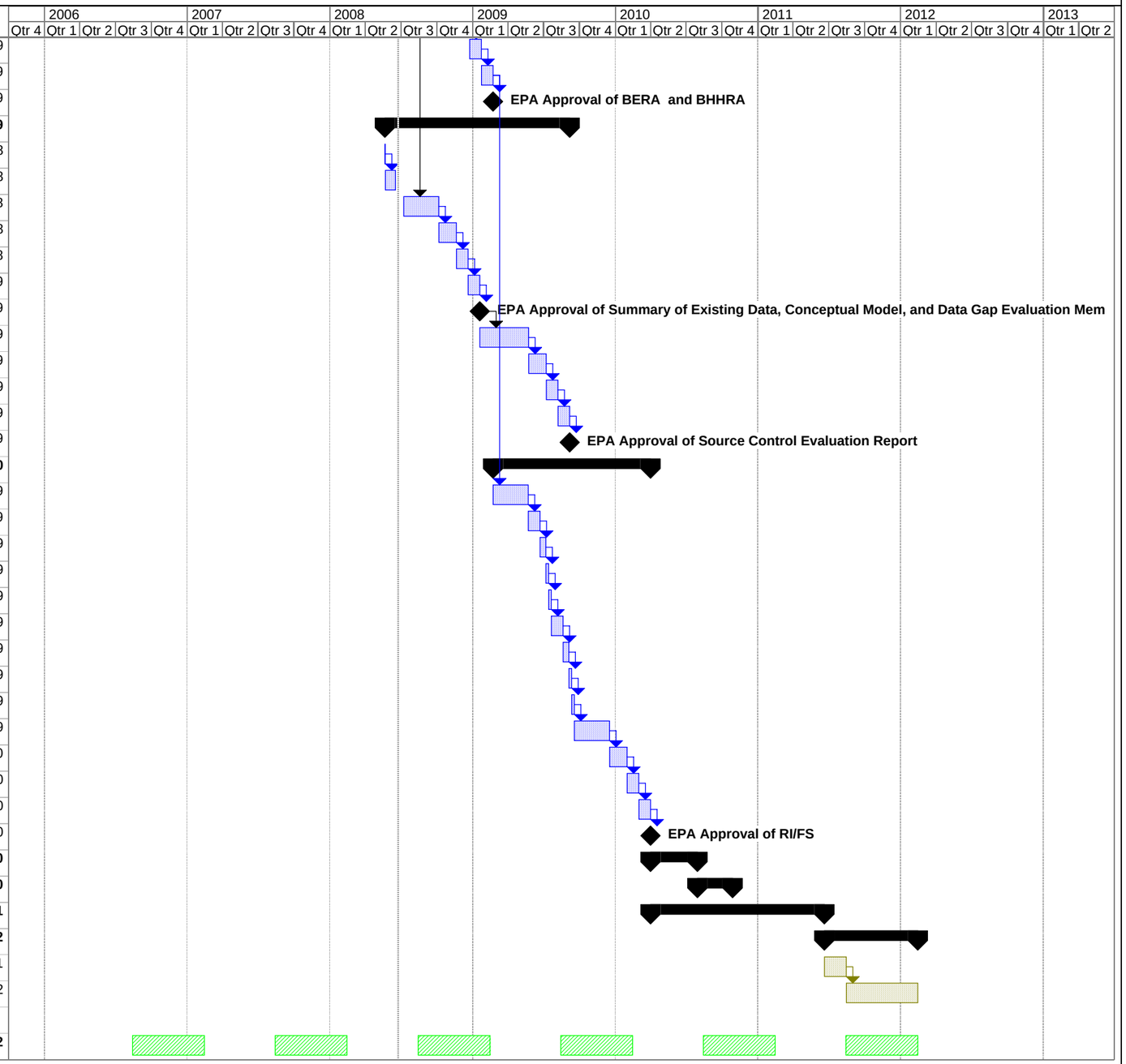
Task | Progress | Summary | External Tasks | Split
Split | Milestone | Project Summary | External MileTask

Note: This schedule is predicated on EPA review and approval within specified time periods. The schedule reflects Lockheed Martins intent to expedite site remediation; however, it does not supersede the schedule presented in the ASAOC.

Mon 6/23/08

Lockheed West RI/FS Representative Project Schedule

ID	Task Name	Duration	Start	Finish
122	Revise BERA and BHHRA	30 edays	Wed 12/24/08	Fri 1/23/09
123	EPA Review of BERA and BHHRA	30 edays	Fri 1/23/09	Sun 2/22/09
124	EPA Approval of BERA and BHHRA	0 days	Sun 2/22/09	Sun 2/22/09
125	**Source Control Evaluation Report**	**464 days?**	**Thu 5/22/08**	**Sun 9/6/09**
126	Source Control Evaluation Workshop	1 day?	Thu 5/22/08	Thu 5/22/08
127	Source Control Approach and Meeting Summary	26 edays	Thu 5/22/08	Tue 6/17/08
128	Prepare Summary of Existing Data, Conceptual Model, and Data Gap Ev	90 edays	Tue 7/8/08	Mon 10/6/08
129	EPA Comment on Draft Summary of Existing Data, Conceptual Model, a	45 edays	Mon 10/6/08	Thu 11/20/08
130	Revise and Submit Summary of Existing Data, Conceptual Model, and D	30 edays	Thu 11/20/08	Sat 12/20/08
131	EPA Review of Summary of Existing Data, Conceptual Model, and Data	30 edays	Sat 12/20/08	Mon 1/19/09
132	EPA Approval of Summary of Existing Data, Conceptual Model, and Data	0 days	Mon 1/19/09	Mon 1/19/09
133	Prepare Draft Source Control Evaluation Report	125 edays	Mon 1/19/09	Sun 5/24/09
134	EPA Comment on Draft Source Control Evaluation Report	45 edays	Sun 5/24/09	Wed 7/8/09
135	Revise and Submit Source Control Evaluation Report	30 edays	Wed 7/8/09	Fri 8/7/09
136	EPA Review of Source Control Evaluation Report	30 edays	Fri 8/7/09	Sun 9/6/09
137	EPA Approval of Source Control Evaluation Report	0 days	Sun 9/6/09	Sun 9/6/09
138	**Remedial Investigation/Feasibility Study Report**	**394 days**	**Sun 2/22/09**	**Thu 4/1/10**
139	Prepare Draft Remedial Investigation	90 edays	Sun 2/22/09	Sat 5/23/09
140	Remedial Action Objectives Technical Memorandum	30 edays	Sat 5/23/09	Mon 6/22/09
141	Submit RAO Technical Memorandum for EPA Comment	15 edays	Mon 6/22/09	Tue 7/7/09
142	Revise RAO Technical Memorandum	7 edays	Tue 7/7/09	Tue 7/14/09
143	EPA Review and Approval of RAO Technical Memorandum	7 edays	Tue 7/14/09	Tue 7/21/09
144	Remedial Alternaives Screening Technical Memorandum	30 edays	Tue 7/21/09	Thu 8/20/09
145	Submit to EPA Remedial Alternatives Screening Technical Memorandum	15 edays	Thu 8/20/09	Fri 9/4/09
146	Revise Remedial Alternatives Screening Technical Memorandum	7 edays	Fri 9/4/09	Fri 9/11/09
147	EPA Review and Approval of Remedial Alternatives Screening Technica	7 edays	Fri 9/11/09	Fri 9/18/09
148	Prepare Feasibility Study	90 edays	Fri 9/18/09	Thu 12/17/09
149	Submit Draft Remedial Investigation/Feasibility Study for EPA Review	45 edays	Thu 12/17/09	Sun 1/31/10
150	Revise RI/FS Report	30 edays	Sun 1/31/10	Tue 3/2/10
151	EPA Review of RI/FS	30 edays	Tue 3/2/10	Thu 4/1/10
152	EPA Approval of RI/FS	0 days	Thu 4/1/10	Thu 4/1/10
153	**Develop Proposed Plan and Record of Decision (EPA)**	**120 days**	**Thu 4/1/10**	**Fri 7/30/10**
157	**Consent Decree for Remedial Design**	**90 days**	**Fri 7/30/10**	**Thu 10/28/10**
160	**Remedial Design**	**445 days**	**Thu 4/1/10**	**Mon 6/20/11**
181	**Remedial Action Construction**	**239 days**	**Mon 6/20/11**	**Tue 2/14/12**
182	Construction Preparation	56 edays	Mon 6/20/11	Mon 8/15/11
183	Remedy Construction Year 1	183 edays	Mon 8/15/11	Tue 2/14/12
184				
185	**Allowable In-water Work Period**	**2010 days**	**Tue 8/15/06**	**Tue 2/14/12**



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(6/24/08)

Task | Progress | Summary | External Tasks | Split
Split | Milestone | Project Summary | External MileTask

Note: This schedule is predicated on EPA review and approval within specified time periods. The schedule reflects Lockheed Martins intent to expedite site remediation; however, it does not supersede the schedule presented in the ASAOC.

Mon 6/23/08

3. POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

3.1 INTRODUCTION

This section presents potential applicable or relevant and appropriate requirements (ARARs) identified for the Lockheed West site.[1] The identification of ARARs is an iterative process. The list of ARARs is expected to change during the various phases of the remedial process and will be updated as appropriate. The ARARs could change due to identification of additional COCs during the RI or due to changes in remedial actions during the feasibility study. Final ARAR determinations will be made during the preparation of the Record of Decision (ROD).

3.1.1 Applicable Requirements

State and federal requirements can be either *applicable* or *relevant and appropriate*. Applicable requirements, as defined in 40 Code of Federal Regulations (CFR) 300.5, are

> those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

In other words, an applicable requirement is one that a private party would have to comply with by law if the situation/action was not undertaken under CERCLA or MTCA. MTCA, the state equivalent to the federal CERCLA program, has a similar definition of applicable or relevant and appropriate requirements at WAC 173-340-710.

3.1.2 Relevant and Appropriate Requirements

If a requirement is not applicable, it may still be relevant and appropriate. Relevant and appropriate requirements, also defined in 40 CFR 300.5, are

> those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state

[1] Most of the text and tables in this section were excerpted from EPA's Harbor Island RI prepared by Weston (1993).

> environmental or facility siting laws, that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

While the determination of "applicability" is a legal one, the determination of "relevant and appropriate" relies on professional judgment, taking into account the circumstances of the site, the chemicals, the actions, and the location. A relevant and appropriate requirement should cover situations similar to those at the site (relevancy) and be suitable for the conditions at the site (appropriateness). Both conditions must exist in order for a requirement to be relevant and appropriate. MTCA has a similar definition of applicable or relevant and appropriate requirements at WAC 173-340-710.

3.1.3 Items to Be Considered

Unenforceable standards or guidelines may be used as items to be considered (TBCs) in developing and evaluating remedial alternatives. Proposed standards, guidance documents, and health advisories are examples of potential items to be considered. Not all items to be considered need be reported [40 CFR 300.4(g)(3)]; a small number of items to be considered are presented at the end of this section.

3.2 ARAR CATEGORIES

ARARs may be divided into the following categories: chemical-specific, action-specific, or location-specific. These different categories are defined in the sections below; potential ARARS for the Lockheed West Site are listed in Table 3-1 (chemical-specific ARARs), Table 3-2 (action-specific ARARs), and Table 3-3 (location-specific ARARs). These tables present both federal and state ARARs.

3.2.1 Chemical-Specific ARARs

Chemical-specific requirements set concentration limits or ranges in various types of environmental media. Such ARARs may set protective cleanup levels for the chemicals of concern in the designated media. Chemical-specific ARARs may also indicate an appropriate level of discharge.[2]

[2] In this instance an ARAR can be considered both chemical-specific and action-specific.

Chemical-specific requirements are health- or risk-based concentration limits such as ambient water quality criteria. Table 3-1 presents a list of potential federal and state chemical-specific ARARs identified for the various media at the Lockheed West site. These ARARs are based on current, publicly available information and do not reflect administrative discretion that may be exercised in the future by federal or state authorities.

EPA (2002b) states the following:

> "Generally, under CERCLA, cleanup levels are not set at concentrations below natural background levels. Similarly, for anthropogenic contaminant concentrations, the CERCLA program normally does not set cleanup levels below anthropogenic background concentrations (EPA 1996, 1997c, 2000b). The reasons for this approach include cost-effectiveness, technical practicability, and the potential for recontamination of remediated areas by surrounding areas with elevated background concentrations."

Therefore, when background concentrations for contaminants are above the ARAR for that contaminant, the ARAR may not be achievable and alternative ARARs or risk-based standards may dictate the appropriate action. This scenario could occur in the Lockheed West site for some chemicals. A detailed comparison of site-specific chemical concentrations with background chemical concentrations will be made during the development of remediation goals.

3.2.2 Action-Specific ARARs

Action-specific ARARs are typically technology- or activity-based requirements or limitations on actions. These requirements are not triggered by the specific contaminants identified, but by activities related to management of these contaminants. Table 3-2 presents the potential action-specific ARARs for soil, surface water, groundwater, and air that have been identified for a preliminary list of remedial actions. The final list of remedial actions will be developed during the feasibility study phase of the RI/FS. Requirements such as Occupational Safety and Health Act (OSHA) standards are excluded as action-specific ARARs because they must be adhered to under all circumstances, regardless of whether the activity is related to a CERCLA or MTCA action.

Because one activity may trigger several requirements, descriptions of the potential ARARs are provided under each activity category. In general, activities may be subject to certain limitations depending upon 1) the type of activity performed (e.g., incineration), 2) the type of waste being managed, and 3) whether the activity is conducted on-site. A discussion of the second and third limitations is provided below.

3.2.2.1 Waste Type

Requirements for treatment, storage, and disposal of hazardous wastes are provided under the federal Resource Conservation and Recovery Act (RCRA) and the Washington State Dangerous Waste Regulations. Activities may be subject to RCRA or state hazardous waste ARARs depending upon the type of waste generated at the Lockheed West site.

RCRA requirements are generally applicable for actions involving RCRA hazardous waste. RCRA hazardous waste must be a 1) solid waste or contaminated environmental media and 2) RCRA-characteristic or RCRA-listed waste. RCRA characteristic wastes exhibit at least one of four characteristics: ignitability, reactivity, corrosivity, or toxicity. Toxicity is determined by the toxicity characteristic leaching procedure (TCLP), which has threshold values for various contaminants above which a waste would be regulated. RCRA-listed wastes are listed in 40 CFR 261, Subpart D.

State dangerous waste requirements are generally applicable for activities involving either a RCRA or non-RCRA state hazardous waste. State dangerous wastes are defined in WAC 173-303-070 and include RCRA plus state-defined "criteria" waste.

Solid wastes are subject to the federal Solid Waste Disposal Act storage and disposal requirements as administered under 40 CFR 257-258 and the state Solid Waste Handling Standards in WAC 173-350.

3.2.2.2 On-site Permit Exemptions

CERCLA §121(e) provides an exemption from federal, state, or local permits for the portion of any removal/remedial action conducted entirely on-site. On-site is interpreted by the EPA to mean "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action."

Although a permit would not be required for on-site activities, substantive, non-administrative requirements of the permit must be met. For example, on-site discharges to the Lockheed West via a pipe, ditch, conduit, or other means of discrete conveyance would be subject to the substantive requirements of an NPDES permit issued by the state, but in itself would not require a National Pollutant Discharge Elimination System (NPDES) permit. However, discharges directly off-site (e.g., into a conveyance system leading to a Publicly Owned Treatment Works [POTW]) would be subject to both substantive and administrative permitting requirements.

3.2.3 Location-Specific ARARs

Location-specific ARARs are restrictions placed on either the concentration of hazardous substances or the conduct of activities performed in certain locations. They may restrict or preclude certain remedial actions or may apply only to certain portions of the area of contamination. Potential Lockheed West-specific ARARs are presented in Table 3-3.

3.3 PROCEDURES FOR DETERMINING ARARS

Compliance with other laws may be either applicable or relevant and appropriate, but not both, based on cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law. Thus, each evaluation of a potential ARAR will consist of a determination as to whether the requirement is applicable, relevant and appropriate, or neither.

The determination of ARARs will be ongoing throughout the RI/FS process, and will progress from the identification of regulatory programs that may impose requirements, to a determination of specific criteria and standards that will become part of the response objectives. In general, potential chemical-specific and location-specific ARARs will be identified during the RI. Later, as remedial alternatives are developed as part of the feasibility study, activity-specific ARARs will be more definitive. Final ARAR determinations will be made during preparation of the ROD.

3.4 ARAR WAIVERS OR VARIANCES

An ARAR waiver or variance may be obtained if an ARAR(s) cannot be met. Typically, the justification for these waivers must be one of the following items:

1. The measure/action that will not attain all ARARs is an interim measure, which will be followed by a complete measure that will attain ARARs.
2. Equivalent or better results can be obtained using a design or method different from that specified in the ARAR.
3. Compliance with an ARAR will cause greater risk to human health and the environment than noncompliance.
4. Achieving an ARAR(s) is technically impracticable.
5. The costs associated with meeting an ARAR in order to obtain an added degree of protection or reduction of risk would jeopardize the funds for remedial actions at other sites. This waiver is available for Fund-financed actions only.

3.5 STATE REQUIREMENTS AS POTENTIAL ARARS

For actions conducted under CERCLA, an analysis of state ARARs is required. CERCLA §121 states that in order for a state requirement to be eligible to be an ARAR, it must be both promulgated and more stringent than federal requirements. A state requirement is promulgated if it is legally enforceable (i.e., it must be issued in accordance with state procedural requirements and contain specific enforcement provisions or be otherwise enforceable under state law), and it is generally applicable. The evaluation of stringency considers two types of regulations: 1) those for which there is a federal counterpart (or program), and 2) those for which there is no federal counterpart (or program).

For most federally authorized state programs (e.g., RCRA, Clean Water Act [CWA]), state requirements are at least as stringent as federal requirements. Therefore, state requirements under these programs do not require a comparison of stringency. It must be determined, however, that the state has been authorized to administer the program and to develop regulations under the authorized program. For non-authorized state programs, the investigator must prepare a side-by-side analysis of requirements to show that the state requirement is more stringent than federal requirements. Regulations promulgated under state programs that do not have a federal counterpart, but address specific conditions within that state, represent ARARs because they are more stringent than federal law and add new or specific requirements to the body of federal environmental regulations.

In addition, state requirements must be substantive; that is, they must not impose only administrative or procedural requirements, or requirements that can be substituted effectively by established CERCLA administrative procedures. Further, EPA will consider state requirements to be an ARAR only if they are "of general applicability." That is, state requirements that apply only to one or more Superfund sites are not to be considered an ARAR. For a state requirement to be a potential ARAR it must be applicable to all remedial situations described in the requirement, not just to Superfund sites. Also, the requirement must be consistently applied to all sites. Local laws are generally not promulgated state requirements and therefore may or may not be ARARs. If the local requirement is developed under explicit state authority or if compliance is a requirement of a promulgated state statute, the local requirement may be an ARAR.

To support the inclusion of state requirements as ARARs, the following information should be provided. First, evidence should be provided that the proposed ARAR is a promulgated standard, including the statute or regulation, the date of enactment, or the effective date. Second, evidence should be provided that the proposed ARAR is broader or that it imposes a more restrictive standard of performance than federal requirements.

If a state disputes the determination by the EPA that a state requirement is not an ARAR, the state may submit its argument to the EPA Assistant Administrator for Solid and Hazardous Waste. Other dispute resolution mechanisms may be developed and presented in a State/Superfund Memorandum of Agreement. If the state's requirement is still not determined to be an ARAR after completing the dispute resolution process, the requirement may nevertheless be applied to the remedy if the state demonstrates an ability and willingness to pay for the additional incremental expense associated with its application. In this circumstance, the state may be required to take the lead in the remedial design and remedial action.

3.6 ITEMS TO BE CONSIDERED (TBCS)

State and local ordinances, advisories, and other requirements that are not ARARs may be used in determining the appropriate extent and manner of cleanup. These requirements can be TBC requirements. Generally, TBC requirements are used when no federal or state requirements exist for a particular situation. Some TBC items are presented in Table 3-4.

Table 3-1. Potential Chemical-Specific ARARs for Lockheed West[3]

Medium/ Requirement	Standard/Criteria	Prerequisite	Citation	Comments
Clean Air Act (42 USC 7401 et seq.; 40 CFR 50-69)	National primary and secondary ambient air quality standards	Site located in nonattainment area for National Ambient Air Quality Standards; treatment unit would be "significant source"	Clean Air Act (Sec.109; 40 CFR 50)	Not anticipated as ARAR; in general, emissions from site not expected to qualify as significant source.
Washington State Clean Air Act (70.94 RCW)	State implementation of ambient air quality standards		General Requirements for Air Pollution Sources (WAC 173-400)	Potential ARAR for investigative or remedial actions; site located in nonattainment zone for CO and ozone.
	Puget Sound Clean Air Agency (PSCAA) ambient and emission standards		PSCAA Regulations I and III	
Resource Conservation and Recovery Act (42 USCA 7401-7642) (40CFR 260-280)	Lists and characteristics for identifying hazardous wastes	Meets listing or characteristic definitions (includes threshold levels for Toxic Characteristic Leaching Procedure [TCLP])	Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste (40 CFR 261.24.10-11, Subpart B)	Using appropriate analytical methods or knowledge of the source of contamination, determination should be made whether sediments (including investigation-derived waste [IDW]) contain hazardous waste characteristic; certain requirements for management of hazardous wastes may be applicable or relevant and appropriate. Dredged sediments are excluded from RCRA Subtitle C if they are managed under the CWA Section 404 program (63 FR 65874).
Washington Dangerous Waste Regulations (WAC 173-303)	State criteria for dangerous waste which are broader than federal criteria	Meets listing or characteristic definitions, or concentrations exceed defined threshold criteria	Section -070, Designation procedures	The appropriate waste designation for state-listed or characteristic waste should be made in order to determine the applicability or relevance and appropriateness of state requirements for the management of IDW. Dredged sediments are excluded as a designated dangerous waste if they are managed under the CWA Section 404 program (WAC 173-303-071.

[3] Tables 3-1, 3-2, and 3-3 provide a menu of requirements that might be ARARs and from which ARARs will be selected in the Record of Decision.

Table 3-1. Potential Chemical-Specific ARARs for Lockheed West (continued)

Medium/ Requirement	Standard/Criteria	Prerequisite	Citation	Comments
Federal Water Pollution Control Act/Clean Water Act (CWA) (33 USCA 1251-1376; 40 CFR 100-149)	Ambient water quality criteria for the protection of aquatic organisms and human health	Discharges to surface waterbody that are sources of sediment contamination	40 CFR 131	CERCLA requires the attainment of water quality criteria where relevant and appropriate under the circumstances of the release or threatened release. Requirements are implemented differently depending on whether discharges are subject to NPDES permits. Also anticipated to be relevant and appropriate for remedial measures involving any discharges.
Toxic Substances Control Act (TSCA) (40 CFR 761)	Because PCBs are a COC at this site, regulations pertaining to "PCB remediation waste"		40 CFR 761.61	Cleanup levels may be determined based on expected exposure and proximity to sensitive environments.
Washington State Public Water Supplies (WAC 246-290)	Includes Maximum Contaminant Levels (MCLs) for drinking water	Public drinking water supply	WAC 173-290-310 Federal MCLs (40 CFR 141)	Depending on the scope of any remedial action, MCLs could be a potential ARAR for groundwater if it were a localized source of public drinking water, which is highly unlikely. MCLs are also potentially relevant and appropriate to groundwater, even if it is not a public source of drinking water, until and unless EPA determines the groundwater is Class III.
Washington State Water Quality Standards for Surface Waters (WAC 173-201a)	State Water Quality Standards; conventional water quality parameters and toxic criteria	Discharges to surface waterbody that are sources of sediment contamination	WAC 173-201a-040	Implementation of federal requirement to develop state water quality control plan. Narrative and quantitative limitations for surface water protection. Requirements are implemented differently depending on whether discharges are subject to NPDES permits. Anticipated as relevant and appropriate to control releases that create concentrations of concern in the sediment.
Model Toxics Control Act (WAC 173-340)	Requirements for establishing numeric or risk-based standards and selecting cleanup actions	State hazardous waste site and any contaminated site in Washington being cleaned up under Superfund	Section 760: Sediment	Sediment cleanup must comply with the requirements of MTCA as well as the Washington Sediment Management Standards. If the remedy involves media other than sediment, other sections of MTCA will also be ARARs.

Table 3-1. Potential Chemical-Specific ARARs for Lockheed West (continued)

Medium/ Requirement	Standard/Criteria	Prerequisite	Citation	Comments
Washington Sediment Management Standards (WAC 173-204)	Numerical and narrative criteria for sediment quality standards, cleanup screening levels (CSL), and minimum cleanup levels	Sediment remediation and source control	WAC 173-204	Anticipated to be applicable to site remediation. Anticipated as relevant and appropriate to control releases that create concentrations of concern in the sediment.

Table 3-2. Potential Action-Specific ARARs for Lockheed West

Actions	Requirement	Prerequisite	Citation	Comments
General Remediation	Requirement for use of all known available and reasonable technologies for treating wastewater prior to discharge to waters of the state	Industrial sources	State Water Pollution Control Act (RCW 90.48), Water Resources Act (RCW 90.54)	Anticipated to be applicable to remedial technologies involving discharges to surface or groundwater. See also MTCA under Pump and Treat.
Construction in state waters	Requirements for construction and development projects for the protection of fish and shellfish	State waters	Construction in State Waters, Hydraulic Code Rules (RCW 75.20; WAC 220-110) Rivers and Harbors Appropriation Act (33 USC 401 et seq.) DMMP (2000) guidelines	Substantive requirements of Army Corps of Engineers permit anticipated to be relevant and appropriate to construction, dredging, and filling below the mean high-water line. (See also Dredging/Disposal under soil action-specific ARARs.) Substantive requirements of State Hydraulic Code may apply.
Source control	Requirements for protecting sediment and surface water quality	Ongoing sources of chemicals to sediments	State Water Pollution Control Act (RCW 90.48) Clean Water Act (40 CFR 100-149) Sediment Management Standards (WAC 173-204) Model Toxics Control Act (WAC 173-340)	Applicable to chemical sources that create concentrations of concern in LDW sediments. Requirements are implemented differently depending on whether discharges are subject to NPDES permits.
Discharge to POTW (Publicly Owned Treatment Works)	Contaminated water must be pretreated to certain limits prior to discharge	Nonhazardous waste	National Pretreatment Standards (40 CFR 403); Metro District Wastewater Discharge Ordinance	Discharges to POTWs are considered off-site activities; pretreatment and permitting requirements would be applicable.

Table 3-2. Potential Action-Specific ARARs for Lockheed West (continued)

Actions	Requirement	Prerequisite	Citation	Comments
Discharge to surface waters	Point-source standards for discharges into surface water bodies	Point-source discharge or site runoff directed to surface water body when the discharges are subject to an NPDES Permit	National Pollutant Discharge Elimination System (40 CFR 122, 125) State Discharge Permit Program; NPDES Program (WAC 173-216, 220)	Anticipated to be applicable to some discharges.
	Federal criteria for water quality to protect human health and aquatic life	Discharges to surface waterbodies	Federal Water Quality Criteria (40 CFR 131)	CERCLA requires the attainment of water quality criteria where relevant and appropriate to the circumstances of the release. Requirements are implemented differently depending on whether discharges are subject to NPDES permits. Anticipated to be relevant and appropriate for remedial measures involving this activity.
	State Water Quality Standards for Surface Water	Discharges to surface waterbodies.	WAC 173-201-045, -047	Implementation of federal requirement to develop state water quality control plan. Narrative and quantitative limitations for surface and groundwater protection, based upon beneficial uses. Requirements are implemented differently depending on whether discharges are subject to NPDES permits. Anticipated as relevant and appropriate.
Containment - Capping - Vertical barriers	(see Capping and General Excavations under Action-specific ARARS for soil)			

Table 3-2. Potential Action-Specific ARARs for Lockheed West (continued)

Actions	Requirement	Prerequisite	Citation	Comments
Air stripping	Meet ambient air quality requirements for significant sources	Site located in nonattainment area for National Ambient Air Quality Standards; treatment unit would be major source	National Ambient Air Quality Standards (40 CFR 50)	Not anticipated as ARAR, not anticipated to qualify as major source.
Granular-activated carbon treatment	Meet design and operating standards for treatment and storage units	Treatment and storage of RCRA hazardous waste	40 CFR 264, Subpart I-Containers 40 CFR 264, Subpart J-Tanks 40 CFR 264, Subpart X-Misc. units	Anticipated to be relevant and appropriate if technology is implemented.
Treatment, storage, or disposal of hazardous wastes	Disposal of contaminated soil or debris is subject to land disposal prohibitions or treatment standards	Dangerous or hazardous waste	40 CFR 268 Federal Land Disposal Restrictions WAC 173-303-140, -141 Land Disposal Restrictions	May be ARAR if placement of hazardous or dangerous waste occurs during remediation.
Storage or disposal of solid wastes	Requirements for solid waste management	Solid waste (nonhazardous)	Solid Waste Disposal (Act 42 USC Sec. 3251-3259, 6901-6991) as administered under 40 CFR 257, 258 Solid Waste Handling Standards (WAC 173-350)	Potentially ARAR to nonhazardous waste generated during remedial activities
Noise control	Maximum noise levels		Noise Control Act of 1974 (RCW 80.107; WAC 173-60)	Potentially relevant and appropriate depending upon remedial activities selected.

Table 3-2. Potential Action-Specific ARARs for Lockheed West (continued)

Actions	Requirement	Prerequisite	Citation	Comments
Air				
Air emissions	National Primary and Secondary Ambient Air Quality Standards for carbon monoxide, lead, nitrogen dioxide, particulate matter (PM10), ozone, and sulfur dioxides	Emissions from a "major" source	Clean Air Act (Sec. 109; 40 CFR 50)	Emissions from site not expected to qualify as major source unless activities will result in emissions of ≥100 tons/year or of a specified air contaminant.
	Regional ambient air quality standards	Emission of regulated air contaminant	Puget Sound Clean Air Agency (PSCAA) Regulation I	Not anticipated as ARAR
	National Emissions Standards for Hazardous Air Pollutants (NESHAPs)	Industrial emissions	Clean Air Act, National Emissions Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61) State Emission Standards for Hazardous Air Pollutants (WAC 173-400-075)	Emission standards would need to be converted to area source standards for use at Harbor Island, if determined to be relevant and appropriate to releases of hazardous air pollutants from remedial actions.
	New Source Pretreatment Standards	New source of hazardous air pollutants	40 CFR 60	Potentially applicable to releases from remedial actions.
	Controls for New Sources of Toxic Air Pollutants	Emission of any Class A or Class B toxic air pollutant (identified in WAC 173-460-150 through -160) into ambient air	WAC 173-460	Potentially applicable to releases from remedial actions.
	Regional Emission Standards for Toxic Air Pollutants	Source of toxic air contaminant requires a notice of construction	PSCAA Regulation III	Potentially applicable depending upon remedial technology used.

Table 3-2. Potential Action-Specific ARARs for Lockheed West (continued)

Actions	Requirement	Prerequisite	Citation	Comments
Soil/Sediment/Fill				
General remediation of hazardous waste	RCRA hazardous waste management requirements	RCRA hazardous waste management in treatment, storage, or disposal facility	Resource Conservation and Recovery Act [RCRA as amended by the Hazardous and Solid Waste Amendments (HSWA) (42 USCA 6901 et seq.)]; 40 CFR 264 for permitted TSDFs	Need to determine waste designation for IDW and remediation waste. In general, RCRA requirements are anticipated to be applicable or relevant and appropriate depending upon designation of waste, if generated. Dredged sediments are excluded from RCRA Subtitle C if they are managed under the CWA Section 404 program (63 FR 65874).
	State hazardous waste management requirements	Management of wastes that pass criteria for WA hazardous waste as specified in WAC 173-303-070	General Facility Standards (WAC 173-303-280-395)	In general, state hazardous waste requirements are broader and more stringent than federal requirements; anticipated to be relevant and appropriate. . Dredged sediments are excluded as a designated dangerous waste if they are managed under the CWA Section 404 program (WAC 173-303-071).
Closure with waste in place (capping)	RCRA design and operational requirements for closures with waste in place require the minimization of need for further maintenance and control, installation of long-term cover, elimination of free liquids, stabilization of remaining waste, post-closure care, etc.	RCRA waste in landfill placed after 19 November 1980	Federal: 40 CFR 264-110 through 117 State: WAC 173-303-610	Potentially ARAR for placement of RCRA wastes, or wastes sufficiently similar to RCRA wastes in on-site upland facility.
Clean closure	RCRA clean closure requirements; complete removal of RCRA hazardous waste	Any unit that is not closing as landfill	40 CFR 264.110 et seq.	Potentially relevant and appropriate depending upon remedial action. Clean closure requires minimization of need for further maintenance and control.
Post-closure care	Post-closure monitoring and maintenance requirements	RCRA TSD Unit	Federal: 40 CFR 264.110 et seq. State: WAC 173-303-665(6)	Requirements provided under each action or storage method (e.g., landfill, waste piles, etc.). Anticipated to be relevant and appropriate.

Table 3-2. Potential Action-Specific ARARs for Lockheed West (continued)

Actions	Requirement	Prerequisite	Citation	Comments
Remediation of PCB-contaminated waste	Regulations pertain to PCB remediation waste	PCBs as chemical of concern	Toxic Substances Control Act (TSCA) (40 CFR 761.61)	Cleanup levels may be determined based on expected exposure and proximity to sensitive environments.
Surface impoundments	Requirements for containment system, emergency repair, contingency plans, design, etc.	New RCRA surface impoundment	Federal: 40 CFR 264.220 et seq. State: WAC 173-303-650	Not anticipated to be relevant and appropriate unless this technology is used during remediation.
Waste piles	Requirements for noncontainerized solid, non-flowing material	RCRA hazardous waste stored in pile	Federal: 40 CFR 264.254 et seq.	Potentially relevant and appropriate if employed during investigation or remediation.
		State dangerous waste stored in pile	State: WAC 173-303-660	
Landfills	Requirements for design, operation, and maintenance	New or replacement on-site landfill units for disposal of RCRA hazardous waste	Federal: 40 CFR 264.300 et seq. State: WAC 173-303-665	Potentially relevant and appropriate to extensions of existing landfill.
	Landfill design, construction, and closure standards developed to protect the water of the state	Hazardous, designated, or nonhazardous wastes and closed landfills	Federal: 40 CFR 257, 258, 264 State: WAC 173-304, 173-303-665, 173-350	Should this technology be used, anticipated to be relevant and appropriate.
Land treatment	Operating, monitoring, and closure requirements; hazardous chemicals must be degraded, transformed, or immobilized within the treatment zone; treatment efficiency must be demonstrated, design criteria must be met, and monitoring must be established. Develop fugitive and odor emission control plan for the treatment activities.	RCRA hazardous waste treatment in land farming unit	40 CFR 264, Subpart M	May be ARAR if technology is selected for remediation.

Table 3-2. Potential Action-Specific ARARs for Lockheed West (continued)

Actions	Requirement	Prerequisite	Citation	Comments
Chemical, physical, and biological treatment	Operating, monitoring, and closure requirements	RCRA hazardous waste	Federal: 40 CFR 264 State: WAC 173-303	Potentially applicable if hazardous or state dangerous wastes are treated using any of these methods. Otherwise, anticipated to be relevant and appropriate for the treatment of nonhazardous waste.
Incineration	Requirements include monitoring and analysis of waste feed and residuals, and disposal of treatment residuals. Performance standards include: - Destruction removal efficiency of 99.99% for each principal organic hazardous chemical - Reduction of hydrogen chloride emissions to 1.8 kg/hr or 1% HCl in the stack gases prior to entering any pollution control devices - Limit maximum particulate matter to 180 mg in stack gases	RCRA hazardous waste	Federal: 40 CFR 264.340 et seq.	Anticipated to be relevant and appropriate should this technology be implemented. On-site operations would need to meet substantive requirements of the operating permit. State requirements would be applicable for non-RCRA hazardous wastes.
		State dangerous waste	State: WAC 173-303-670	
	Performance standards for incinerators	Incinerator with charging rates of more than 45 metric tons per day	Federal: CAA 42 USCA 7401-7642 State: WAC 173-303-670; PSCAA emission and ambient standards	Anticipated to be relevant and appropriate if this technology is employed.
Thermal treatment (other than incineration)	Operating, monitoring, and closure requirements	Treatment using technologies other than controlled flame combustion	Federal: 40 CFR 265, Subpart P State: WAC 173-303-680 State: WAC 173-303-680	Potentially applicable if wastes are treated using this method. Otherwise, anticipated to be relevant and appropriate for wastes sufficiently similar to hazardous or dangerous waste.

Table 3-2. Potential Action-Specific ARARs for Lockheed West (continued)

Actions	Requirement	Prerequisite	Citation	Comments
Excavation and disposal of hazardous wastes	Disposal of contaminated soil or debris is subject to land disposal prohibitions of treatment standards	RCRA hazardous waste	Federal: 40 CFR 268 federal land disposal restrictions	May be ARAR if placement of hazardous or dangerous waste occurs during remediation.
		State dangerous waste	State: Land Disposal Restrictions (WAC 173-303-140, -141)	
Excavation and disposal of solid wastes	Requirements for solid waste management	Solid waste (nonhazardous)	Federal: Solid Waste Disposal Act (42 USC Sec. 325103259, 6901-6991), as administered under 40 CFR 257, 258 State: Solid Waste Handling Standards (WAC 173-350)	Potentially applicable to the disposal of nonhazardous waste generated during remedial activities.
Treatment of non-RCRA hazardous or state dangerous waste	Treatment requirements for non-RCRA hazardous or state dangerous wastes	Non-RCRA hazardous waste	Federal: 40 CFR 257, 258, 761	Standards for non-RCRA hazardous or non-RCRA state dangerous waste, including PCB waste, incinerator treatment residuals, etc. Anticipated to be applicable to non-RCRA hazardous and dangerous wastes, or relevant and appropriate to sufficiently similar wastes.
		Non-RCRA state-only dangerous waste	State: WAC 173-303-141	
Sediment remediation	Methods for determining allowable levels of chemicals and/or biological effects in sediment	Marine/estuarine environment	WAC 173-204; WAC 173-340-760	Marine sediment. Anticipated as ARAR.
Dredging/disposal	Requirements for the discharge of dredged/fill material into navigable waters or wetlands	Waters of the US	CWA 33 USC 401 et seq.; 33 USC 1413; 33 USC 1251-1316; 40 CFR 230, 231, 404; 33 CFR 320-330 Hydraulic Code Rules on Dredging (WAC 220-110-130, -320) Aquatic Land Management Open Water Disposal Sites (WAC 332-30-166) PSDDA (1988a,b; 1989)	Potential ARAR. Deposited materials could be considered point-source discharges under NPDES. (See also General excavation activities and Construction in state waters under Action-specific ARARs for waters.)

Table 3-2. Potential Action-Specific ARARs for Lockheed West (continued)

Actions	Requirement	Prerequisite	Citation	Comments
Noise control	Maximum noise levels	Activities which may result in exceedance of maximum noise levels	Noise Control Act of 1974 (RCW 70.107; WAC 173-60)	Potentially relevant and appropriate depending upon remedial activities selected.

Table 3-3. Potential Location-Specific ARARs for Lockheed West

Location	Requirement	Prerequisite	Citation	Comments
Within 61 m of a fault displaced in Holocene time	New treatment, storage, or disposal facilities of hazardous waste are prohibited in these areas	RCRA hazardous waste; treatment, storage, or disposal	40 CFR 264.18(a)	Not potential ARAR. Not within 61 m of Holocene fault.
Within 61 m of shoreline	Requirements for construction and development near shorelines	Shorelines of statewide significance, including marine waters and wetlands	Shoreline Management Act (RCW 90.58); Coastal Zone Management Act (16 USC 1451 et seq.).	Anticipated to be relevant and appropriate.
Within 100-year floodplain	Facility must be designed, operated, and maintained to avoid washout	RCRA hazardous waste	40 CFR 264.18(b); 40 CFR 761.75.	None
Within floodplain	Actions must be performed so as to avoid adverse impacts, minimize potential harm, restore and preserve natural and beneficial values of the floodplain	Actions that will occur in a floodplain (i.e., lowlands) and relatively flat areas adjoining inland and coastal waters and other flood-prone areas	Executive Order 11988, Protection of Floodplains (40 CFR 6, Appendix A).	None
Within/adjacent to wetlands	Action must be performed so as to minimize the destruction, loss, or degradation of wetlands. Requirement for no net loss of	Wetland as defined by Executive Order 11990, Section 7	Executive Order 11990, Protection of Wetlands (40 CFR 6, Appendix A).	None
Critical habitat upon which endangered or threatened species depend	Actions must be performed so as to conserve endangered or threatened species, including consultation with the Department of the Interior and National Marine Fisheries Service	Determination of endangered or threatened species and the essential fish habitat on which they depend	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Part 200, 50 CFR Part 402 Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act (50 CFR 600).	Lockheed West is used as a salmon migratory route.
State waters	Dredging and other construction must meet specific standards.	Applies to any construction activity in or near state waters	Hydraulic Code (RCW 77-55-100) Hydraulic Code Rules (WAC 220-110).	Substantive standards potentially applicable. No Hydraulic Project Approval required on-site. Dredging is explicitly considered as a construction activity.

Table 3-3. Potential Location-Specific ARARs for Lockheed West (continued)

Location	Requirement	Prerequisite	Citation	Comments
Oceans or waters of the US	Permit requirements for activities that may obstruct or alter a navigable waterway	Obstruction or alteration of a navigable waterway	Section 10 of the Rivers and Harbors Appropriations Act (33 USC 403)	None
Within state siting criteria locations for dangerous waste	Siting criteria to be used as initial screen for consideration of dangerous waste facility sites	New dangerous waste facilities	WAC 173-303-282(2)(b)(iii)	Not ARAR. Does not apply to facilities conducting CERCLA remediation.
Habitat for fish, plants, or birds subject to WDFW oversight	Prohibits water pollution with any substance deleterious to fish, plant life, or bird life	Discharges of chemicals to sediment	US Fish and Wildlife Coordination Act. 16 USC 661-667e.	Lockheed West is used as a salmon migratory route and provides habitat for other species of fish and wildlife. Requirements are implemented differently depending on whether discharges are subject to NPDES permits.
Harbors, tidelands, shorelines, or beds of navigable rivers	Siting criteria and requirements for fill operations		Constitution of the State of Washington (RCW 79.90.020; WAC 332-300-117, -118).	Potentially relevant and appropriate to remedial actions.
Native American graves	Excavation must cease if Native American burials or cultural items are inadvertently discovered	Potentially applicable to sediment removal	Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.; 43 CFR Part 10).	None
Sacred Native American sites	Work must stop if sacred religious sites are discovered	Potentially applicable to sediment removal	American Indian Religious Freedom Act (42 USC 1996 et seq.).	None
Historic sites or structures	Alternatives must be evaluated to avoid, minimize, or mitigate the impact on historic sites or structures	Activities that could disturb historical sites or structures	National Historic Preservation Act (16 USC 470f; 36 CFR Parts 60, 63, and 800).	None
Archaeological Resources on public and Indian lands	Removal of archaeological resources is prohibited without a permit	Potentially applicable to sediment removal	Archaeological Resources Protection Act (16 USC 470 aa et seq.; 43 CFR Part 7).	None

Table 3-4. Potential items to be considered (TBCs) for the Lockheed West

Federal, State, and Local Criteria, Advisories, and Procedures
Guidelines developed by the Elliott Bay/Duwamish Restoration Program
Sediment Cleanup Standards Users Manual, Washington Department of Ecology (December 1991)
Dredged Material Management Program (DMMP) Guidelines (DMMP 2000)
Puget Sound Water Quality Management Plan
EPA Total Maximum Daily Load (TMDL) regulations (40 CFR 130)
Guidance Document for Discharging CERCLA Aqueous Wastes to POTWs, EPA/540/G-90/005
FDA Maximum Concentrations of Contaminants in Fish Tissues (49 CFR 10372-10442)
Water Quality Guidance Documents:
Water Quality Criteria and Standards Plan (EPA, June 1998)
Water-Related Environmental Fate of 129 Priority Pollutants (1979)
Water Quality Standards Handbook, Second Edition (August 1994)
Technical Support Document for Water Quality-based Toxics Control (1994)
Local Shoreline Substantial Development Permits
EPA Wetlands Action Plan (Jan 1989, OWWP)

4. SUMMARY OF EXISTING INFORMATION, PRELIMINARY CONCEPTUAL SITE MODEL, AND IDENTIFICATION OF DATA GAPS

This section provides a summary of the existing information on the Site, including property boundaries, current and former site uses, and environmental and other physical data. This section also describes the known or anticipated future site use assumptions to be used in the evaluation of remediation alternatives. In addition, Appendix A evaluates the existing data quality and usability for the purposes of the RI/FS and presents a summary of the nature and extent of contamination. Based on the evaluation of existing information, data gaps are identified in Section 4.7.

Much of the existing data are useful for understanding the general CSM, nature and extent of contamination, and identification of data gaps; however, the majority of the information is aged. Data collection for the RI will supersede the existing data and will provide a more comprehensive suite of information for the evaluation and selection of remedial alternatives for the Site. Given that extensive data collection will be completed as part of this Work Plan, the summary of existing data, presented in Appendix A, is intended to inform development of the RI sampling activities and to provide general background for the planned RI/FS activities and is, therefore, not validated according to EPA standards or used for making decisions at the site.

Note: at the time of approval of this Work Plan, the purposed site surveying and sediment quality sampling has been completed. These data are however, not considered to be pre-existing information and are therefore not discussed in this section.

4.1 SITE USE AND HISTORY

4.1.1 Site Development, Dredging, and Filling History

The summary of development of the Lockheed West Site is based on a review of historical areal photographs and documents of the Site as well as U.S. Army Corps of Engineers (USACE) permitting and dredging records. Dredge material areas and volumes are considered to be approximate because as-built drawings confirming actual project dimensions were not located. A summary of historical development of the Lockheed West Site is presented in Table 4-1. Prior to development in the early 1900s, Lockheed West and vicinity consisted of an intertidal deltaic environment at the mouth of the Duwamish River. Progressive dredging and filling created Harbor Island, the West Waterway, and a

peninsular area (now known as Terminal 5) near the present location of the Site. The West Waterway and a defined upland peninsula near the Site were completed in 1917.

Information compiled for the 1994 South West Harbor (SWH) Project Environmental Impact Statement (EIS; Parametrix 1994a), review of USACE dredge and fill permits, review of historical shipyard documents, and review of available areal photographs indicate that shipyard activities at Lockheed West began during WWII. A moorage pier south of the Site along the West Waterway is visible in a 1946 areal photograph (Figure 4-1), along with extensive wood treatment and export operations at the current PSR Site to the west. The PSR Site features a major export dock near the location of the (existing) Lockheed West shipway.

By 1942, Lockheed West was operated by Puget Sound Bridge and Dredge Co., a predecessor of Puget Sound Bridge and Drydock Company. Puget Sound Bridge and Dredge Co. obtained permits for the dredging of the eastern portion of the Lockheed West Site and the West Waterway to allow sufficient depth for dry docks in this area. The dredged material was permitted for disposal on the adjacent tide flats in 1952 and 1954. These dredge and fill events, as well as others extended the Lockheed West uplands site to the north. Figure 4-2 shows the shoreline expansion based on historical areal photos as well as the areas where material was dredged and filled at or near Lockheed West.

The Puget Sound Bridge and Drydock Company was subsequently purchased by the Lockheed Shipbuilding and Construction Company in 1959. During the 1960s, areal photographs identify progressive construction of Piers 21 through 24 from east to west. Pier 21 and Pier 22 were in-place by 1960 (Figure 4-3), along with two large floating dry docks (one owned by Lockheed and known as the “Huff” dry dock and one owned by the U.S. Navy). Historical and existing site structures are shown in Figure 4-2. Pier 21 was used as moorage location for these dry docks for over 40 years. Until the mid-1960s, Lockheed West was bounded on the west by a major inlet and tidal area used to store logs for the PSR Site and probably other wood processing operations (Figure 4-1). This inlet was filled for expansion of Terminal 5 by 1965. Pier 23 was also constructed by that time. Further development prior to 1969 led to construction of Pier 24 and the shipway (Figure 4-4).

Later areal photographs through the 1970s and 1980 (Figures 4-5 and 4-6) show that the shipyard was in use, including dry docking at three dry docks (two owned by the U.S. Navy and one owned by Lockheed), moorage along the piers, and construction in the shipway. Upland activity is also readily apparent until closure of the shipyard in 1987 and expansion of Terminal 5 container handling for Port operations. The Port purchased the LMC

shipyard property in 1988 and conducted remediation of the uplands as part of the Terminal 5 expansion in the later half of the 1990s. A more recent view of the Site is provided in Figure 4-7.

In summary, the Lockheed West Site was developed beginning in 1942 by dredging the intertidal areas located on the northern terminus of the now Port of Seattle Terminal 5. Multiple dredging events were completed to create working space for drydocks and vessel moorage. Several pier structures were constructed over-time as part of the shipyard development.

4.1.2 Historical Shipyard Activities

Lockheed West primarily served as a ship repair, maintenance, and new ship construction facility. Shipyard activities included sandblasting. Sandblasting occurred as part of routine dry dock, pierside, and shipway maintenance operation over many years. The shipway and Pier 21 and Pier 22 dry docks in particular were major work areas that were subject to spent sandblast grit. Blast grit is reported to cover the upland area near the shipway to a depth of 0.5 foot or more.

The 1994 EIS and supporting documents also describe abundant use of gasoline, diesel, and lubricating oils that led to areas of significant petroleum hydrocarbon contamination in the upland areas. In addition, elevated concentrations of PAHs, PCBs, metals, and petroleum hydrocarbons were found in sediments from former catch basins in upland areas (Tetra Tech 1988). Catch basin sediment was removed and the catch basins replaced as part of subsequent upland development for Terminal 5 in the late 1990s. The storm drains were also identified as a likely pathway for contaminant transport to the aquatic areas.

4.1.3 Southwest Harbor Project and Terminal 5 Development

In the early 1990s, the Port proposed to complete major upgrades to Terminal 5 and upland portions of Lockheed West as part of comprehensive redevelopment for the SWH Project. The proposal included constructing new 400- and 1,000-foot piers in the West Waterway south of Pier 21, and dredging of additional berths. Proposed activities for the SWH Project are described in the 1994 EIS (Parametrix 1994d).

Following the approval of the SWH Project EIS, the Port completed additional upland improvements to the Terminal 5 area, constructed one new berth, and completed the 400-foot pier extension south of the Lockheed West aquatic lease area. A proposed 1,000-foot pier extension and dredging of a second berth were described in the EIS, but have not been

completed. Future plans for the developing the second berth and pier extension are uncertain.

4.1.4 Ecology Designation for Lockheed West

A key component of the SWH Project involved cleanup of sediments and upland areas at Lockheed West. Cleanup planning and design were completed under the Washington State MTCA (Chapter 173-340 WAC). The combined upland and aquatic areas are identified on Ecology's Hazardous Sites List as "Southwest Harbor Project Lockheed Yard 2." The listing includes both the upland and aquatic portions of the Site with "Remedial Action In-Progress." A Site Hazard Ranking score of "1" is assigned to the Site and represents the ranking of highest concern for listed sites. Ecology database information indicates confirmed contamination for base-neutral compounds and PAHs, metals, PCBs, and petroleum products.

The upland portions of the Site have not been proposed for inclusion on the CERCLA NPL for potential Superfund cleanup; however, pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, EPA proposed listing the aquatic portions of the Lockheed West Site on September 26, 2006. EPA concurred with the plan for Ecology to take a lead role on cleanup activities associated with the upland portions of the former shipyard. As part of the purchase agreement between the Port and LMC, the Port agreed to remediate both the upland portion of the Site, and also the aquatic areas where remedial actions were necessary for constructing new Terminal 5 facilities (see Figure 4-8). For undisturbed aquatic areas, LMC maintains the primary responsibility for sediment cleanup where contamination resulted from past site activities by the shipyard.

4.1.5 Ecology Proposed Cleanup Action Plan for Lockheed West

Parametrix prepared an RI/FS to evaluate various sediment remediation options (Parametrix 1994a,b). The documents were prepared as companion pieces to the 1994 SWH Project EIS, and to fulfill requirements of the MTCA as a state-led cleanup. Remedial alternatives for the aquatic area were further described in Ecology's Draft 1996 CAP and earlier EIS and FS documents.

The preferred option for sediment cleanup was originally tied to dredging of the second Terminal 5 berth in the West Waterway portion of the Site. The preferred remedial option called for constructing a submerged nearshore fill in the aquatic area to permanently contain sediments from dredging as well as contaminated sediments from other sites. Constructing this submerged fill would also create about 13.5 acres of intertidal habitat. If the nearshore

fill could not be constructed to meet the timing of dredging the second berth, a smaller nearshore fill was planned that could be enlarged for future dredging of the second berth.

Neither remedial option nor other cleanup actions were designed or implemented because the Port decided to not expand the second berth area of Terminal 5. The 1994 EIS and FS indicate, however, that cleanup could proceed independently of the SWH Project, and would be required regardless. Cleanup of the site, independent of the SWH Project was not, however, prioritized by Ecology. Cleanup was originally expected to take 2 to 5 years.

4.1.6 Ecology Delineation of Cleanup Areas

For reference purposes, Figure 4-8 shows the Site and the five use areas that were identified by Ecology for remediation as part of the SWH Project. These areas were defined by Ecology during the FS for the SWH Project based on the interpreted lateral and vertical extent of contamination, planned dredging, and anticipated development. Ecology used the SQSs and CSLs of the Sediment Management Standards (WAC 173-204) to delineate sediment cleanup areas.

The Ecology derived Site areas include the Central Area, Lockheed West Waterway, East Dry Dock, West Dry Dock, and Ship Way site units. The Central Area is located between the Ship Way and West Dry Dock site units on the northern portion of the Site. According to Ecology's assessment, the Central Area is the only area of the Lockheed West Aquatic Area that has the potential to recover naturally and, therefore, was formed into a separate site unit (Ecology 1996). The Lockheed West Waterway unit is located north of the Terminal 5 pier including the area that was proposed to be dredged for the extension of the Terminal 5 pier. The East Dry Dock unit is located east of Pier 21, which was the former site of Lockheed's Huff dry dock and U.S. Navy drydocks. The dry dock area has been separated into an east and west portion because there are different remediation options that apply due to differences in depth of contamination, bathymetry, and because the East Dry Dock is part of the main navigation channel. The East Dry Dock portion is outside the Port's fee-owned property (the Inner Harbor line) and extends into the mouth of the West Waterway. The eastern boundary of the East Dry Dock area blends into the West Waterway, on the east side of which is located the Harbor Island Superfund Site. The West Dry Dock unit is located west of the former Huff Dry Dock (Pier 21) and is within the Port's fee-owned property at the north end of the Lockheed West aquatic area. The Ship Way unit is near the western boundary of the aquatic area and surrounds an area formerly used as a ship way (Ship Way 21). Table 4-2 provides a summary of ownership status, historical uses, and the 1996 Ecology estimated extent of contaminated sediment (as compared to the SMS) for the Lockheed West aquatic area cleanup site units.

Including planned dredging for the second Terminal 5 berth, a total of about 1,300,000 cubic yards of contaminated sediments were delineated by Ecology based on the SMS criteria (Table 4-2) for remediation. This estimated volume included the full vertical-extent of contamination based on the available (pre-1994) subsurface data. As discussed further below, uncertainty exists regarding the vertical extent of contamination in several areas of the Site. This in turn affects the accuracy of the estimated volumes of contaminated sediments. Additionally, cleanup standards will be derived as part of this RI/FS to delineate the extent of sediment contamination. Volume estimates utilized as part of the remedial alternatives evaluation will be based on the derived cleanup criteria.

Approximately half of the Ecology estimated total volume of contaminated sediments is contained within the "Central Area" with low concentrations of constituents that were recognized as being amenable to natural recovery over a 10-year period (at the time predicted to be 2004). According to Ecology, natural recovery would involve chemical degradation of constituents and natural sedimentation processes of the aquatic area and adjacent West Waterway to physically cover contaminated surface sediments.

Outside of the Central Area, contamination was considered to be above levels that would recover naturally over a 10-year time frame (the regulatory compliance period considered by Ecology). Active dredging or capping was proposed for these areas as part of the preferred nearshore fill alternative. The proposed dredging and capping included about 200,000 cubic yards associated with proposed Terminal 5 dredging in the Lockheed West Waterway Area. The estimated volume also included dredging in the West Waterway outside of the DNR lease boundary and about 80,000 cubic yards of potentially non-contaminated sediments suitable for open water disposal. The actual quantity of contaminated sediments in the Lockheed West Waterway, East Dry Dock, and West Dry Dock areas could differ under other scenarios for future site use (i.e., if the proposed Terminal 5 dredging and improvements is not constructed) and because different cleanup criteria will be used.

As noted in Section 4.1.8, a portion of the contaminated sediments within the Lockheed West Site was addressed as part of the PSR remediation (a sediment cap was placed in the southwest part of the Site adjacent to the former shipway). Remedial actions included grading (to create more favorable habitat conditions) and capping.

4.1.7 Completed Upland Cleanup Actions

Cleanup efforts for the upland portion of the former shipyard were completed by the Port in the late 1990s in conjunction with the Port's Terminal 5 expansion. The Port agreed to

complete the remediation of the uplands in the purchase and sale agreement for the property, which includes source control. . There are no existing access agreements for properties within the inner harbor line (shown on Figure 4-9). The Port of Seattle remediation removed or capped contaminated soils and debris, including areas of metal slag fill. Slag fill remains in some of the shoreline areas between Pier 21 and Pier 23 (shown on Figure 4-6). The cleanup work was completed as a state-led effort under MTCA to eliminate potential threats to users of the Terminal 5 and eliminate sources of recontamination to the aquatic area.

Upland remediation actions were completed to address the media identified by various environmental investigations of the Site including the following:

- Sand blast grit with metal and metalloid contamination;
- Soil with metal and metalloid contamination;
- Soil with total petroleum hydrocarbons (TPH) and total carcinogenic polycyclic aromatic hydrocarbons (CPAH) contamination; and
- Slag with metal and TPH contamination.

Upland remediation included the following elements:

- Excavation of soils with metals and sandblast grit for incorporation into concrete,
- Excavation of soils with petroleum hydrocarbons for thermal desorption,
- Excavation of stormdrain and catch basin sediments for off-site disposal,
- Replacement of storm drain system (see Appendix A-5),
- Paving the Site with asphalt,
- Groundwater monitoring, and
- Fencing and controlled access.

Upland remedial activities included 30 excavations on the Lockheed West Site to remove and soils containing metals and TPH. The distribution of hydrocarbon contamination at the Site was generally sporadic and related to spills during past facility operations. Previous analytical data indicated elevated TPH concentrations in on-site soils were more pervasive than CPAH concentrations; thus, TPH was considered to be the primary indicator hydrocarbon compound and CPAH the secondary. TPH levels were used to guide cleanup action and CPAH concentrations were verified after achieving the TPH RAOs. Where necessary, additional cleanup action was then conducted in order to achieve CPAH RAOs. Lead (Pb) was selected as the primary indicator metal in areas outside of the sandblast grit

area in the northwest portion of the Site because of its high degree of coincidence with other metals of concern. Arsenic (As) was selected as the secondary indicator metal for areas of industrial use because of its relatively high toxicity and human carcinogenicity. Arsenic was not generally coincident with other metals of concern besides lead, and, therefore was not selected as a primary indicator metal outside of the sand blast grit area. In the northwest part of the Site where sand blast grit was stockpiled by the shipyard, analytical data indicated a high degree of coincidence of metals of concern. Therefore, based on toxicity and carcinogenicity to humans, arsenic was selected as the primary indicator metal and lead as the secondary indicator metal in the sand blast grit area of the northwest portion of the Site. Groundwater data summaries are presented in the Enviros (1990) Distillation report presented in Appendix A-3.

Groundwater sampling and analysis was conducted as part of the multiple site investigations. Sampling and analysis was completed at the Site to assess the following conditions:

- Groundwater quality beneath the potential source areas;
- The direction and gradient of groundwater flow;
- Shallow aquifer transmissive properties by slug and pump testing;
- The tidal effects on the groundwater levels; and
- Likely groundwater quality upgradient of the Site.

Approximately 118 groundwater samples were collected and analyzed for the following compounds depending upon the drilling location, suspected source area contamination, and objectives of the sampling episodes:

- Priority pollutant metals;
- Cyanide;
- TPH;
- VOCs;
- Volatile aromatic compounds;
- Volatile halogenated compounds;
- SVOCs;
- PAHs; and

- Conventional analyses (pH, general minerals, ammonia, nitrate, nitrite, sulfate, sulfide, salinity, total organic carbon (TOC), dissolved organic carbon, and dissolved oxygen).

Based on the sampling and analysis results, the COCs for groundwater were identified as metals (arsenic, lead, antimony, chromium, copper, nickel) and hydrocarbons (Enviros 1993, 1994). Future groundwater quality monitoring conducted as part of the long-term evaluation of the upland remediation effectiveness is expected to include analysis of these COCs.

The upland remedial actions did not specifically address risk from exposure to site groundwater contamination because of the following:

- The groundwater is tidally influenced, brackish, and not considered to be potable;
- The Site and surrounding properties are used for industrial purposes and the aquifer is not currently used for domestic, agricultural, or industrial purposes;
- Potential exposure to contaminants in the groundwater is restricted to the potential migration of contaminants into Elliott Bay where they may directly impact the local aquatic environment and may indirectly affect human populations via ingestion of local fish; and
- Chemical concentrations representing the incremental contribution from Lockheed activities could not be discerned from off-site sources.

In 2005, the Port of Seattle completed a Phase I groundwater confirmation monitoring program for hydrologic characterization (Aspect 2005) of the uplands adjacent to the Site, including the former shipyard area. The Hydrologic Characterization Report summarized the findings of the SWH Project Phase I Groundwater Confirmation Monitoring Program (GWCMP). The Phase I GWCMP specifically addresses characterization of the post-redevelopment groundwater flow system, and forms the basis for development of a site-wide water quality monitoring program to evaluate the effectiveness of remedial actions completed in conjunction with site redevelopment. At present, the Port of Seattle is negotiating the long-term groundwater quality monitoring requirements based on the results of the hydrologic characterization. No recent groundwater quality monitoring has been performed. LMC is actively seeking to coordinate with the Port on future groundwater monitoring activities at the Site. Tidal monitoring work has concluded that mean shallow groundwater gradients are generally in the offshore direction toward the West Waterway and Elliott Bay, groundwater levels have been measured to range from 7.5 to 8.5 feet mean lower low water (MLLW) at the shoreline within the former shipyard facility (See Appendix A-4; Aspect 2005).

Reduction of potential sources of contamination as the result of closure of the former shipyard and cleanup of the upland areas is evidenced by the significant reduction in concentration of historical shipyard contaminants in the Lockheed West surface sediments between the mid 1990s and 2003 sampling events (see Appendix A).

No additional information regarding the status of the upland cleanup and final condition of the property has been obtained.

4.1.8 Pacific Sound Resources Cleanup Actions

Upland remediation efforts were also completed for the former wood treatment facilities at PSR. Documents describing details of remediation have been requested from EPA, but have not been received. It is known, however, that an underground slurry cutoff wall was constructed to control flow of contaminated groundwater and possibly non-aqueous phase liquid (NAPL) and dioxin/furan constituents sourced from the wood treatment compounds used at the Site. The current status and the effect of possible contaminant transport toward shoreline and aquatic areas of the PSR and Lockheed West Site are assumed to be effective and are subject to long-term monitoring. These assumptions will be further evaluated as part of the source control evaluation (see Section 12).

Offshore contaminated sediment and marine pilings were dredged and removed off site during the 2003 in-water construction season. Additionally, the marine sediment unit was subdivided into five distinct remedial action areas to accommodate varying capping environments (subtidal and intertidal slopes [0 to 40 percent] and depths [0 to 300 feet] vary considerably in the marine sediment unit). Construction activities in the first three remedial action areas in the marine sediment unit, including installation of the new beach in the intertidal area, were completed during the 2003 in-water construction season. Construction work in the remaining two remedial action areas in the marine sediment unit, the areas with the steepest slopes and greatest depths, were completed during the 2004 in-water construction season, ending on February 15, 2005.

4.1.9 West Waterway OU No Action Clean Up Decision

The U.S. Environmental Protection Agency (EPA) made a determination in 1999 that no action is necessary for the marine sediments in the West Waterway of the Duwamish River estuary, which is known as the West Waterway Operable Unit of the Harbor Island Superfund Site, Seattle, WA. EPA stated that a no action decision is appropriate because environmental investigations and site-specific risk assessments found that concentrations of chemicals (including PCBs, tributyltin [TBT] and mercury) in marine sediments within the West Waterway Operable Unit do not pose unacceptable risks to human health and the

environment. Further, environmental investigations did not identify any "hot spots" of contaminated sediments that warranted cleanup. EPA stated that sediments with the highest concentrations of chemicals on the western side of Harbor Island are already being cleaned up under EPA's Record of Decision for the "Shipyard Sediment" (Todd and Lockheed Shipyards). Finally, EPA stated that the majority of the contamination associated with the Harbor Island Site, including contamination that could have contributed to sediment problems in the West Waterway Operable Unit, is being addressed as part of the Shipyard Sediment cleanups, upland soil and groundwater cleanups, and upland source cleanups implemented to reduce contaminant inputs into the marine environment.

The West Waterway Operable Unit (West Waterway OU) includes approximately 70 acres of marine sediments and is located in the West Waterway at the mouth of the Duwamish River estuary near Harbor Island and adjacent to Lockheed West. The West Waterway is a dredged navigable channel used extensively for industrial purposes. The waterway consists primarily of subtidal sediments, which remain under water even at low tides. The shoreline of the West Waterway is predominantly pilings, bulkhead, and riprap. Areas of intertidal sediments along the shorelines adjacent to the West Waterway OU are generally nonexistent.

EPA stated that all actions necessary to control contaminant releases from the uplands portion of the site to adjacent sediments in the West Waterway OU have been completed or will be addressed through ongoing actions.

As part of the RI/FS and supplemental investigations, EPA conducted risk assessments to evaluate the current and future effects of contaminants on the environment and human health. The conclusions from the ecological and human health risk evaluations are summarized below.

Ecological Risk Evaluation Conclusion – Chemicals in sediments within the West Waterway OU do not pose a risk to the benthic community that live in the sediments. Further, bioaccumulative chemicals (PCBs, tributyltin, and mercury) in sediments do not appear to negatively affect aquatic invertebrates or fish. Thus, based on these assessments, sediments in the West Waterway OU do not require remediation to address ecological concerns.

Human Health Risk Evaluation Conclusion – A human health risk assessment was conducted to identify potential risks posed by chemicals detected in sediments or seafood (e.g., fish, shellfish) from the West Waterway OU. Based on these assessments, the cumulative site risk to an individual based on reasonable maximum exposure for both current and future use is 1 x 10-4, and the *true* risk is likely to be less than 1 x 10-4. Further,

although the hazard index is slightly greater than 1, non-cancer health effects are unlikely to result from site exposure. Given that the estimated excess cancer risk is within EPA's target risk range, and considering site-specific conditions and the conservative nature of the human health risk assessment, EPA stated that the sediments in the West Waterway OU do not pose unacceptable risks to human health and sediment cleanup is not warranted.

Summary – For the West Waterway OU, the RI/FS and supplemental investigations demonstrate that concentrations of chemicals (including the three bioaccumulative chemicals of concern, PCBs, tributyltin, and mercury) in marine sediments do not pose unacceptable risks to human health or the environment. This conclusion is based on a comparison of site data to the Washington State Sediment Management Standards, results of site-specific human health and ecological risk assessments, and results of site-specific work on tributyltin toxicity and bioaccumulation. Chemical contaminants were not found to cause toxicity to animals living in or on bottom sediments, and estimates of human health risks were within EPA's acceptable risk range. Additionally, no "hot spots" of chemical contamination were found in the sediments.

In summary, EPA stated that a no action decision is appropriate for the West Waterway Operable Unit of the Harbor Island Superfund site because the marine sediments do not pose unacceptable risks to human health and the environment.

4.2 SITE DESCRIPTION INCLUDING GEOGRAPHIC AND PROPERTY BOUNDARIES

The Lockheed West Site is located at the terminus of the West Waterway of the Duwamish River estuary and Elliott Bay (T24N, R3E). The Site is bounded on the south by Southwest Florida Street, on the east by the West Waterway, and on the north by Elliott Bay. Directly to the west is the PSR (formerly Wyckoff Industries) wood treatment facility. The aquatic property previously owned by LMC includes approximately 2,050 feet of shoreline and is approximately 26.5 acres in size. The Lockheed West aquatic area is located at the northern end of the Site, extending into Elliott Bay.

Lockheed West is located along the southwestern shoreline of Elliot Bay, adjacent to the Port's container shipping operations at Terminal 5 (Figure 4-9). A portion of the Site borders the West Waterway of the Duwamish River. The former shipyard facility included the following:

- Approximately 20 acres of land previously leased from DNR, and
- Approximately 7 acres of aquatic land south of the DNR lease areas that are owned by the Port.

The DNR lease area consists of several parcels, as identified on Figure 4-9. All current and former leases with LMC have been assumed by the Port under the September 2000 Port Management Agreement between the Port and LMC. The aquatic lands south of the DNR lease area were sold by LMC to the Port in 1992. The Port also acquired the upland portion of the former shipyard from LMC for expansion of the cargo facilities at Terminal 5.

The PSR Site is located to the west of the Lockheed DNR lease area. The PSR Site was the location of a historical wood treating and export operation. Upland portions of the PSR Site have recently been remediated under the CERCLA Superfund program as part of the Terminal 5 expansion. The offshore portion of the PSR Site was addressed by EPA under CERCLA as a Superfund-led project.

The RI for the SWH Project completed in 1994 (Parametrix 1994b) states that "…a portion of the Lockheed aquatic area that is part of the PSR Site in terms of contamination similarities, but is within the Lockheed West property boundary. This area will be cleaned up as part of the PSR Site…" Figure 4-9 shows that the remedial action area of the PSR Site extends into the western portion of Lockheed West Site. According to the PSR remedial design documents and as evidenced by low tide observations, the PSR cap does extend into the area formerly occupied by the historical shipyard.

The southern edge of Lockheed West Site is defined for this report as the mean higher high water mark (+11.35 ft MLLW) along the shoreline adjacent to Terminal 5 (Figure 4-9). The Port completed extensive redevelopment and environmental remediation of upland areas at Terminal 5 in the late 1990s. The eastern and northern boundaries of the historical shipyard use area are defined by the outer limits of the DNR aquatic lease areas (Outer Harbor Line).

Access to the shoreline, piers, and aquatic areas of the former shipyard is controlled by the Port with fencing and locked gates. During redevelopment of the upland container facilities for Terminal 5, the Port constructed a sheet pile bulkhead across the apron of the former shipway in the western portion of the Site (see Figure 4-7). The shoreline to the east consists of areas of open slope, riprap-reinforcement, and wooden or steel retaining walls in generally poor condition. Since closure of the shipyard, the Port has demolished Piers 21 and 22. In addition, the decking has been removed from Piers 23 and 24.

Cleanup boundaries will be determined using cleanup levels or based on the extent of COC's that are known to be directly related to shipyard contamination, such as copper, zinc, and TBT as part of the RI/FS. As a result, the following discussion relates to the property and geographic boundaries for the Site.

4.3 IDENTIFICATION OF POTENTIAL HISTORICAL AND ONGOING SOURCES OF CONTAMINATION TO THE LOCKHEED WEST SITE

Potential historical and ongoing sources of contamination to the Lockheed West site will be evaluated as part of the Source Control Evaluation described in Section 12. The Source Control evaluation will assess each of these potential mechanisms relative to their potential to contaminate sediments at the Lockheed West Site. The potential contamination source mechanisms will be evaluated using the available existing data from Lockheed West and the adjacent areas on sediment transport and contaminants of potential concern. The following is a summary of the identified potential sources of contamination.

Sediments at Lockheed West can be impacted by a number of potential mechanisms giving rise to elevated chemical concentrations in the sediment including:

- Surface water runoff from adjacent upland areas;
- Bank erosion;
- Outfall discharges of water and sediment to the waterway from storm and CSO drainages located in and nearby the site;
- Direct discharge from vessel leaching and overwater activities such as historical shipyard work;
- Groundwater flow and discharge to the site and within the adjacent waterway;
- Transport and deposition of sediment from adjacent Elliott Bay, West Waterway and Lower Duwamish Waterway containing higher concentrations than the Lockheed West cleanup objectives due to resuspension from both natural and vessel induced waves and currents; and
- Atmospheric deposition.

A site conceptual model, further describing these potential source mechanisms is described in Section 4.6.

4.3.1 Potential Historical Sources

Historical upland uses of the Lockheed West Site provided several potential pathways for sediment contamination. Potential contaminants from historical shipbuilding practices at the Site include petroleum hydrocarbons, solvents, metals, oil, diesel, gasoline, PCB; volatile organic chemicals, and sandblast grit.

Historically the adjacent uplands at the site included areas used for sheet metal fabrication, electrical, and pipe shops and substations; various repair and storage buildings; diesel fuel

tanks and automobile shop; hazardous waste storage areas; and paint and sandblast facilities. Soils contaminated as the result of spills and other environmental releases from these facilities would have a potential pathway to the adjacent aquatic sediments from direct discharge, transfer through stormdrain systems, or groundwater transport.

Historical over-water operations at the former shipyard provided several potential pathways for sediment contamination. The historical shipyard included five major piers, drydocks and a shipway. The dry docks and shipway were used to repair, sandblast, and paint vessels. Paint chip fragments, as well as chemicals and solvents used in the construction and maintenance of vessels, would have a direct path to sediments. Most ship construction activities occurred pierside and off moorings in the vicinity of Piers 23 and 24. Chemical contamination in these areas consists of a wide range of organic compounds and metals that reflect both the types of materials used at the dry docks and ship way facilities and the length of time over which the facilities operated.

A historical wood treatment facility (Pacific Sound Resources) was historically located upland of the western portion of Lockheed West. Soils contaminated as the result of spills and other environmental releases would have had a potential pathway to the adjacent sediments from direct discharge, transfer through stormdrain systems, or groundwater transport. COCs identified for the former wood treating facility include PAHs and dioxin.

Other historical sources include nearby uncontrolled combined sewer overflows. The SW Florida Street combined sewer overflows and storm drain, which discharges into the West Waterway adjacent to the southeast corner of the property. CSOs are generally accepted as potential sources to sediment contamination, given their periodic uncontrolled and untreated discharges.

Other possible historical sources include the Duwamish River and Elliott Bay. No barriers are known to exist that would prevent free exchange of suspended sediment between Lockheed West and the adjacent waterways. Sediment exchange would most likely have been the result of suspension and transport by river and tidal currents. Multiple point and non-point sources of contamination to the adjacent Duwamish river, West Waterway, and Elliott Bay have been documented.

4.3.2 Ongoing Potential Sources of Contamination

Currently, the upland areas adjacent to Lockheed West are used by the Port for shipping container storage. Occasionally barges are temporarily moored along the existing pier structures using tug boats. In addition, non-commercial vessel traffic such as recreational boats may transit the Site. Commercial vessels operating in the vicinity of the Site are

controlled by the Coast Guard and are required use the established navigational channels and berth approaches.

Potential ongoing sources of contamination from Terminal 5 may include direct groundwater discharges, and untreated discharges from the SW Florida Street CSO. Other nearby storm drains and outfalls associated with the former shipyard facility have been plugged or removed as part of the upland remediation.

The transport of sediments from the Duwamish River, West Waterway and Elliott Bay may pose a potential source of contamination at the Site. As described above, sediments are assumed to exchange between these waterways and the Site. Multiple ongoing sources of contamination may be transported by river and tidal currents. Whether this is a source of future contamination depends on the chemical concentrations associated with suspended sediments.

4.3.3 Adjacent Site Uses

Currently, both the uplands portion and the offshore portion of the former PSR Site have had remedial actions performed. These actions presumably have controlled the potential historical sources from the Site. At present, the uplands portion of the PSR Site is part of the Port's Terminal 5 operation and is subject to the source control activities conducted by the Port. The shoreline and offshore portion of the PSR Site is not currently used for a specific purpose. It also has restrictive signs and fencing that limit public access to the shoreline for recreational purposes.

The West Waterway continues to be maintained and functions as an industrial waterway for navigation and commerce. Several cleanup actions have taken place along the waterway (e.g., Lockheed Shipyard Sediment Operable Unit (LSSOU), Todd Shipyard) that are assumed to have reduced the potential sources of contaminants to Lockheed West from these locations. The West Waterway continues to be subject to influences from the Lower Duwamish River. The effectiveness of these completed remedial actions is subject to evaluation of the long-term monitoring program data for the sites.

4.3.4 Completed Source Control Activities

Several source control activities have been completed to address some of the potential historical and ongoing sources of contamination to the Site (described above).

Upland areas of the former shipyard were remediated by the Port under Ecology supervision (described above), and are subject to long-term monitoring. Remediation and redevelopment efforts for the Site included treatment and removal of contaminated soils

(total petroleum hydrocarbons [TPH] and metals), paving the majority of the former shipyard area, and replacement of upland storm drains and related outfalls. Contaminated soil removal and treatment actions effectively reduced potential sources to sediment contamination resulting from direct transport from the upland areas. Paving of the Site effectively reduces surface water infiltration to groundwater at the Site. According to the available information, the historical storm drains were removed or plugged in accordance with the Port's remediation plans. Note that the storm drain lines at the north side of the facility were plugged at a point some distance inboard of the shoreline, immediately downstream of the last catch basin. Historical structures that were maintained and protected were preserved to drain the Terminal 5 yard located immediately to the south.

Upland remediation efforts were also completed for the PSR Site under the CERCLA Superfund program as part of the Terminal 5 expansion. As part of this remediation effort, an underground slurry cutoff wall was constructed to control flow of contaminated groundwater and possibly NAPL and dioxin/furan constituents sourced from the wood treatment compounds used at the Site. In addition, remediation of the offshore portion of the PSR Site was completed under CERCLA as a Superfund-led project. A portion of the PSR sediment remediation area extends into the western portion of the Lockheed West Site. Remedial design documents for the PSR Site indicate that this area was capped as part of the PSR remediation program. Based on the available data and information on the PSR remediation, it is assumed that this cleanup has addressed to the extent possible the extent of PSR derived sediment contamination. Confirmation of the remedy effectiveness will be identified by the long-term monitoring of the Site.

4.4 GEOGRAPHIC AND PHYSICAL SITE CHARACTERISTICS

Sediment descriptions, subsurface conditions, and occurrence of groundwater are described in geotechnical investigations by Enviros (1990), Hart Crowser (1995), and in the 1994 RI, FS, and EIS documents for the SWH Project (Parametrix 1994a,b,c,d). Information was also collected by McLaren-Hart for the remedial investigation of upland areas of Lockheed West, and by Converse Consultants and Pacific Groundwater Group as part of a sediment dredge disposal and containment model study (Converse Consultants and Pacific Groundwater Group 1993) for the Port.

4.4.1 Future Site Use Assumptions

Future plans for the Site are uncertain, but the development of the RI/FS will consider potential future Port plans and use of the Site for tribal fishing and shellfish harvesting. As discussed above, in the early 1990s, the Port proposed to complete major upgrades to

Terminal 5 as part of the SWH Project. Part of the proposal included constructing new 400- and 1,000-foot piers in the West Waterway south of Pier 21, and dredging of additional berths. Proposed activities for the SWH Project are described in the 1994 EIS. The proposed 1,000-foot pier extension and dredging of a second berth were described in the EIS, but have not been completed.

Future plans for the developing the second berth and pier extension are uncertain, but the Port has expressed continued interest in completing this work. The Port has provided LMC schematic drawings of the potential project's footprint. LMC also understands that the Port may also want to use the northern portion of the Site for temporary barge moorage, with the potential construction of mooring dolphins. LMC will consider these plans, to the extent possible, in the evaluation of potential remedial options at the Site.

4.4.2 Shoreline Characteristics and Vicinity Land Use

Elliott Bay and the Duwamish Waterway are shorelines of statewide significance under the Shoreline Management Act and the Coastal Zone Management Program. They are part of Puget Sound, an estuary of national significance under the National Estuary Program. The Duwamish Estuary and Elliott Bay have experienced extensive development and urban growth during the 20th century. Dredging of the Duwamish Waterway, completed in 1921, resulted in straightening what was originally 9.3 miles of meandering estuarine channel habitat into the 5.3-mile deep-draft channel that exists today. Tidal flats and marshes that once dominated the mouth of the river were dredged and filled to form Harbor Island and the upland areas of the Site. Currently, less than 2 percent of the flats, shallows, and tidal marshes remain.

The Duwamish Waterway is part of the larger south Seattle/Duwamish industrial district, the oldest of three industrial concentrations in the greater Seattle area. The Duwamish industrial district is a major transportation corridor for rail, trucking, and waterborne shipping. The primary land uses in the vicinity of the Lockheed West Site have been industrial and maritime related for over 100 years. Warehousing, commercial, and industrial distribution activities are located throughout the area (see Figure 1-2).

Land use to the south of the Lockheed West Site is primarily industrial. Birmingham Steel (formerly Salmon Bay Steel), located between SW Spokane Street and SW Andover Street, is the largest industrial facility in the area. Birmingham Steel's property is used for open scrap storage and slag (an inorganic by-product of steel production) processing. There are also Burlington Northern rail lines south of the Lockheed West Site. To the southwest of

the Site, between West Marginal Way SW and SW Spokane Street, are relatively small parcels that support various retail and commercial facilities.

Land use in the upland areas to the west of the Site is primarily single-family residential, including the residential neighborhoods of West Seattle. Also to the west, along Harbor Avenue SW, are bluffs that are part of the Duwamish Head Greenbelt, consisting of approximately 343 acres of developed, publicly owned land and undeveloped or privately owned land. Denser residential areas are located on the bluffs and have an unobstructed view of the Site. Harbor Avenue SW is considered the gateway to the Alki Beach shoreline area. Commercial land uses and park land are located along the shoreline of Elliott Bay to Duwamish Head.

The Lockheed West Site was formerly owned by the Lockheed Company and used for ship repair and ship construction; in 1987 Lockheed ceased operations. The Port currently owns the Site and the Terminal 5 to the south. Terminal 5 and a portion of the former shipyard are currently leased by American President Lines for container-handling operations. The shoreline of the former shipyard is characterized by armoring or bulkheads with the exception of a small intertidal beach located on West Waterway.

The Lower Duwamish Waterway and southern Elliott Bay provide recreational opportunities for area residents. Numerous boat ramps, parks, waterfront trails, public moorages, and open-space areas provide the public with access to the shoreline. Lower Duwamish Waterway and Elliott Bay are also usual and accustomed tribal fishing areas.

4.4.3 Watershed

The West Waterway is at the mouth of the Duwamish/Green River system, which drains an area of about 483 square miles (Grette and Salo 1986). From the mouth to river mile (RM) 11 (location of former Black River confluence), the river is referred to as the Duwamish River; above RM 11 it is called the Green River. The upper drainage is fed by rain and snowmelt, while the lower drainage and two main tributaries, Big Soos Creek and Newaukurn Creek, are fed by rain and groundwater. Flows in the main river below RM 64.5 are controlled by releases from Howard A. Hanson Dam and the City of Tacoma water diversion at RM 61. USACE has limited discharges to 12,000 cubic feet per second (cfs) at Tukwila and minimum flows to as low as 200 cfs, with an average flow of 1,500 to 1,800 cfs (Weston 1993). The West Waterway carries most of the river flow due to shoaling at the entrance of the East Waterway (USACE 1983). The upper drainage originates in the high Cascade Mountains and flows generally west and northwest through mostly narrow valleyed, steep-sloped, forested clear-cut terrain, before encountering more gentle slopes

and broader valley conditions at about RM 46 (Williams et al. 1975). From this point, the river passes through upland fields, woods, and increasing residential/commercial use areas. The lower end of the river (Duwamish River section) flows through intensive commercial and industrial use areas, including the proposed project area (Grette and Salo 1986).

4.4.4 Shoreline and Aquatic Area Bathymetry

As shown in Figure 4-11, the aquatic area of Lockheed West is situated on a relatively flat bathymetric bench with elevations varying between about +14 to -40 feet MLLW. Underwater slopes continue to the north at an angle ranging from about 5 horizontal to 1 vertical (5H: 1V) to 2H:1V.

The Site is located in a transition zone between estuarine and marine environments. As described above, shoreline areas of the Site include open, exposed slopes with sand and gravel, a new interlocking sheetpile bulkhead across the former shipway, and older retaining walls and riprap-reinforced areas. Exposed shoreline areas have relatively steep slopes. Debris piles of amalgamated sandblast grit and slag are also locally present in the intertidal area. Intertidal areas contain scattered debris and gravel near the shoreline. Sandy surficial sediments in the subtidal areas contain less gravel and debris.

Intertidal habitat is affected by relatively low-saline water from the Duwamish River that forms an approximate 3- to 6-foot layer over denser saline waters. There is an apparent upwelling effect of marine waters toward the northern edge of the property to the west, toward Duwamish Head.

As part of the summary of existing data, a high resolution multibeam sonar bathymetric survey was conducted for Lockheed by Tetra Tech on May 20, 2006. The multibeam sonar system provided a high resolution, full bottom coverage, bathymetry of the area in the vicinity of the Lockheed West project site, from which contour lines and hill-shade maps (hard copy and electronic) digital terrain models where created.

The survey data was collected to chart bottom features and provide detailed bathymetric data to: 1) support future site characterization activities; 2) determine bathymetric anomalies (e.g., debris); and 3) provide data for potential remedial designs. Additionally, the collected data may also be used to: 1) analyze bottom substrate composition; and 2) evaluate sediment transportation.

The survey was conducted using the latest technology and followed all appropriate QA protocols. The results from the multibeam bathymetry survey are shown in Figure 4-11. Bathymetry data extended from near shore to approximately 192 feet below MLLW off shore. The high resolution bathymetry data shows topographic details of the seafloor

including areas that have been historically dredged and the location of debris deposits, which are primarily in the area around the former drydocks. Timber pilings, lying on the seafloor, are also apparent in the bathymetric data.

4.4.5 Regional Geology

Information on the geology of the Lockheed West Site is derived from investigations previously conducted and summarized in the EIS and Aquatic RI for the SWH project (Parametrix 1994a,b). Prior to the 20th century, the surface of the delta consisted of an estuary of shallow, meandering channels, marshland, and tidal mudflats. During the 20th century, the Duwamish River channel has been straightened, and the marshes and mud/sand intertidal substrates at the mouth of the river have been filled. The prevalence of human activity over the last 100 years, including the channelization of the river, construction of shoreline protection, extensive pavement, and development of the Longfellow Creek storm water outfall, have stabilized the geology of the Site. Geologic cross sections, derived from soil borings taken from offshore and upland portions of the Lockheed West Site, indicate the presence of layers of sand, silty sand, and occasionally silt. Four distinct geological units are present in the upland and offshore portions of the Site. These units are described as follows (in descending order from the soil/sediment interface downward):

- **Upland Fill.** The soil unit underlying the present upland configuration consists of an approximate 20-foot-thick layer of medium dense fill material containing varying amounts of sand, silt and clay. Review of historical dredging permits indicates the source of this fill to be material previously dredged from areas within the West Waterway of the Duwamish River (adjacent to and within the Site).
- **Recent Sediment Deposits.** The upper offshore geological unit is comprised of a veneer of soft, organic silt and sand deposited at the Site after completion of historical dredging activities were performed to construct the current configuration of the Site.
- **Post-Glacial Deposits.** Underlying the Recent Sediment Deposits is a post-glacial unit comprised of soft, organic silt ranging from approximately 3 to 7 feet in thickness. Below the surface silt layer are sands with interbedded thin silt layers. This post-glacial unit ranges from approximately 100 to greater than 155 feet in thickness. This deposit is likely the result of estuarine deposition from the Duwamish River.
- **Glacial Deposits.** A unit of hard sandy silt was observed in the two southernmost portions of the offshore area of the Site. This unit is a glacially overridden deposit

and was encountered at elevations of approximately -60 to -140 feet MLLW. This unit is assumed to slope downward into the Site toward Elliott Bay.

These layers are not continuous across the Site, but alternately grade laterally from sand to silty sand back to sands, with localized areas of silt. The variable deposition, resulting in indistinct contact between materials, is consistent with an offshore deltaic environment. The changing currents near the Duwamish delta have moved different materials intermittently through space over time to result in the variation in grain size. No continuous layers of any one material were noted across the entire Site. One boring on the Site indicated "over consolidated" materials that would possibly represent glacial deposits and therefore the hydraulic bottom of the system, with the contact between low-density and high-density sediments lying about 60 feet below MLLW. This sample may represent the edge of materials that have been glacially overridden. Other borings drilled to depths of almost 160 feet below MLLW indicated only low-density sediments. These silts and sands are at high risk of liquefaction, given the relatively high level of seismic activity in Washington associated with plate tectonic movement.

4.4.6 Currents, Tidal, and Wave Influences

4.4.6.1 Tides

The tides in the Duwamish River estuary have marked inequalities in the successive high- or low water stages. Based on a tide reference station approximately 1 mile from the mouth of the estuary, the mean tide stage is 6.5 feet above MLLW, and maximum and minimum estimated stages are 15.00 feet ± 0.5 foot above MLLW and 4.5 feet ± 0.5 foot below MLLW, respectively (King County Department of Natural Resources 2001).

4.4.6.2 Currents

Physical properties of the waters of the Site are similar to salinity and current patterns in inner Elliott Bay. Both are affected by the interaction of tidal flows and outflow from the Duwamish River. Circulation and salinity distribution in the inner bay were investigated by NOAA (Sillcox et al. 1981). The general circulation pattern in the inner bay is counterclockwise with Duwamish River flows discharging to the bay. This pattern can create eddies at the mouth of West Waterway during high river flows and during ebb tides. During flood tides with low river flow, long shore currents are reported to be in the range of 0.2 foot per second (ft/sec). West Waterway flows reach as high as 1.4 ft/sec just below the water surface. The combination of tidal and river flows results in a consistent flow across the Site from west to east. Wind-driven circulation will upset this circulation pattern at some time, but east winds are not frequent or strong enough to reverse the overall

circulation pattern. Current meters placed over 100 meters deep showed that current velocities in the bay were too low to resuspend sediments (Sillcox et al. 1981). However, localized wind-driven currents may be sufficient to resuspend sediments in the shallow areas. Wind-induced resuspension was not investigated by NOAA. Circulation of water in the Duwamish estuary is a function of river flows and the movement of saltwater upstream during tidal cycles. The intrusion of saltwater into the river creates a saltwater wedge overlain by freshwater that extends as far as 10 miles upstream (NOAA 1987, Ebbesmeyer et al. 1998).

4.4.6.3 Waves

A coastal engineering analysis was conducted by Coast and Harbor Engineering, Inc. (CHE) in 2004 in support of sediment remediation efforts at the Lockheed Shipyard 1, which is representative of conditions at the Site. This analysis evaluated wind-wave, vessel wake, and prop wash data, which are all forces potentially influencing the stability of aquatic sediment. See CHE (2004) for additional details regarding methods, analysis assumptions, and input data. The following discussion summarizes their findings.

Wind speed and direction data were derived from the National Data Buoy Center C-MAN Station WPOW1 at West Point Washington, collected from 1984 through 2001. The Site is open to direct wind-wave impacts from primarily the north and northwest. Of these, wind from the northwest direction is estimated to be critical for the wind generated wave conditions.

Wind data, in combination with bathymetry data derived from NOAA (1930 to 1999) and the USACE (2004), were used to hindcast wave conditions in the vicinity of the Site. Extreme wave heights ranging from 3.6 to 3.9 feet are expected to occur every 5 to 10 years, respectively, with larger waves (4.4 feet to 4.7 feet) occurring at intervals of 25 years or greater. Wind-wave heights, periods, and directions are strongly affected by local site features, with the greatest extreme wave heights occurring in Elliott Bay and declining as the distance landward in the West Waterway increases.

The vessel wake analysis determined that a vessel traveling at 8 knots would produce a wake 2 feet high with a period of 3.5 seconds. Propeller wash effects on bottom velocities are dependent on the vessel propeller position, the vessel size (large/small), and the vessel orientation. Based on a large vessel with a distance and orientation (propwash directed toward shore) typical of operational conditions in the West Waterway, peak bottom velocity was estimated to be 6.5 feet per second.

4.4.7 Sedimentation

Previous site investigations provide a considerable amount of data describing the physical characteristics and distribution of surface and subsurface sediments. Investigations include 25 soil borings completed by Hart Crowser for engineering design support for proposed improvements of the SWH Project (Hart Crowser 1995), and other work presented in the Parametrix RI (1994b) and Enviros (1990).

Sediment sampling and drilling data from Hart Crowser's 1995 site explorations indicate the presence of soft organic silt commonly extending from the surface to depths of about 3 to 7 feet below the mudline. These sediments represent the majority of materials affected by historical contaminants at the former shipyard. Other investigations (e.g., Parametrix 1994b) describe the uppermost sediments as sand with varying amounts of gravel and silt. The uppermost sediments are underlain by interbedded sands and silts of alluvial origin from the deltaic environment of the Duwamish River, or fill derived from these materials. Alluvial sands and gravels extend to depths of 100 feet or more below mudline and have varying densities.

Individual layers of silt, sand, and gravel are laterally discontinuous and do not have obvious physical characteristics that produce preferential pathways for groundwater flow or contaminant migration. Contacts between units are not distinct and suggest variations in depositional environment or filling.

4.4.7.1 Sedimentation Loading

Sediment loading to Lockheed West is primarily from the Duwamish River and Elliott Bay. Most of the Duwamish River sediment originates from the Green River, with annual loading ranging from 160,000 to 190,000 cubic yards per year (Weston 1993). The total sediment load for the Duwamish River is estimated to range from approximately 210,000 to 270,000 cubic yards per year (USACE 1983). Approximately 80 percent of the Duwamish River sediment load settles out in the river because of differing densities in the saline water entering from Elliott Bay during tidal cycles (Weston 1993). The remaining sediment is transported to the East Waterway, West Waterway, and North Harbor Island area and is assumed to be redistributed through tidal fluctuations. It is assumed that sediment loading to the Site is also likely to result from localized long-shore currents within Elliott Bay.

4.4.8 Hydrogeology and Groundwater Flow

Site hydrogeology and groundwater flow are dominated by the influence of tides and the presence of denser, saline marine water. Groundwater movement beneath the Site is affected by tidal action, although the net tidal inflow and groundwater outflow appear to

balance out. Tidal response is generally controlled by density-driven flow and local variations in sediment permeability. Groundwater flowing northward from the adjacent upland areas discharges to Elliott Bay at elevations of about -40 feet (MLLW) and above. More dense marine waters flow inland below this elevation. The difference in hydraulic response of the two zones is driven by density gradients and slight local variations in sediment permeability. At low tide, groundwater may discharge to surface waters of Elliott Bay through intertidal seeps. Depth to shallow groundwater in upland areas adjacent to Lockheed West varies considerably depending on tide.

The western portion of the Lockheed West aquatic area and adjacent shoreline may be influence by groundwater flow from the upland areas of the adjoining PSR site. Groundwater flow before implementation of the PSR slurry wall remedy had a component of groundwater flow to the Northwest toward the Lockheed West site. More recently, there was evidence of groundwater flow around the eastern end of the PSR slurry wall and toward the Lockheed West site (RETEC 2004). Additional information on the nature of these potential sources in upland portions of the PSR Site and the outcome of remediation previously completed have been obtained and will be incorporated into the Source Control Evaluation Report.

4.4.9 Biota

Flora and fauna of the aquatic area and shoreline include a typical mix of invertebrates and algal plants found in Elliot Bay and similar environments of Puget Sound with a history of industrial use. Fine sediments are dominated by bivalves, crustaceans, and several species of worms. Coarser sediments host a diverse array of crustaceans and amphipods. The environment also reportedly supports crabs, squids, octopi, and resident fish such as perch, sculpins, and rockfish, as well as anadromous fish. This assemblage of species provides a fairly diverse marine community representative of shallow areas of Elliott Bay and Puget Sound with modified or disturbed shoreline features. It is noted that the current use of aquatic biota for human consumption is unknown.

4.4.10 Debris and Structures

From observations of the Site, review of recent high resolution bathymetry, and from areal photos, there are several structures and debris located along the shoreline of the Site. There are historical piers and a shipway that were associated with the operations of the former shipyard site. During redevelopment of the upland container facilities for Terminal 5, the Port constructed a sheet pile bulkhead across the apron of the former shipway in the western portion of the Site. Many pilings remain in place at the shipway location. The shoreline to

the east consists of areas of open slope, riprap-reinforcement, and wooden or steel retaining walls in generally poor condition. Since closure of the shipyard, the Port has demolished Piers 21 and 22. In addition, the decking has been removed from Piers 23 and 24.

Numerous apparent debris piles are observed in the area of the former drydocks. Additionally, multiple pilings are observed on the seafloor throughout the Site (Figure 4-11).

4.5 SUMMARY OF EXISTING SITE CHARACTERIZATION STUDIES

Previously collected data for the Site are summarized below (Table 4-3) and in Appendix A. These data are summarized to serve as a background for understanding the general CSM, nature and extent of contamination and identification of data gaps, however; the majority of the information is aged. Data collection for the RI will supplement the existing data and will provide a contemporaneous and more comprehensive data coverage than does the existing data. The data collected during the RI will provide a more comprehensive suite of information for the evaluation and selection of remedial alternatives for the Site. Given that extensive data collection will be completed as part of this RI, the summary of existing data is presented to inform development of the RI sampling activities and to provide general background for the planned RI/FS activities and is, therefore, not intended to be fully comprehensive.

4.5.1 Existing Groundwater Monitoring Data

Preliminary groundwater monitoring at the Lockheed West Site began in 1989 by McLaren Engineering and Enviros Corporation (McLaren 1989, Enviros 1989). During the summer of 1990, further groundwater characterization was conducted (McLaren-Hart 1990, Enviros 1990). Groundwater data are summarized Appendix A and in the Enviros Distillation Report (see Appendix A-3) and McLaren Hart and Enviros Remedial Investigation Work at the Former Lockheed Shipyard (Yard II) in West Seattle, Washington (Enviros 1993).

Currently there are seven groundwater monitoring well locations (Figure 4-12). Four are located near Lockheed West, including one just south of pier 24, one east of pier 23, and two near the southeast corner of the Site. The Port of Seattle has not performed groundwater quality monitoring at these wells as part of the long-term remediation monitoring. The Port is currently working with Ecology to finalize a long-term groundwater monitoring program for the site.

4.5.2 Existing Uplands Data

The Port's Terminal 5 expansion project, completed in 1998, involved the remediation of the uplands portion of the Site, with the objective of removing the Site as potential source of continuing contamination to the environment and to complete the Port's obligations from the acquisition of the shipyard property from Lockheed. Prior to this, upland remedial investigation work had been conducted between 1988 and 1992 by McLaren-Hart, on behalf of Lockheed, and Enviros, on behalf of the Port. Documents containing and summarizing the RI work and associated data upon which the Terminal 5 uplands remediation activities were based include McLaren-Hart (1992) and Enviros (1991, 1992a,b).

The work by McLaren-Hart, which incorporates data collected by Enviros collected in 1991, was directed towards determining the magnitude and extent of contamination in site upland soil, groundwater, and storm drain sediments. Soil samples were obtained from approximately 222 locations around 35 potential sources areas on site using grab sampling, drill rig, and hand auguring techniques.

4.5.3 Sediment Quality Data

Since 1984 an extensive series of studies have been independently conducted by LMC and the Port in an effort to determine the nature and extent of sediment contamination in the Lockheed West Site and vicinity (Table 4-3). Historical and recent sample locations are shown Figure 4-12.

Much of this information was compiled by Parametrix and by Enviros (1990) to support characterization of the Lockheed Shipyard No. 2 for the Southwest Harbor Cleanup and Redevelopment Project (SWHCRP). This work included 23 surface grab samples and 85 individual core samples from 22 locations at various depth intervals. Previous work also supported studies for the Harbor Island RI/FS (Weston 1993), evaluation of sediments in the West Waterway of the Duwamish River, and other sediment quality evaluations. In addition to bulk chemical analysis, sediment characterization work also included the following tests for some of the samples collected:

- Nineteen bioassay tests;
- Eight infauna sampling locations;
- Five surface samples tested using the Toxicity Characteristic Leaching Procedure (TCLP);
- Forty benthic flux samples from two locations;
- Sixty interstitial porewater samples from six squeeze core locations;

- Five interfacial pore water surface samples; and
- Sequential Batch Leaching Test extractions from three locations and two composite samples.

Results of the technical studies by Parametrix, Enviros, and others were evaluated to identify SWHCRP remedial alternatives in the 1994 FS (Parametrix 1994c) and EIS (Parametrix 1994d). In addition to sediment characterization, collected data were used to develop contaminant migration models, assess potential toxicity to marine life, and evaluate potential human health risks.

In a separate study for the Port, Hart Crowser (1995) completed 24 additional subsurface geotechnical borings to assess sediment types and physical properties throughout the Lockheed West Site and the adjacent West Waterway (Figure 4-12). Data from these borings were used for engineering design and stability analysis of the Port's development of Terminal 5, which included the construction of the 400-foot pier extension south of Lockheed West.

4.5.4 Existing Geotechnical Data

Two geotechnical investigations have been completed in and around the Site and are described below.

- **Enviros (1990)**. A total of 5 deep borings were drilled along the outer harbor line to depths ranging from approximately 60 to 110 feet. Additionally, a total of 12 shallow borings were drilled within the Site boundary to depths ranging from approximately 4 to 25 feet. Standard penetration test data and split spoon samples were collected in the field and laboratory analyses were performed to determine sediment moisture content and gradation properties.
- **Hart Crowser (1995).** A total of 25 borings were completed offshore, from existing pier structures and within upland areas of the Site to depths ranging from approximately 40 to 170 feet. Standard penetration test data and split spoon samples were collected in the field and laboratory analyses were performed to confirm field sediment classifications and to determine sediment moisture content, Atterberg Limits, gradation, consolidation, and shear strength properties.

4.5.5 Summaries of Previous Risk Assessments

Both (HHRAs and ERAs) have been performed for either the Lockheed West property or for sites located in the vicinity of the Lockheed West Site. The aquatic habitats of the Lockheed West Site are marine along the Elliott Bay shoreline, and the lower water column

and sediments are mostly marine along the West Waterway shoreline. The sites that are located in the vicinity of the Lockheed West Site for which RAs have been performed in the past are either fully marine habitat, such as the PSR Site located to the west of Lockheed West along Elliott Bay, or may have some minimal influence of freshwater from the Duwamish River outflow, such as the West Waterway Operable Unit (OU) of the Harbor Island Site or the LDW Site, located adjacent to and flowing partly into the West Waterway. For the Harbor Island sites such as Lockheed-Harbor Island and the West Waterway OU, the site-associated sediments have been evaluated as marine sediments. There is minimal influence from the freshwater component of the flow coming in the Duwamish River discharge on the sediment regime of the Harbor Island sites, due to the water depth and presence of the marine waters of Elliott Bay.

The baseline HHRA and ERA have recently been completed for the LDW site. The LDW consists of a gradient of salinities with the highest salinity in the downstream portion of the waterway, at the mouth of the waterway adjacent to Harbor Island. Both the ERA and HHRA for the LDW site assess exposures to contaminants in sediment areas located throughout the LDW site as a primarily marine or estuarine habitat. The assessments encompass human exposures and fish and wildlife exposures to primarily marine intertidal and subtidal sediments. Since the Lockheed West site is comprised of similar marine/estuarine habitat, the RAs for the LDW site are considered appropriate for comparison in the development of plans for the Lockheed West streamline ERA and HHRA. Although the LDW RAs and those performed previously for Lockheed West and nearby PSR and West Waterway sites provide useful information on approaches and data, some of which are used in planning the RAs for Lockheed West, the PSR and West Waterway RAs in particular are considered to be dated because they were completed prior to establishment of the Framework used on the LDW.

Summaries of the previous RAs conducted at nearby sites and for other media at Lockheed West are presented in Appendix A.

4.6 PRELIMINARY CONCEPTUAL SITE MODEL

This section of the Work Plan provides a general summary of how contamination of the Lockheed West Site is suspected to have occurred, taking into account the historical uses and operations in combination with current physical and chemical data described above. An understanding of the contamination process is critical to ensuring that remedial actions are targeted at both the problem, as well as the sources that caused the problem. Figure 4-13 provides a schematic of the historical and current discharges and the groundwater flow regime of the Lockheed West Site. This section discusses how different discharges and

transport pathways at the Site may relate to the contaminated sediment distributions found at the Site. The preliminary CSM will be refined using data collected, and analyses completed as part of the RI. The development of baseline ERA and HHRA will include more specific CSMs (see Section 11).

The general mechanisms by which the sediments adjacent to the former shipyard could have been contaminated include the following:

- Historical shipyard operations/activities;
- Direct discharges from historical shipyard operations into the receiving water (e.g., loss of wastes from floating drydocks);
- Transport and discharge from groundwater flowing from the uplands area into Elliott Bay;
- Atmospheric deposition from the shipyard; and
- Transport via sediment, water, or atmospheric from other regional activities throughout Elliott Bay and the Duwamish Estuary.

4.6.1 Known and Suspected Sources of Contamination

4.6.1.1 Historical Site Uses

Potential sources of contamination related to historical site uses are presented in Section 4.3.1.

4.6.1.2 Potential Ongoing Sources to Sediment Contamination

Potential ongoing sources to sediment contamination are presented in Section 4.3.2.

4.6.1.3 Adjacent Site Uses

Currently, both the uplands portion and the offshore portion of the former PSR Site have had remedial actions performed. These actions presumably have controlled the potential historical sources from this Site. At present, the uplands portion of the PSR Site is part of the Port's Terminal 5 operation and is subject to the source control activities conducted by the Port. The shoreline and offshore portion of the PSR Site is not currently used for a specific purpose. It also has restrictive signs and fencing that limit public access to the shoreline for recreational purposes.

The West Waterway continues to be maintained and functions as an industrial waterway for navigation and commerce. Several cleanup actions have taken place along the waterway

(e.g., LSSOU, Todd Shipyard) that have reduced the potential sources from these locations. The West Waterway continues to be subject to influences from the Lower Duwamish River.

4.6.2 Types of Contamination and Affected Media

Sediment contamination at Lockheed West includes a variety of metals and organic constituents related to historical activities at the shipyard and potentially from nearby areas. Sediments are the primary affected media at the site; other potentially affected media include marine organisms that may contact contaminated sediment, surface waters of West Waterway and Elliott Bay that overlie contaminated sediment, and possibly upland sources such as groundwater and upland soils that may contribute to sediment or sediment porewater contamination. The COIs at Lockheed West are those listed in the Washington State SMS (Chapter 173-204 WAC) and chemicals that have been previously detected at the site or are suspected of contaminating site sediments based on findings of contamination at nearby sites such as the upstream LDW site. Tributyltin TBT is not a compound regulated under the SMS but is, however, included as a COI due to its association with shipyard activities. For TBT, concentrations were compared to the confirmational number established for the nearby Harbor Island LSSOU. Other non-SMS COIs that may be present at Lockheed West based on their known presence in sediments in the upstream LDW site include carcinogenic PAHs and dioxins/furans.

Based on historical activities at the former shipyard and adjacent sites, elevated concentrations, and possible identification as chemicals of concern in the risk assessments, are likely to be the metals arsenic, copper, lead, mercury, and zinc, and PAHs and PCBs.

4.6.3 Known and Potential Routes of Migration

Historical site use and operation provided several potential pathways for shipyard-related sediment contamination. As discussed above, direct discharges from stormwater outfalls and from the operation of the dry docks, shipways, and pierside new ship construction likely contributed contamination directly to marine waters and to sediments. However, these were historical activities that no longer contribute new contaminants to the Site.

Current routes of potential contaminant migration into the Site include on the on-going deposition of particulates and contaminants from the surrounding and adjacent waterways (i.e., West Waterway, Lower Duwamish). In addition, stormwater runoff from upland areas may continue to be a source; however, the uplands portion of the former shipyard was remediated and the stormwater system was cleaned and re-routed, so this likely represents a very minor contribution, if at all. Marine biota, through direct contact and ingestion of water and sediments are exposed to the contamination that can ultimately bioaccumulate in

marine tissues. Baseline ERAs and HHRAs will evaluate the potential for contaminant migration into these receptors.

4.6.4 Exposure Media, and Known or Suspected Human and Ecological Receptors

The primary receptors exposed through each transport pathway are marine waters, sediments, and marine biota. For the historical site operation-related discharges (dry docks, piers, and shipway), the first receptor is the marine water. Soluble contaminants would have dissolved into the receiving water. A secondary receptor is the marine sediments. Soil particles, paint fragments, and other shipbuilding-related debris would ultimately mix with the sediments where contaminants could be absorbed onto sediment particles. For direct discharges from surface runoff or from deposition from the West water/Duwamish River, a similar two-step receptor pathway would occur. For groundwater discharge, the receptor pathways are reversed. Sediments would be the initial receptor, followed by marine water. For all discharge mechanisms, marine biota are a secondary receptor in that they are exposed to water-borne and/or sediment-borne contaminants. Human receptors would include tribal and recreational consumption of marine biota and potential direct exposure to on-site workers and/or through recreational activities.

4.6.5 CSM Summary

Based on the current understanding of the nature and extent of contamination related to historical shipyard activities in the Lockheed West sediments and the current status of source control discussed above, the conceptual model for the Site can be summarized as follows:

- COIs for the Lockheed West Site are primarily related to shipyard activities, though contributions may also come from other areas (e.g., cPAHs, dioxin/furans), and include but are not limited to PAHs, PCBs, arsenic, copper, lead, mercury, TBT, and zinc.
- Primary potential pathways for COIs include historical site operations and activities associated with the dry docks, shipway, and pierside new ship construction along with direct discharge of materials from over-water structures.
- Secondary potential pathways for site-related COIs to sediments include discharges from storm drain outfalls, discharge of contaminated groundwater, and erosion of contaminated upland soils.

- There is no evidence of mass sediment redistribution at the site as shown by the presence of historically contoured bottom features, such as drydock areas and former pier areas, in the recent hydrographic survey.
- There is some evidence that regional influences have affected the Site in the past and continue to affect the Site, especially on the eastern side of the Site where the effect of West Waterway is most prevalent. Concentrations of mercury and PCBs were relatively greater on this part of the Site, and sediment studies of adjacent areas in the West Waterway indicate that these chemicals are prevalent throughout the area.
- Several ongoing potential contaminant sources exist. The West Waterway, currently under a No-Action ROD, contains elevated concentrations of COIs relative to the Site and is a potential source of sediment to the Site. Likewise, the upstream LDW Superfund Site, which also contains concentrations of COIs above those at the Site, is a sediment source.

The preliminary CSM will be refined using data collected as well as analyses completed as part of the RI. The development of baseline ERA and HHRA will include more specific CSMs (see Section 11).

4.7 IDENTIFICATION OF DATA GAPS

Based on the summary of existing data, the following data gaps have been identified. RI sampling, analysis, and data evaluation discussed in Section 8 will provide any additional data necessary to meet the requirements of the SOW. Section 8 describes the specific sampling, analysis, and technical evaluations that will be completed to fill the data gaps discussed below.

4.7.1 Nature and Extent of Contamination

4.7.1.1 Spatial Resolution of Contaminant Distributions

The data discussed in the above sections and in Appendix A are suitable for establishing a background understanding of the Site. They were used to identify COIs and the general spatial distributions and trends of these contaminants. However, with the exceptions of the areas addressed by Hart Crowser in 2003, the majority of the data was collected prior to 1998. Therefore, additional surface and subsurface sediment sampling is necessary to confirm and further delineate the nature and extent of sediment contamination (including hot spots and the potential presence of sand blast grit) and is identified as a data gap. The

RI sampling, analysis, and data evaluation necessary to address this data gap are summarized below in Section 8.

4.7.1.2 Depth of Sediment Contamination and Volume

Existing data are insufficient to determine the nature and extent of subsurface sediment contamination at the Site. The RI sampling, analysis, and data evaluation necessary to address this data gap are summarized below in Section 8. Additional subsurface borings will resolve uncertainties regarding depth of contamination and overall volume of contaminated sediment at the Site.

4.7.2 Physical Site Characterization

4.7.2.1 Physical Characterization of the Waterway

Evaluation of the existing data indicates that additional physical characterizations (e.g., grain size, TOC) are necessary to support the evaluation of remedial options. Multibeam bathymetry survey data were collected as part of the work performed for the summary of existing data; however, a topographic survey of the banks and shoreline to tie into the bathymetric data is needed. A need for a shoreline conditions survey was identified and conducted to document current physical conditions (e.g., substrate type, slope, debris, structures, seeps, outfalls) along the shoreline at the Site. This survey was conducted during a daylight low tide in August 2006 prior to the RI field sampling activities. Sufficient geotechnical explorations have been conducted to evaluate the impact of possible sediment removal or capping on waterway structures and slope stability, so no additional geotechnical data collection activities are identified.

4.7.3 Assessment of Habitat Distribution

A large amount of information on habitat distribution and resource use for the general Elliott Bay and Lower Duwamish River are available. This information will provide the basis for any habitat evaluations that may be needed. In addition, existing information on habitat distribution and resource use was supplemented with a shoreline video survey that documented existing intertidal habitat. A current habitat assessment was completed as part of the shoreline conditions survey in August 2006. Additional habitat data collection needs have not been identified at this time.

4.7.4 Human Health and Ecological Baseline Risk Assessment.

As discussed in Section 2.1, LMC is committed to active remediation of the entire Lockheed West Site. At the minimum, remediation plans consist of placing a cap over all contaminated sediments at the Site. The placement of a cap will eliminate all exposures of humans and ecological receptors to the sediment contaminants. Because of plans to mitigate such future exposures, streamlined baseline risk assessments, performed under EPA guidance for CERCLA Superfund sites, will be performed at the Lockheed West Site. Risks to human health and ecological receptors from exposures to chemicals in Site sediments will be evaluated through streamlined approaches. The streamlined RAs will evaluate potential risk by structuring the assessments to use technical information from the risk assessments performed at the nearby LDW site. Thus, site-specific tissue data are not necessary to complete the streamlined baseline HHRAs and ERAs. The specific approaches to the streamlined RAs are discussed as part of the Risk Assessment Work Plan (Section 11).

4.7.5 Preliminary Design Parameters for use in Selection of Remedial Alternatives

4.7.5.1 Sediment Contaminant Mobility

Site-specific contaminant mobility tests are necessary to support an evaluation of capping options, evaluation of the behavior of potential dredge material to support detailed evaluation of confinement options, and an assessment of potential water quality impacts during dredging. This testing will be limited to subtidal areas where, based on existing data, remedial options will likely require capping or removal.

4.7.5.2 Sediment Stability

Results of high resolution multibeam bathymetry data do not indicate significant erosional features at the Site. There is little evidence of sediment redistribution at the site as shown by the presence of historically contoured bottom features, such as drydock areas and former pier areas. However, confirmation of sediment stability to determine the ability to support a cap or dredge cuts is needed. Additional information on current site scour potential, and sediment stability is needed to fully evaluate capping and dredging remedial options for the Site.

4.7.5.3 Potential for Sediment Recontamination

A comprehensive understanding of potential sources of recontamination is essential to ensuring that the remedy is protective and to determining parameters on which to measure long-term performance.

Based on a review of the historical land use information and existing outfalls and surface sediment samples, potential sources that may require further evaluation have been identified. Additional data from previous cleanup actions by the Port in the uplands and by EPA at the PSR sites are needed. In addition, ongoing inputs from West Waterway need to be evaluated.

- Obtain and review available summary reports and groundwater monitoring data for Lockheed West and PSR sites through EPA, Ecology, and the Port.
- Determine whether Ecology has issued determination of completion or no further action for Lockheed uplands.
- Verify the current condition and status of previous cleanup actions to assess cleanup performance and potential for sediment recontamination.
- Evaluate potential benefits and impacts of the PSR remediation on Lockheed West.
- Evaluate potential impacts of sediment transport from the Duwamish River and West Waterway on the Lockheed West Site.
- Evaluate post-remediation groundwater elevation data and post-remediation groundwater chemistry data for the former shipyard remedy. The Port is currently negotiating the post-remediation groundwater monitoring work plan for T5. LMC will work with the Port to obtain both groundwater elevation and groundwater chemistry data. These data will be used to determine if the adjacent uplands groundwater is a potential ongoing contaminant source to project site sediments.
- Evaluate post-remediation monitoring data for PSR. The year one monitoring report will be reviewed when available to determine if capped sediments at the PSR Site are a potential source of contamination to Lockheed West.

4.7.5.4 Future Potential Site Development/Property Use Restrictions

LMC's understanding of current and planned property use are discussed above in Section 4.1. No data gaps exist and LMC will continue to communicate and plan strategies for discussions with the Port on the potential for performing remedial actions on Port property including evaluation of future site uses.

Table 4-1. Historical Site Development, Dredging, and Filling Summary from Lockheed West Seattle

Date	Ownership	Operations and Activities
Early 1900s	Undeveloped	Dredging and filling to create uplands near Site
1917	Undeveloped	Dredging for West Waterway
Early 1940s	Associated Shipbuilders (operated by Puget Sound Bridge and Dredging Co.) operates the Site	Construction, dredging and filling operations.
1942	Associated Shipbuilders dredging permits transferred to Puget Sound Bridge and Dredging Co.	Construction, dredging and filling operations. New ship construction and repair began during WWII.
1945-1947	Puget Sound Bridge and Dredging Co. obtain permits for dredging and dolphin placement for dry dock moorage.	Two dry docks present.
1952	Puget Sound Bridge and Dredging Co.	Permitted for dredging of approx. 260,000 cy (target elevation of -45 ft MLLW) from the east side of the Lockheed West property and the West Waterway for dry dock berthing and disposal of the dredged material west of the dredged area, at Lockheed West uplands site (see Figure 4-2). Vessel construction, maintenance, repair, and dredging/filling.
1954	Puget Sound Bridge and Dredging Co.	Permitted for dredging of approx. 60,000 cy (target elevation of -30 ft MLLW)from the east side of the Lockheed West property and disposal of the dredged material west and just north of the dredged area at the Lockheed West Site (see Figure 4-2). Vessel construction, maintenance, repair, and dredging/filling.
1954	Puget Sound Bridge and Dredging Co.	Permitted for dredging of approx. 140,000 cy (target elevation of -45 ft MLLW) from the east side of the Lockheed West property and West Waterway for dry dock berthing. Disposal of dredged material in Elliot Bay at -60 ft MLLW (see Figure 4-2). Vessel construction, maintenance, repair, and dredging/filling.
1959	Puget Sound Bridge and Dredging Co purchased by Lockheed. Then operated as Puget Sound Bridge and Drydock Co.	Vessel construction, maintenance, repair, and dredging/filling.
Early 1960s	Land west of Pier 25 purchased from Neddleton Company (wood products manufacturing)	Vessel construction, maintenance, repair, and dredging/filling.
1965	Name changed to Lockheed Shipbuilding and Construction Company.	Vessel construction, maintenance, repair, and dredging/filling. Embayment southwest of shipyard filled.
1988	Port of Seattle acquires upland area of Lockheed West for Terminal 5 expansion.	Lockheed ceased operations at Lockheed West.
Date Unknown	Port of Seattle acquires 7 acres of Lockheed West Aquatic Area from Lochkeed.	No shipyard activity.
Circa 1995-1999	Lockheed and Port of Seattle	Port of Seattle completes Terminal 5 400-ft pier extension in West Waterway, upland improvements, and upland remediation

Table 4-2. Ownership and Historical Use of Lockheed West Aquatic Area Cleanup Area Site Units

Site Unit	Ownership	Area (acres)	Previously Estimated Volume of Contaminated Sediments (cubic yards)	Reported Depth of Constituents Exceeding SQS (feet below mudline)	Historical Use
Lockheed West Waterway	State Owned	7	200,000 (proposed for dredging for second Terminal 5 berth); 80,000 PSDDA-suitable[1/]	5	Navigation and estuary
East Dry Dock	State-Owned	7.2	235,000[1/]	>13	Dry dock, ship repair, navigation, and moorage
West Dry Dock	Primarily Port-owned, some state owned	5.7	140,000	>5	Dry dock, ship repair, and moorage
Central Area	Primarily state-owned, some Port owned	14.8	645,000[2/]	>12	Navigation, moorage, new ship construction, ship repair
Ship Way	Primarily state-owned, some Port-owned	3.5	75,000	>24	Ship construction, repair, and moorage

[1/] Included sediment outside of lease area
[2/] Identified for natural recovery
Source: Lockheed Aquatic Area Draft CAP (Ecology 1996) and SWH Project Feasibility Study (Parametrix 1994b)

Table 4-3. Summary of Key Existing Data for Lockheed West

Study Description	Author	Study Date	Number of Sampling Locations in the General Vicinity of Lockheed West	Sample Location Identifier	Parameter Groups Analyzed
Dredged material characterization for the American President's Line maintenance dredging project	Unknown	1992	2	AMPRES92C001, AMPRES92C002	conventionals, metals, PCB, pesticides, SVOC, VOC
Duwamish Head sediment quality survey	Unknown	1984	1	U120	conventionals, grain size, metals, SVOC
Elliott Bay sediment quality survey	Unknown	1995	8	NH-04,NH05, NH-06, WW-10,WW-13, WW-15, WW-17, WW20	conventionals, grain size, metals, PCB, pesticides, SVOC, TPH, VOC
Sediment quality survey of Duwamish River	EPA	1982-1983		41, 42, 43, 5, 6, 6B, 6C	metals, TBT, PCB, pesticides, SVOC, VOC
Gamponia sediment quality survey of Elliott Bay	Unknown	unknown	5	8500342, 8500346, 8500354, 8500358, 8500364	metals, PCB, SVOC
Harbor Island Sediment Operable Unit Remedial Investigation	Weston	1994	244	E-01, E-02, E-03, E-06, E-06-D1, E-06-D2, E-07, E-08, E-09, E-11, E-12, E-13, E-14, E-15, E-15-D1, E-15, D2, E-16, E-17, E-19, E-20, E-21, E-22, E-23, ICE-03-01, ICE-03-01-D1, ICE-03-02, ICE-03-02-D1, ICE-03-03, ICE-03-03-D1, ICE-03-04, ICE-03-04-D1, ICN-04-01, ICN-04-01-D1, ICN-04-02, ICN-04-02-D1, ICN-04-03, ICN-04-03-D1, ICN-04-04, ICN-04-04-D1, ICN-17-01, ICN-17-01-D1, ICN-17-02, ICN-17-02-D1, ICN-17-03, ICN-17-03-D1, ICN-17-04, ICN-17-04-D1, ICN-24-01, ICN-24-01-D1, ICN-24-02, ICN-24-02-D1, ICN-24-03, ICN-24-03-D1, ICN-24-04, ICW-21-01, ICW-21-01-D1, ICW-21-02, ICW-21-02-D1, ICW-21-03, ICW-21-03-D1, ICW-21-04' ICW-21-04-D1, ICW-21-05, ICW-31-01, ICW-31-01-D1, ICW-31-03, ICW-31-03-D1, ICW-39-01, ICW-39-01-D1, ICW-39-02, ICW-39-02-D1, ICW-39-03, ICW-39-04, K-02, K-02-1, K-02-10, K-02-2, K-02-3, K-02-4, K-02-5, K-02-6, K-02-7, K-02-8, K-02-9, K-02-D1, K-02-D2, K-03, K-03-D1, K-03-D2, K-04, K-04-D1, K-04-D2, K-05-1, K-05-1-D1, K-05-1-D2, K-05-2, K-05-2-D1, K-05-2-D2, K-05-3, K-05-3-D1, K-05-3-D2, K-06, K-07,	conventionals, grain size, metals, TBT, PCB, pesticides, SVOC, TPH, VOC

Table 4-3. Summary of Key Existing Data for Lockheed West (continued)

Study Description	Author	Study Date	Number of Sampling Locations in the General Vicinity of Lockheed West	Sample Location Identifier	Parameter Groups Analyzed
Harbor Island Sediment Operable Unit Phase II Remedial Investigation	Weston	1995	22	N-09, N-10, N-11-10-15, N-11-10-9, N-12, N-19, N-20, N-21, N-28, W-29-10-3, W-29-10-4, W-30, W-33, W-36, W-37, W-40, W-42, W-44, W-48, W-49, W-52, W-53	conventionals, grain size, metals, TBT, PCB, pesticides, SVOC, TPH, VOC
Lockheed Shipyard No. 2 Sediment Characterization	Hart Crowser	2003	19	HC-03-01, HC-03-02, HC-03-03, HC-03-04, HC-03-05, HC-03-06, HC-03-07, HC-03-08, HC-03-09, HC-03-10, HC-03-11, HC-03-12, HC-03-13, HC-03-14, HC-03-15, HC-03-16, HC-03-17, HC-03-18, HC-03-19	conventionals, metals, TBT, PCB, SVOC, VOC
Lockheed Shipyard No. 2 Sediment Characterization and Geotechnical Study	Enviros	1990	68	D1-C, D1-D, D1-S, D2-C, D2-D, D2-S, D3-A, D3-B, D3-C, D3-D, D4-D, D4-S, D5-C, D5-D, G1, G10, G11, G12, G13, G14, G15, G2, G3, G4, G5, G6, G7, G8, G9, M1-C, M1-D, SA10-A, SA10-B, SA10-C, SA10-D, SA10-S, SA1-A, SA1-B, SA1-C, SA1-D, SA2-C, SA2-D, SA2-S, SA3-A, SA3-B, SA3-C, SA3-D, SA4-C, SA4-D, SA5-A, SA5-C, SA5-D, SA6-C, SA6-D, SA6-S, SA7-A, SA7-B/C, SA7-D, SA8-A, SA8-C, SA8-D, SA9-A, SA9-B, SA9-C, SA9-D, SB1-A, SB1-C, SB1-D	conventionals, grain size, metals, TBT, dioxin, PCB, Pesticides, SVOC, VOC
Sediment Quality Survey of Elliott Bay	NOAA	1980	1	10028	metals, SVOC, VOC
PSAMP Measures of Bioeffects Survey	NOAA	1999	10	197-1, 197-1-1, 197-2, 197-2-1, 197-2-2, 198-1, 198-1-1, 199-1, 199-1-1, 315-2	conventionals, grain size, metals, TBT, PCB, Pesticides, SVOC, VOC
Terminal 5 Sediment Quality Investigation	Port of Seattle	1997	1	C2/1/1	conventionals, metals, TBT, PCB, pesticides, SVOC, VOC
Elliott Bay Full Monitoring Investigation	PSDDA	2000	3	E023, E024, E025	conventionals, metals, VOC
Elliott Bay Tiered Partial Monitoring Investigation	PSDDA	2002	3	EBB01-A, EBB01-B, EBB01-C	conventionals, grain size, metals, VOC
Southwest Harbor PSDDA Related Sediment Quality Investigation	Port of Seattle	1992	6	PC-1A, PC-1B, PC-1C, PC-2A, PC-2B, PC-2C	conventionals, metals, PCB, pesticides, SVOC, VOC
Phase I Survey of PSDDA Disposal Sites	PSDDA	unknown	2	EBB01C, EBB01I	conventionals, grain size, metals, TBT, PCB, pesticides, SVOC, VOC

Table 4-3. Summary of Key Existing Data for Lockheed West (continued)

Study Description	Author	Study Date	Number of Sampling Locations in the General Vicinity of Lockheed West	Sample Location Identifier	Parameter Groups Analyzed
PSDDA Post-Disposal Site Monitoring Investigation	PSDDA	1990	1	EB90_B01	conventionals, grain size, VOC
Elliott Bay Full Monitoring Investigation	PSDDA	1992	3	PMONB01AS025, PMONB01AS026, PMONB01AS027	conventionals, metals VOC
Southwest Harbor Remedial Investigation Sediment Quality Investigation	Hartman et al.	1991	8	C1, C2, C3, C4, C5, C6, C7, C8	conventionals, metals, PCB, SVOC, VOC
Terminal 5 Pier Extension Sediment Quality Investigation	Port of Seattle	1994	2	C1, C2	conventionals, metals, PCB, pesticides, SVOC, VOC
Harbor Island Supplemental Remedial Investigation	EVS	1994	73	EW-01-HC, EW-02, EW-03, EW-04, EW-08, EW-09, EW-10, EW-11-HC, EW-12, EW-5, EW-6-HC, EW-7, HI-EW-01, HI-EW-06, HI-EW-11, HI-NS-04, HI-NS-08, HI-WW-05, HI-WW-10, HI-WW-27, HI-WW-30, NS-01, NS-02, NS-03, NS-04-HC, NS-05, NS-06, NS-07, NS-08-HC, NS-09, NS-10, NS-11, NS-12, NS-13, NS-14, NS-15, NS-16, RF-01, RF-02, RF-03, WW-01, WW-02, WW-03, WW-04, WW-05-HC, WW-06, WW-07, WW-08, WW-09, WW-10, WW-11, WW-12, WW-13, WW-14, WW-15, WW-16, WW-17, WW-18, WW-18B, WW-19, WW-20, WW-21, WW-22, WW-23, WW-24, WW-25, WW-26, WW-27-HC, WW-28, WW-29, WW-30-HC, WW-31, WW-32	conventionals, grain size, metals, TBT, PCB, pesticides, SVOC, VOC
TPPS Preliminary Sediment Quality Survey	TPPS	unknown	1	S0063	metals, PCB, Pesticide, SVOC

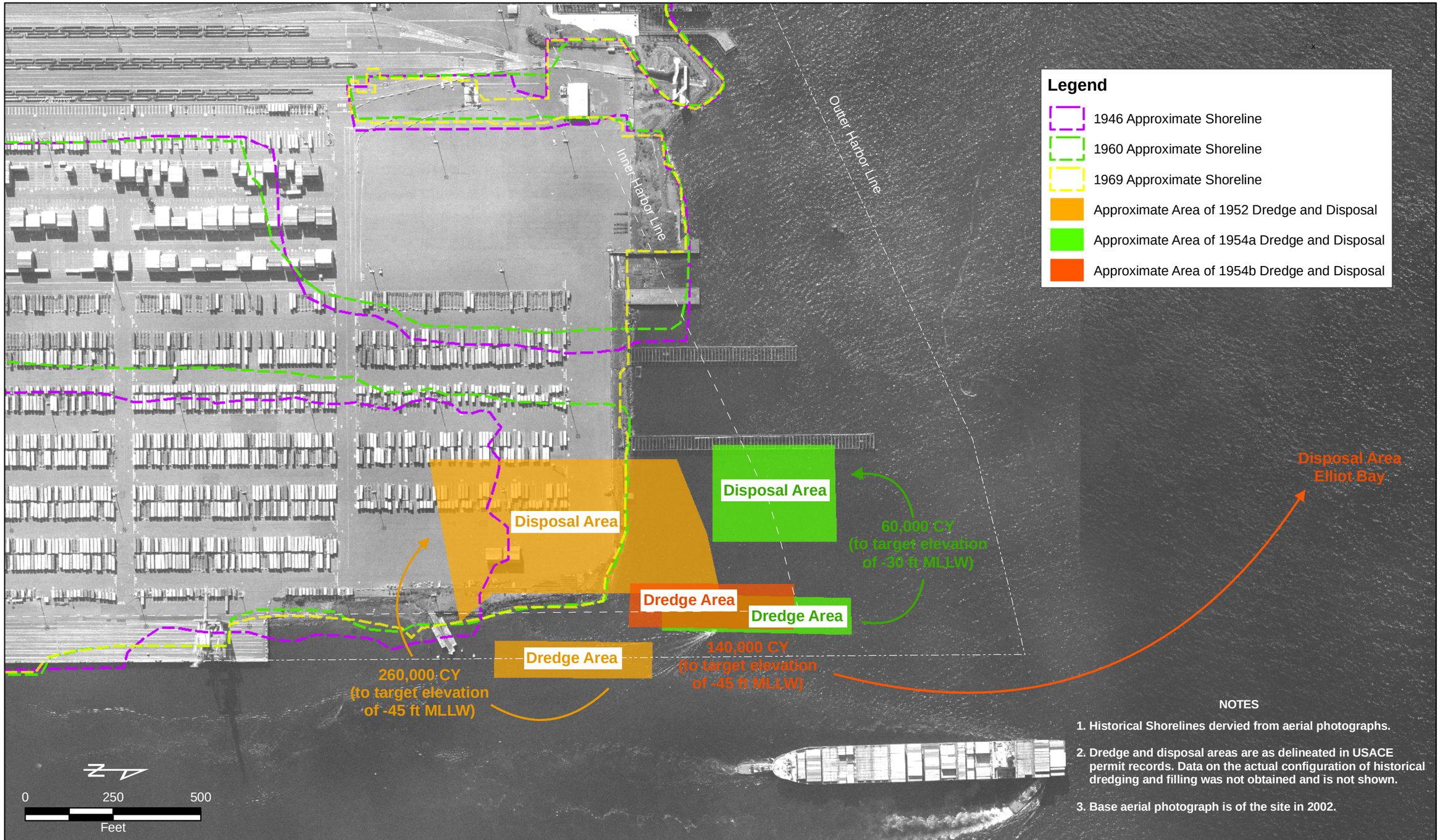
TBT – tributyltin
TPH – Total Petroleum Hydrocarbons
PCB – Polychlorinated Biphenyl
SVOC – Semi-Volatile Organic Compound
VOC – Volatile Organic Compound



TETRA TECH

Lockheed West Seattle Superfund Site Seattle, WA

Figure 4-1
1946 Aerial Photograph



TETRA TECH

Lockheed West Seattle
Superfund Site
Seattle, WA

Figure 4-2
Site Development, Dredging, and Filling History

DATE: 8/7/2006 10:44:37 AM
MXD NAME: F:\projects\TT-LMC\GIS\Data Summary\Work Plan RI NatureExtent Figures\Finalized TT Work Plan Figures\Figure 4-2 Site Development and Dredging History.mxd



TETRA TECH

Lockheed West Seattle Superfund Site Seattle, WA

Figure 4-3
1960 Aerial Photograph



TETRA TECH

Lockheed West Seattle Superfund Site Seattle, WA

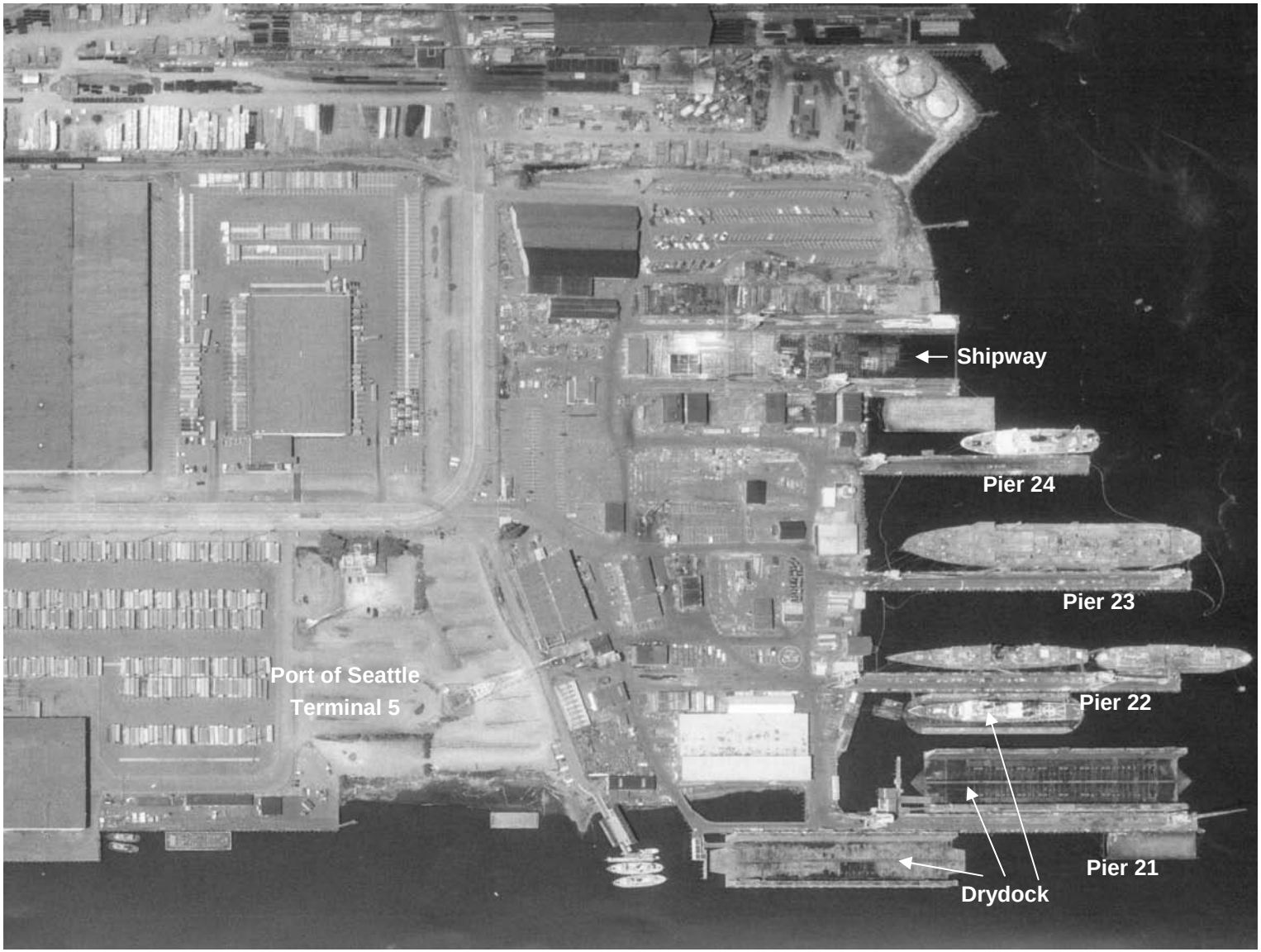
Figure 4-4
1969 Aerial Photograph



TETRA TECH

Lockheed West Seattle Superfund Site Seattle, WA

Figure 4-5
1974 Aerial Photograph



TETRA TECH

**Lockheed West Seattle
Superfund Site
Seattle, WA**

**Figure 4-6
1980 Aerial Photograph**



TETRA TECH EC, INC.

Lockheed West
Shipyard No. 2
Seattle, WA

Figure 4-7
2002 Aerial Photograph

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N

0 200 400
Scale in Feet

Approximate Site Boundary

Agency-Defined "Aquatic Area Cleanup Boundary" (Ecology 1996 Draft Cleanup Action Plan)

Central Area — Aquatic Area Site Subunit

Approximate Boundary of Puget Sound Resources Offshore Remediation Area (Construction to be Initiated in 2003)

Soil Excavation Area

Notes:
1) Upland features shown are historical and do not reflect the current condition. Presently, upland area is used for container storage for Port of Seattle Terminal 5.
2) Pier 21 has been demolished.
3) Surface decking has been removed from Piers 22 and 23.

Source: Base map prepared from drawing provided by Port of Seattle entitled provided by Port of Seattle entitled "Terminal 5 and Seattle Steel", dated "Terminal 5 and Seattle Steel", dated August 17, 1986. August 17, 1986.

HARTCROWSER

TETRA TECH EC, INC.

Lockheed West
Shipyard No. 2
Seattle, WA

Figure 4-8
Aquatic Area Site Boundary
and Site Units

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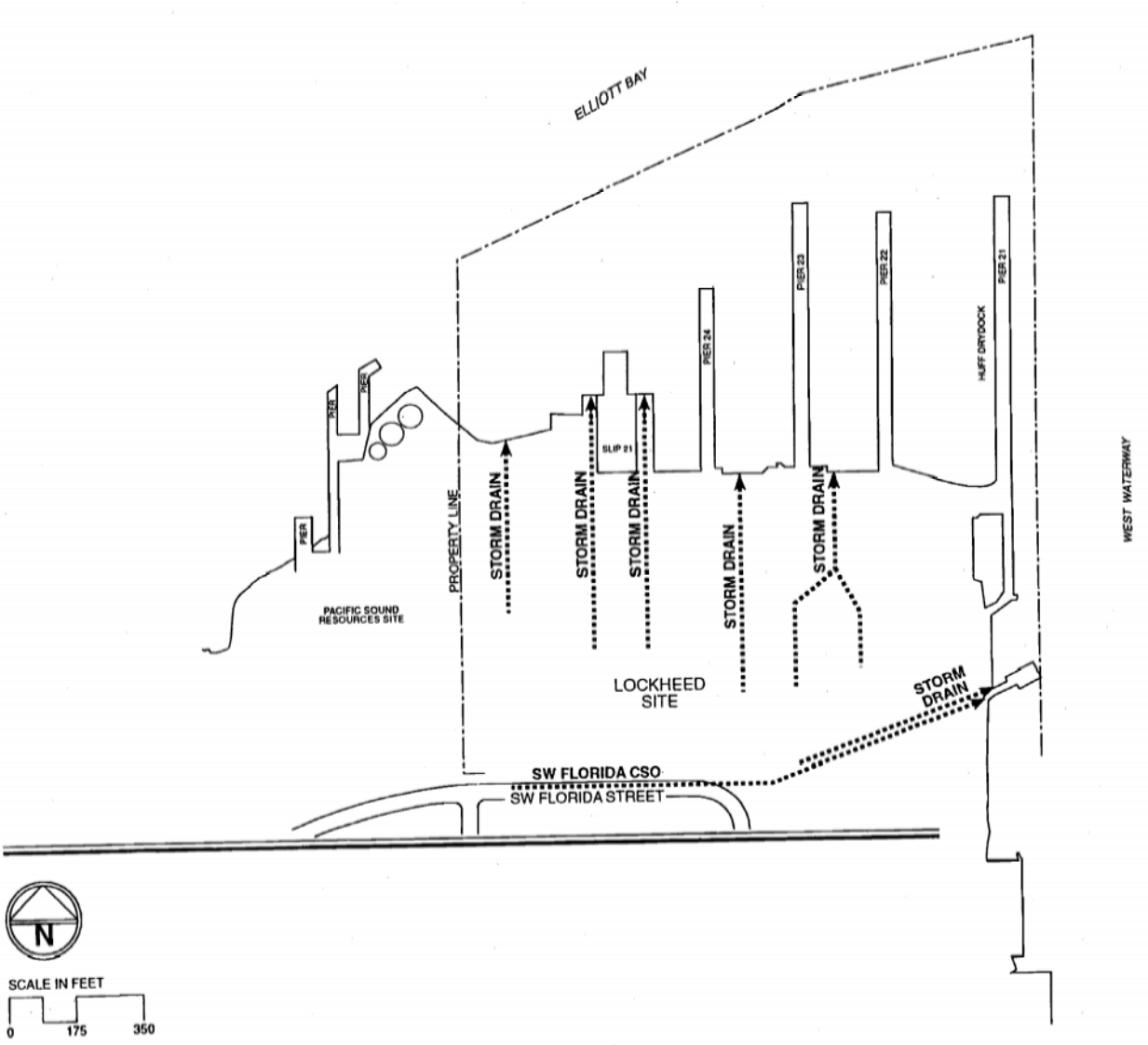
TETRA TECH

Lockheed West Seattle
Superfund Site
Seattle, WA

Figure 4-9
Property Boundary Map

DATE: 8/9/2006 7:27:21 AM
MXD NAME: F:\projects\TT-LMC\GIS\Data Summary\Work Plan RI NatureExtent Figures\Finalized TT Work Plan Figures\Figure 4-9 Site Boundary Map.mxd

Figure 4-10. Historic Site Stormwater Drainage



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Legend

- Abandoned Storm Drain
- Property Boundary
- 10 Foot Contours

N

0 125 250 500 Feet

Note:
1. Multibeam Bathymetry Survey conducted by TtEC on May 20, 2006 using a RESON SeaBat 8125 system. Datum: State Plane NAD 83, Projection: WA-4601 Washington North, Units: US Survey Feet

TETRA TECH EC, INC.

Lockheed West Shipyard No. 2 Seattle, WA

Figure 4-11
Lockheed West Site Bathymetry

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Legend

1998 and Earlier Sampling Locations

- Surface Grab
- Subsurface Core
- PSR RI STNS Points

2003 Sampling Locations

- Surface Grab

Upland MW Locations

- Existing Well Location
- Historical Well Location
- Property Boundary
- Abandoned Storm Drain
- 10 Foot Contours
- Haborlines
- Pacific Sound Resources Superfund Site (approx)
- Western Waterway OU (approx)

N

0 125 250 500 Feet

Notes:
1. Harbor Lines from the Washington State Dept. of Natural Resources website (2003).
2. 1998 and earlier sampling locations from SEDQUAL or transposed from plan sheet.

Inner Harbor Line

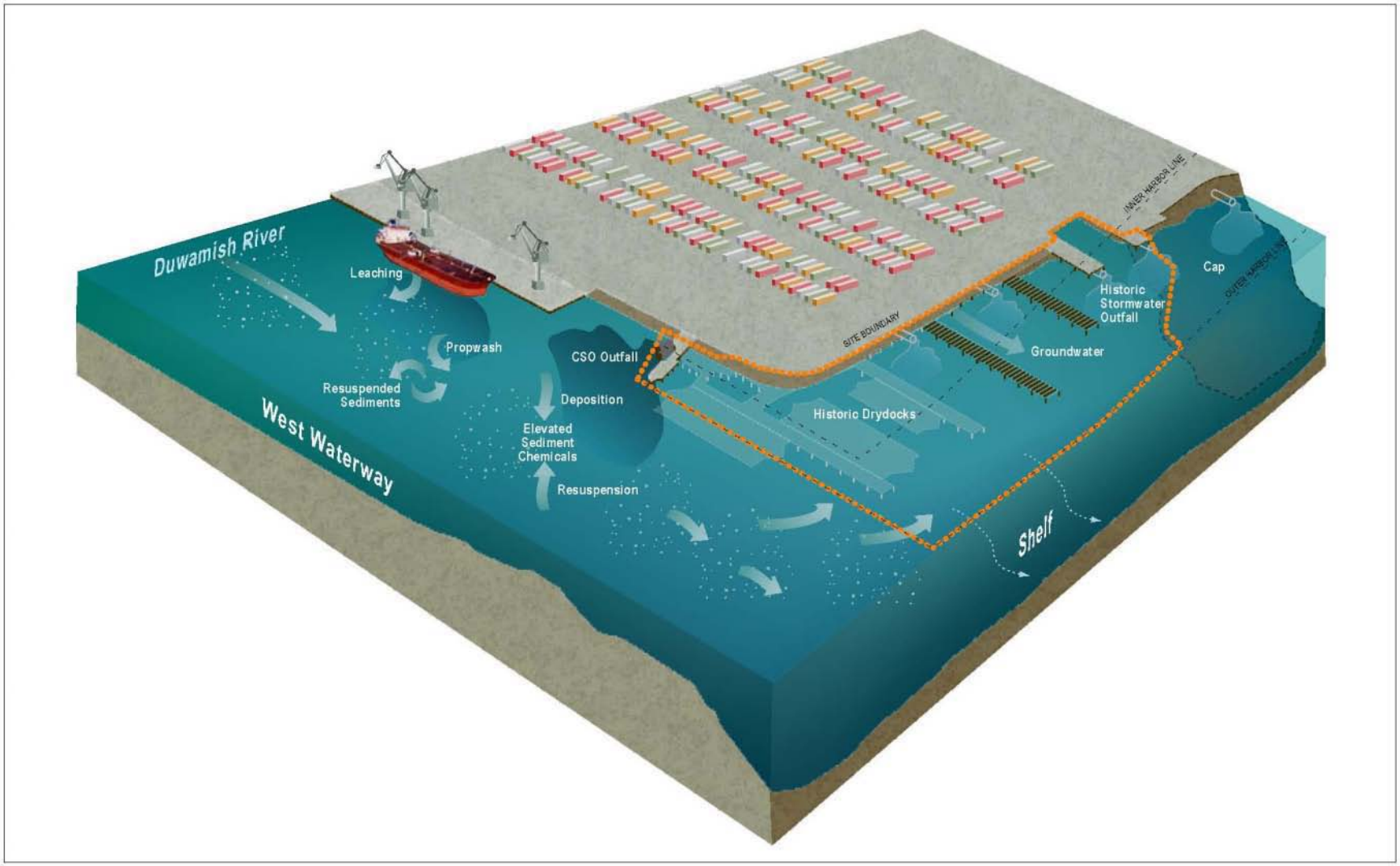
Outer Harbor Line

TETRA TECH EC, INC.

Lockheed West
Shipyard No. 2
Seattle, WA

Figure 4-12
Summary of Existing Sediment Sample and Upland Well Locations

Y:\GIS\Pdrive\Projects_2006\Lockheed\maps\work_plan_figures_04-01-08\Fig_4-12_wells.mxd



TETRA TECH	**Lockheed West Shipyard No. 2 Seattle, WA**	**Figure 4-13 Site Conceptual Model**

5. PRELIMINARY IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES AND POTENTIAL REMEDIAL ALTERNATIVES

Remedial action objectives (RAOs) provide the foundation upon which remediation alternatives are developed. RAOs are generally developed once it has been determined that significant risks to human health and/or the environments are present at a site. These risks, together with other federal, state, and local regulatory requirements, are considered as the preliminary RAOs are defined.

RAOs are required to support remedial action planning for the Site. The RAOs are needed to clearly articulate the intent of any remedial actions that may be undertaken to address risks to human health and/or ecological receptors at the Site. PRGs are then developed to address the RAOs. PRGs are the target concentrations in the affected media that correspond to the specific RAOs. For example, if the RAO is protection of humans from incidental ingestion of sediments during recreational activities, the PRG may be the concentrations of the COCs that correspond to an acceptable risk level.

Establishment of preliminary RAOs, and associated PRGs, will also enable evaluation of the various remedial alternatives that are identified for the Site relative to their ability to reduce risks to human health and ecological receptors to acceptable levels and their relative costs. The development of RAOs requires a long-term vision for the Site.

5.1 REGULATORY REQUIREMENTS

The identification of federal, state, and local regulatory requirements is a key component in the development of preliminary RAOs and the planning, evaluation, and selection of comprehensive remedial action alternatives. They are necessary to evaluate the appropriate extent of site cleanup, scope and formulate remedial alternatives, and control the implementation of the selected remedial action. A list of preliminary regulatory requirements and ARARs is presented in Section 3.

5.1.1 Preliminary Remedial Action Objective

Restoration of natural resources and their uses has been identified as an important long-term goal for the Site. However, this goal is too general to support the development of meaningful planning, research, and management initiatives for the Site. To be useful, this ecosystem goal must be further clarified and refined to establish specific objectives that are more closely linked with ecosystem science. In turn, more specific ecosystem objectives

support the identification of indicators and metrics that provide the information needed to more directly assess the health and integrity of the ecosystem.

The following is a list of preliminary RAOs that have been identified for the Lockheed West Site:

- Reduce site COCs to acceptable levels in sediments that may be acting as an ongoing source of sediment contamination at the site.
- Restore the Site benthic habitats to a condition that will promote a healthy and diverse benthic community.
- Reduce the concentrations of site-related COCs in the tissues of fish and other prey species to levels that do not pose unacceptable risks to ecological and human health endpoints (e.g., tribal, recreational, and worker exposure scenarios).
- Reduce to acceptable levels the risk to tribal members (adults and children) from ingestion of fish and shellfish taken from the site.
- Reduce to acceptable levels the risk to tribal members (adults and children) from dermal contact with contaminated sediments while harvesting fish and shellfish from the site.
- Reduce to acceptable levels the toxicity to benthic organisms at the site.
- Reduce to acceptable levels the risks to fish that feed on benthic organisms at the site.

The focus of the preliminary RAO development is the impact of the contaminated sediments on human health and the benthic invertebrate communities. The preliminary RAOs will be refined and updated as site conditions, COCs, and RAOs become better defined based on additional site information collected as part of the remedial investigation (see Section 12). While such RAOs define the narrative intent that any remedial actions that may be undertaken to address these risks will need to meet, numerical PRGs are also required to support the evaluation of remedial alternatives for the Site. Such PRGs define the concentrations of COCs in the affected media that correspond to the RAOs (i.e., that will be protective of ecological and human health receptors). Development of PRGs is discussed in Section 6.

5.2 POTENTIAL REMEDIAL ALTERNATIVES

As discussed in Section 2.1, risk assessments performed at the LDW Superfund Site have concluded that the cleanup levels mandated under the Washington State SMS (WAC 173-

204) may not meet risk-based cleanup levels for certain contaminants when site-specific input assumptions are used. Given this finding, LMC concluded that No Action and Natural Recovery remediation alternatives are infeasible for meeting risk-based cleanup levels and that more active remediation alternatives would be required throughout the extent of contaminated sediments on the Lockheed West Site. At the minimum, remediation of the Site will consist of placing caps over contaminated sediments identified by the Remedial Investigation as being the result of historical shipyard activities. Other remediation approaches, such as dredging, may also be implemented if site conditions warrant their use.

6. PRELIMINARY REMEDIATION GOALS AND CLEANUP LEVELS

The primary focus of the RAO development is the impact of the contaminated media to the human health and ecological receptors (i.e., endpoints) identified in the baseline RAs. While such RAOs define the narrative intent that any remedial actions that may be undertaken to address these risks will need to meet, numerical PRGs are also required to support the evaluation of remediation alternatives for the Site. Numerical PRGs define the concentrations of COCs in the affected media that correspond to the RAOs (i.e., that will be protective of human health and ecological receptors on the Site). PRGs recommended to support the evaluation of remediation alternatives for the Lockheed West Site are discussed below.

Generally, PRGs that are protective of human health and the environment are developed early in the RI process based on readily available screening levels for both human health and ecological risks. As discussed in Section 3, the key ARARs for this project include the Washington State SMS, CWA, Model Toxics Control Act (MTCA; WAC 173-340), and Rivers and Harbors Act. As per EPA guidelines, PRGs are based on a combination of ARARs and the RAOs that are designed to minimize risks to human health and the environment.

For the Lockheed West Site, PRGs can be identified as SMS for benthic invertebrates, and risk-based concentrations presented in the human health and ecological risk assessment plans (Section 11) for human and ecological receptor exposures, respectively. The following sections discuss SMS as benthic invertebrates PRGs, and the development of risk-based PRGs for human health and ecological receptors.

6.1 BENTHIC PRGS – WA SEDIMENT MANAGEMENT STANDARDS

The Washington State SMS (Chapter 173-204 WAC) provide a basis for the management and reduction of pollutant discharges and guide contaminated sediment cleanup efforts. The SMS are regionally-developed numerical sediment guidelines for the protection of benthic invertebrates. There are two primary types of SMS: source control standards, which define the maximum degree of sediment contamination allowed in sediments impacted by ongoing discharges; and, screening standards, which indicate the maximum degree of sediment contamination allowed before an evaluation of contamination is required.

The SMS define two levels of chemical and biological standards. The more stringent level, the SQS, is the sediment cleanup objective and corresponds to a sediment quality which has

no acute or chronic adverse effects on benthic marine organisms. The less stringent level, the cleanup screening level (CSL), is the level above which minor adverse effects may occur in benthic marine organisms. The biological standards are based on results of biological tests that demonstrate adverse effects in benthic organisms that dwell in sediments. If both biological and chemical data are obtained at a site, the biological data determine compliance with the SMS.

According to the SMS, sediment cleanup standards for benthic invertebrates are established on a site-specific basis (WAC 173-204570). The site-specific standard must be between the SQS, which is the cleanup objective, and the CSL, also known as the minimum cleanup level (MCUL). The SMS address standards for chemical concentrations, biological effects, human health, and other toxic, radioactive, biological, or deleterious substances criteria related to sediment quality. The SMS acknowledge the Water Pollution Control Act (Chapter 90.48 RCW) and the MTCA (Chapter 70.105D RCW) as the primary authorizing legislation for establishing sediment source control and cleanup standards, respectively.

6.2 RISK-BASED CONCENTRATIONS AND CLEANUP LEVELS

This section presents the plan for refining the preliminary RAOs and PRGs to determine sediment cleanup levels and performance criteria for the Lockheed West Site. As per EPA (1988) guidance on conducting RI/FS under CERCLA, RAOs are to be developed based upon the results of the human health and ecological risk assessments. RAOs are medium-specific goals designed to protect human health and the environment, and consist of both narrative statements and numerical values as remediation goals (RGs). Narrative RAOs for the Lockheed West Site are presented in Section 5. Numerical PRGs can consist of risk-based concentrations for COCs and other values, such as ARARs and background concentrations. EPA (1999c) guidance further states that RAOs based on the risk assessments should specify the following:

- COCs,
- Exposure routes and receptors, and
- Acceptable contaminant level or range of levels for each exposure route.

As presented in Sections 2.1 and 11, the streamlined approaches to the RI and the baseline RAs are based on the recognition that the “no action” or “natural recovery” alternatives for sediment remedy at the Lockheed West Site would likely not meet risk-based cleanup levels for PCBs because the most stringent cleanup levels would be based on human health risks related to the tribal seafood consumption exposure pathway, and would be very low. This

conclusion is based on review of potential RGs and associated sediment concentrations at the LDW Site. The streamlined approach to the RI also recognizes that the most stringent risk-based cleanup levels, particularly for PCBs, could be below background concentrations.

For the Lockheed West Site, the risk-based cleanup levels will be determined for the list of COCs identified in the streamlined risk assessments, and will be acceptable levels for the primary exposure pathways of highest risks, in accordance with EPA guidance. The development of acceptable levels for each COC for each exposure route is a refinement of the PRGs and they serve as risk-based RGs. Additional cleanup levels will be determined for select COCs based on background concentrations, under the assumption that risk-based levels for these COCs will be below background.

In summary, sediment cleanup levels for the Lockheed West Site will be developed based on at least the following:

- Washington State Sediment Management Standards
- Risk-based levels
- Background concentrations for COCs with risk-based levels less than background.

Final cleanup levels will consist of either the risk-based levels or the background concentrations, whichever are greater. The following describes how each of these sets of cleanup levels will be determined for the Lockheed West Site.

6.2.1 Development of Risk-Based Cleanup Levels

6.2.1.1 Approach

Risk-based cleanup levels for Lockheed West Site sediments will be developed as risk-based concentrations (RBCs), which are determined as concentrations for each COC in sediment that correspond to acceptable risk levels for each human health and ecological exposure pathway. The focus of the RBCs will be the protection of the exposure pathways of highest risk for human activities and ecological receptors. RBCs for the exposures of highest risk in a given exposure medium will be protective of all other exposures. The RBCs will be considered to be one of the refined numerical PRGs for the Site, as per EPA (1988) guidance. The RBCs will form the basis for setting both risk-based cleanup levels for Site sediment and risk-based monitoring criteria for post-remedy sediments and capping material.

RBCs will be identified for each COC for each of the major exposure pathways, if data are available. The recent draft RI for the LDW site developed RBCs for a subset of COCs that were identified as the risk drivers, but not for all COCs due to a lack of data or lack of quantifiable relationships between sediment and tissue concentrations at the site. For those reasons, the LDW RI did not develop sediment RBTCs that consider bioaccumulation and consequent seafood consumption risks of cPAHs, arsenic, or dioxins/furans. The major exposure pathways are defined as those presenting the highest risk estimates in the streamlined human health and ecological risk assessments. The selected exposure scenarios are deemed to provide the most stringent (i.e. lowest cleanup level) when considering all populations of receptors that might undergo that exposure. For example, Asian and Pacific Islander seafood consumers are likely to have lower exposures to seafood contaminants than Tribal seafood consumers, and so are not included here. The exposure pathways that will be evaluated in the streamlined RAs and for which COCs will be identified are listed below.

Human Health Risk Assessment

The HHRA exposure pathways will consist of the following:

- Tribal consumption of seafood – indirect exposure to sediment COCs through ingestion of fish, clams, and crabs from the Site;
- Tribal clamming – direct exposure to intertidal sediment COCs through dermal contact and inadvertent sediment ingestion during clam harvesting;
- Tribal netfishing – direct exposure to intertidal and subtidal sediment COCs through dermal contact and ingestion; and
- Child beach play - direct exposure to sediment COCs through dermal contact and ingestion during beach play in intertidal areas.

Ecological Risk Assessment

The ERA exposures will consist of the following:

- Benthic invertebrate community exposures to intertidal and subtidal sediment COCs;
- Fish and crab exposures to intertidal and subtidal sediment COCs; and
- Sandpiper exposure to intertidal sediment COCs.

Estimates of potential health or ecological risk associated with each of these exposures will be determined in the streamlined RAs based on the level of risk for human health or

exceedance of toxicity reference values (TRVs), or sediment criteria for ecological receptors. PRGs for benthic invertebrates were identified above as SMS. The RBCs will be identified for the exposure or exposure pathways showing the highest potential risk based on the streamlined risk assessments. RBCs will be concentrations in sediment associated with regulatory risk thresholds for human health and ecological receptors for these exposures.

Once the RBCs are identified for the exposure pathways, the most stringent levels for intertidal and subtidal sediments will be identified as the RGs (risk-based cleanup levels and risk-based monitoring criteria).

6.2.1.2 Sources of Risk-Based Concentration Values

Consistent with the streamlined approach to the RI, human health and ecological receptor exposure pathways in the Lockheed West Site RAs are a subset of those exposure pathways evaluated in the RAs for the nearby LDW Site. The RBCs for Lockheed West sediment will be identified for the Lockheed West exposure pathways as those RBCs and cleanup levels for the same exposure pathways evaluated at the LDW site. The draft LDW RI evaluates risk-based threshold concentrations (RBTCs) for COCs for all exposure pathways for both human and ecological receptors at the LDW (Windward 2007c), and develops RBTCs for some COCs for some of the exposure pathways and ecological receptors. Not all the COCs for the different seafood ingestion scenarios were assigned sediment RBTCs due to lack of quantifiable relationships between tissue and sediment concentrations. Because of the use of exposure pathways and inherent exposure assumptions from the LDW site for the Lockheed West Site (see Section 11, Risk Assessment Work Plan), the RBTCs developed for the LDW Site will be the primary source of RBCs and hence risk-based cleanup levels for the Lockheed West Site. For those COCs for which RBTCs are not available from the LDW site, the final approach to setting cleanup levels for those chemicals at the LDW site will be evaluated for application to the Lockheed West site cleanup.

RBTCs are defined as concentrations for COCs that are associated with various regulatory risk levels; i.e., 10^{-6} cancer risk for human health and HQ of 1.0 for human health noncancer risks and ecological receptor exposures. RBTCs are developed in the draft LDW RI for PCBs, arsenic, and PAHs in sediment for the direct sediment exposures of netfishing, beach play, and clamming, and in clam and fish tissue for exposures due to seafood consumption. The RBTCs for the direct sediment contact pathways are developed essentially by back-calculation from the regulatory risk level, using exposure parameters specific to each scenario, to arrive at a sediment concentration associated with the regulatory risk level.

Sediment RBTCs for seafood consumption are developed in the draft LDW RI from food the web model for PCBs, which was developed using LDW data. An attempt to use regression modeling or simple biota-sediment accumulation factors (BSAFs) developed from co-located sediment and clam data from the LDW to develop tissue-sediment relationships for arsenic and PAHs was found to result in poor relationships. Consequently, sediment RBTCs that consider bioaccumulation of arsenic and cPAHs and seafood consumption were not developed.

Consistent with the streamlined approach to the RI, RBTCs from the LDW RI document will be used as the basis for risk-based cleanup levels for the Lockheed West COCs. For those COCs for which RBTCs are not available from the LDW site, the final approach to setting cleanup levels for those chemicals at the LDW site will be evaluated for application to the Lockheed West site cleanup. An alternative approach to developing risk-based cleanup levels for the seafood consumption scenario for those chemicals lacking RBTCs from the LDW site consists of modeling tissue to sediment relationships with BSAFs. In this approach, BSAFs would be taken from literature sources referenced in EPA-approved LDW documents. If data become available on co-located tissue and sediment samples from Lockheed West Site, or from the LDW site in the future, they may serve as another source for BSAF development.

The draft RI for the LDW Site recognizes that the driving risk scenario for deriving risk-based cleanup levels for the LDW is tribal consumption of seafood, which as mentioned above is also assumed to be the risk driver pathway for the Lockheed West Site. For the tribal seafood consumption scenario at the LDW Site, the COCs driving the cancer risks are total PCBs and arsenic, with contribution from cPAHs. Because it is the driving risk scenario for setting cleanup levels at the LDW site, the procedure for developing RBTCs based on the tribal seafood consumption scenario is described in more detail below. Tissue dioxin/furan results were not available for the LDW project, but it was noted that if tissue dioxin/furan data had been available, that seafood consumption risks would likely have been unacceptable. For the LDW site, sediment dioxin/furan remediation will be based on background levels of these contaminants.

An RBTC for mercury was not developed in the LDW RI, but could be developed from site-specific data in the LDW risk assessments and the RI, or using data from the West Waterway on sediment and tissue mercury concentrations (EPA 2003a). Alternatively, if site-specific clam tissue and sediment data become available for the Lockheed West Site, they may be used to derive BSAF relationship for mercury that could be used to set an RBTC based on seafood consumption. Similarly, if site-specific clam tissue and sediment

data become available for the Lockheed West Site, or similar data become available for the LDW RI, they may be used to derive BSAFs for cPAHs that could be used in RBTC development. Although the data have not been reviewed for their applicability for this purpose, the PSR site sediment concentrations of PAHs that were associated with acceptable risk for clam consumption could be used, with adjustments to the intake rates, if necessary, in accordance with the Framework document, to develop RBTCs. Use of data from other sites for the development of BSAFs and RBCs for application to the Lockheed West Site in derivation of cleanup levels would be decided by consultation with EPA.

6.2.1.3 RBCs for Indirect Sediment Exposures: Seafood Consumption

As mentioned above, the tribal seafood consumption pathway is the anticipated risk driving exposure scenario for the Site, based on results from the LDW Site HHRA and the similarity between the two sites. The sediment RBCs for seafood consumption are sediment concentrations of COCs associated with seafood tissue concentrations at acceptable levels of risk based on seafood consumption. The sediment RBCs are calculated from the acceptable tissue concentrations of COCs using acceptable risk thresholds and exposure parameters for tribal seafood consumption, including seafood ingestion rates. The calculation starts with the regulatory risk thresholds of 10^{-4}, 10^{-5}, and 10^{-6} cancer risk, and the non-cancer HQ of 1. For PCBs, arsenic, and cPAHs, the primary risk driver chemicals at the LDW site and assumed risk driver chemicals for the Lockheed West Site, the primary regulatory risk threshold is excess cancer risk. Working backward through standard risk assessment equations, the regulatory risk level is factored in with the exposure parameters for tribal consumption of fish, tribal body weight, and exposure frequency and duration, resulting in regulatory risk threshold-associated fish tissue concentrations of PCBs, arsenic, or cPAHs. From these tissue concentrations, quantifiable tissue-to-sediment relationships are used to determine associated sediment concentrations. Quantifiable tissue-to-sediment relationships can consist of BSAFs or regression relationships, which could be developed for use at the Lockheed West Site, or the food web model that was developed for use with PCBs at the LDW Site.

The above procedures were explored in the draft LDW RI to develop the RBTCs for carcinogenic risk drivers for the indirect exposure pathway of seafood consumption. As mentioned above, BSAFs or regression relationships may be used to develop RBTCs for any risk driver COCs at the Lockheed West Site for which RBTCs have not been developed in the LDW RI, if data are or become available. For dioxins and furans, RBTCs will not be developed in the LDW RI due to the lack of suitable data, and hence sediment dioxin/furan remediation will be based on background levels of these contaminants. In the development

of RBTCs for seafood consumption, exposure parameters for tribal seafood consumption will be based on the LDW HHRA, which were developed using exposure parameters from the EPA Framework document. The quantifiable tissue-to-sediment relationships for COCs for the Lockheed West Site will be based on BSAF modeling using either the literature sources developed for the LDW site or site-specific clam tissue and sediment data that may be collected for the Lockheed West Site. Secondary sources may include data from other nearby sites such as the LDW, PSR, or West Waterway Sites. Further discussion on the derivation and use of tissue-to-sediment relationships for setting RBTCs for COCs in sediment is presented below. The quantitation of any sediment-to-tissue relationships for the Lockheed West Site will follow the derivation method used for the LDW Site.

6.2.1.4 Approach to Applying Sediment-to-Tissue Relationship Data to the Lockheed West Site

The above described approach to applying sediment-to-tissue relationship data to the Lockheed West Site is not designed to be highly site specific. As mentioned earlier, the intent of the method chosen for identifying risk-based cleanup levels and performing the risk assessments is to streamline the process. Since the site will be fully remediated, with no evaluation of natural recovery of sediments, identification of site-specific risks is not critical to the remediation, although an assessment of risks is needed to support the need for remediation. As described in Section 11, risks to humans and ecological receptors will be assessed by using exposure scenarios and pathway parameters from the risk assessments performed for the upstream LDW site, in conjunction with site-specific sediment data. The COCs, primary risk driver COCs, and exposure pathways for the Lockheed West Site will be identified through that process. The use of the LDW site parameters for risk assessment or cleanup levels does not entail assumptions about their applicability to the Lockheed West Site, but is intended to provide a means to streamline the process. Cleanup levels need to be sufficiently protective of the exposure pathways and ecological receptor exposures that drive risks at the site. The exposure pathways and ecological receptor exposures that drive risks at the Lockheed West Site are anticipated to be the same as identified for the upstream LDW site, and therefore cleanup levels based on risk-based concentrations from the LDW site will be sufficiently protective of exposures at the Lockheed West Site. As described more fully below, the risk-based cleanup levels that have been developed for risk drivers (i.e., PCBs and arsenic) at the upstream LDW site have been evaluated as being below background concentrations. As such, cleanup levels and criteria for monitoring the performance of the remediation at Lockheed West will likely be background concentrations for those risk drivers, or will be low enough to be sufficiently protective of future human and ecological exposures at the site.

At present, site data on chemical concentrations in clam tissue and collocated sediment samples are not available for the Lockheed West Site for use in deriving site-specific BSAFs. Should such data become available in the future, or if not, should similar data become available for the upstream LDW site, the field data may be used for deriving BSAFs for use in development of RBTCs for the Site. In the absence of any future field data, literature values will be used to derive BSAFs for application to developing RBTCs. Note that the risk assessments will use literature BSAFs for modeling tissue concentrations from sediment data (see Chapter 11). Existing data on clams and collocated sediment chemistry from the LDW site that might be useful for BSAF development are available only for filter feeder clams and are not preferred over literature values for deposit feeder clams. Evaluation of data on collocated clam and sediment chemistry from the LDW in the draft RI did not observe significant relationships between tissue and sediment for either arsenic or cPAHs. The stated reason was likely due to the use of filter feeder *Mya* species that likely had significant water column exposures in addition to sediment exposures (Windward 2007b). A deposit feeding organism would have a stronger relationship with the surrounding sediment. Thus the use of any existing LDW data to derive BSAFs would add a high level of uncertainty to risk estimates and cleanup levels. In addition, BSAFs for the LDW were deemed to be of limited reliability given the decrease in tissue PCB levels that occurred following 2004 tissue sampling.

Should future clam data collection efforts at the LDW site focus on deposit feeders, resultant data would be evaluated for potential application for BSAF development for the Lockheed West Site. However, according to the LDW RI report, deposit feeder clams are not abundant in the LDW, so their future collection from the LDW site is uncertain. Whether deposit feeder clams are present at the Lockheed West Site is also uncertain since a clam survey has not been performed at the Site. Because both the LDW site and West Waterway area of the Lockheed West site are estuarine in nature, both receiving some influences from the Duwamish River, they may have similar clam communities. The Elliott Bay area of the Lockheed West Site is more saline than the West Waterway area; however, it is not known whether the clam community compositions differ between these two areas of the Site.

6.2.1.5 Sediment-to-Tissue Relationships for COCs

Sediment-to-tissue relationships are quantified in the draft LDW RI by two primary approaches: BSAF or regression modeling, and a food web model (Windward 2007c). Consistent with the streamlined approach to the RI, the BSAF approach for evaluating sediment-to-tissue relationships will be preferred. As mentioned earlier, consistent with the

streamlined approach to the Lockheed West RI, BSAFs derived from site data may be used as a secondary resource in developing RBTCs for cleanup. Derivation of BSAFs with site data will use collocated sediment and tissue data if they are available for either the Lockheed West Site or the LDW site. The use of the BSAF and food web modeling approaches to derive RBTCs is described in more detail below.

Biota-Sediment Accumulation Factors

As mentioned earlier, consistent with the streamlined approach to the Lockheed West RI, BSAFs derived from site data may be used as a resource in developing RBTCs for cleanup, should they become available in the future. Derivation of BSAFs would use collocated sediment and tissue data on clams. Deposit feeding clams are the preferred species due to their closer relationship with the sediment than filter feeder clams. Whether sufficient abundance of deposit feeding clams for BSAF derivation are available at either the Lockheed West Site or the LDW site is presently unknown. In lieu of field data for BSAF derivation, literature values will be used, as are planned for use in the HHRA and ERA (see Chapter 11).

For any data that might be used from the LDW RI to develop BSAFs for application to the Lockheed West Site, the locations and spatial extent of collocated samples will depend on the exposure area for seafood types, which depends on their relative home ranges within the LDW. For example, collocated data for clams would be based on specific sample station locations in intertidal sediments; collocated data for crabs or fish with small home ranges, such as sculpin, would be taken from intertidal and subtidal sediments on an area-wide scale, with a focus on the sampling areas with the most marine habitat (i.e., probably excluding upstream areas); and collocated data for English sole would be based on the full intertidal and subtidal data set from the LDW site on a site-wide sampling basis. The LDW ERA and RI present analyses of relationships between chemicals in sediment and those in tissue collected from the LDW that tend to support smaller home ranges for sculpin and shiner surf perch on an area basis, and larger home ranges for English sole and crab on a site-wide basis.

Food Web Modeling

As part of the RI for the LDW Site, the LDW Group has developed a food web model (FWM) that predicts total PCB concentrations in tissue of fish and crabs from sediment PCB concentrations. The FWM was used in the draft RI for the LDW Site to translate acceptable RBCs in fish and crab tissue into RBTCs for sediment. If modeled relationships were needed for chemicals at the Lockheed West Site, the food web model could be used to

model RBTCs for other hydrophobic organic compounds in the LDW for subsequent application to the Lockheed West Site. Since the intent for the Lockheed West RI is to streamline the approach to identifying cleanup levels, including borrowing directly from the LDW site, the use of food web modeling is considered a tertiary resource to simple BSAF or regression modeling based on field data, or the use of BSAFs from the literature.

The food web model being developed for PCBs for the LDW site data could be adapted to relate sediment and tissue concentrations for other chemicals for the Lockheed West Site. The habitat parameterization of the LDW food web model was determined through several technical memoranda (Windward 2005b,c). If the food web model were to be used to develop sediment RBCs for additional COCs at the Lockheed West Site, the model could use the established parameterization for the LDW in primarily marine areas as the habitat most similar to the Lockheed West Site.

6.2.2 Identify Sediment Cleanup Levels

The RBCs for the Lockheed West Site, as identified or developed as per the above approaches, will be used as refined numerical RGs for the Lockheed West sediments, following EPA guidance on developing cleanup levels for contaminated sites under CERCLA. Since these refined numerical RGs are based on the RBCs, they are defined as risk-based RGs or risk-based cleanup levels for the site sediment. As described above, the risk-based RGs as developed from RBCs will be based on the RME risk driver scenarios for the Site. The primary risk driver scenario for sediment cleanup is expected to be the tribal consumption of seafood, as it has been identified for the LDW site. The RBCs for the tribal seafood scenario will be developed from the RME exposure parameters, including tribal seafood consumption rates, that are documented for RBTC development in the LDW draft RI, which follow from the EPA Region 10 Framework, which includes consultation with the affected tribes. The RME tribal exposure for the Lockheed West site will be parameterized using Tulalip survey data. Selection of whether Tulalip or Suquamish consumption rates constitute RME will be made in consultation with the tribes.

These risk-based cleanup levels will be compared with background concentrations of the COCs to determine whether a cleanup to the risk-based levels would be achievable. Based on the preliminary analyses from the nearby LDW Site, it is anticipated that risk-based cleanup levels for carcinogenic COCs at the Lockheed West Site that are determined from the tribal seafood consumption exposure pathway will be less than background concentrations. As per EPA (2002b, 2002c) and Ecology MTCA guidance (WAC 173-340) on cleanup of hazardous waste sites, cleanup below background is not feasible for long-term remedy and would not be required. Due to the urbanized region of the Lockheed West

Site location, regional background concentrations of COCs in sediment may be the lowest values achievable for site cleanup. In this case, background concentrations of COCs become the cleanup levels for the site sediments (EPA 1999c).

Based on the above, the suite of cleanup levels for the Lockheed West Site sediments will be identified in the RI as the following:

1. Risk-based cleanup levels developed from the RBTCs and RBCs for the LDW Site, including any RBCs developed from LDW site data or Lockheed West Site data, and SMS for benthic invertebrates. Use of established RBTCs as risk-based cleanup levels assumes that the primary risk COCs for Lockheed West sediment will be total PCBs, arsenic, and cPAHs. For other potential COCs such as mercury and other metals, risk-based cleanup levels for the Lockheed West Site may be developed using data from the LDW and possibly other sites, or from site-specific data if available.
2. Background concentrations of COCs, as determined through site-specific sampling or as previously determined at nearby sediment sites. Issues with determining background concentrations of COCs for the Lockheed West Site are discussed below.

From this suite of cleanup levels, the final cleanup level for each COC in sediment will consist of either the risk-based level or the background concentration, whichever is greater.

6.3 DETERMINATION OF BACKGROUND CONCENTRATIONS

The approach for determining background concentrations for evaluation as cleanup levels will be documented as the RI process ensues. For the purposes of this work plan, the discussion on background concentrations focuses on the present usage under State of Washington guidelines. Background determination for the Lockheed West Site for use in the RI/FS to set cleanup levels will follow the approach of the final RI for the LDW site, and will be appropriate for the Lockheed West Site. The final approach will be determined with EPA. At present, the draft RI for the LDW site presents background data for natural and urban areas, based on data collected from the Puget Sound area, intra site data, and upstream of the site. The application of these data to determining background for the cleanup of the LDW site is still to be determined with EPA and Ecology. The specific approach or application of the LDW approach to the Lockheed West Site RI will be developed in the future.

Both EPA and Ecology recognize two types of background, natural and urban (also referred to as anthropogenic or area), although their definitions and uses differ. The most important

difference is in the potential application of urban or area background concentrations in making risk management decisions. Since the Lockheed West site is under EPA lead, the approach to background that Ecology uses is not considered applicable to the site. EPA generally does not require cleanup levels below urban background concentrations because of the potential for recontamination from sources unrelated to the site, cost effectiveness, and technical practicability (EPA 2002d). Under Ecology's regulations, when area background concentrations would result in recontamination of the site to levels that exceed cleanup levels, that portion of the cleanup action that addresses cleanup below area background concentrations may be delayed until the offsite sources of hazardous substances are controlled. In these cases, the cleanup action will be considered an interim action until cleanup levels are attained.

Background concentrations of COCs at the Lockheed West Site will be determined after consultation with EPA and stakeholders. Preliminary discussion of background concentrations include identification of potential data sources, as summarized in the following sections. The approach to identification of background concentrations will be further refined through technical workshops with EPA and the project stakeholders. Details of the approach stemming from the technical workshops will be documented and submitted for review and approval.

6.3.1 Existing Background Data

Data on existing background concentrations of COCs for Puget Sound are presently available from two sources. (1) Metals in sediment are available as background concentrations from the PSAMP program and may be available from the Ecology SEDQUAL database. (2) Background concentrations for PAHs have been identified for Puget Sound sediment in the RI for the PSR Site (Weston 1998a). These background data may be used for development of area or natural background.

6.3.2 Site-Specific Background Data

Background concentration data for arsenic and organic chemicals (e.g., PCBs and PAHs) that are identified as COCs may be collected as part of the RI for the Lockheed West Site. The identification of appropriate background areas and approaches to determining background will be decided after consultation with EPA.

6.3.3 Background Concentration Data from the LDW Site

Background concentration data for COCs (e.g., arsenic, PCBs, and PAHs) have been compiled from the LDW in the draft RI for the LDW Site, as mentioned above. Background concentrations of PAHs in Puget Sound have also been compiled for the PSR site. Any data collected on background for nearby sediment sites, particularly the LDW, will be evaluated for potential application as background to the Lockheed West Site, in consultation with EPA.

7. SEDIMENT STABILITY

The stability of the sediments within the Lockheed West Site will be evaluated to ensure the long-term integrity of potential capping materials at the Site. The evaluation of sediment stability will be conducted using a three-tiered approach, (1) evaluation of existing data on bathymetry, subsurface sediment quality, sedimentation rate and flow characteristics for the West Waterway and Elliott Bay (completed as part of this work plan; see Section 4.4), (2) collection of subsurface chemical data (to be completed as part of the proposed site investigation activities; see Section 8), and (3) numerical modeling using wind, current, and propeller scour predictions.

Sediment stability at the Site will be indicated by evidence of the burial of historical shipyard contamination, the presence of newly deposited material transported from the Duwamish River and Elliott Bay, the absence of significant geomorphic features indicative of scour or failure, a net sedimentation rate, and evidence of increasing site elevations over-time.

In addition to the existing and supplemental data evaluations completed for Tiers 1 and 2, numerical modeling will be conducted to evaluate the potential effects of wind, waves, currents and propeller wash on site sediments.

7.1 EVALUATION OF EXISTING DATA (TIER 1)

Tier I analysis relies on existing data on bathymetry, subsurface sediment quality, sedimentation rate and flow characteristics for the West Waterway and Elliott Bay to determine the long-term stability of sediments at the Site. Stability will be indicated by evidence of sediment burial over-time. Characteristics of a stable environment at the Site are the burial of historical shipyard contaminants and infilling of site features over-time. Evaluation of the potential burial rate will consider indicator contaminants unique to the shipyard and the operational history.

The following data will be considered as part of the initial evaluation tier.

- Review existing sediment quality data to identify subsurface sediment chemical concentration trends indicative of an accretional environment.
- Existing geotechnical data will be reviewed to determine the physical characteristics of sediment at the Site (Hart Crowser 1995 and Enviros 1990). Sediment physical characteristics, such as grain size can be representative of the depositional energy within the site area. It can also be used to help identify potential cap material types and grain sizes.

- The most recent bathymetric survey (Tetra Tech 2006) will be reviewed to identify geomorphic features on the seafloor that may be indicative of sediment scour, land slides and other actions that may impact sediment stability.
- Previous bathymetric surveys will be qualitatively compared to the most recent bathymetric survey to identify areas of potential sediment erosion or accretion over-time.
- Subsurface sediment chemical concentration trends will be evaluated to determine if surface COC concentrations are increasing, remaining stable, or decreasing. Decreasing surface COC concentrations are indicative of sediment deposition and stability, and can potentially be correlated with a regional sedimentation rate for Elliott Bay.

7.2 EVALUATION OF SUBSURFACE SEDIMENT QUALITY (TIER 2)

Tier 2 evaluation of sediment stability will utilize the supplemental subsurface sediment quality data collected as part of the RI/FS field investigation. The supplemental subsurface sediment quality data will be used to confirm the sediment chemical trends identified in the Tier 1 analysis.

The following data will be considered as part of the Tier 2 evaluation:

- Subsurface sediment quality data, generally collected in one-foot intervals at select locations, will be evaluated for concentration trends indicative of sediment deposition and stability.

7.3 EMPIRICAL MODELING EVALUATION (TIER 3)

Tier 3 will include numerical modeling of wind, waves, currents and propeller scour. The sediment dynamics of the Site will be evaluated using an empirical model. This modeling will provide information on how hydrodynamic forces such as wind-induced waves, currents, and vessel wakes and propeller scour impact sediment transport, bottom and shoreline sediment scouring, and sediment accumulation in the project area. The results of the modeling evaluation will be used to determine the cap erosion potential. Erosion from wind-induced waves, currents, vessel wakes and propeller scour can reduce cap thickness and degrade slope stability. Input parameters for the modeling evaluation will be obtained from existing site information when possible, or adjacent representative site information. Additional numerical modeling, if not completed as part of the RI/FS, may be performed as part of the remedial design.

8. SAMPLING AND ANALYSIS

This section provides an overview of, and strategies for the remedial investigation field sampling and data gathering activities. Detailed descriptions of the activities are presented in the supporting project SAP, QAPP, and HASP (Appendices C - E to this Work Plan).

8.1 OVERVIEW OF SEDIMENT SAMPLING AND ANALYSIS

8.1.1 Data Quality Objectives

The rationale for the sampling approach is based on the assessment of existing data and identification of data gaps (see Section 4.9). EPA's seven step Data Quality Objectives (DQOs) process was followed to develop all the data collection efforts (e.g., Guidance on Systematic Planning using the DQOs Process (QA/G-4), EPA 240/B-06/001 Feb 2006), and provides the technical and decision-making basis for the collection of all data. Table 8-1 summarizes the results of the DQO development process for the identified data gaps.

8.1.2 RI Sampling Summary

The primary objectives of sediment sampling and analysis are the support of the spatial resolution of chemical contaminant distribution to identify areas and volumes of sediment that may require active remediation, to characterize exposure and consequent risk for human and ecological receptors. Several of the RI activities described below have been implemented. The bathymetric and shoreline surveys were conducted in the summer of 2006. The subtidal sediment and background range finding studies were conducted in January 2007 and intertidal sediment sampling was conducted in April 2007. Data collected as part of these activities will also support the assessment of sediment contaminant mobility, the potential for sediment recontamination, and physical characterization of the Site.

The consulting team is responsible for the tasks associated with the collection of sediment and site characterization data for Lockheed West. The scope of work includes the following:

- Collection and analysis of samples for chemical, conventional, and physical testing; and Site characterization for remedial design planning; and
- Data analysis, interpretation, and reporting (see Sections 10 and 13).

The organization of activities and field procedures required to meet the DQOs and overall objectives of this work are described in the Site Characterization SAP (Appendix C). This SAP and the other RI documents (QAPP, HASP) were prepared following the general guidance provided by the EPA for conducting investigations at Superfund sites and by Ecology.

Following approval of these RI Work Plans by the EPA, field crews were mobilized to collect the required environmental samples and physical data. All samples and field data were collected in accordance with the procedures outlined in the SAP and QAPP (Appendix C and D, respectively). Environmental samples were submitted for testing and analysis in accordance with the requirements of the QAPP.

A synopsis of the RI field program is provided below. Based on the summary of existing information, knowledge of historical site uses, future site plans, and recent high-resolution site bathymetry, the Site was divided into general use areas (Figure 8-1). These general areas were used to focus the selection of additional sampling needs, as explained below. Surface data will be used to define potential remediation areas. Subsurface data will be used to define the maximum potential dredging depth and will indicate whether any of the sediments may be suitable for disposal under the PSDDA program. A full PSDDA characterization is not being performed during the RI sampling activities.

Surface Sampling. Surface sampling was conducted as part of the field effort to ensure that the surface sediments are undisturbed and not impacted by the other RI field activities. Sample locations were selected to be representative of the surface sediment conditions and to provide adequate spatial coverage of the Site based on the historical site uses. Surface samples were used for bulk chemical analysis.

Subtidal surface samples were collected using standard van Veen grab methods deployed from a work vessel. Intertidal bank samples were collected with bowls and spoons at low tide to allow field personnel to assess the slope and substrate for optimal sampling locations.

Subsurface Sampling. Subsurface sampling was performed using a vibracore system. Data gathered from the subsurface cores will be used for characterization of the subsurface material, sediment chemical characterization, and dredgability and contaminant mobility testing. Sample locations were selected to provide adequate spatial coverage of the Site based on historical site uses and previous sediment core results. The coring system was operated from a work vessel.

Most subsurface cores were advanced beyond the deepest extent of PRG exceedances indicated by the existing data or to native material, expected to be an approximate elevation

of -45 feet MLLW, which is the historical dredging depth. Several cores were advanced to -53 MLLW, the maximum depth potentially required for navigation. The primary objective was to determine the vertical extent of sediment potentially requiring remediation. Subsurface sediment intervals may also be used to support a preliminary PSDDA evaluation in the area south of the property boundary along the West Waterway. The Port of Seattle may expand Terminal 5 into this area. If this preliminary evaluation indicates that PSDDA requirements have a reasonable probability of being achieved, LMC will discuss the need for a full PSDDA characterization with EPA.

In areas where removal may be a feasible remedial option, a sediment composite representative of the potential dredge prism was created from representative subsurface core intervals to support contaminant mobility testing. The specific elements of the investigation are summarized in the following sections and discussed further in the SAP (Appendix C).

8.2 IDENTIFY EXTENT OF SEDIMENT CONTAMINATION EXCEEDING PRGS

Sediment sampling and analysis as performed in accordance with the SOW for the purpose of identifying the extent of chemical concentrations in sediment that exceed the PRGs protective of human health and the environment as described in Section 6. Sediment sampling was performed in the general vicinity of the Lockheed West property boundaries. Sediment samples included surface (0 to 10 cm) grab samples and subsurface core samples. All sampling, handling, and analyses was performed in general accordance with EPA-recommended methodology and PSEP protocols. The sampling program included evaluation of intertidal and subtidal surface and subsurface samples for the COCs. Sediment sampling was performed at 51 locations throughout the Site as shown on Figure 8-2. Subsurface and co-located surface sediment sampling was performed at 35 locations, surface sediment sampling only will be performed at 7 locations, and nine discrete intertidal bank samples are collected along the shoreline. The rationale for samples is included in Table 8-2. In addition, 7 locations in Elliot Bay were sampled to find a range of background-like locations. The rationale for the range-finding background sample locations are discussed below.

8.2.1 Surface Sediment Samples

Surface sediment samples were collected to determine the horizontal extent of COIs exceeding PRGs and the exceedances of human and environmental health risk-based concentrations. COIs consist of the SMS parameters with SQS and CSL chemical criteria as well as bulk sediment TBT and supporting conventional parameters.

The surface sediment samples are comprised of the top 0 to 10 cm at three types of locations:

- Forty-two surface samples collected from the subtidal areas of Lockheed West;
- Representative samples (up to nine) collected from the intertidal bank areas of Lockheed West and analyzed for COIs; and
- Seven Range-finding background samples collected from around Elliot Bay for comparison to the Lockheed West Property samples.

Subtidal Surface Sediment Samples. A total of 42 surface samples, representative of the upper 10 cm of sediment, were collected at 42 locations in the subtidal area for the purposes of determining surface sediment quality and establishing the locations of chemical "hot spots." Samples collected from the subtidal portion of the Site were collected using a van Veen grab sampler deployed from a work vessel. Additional sediment was collected at all the surface grab locations and archived for potential PCB Congener analysis. Additional sediment was archived for potential dioxin/furan analysis at two locations (i.e., 38 and 39). Additional material was collected at 7 surface sediment sample locations for the analysis of porewater for the COIs.

Intertidal Surface Sediment Bank Samples. Waterway bank areas are representative of nearshore surface sediments that may be impacted by eroding banks, historical and current outfalls, seeps, or surface runoff. These areas are also subject to deposition of suspended particulate material that may be re-suspended during storm events, from vessel wakes, or during dredging within the waterway. No data exist on the condition of the banks. Based on a visual survey of the Lockheed West bank areas, four bank segments have been identified. Designation of bank segments considered similar physical attributes, potential significant sources, and current property ownership.

Sediment samples were collected from the intertidal bank areas for the purpose of determining the sediment chemical concentrations and extent of sandblast grit, defining the location of chemical "hot spots," and determining the intertidal sediment physical characteristics. These data will also provide data that will define the upper (shoreward) boundary of the sediments in Lockheed West.

To characterize the upper portion of the slope (intertidal zone), samples were collected along the Site shoreline bank (locations IT-1 through IT-9). Each sample is comprised of a discrete sampling location and analyzed for COIs. The samples were collected from the top 10 cm of silt and/or sand, either at the sediment/riprap interface at the top of the slope or along the exposed bank slope if no riprap is present. The bank locations are shown on Figure 8-2. Locations were determined in the field, based on the results of the low tide

habitat and structure survey. Areas that were avoided are rip rap and areas with little sediments. In the event that a suspected source material was identified, the location documented, a discrete sample was collected, and EPA will be notified. A sufficient volume of sediment will be collected from each location for analysis of the COIs listed in Table 8-3. The location of each discrete sample, tidal elevation, material description, and identification of suspected source material documented and presented in the RI Data Collection Report.

Rangefinding Samples. Proposed cleanup actions at the Lockheed West Site requires characterization of background sediment quality conditions. Background sediment quality concentrations for the Lockheed West COCs will be used as site cleanup objectives if risk-based cleanup numbers based on the human health and ecological risk assessments are determined to be below background. In this case, use of background sediment concentrations as cleanup objectives would represent the lowest, practically achievable sediment quality condition within the greater Elliott Bay system. Determination of the sediment background concentrations for the LW site will be conducted in conjunction with EPA. However, the process of establishing background is likely to require sampling and chemical analysis of sediment samples from Elliott Bay to determine the potential range in the concentration of COCs. To begin this process, LMC collected rangefinding sediment samples from greater Elliott Bay as part of the RI field sampling effort.

Elliott Bay is an urbanized water body subject to multiple natural and anthropogenic processes that affect background concentrations (Figure 8-3). The background range finding process was intended to identify a representative range of concentrations for Lockheed West contaminants of concern throughout Elliott Bay through sampling and chemical analysis of sediment samples collected from within the bay. Based on the sampling and analysis results, the range of concentrations for the Lockheed West contaminants of concern will be analyzed to determine if the samples collected are representative of the background sediment quality condition and are not directly affected by anthropogenic or natural processes. Sampling locations showing uncharacteristically high concentrations, relative to the other location samples, would be considered to be non-representative and therefore, not considered in the determination of cleanup objectives for the Site. Additional field sampling would be performed if necessary, if the initial characterization does not yield a data set sufficient to characterize a background characteristic of Elliott bay.

Objectives and rationale for the selection of proposed Elliott Bay background sediment concentration rangefinding sampling locations are described below. Sampling and analysis

of the proposed locations was performed in conjunction with the surface sediment sampling effort.

Objectives for selection of urban background sediment quality sampling locations include the following:

- Sample areas that are representative of the overall ambient sediment quality condition,
- Sample in areas that do not have a potential to be biased by known or suspected contaminant sources,
- Sample at depth ranges comparable to those of Lockheed West Site (e.g., less than 45 feet MLLW), and
- Sample sediments that are comparable to those of Lockheed West Site (e.g., %TOC, grain size).

Locations and Rationale. Proposed Elliott Bay background sediment concentration range-finding sampling locations are presented on Figure 8-3. Rationale for selection of the proposed locations is presented below.

- Sampling Location 1 is representative of northern Elliott Bay and is the same as the LDW background site 2. This site is situated near the Magnolia marina and Terminals 90 and 91 and will be located at depths that are comparable to those of Lockheed West. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination.
- Sampling Location 2 is representative of northern Elliott Bay and is the same as the PSR background location "BK02." This location is situated along a municipal park and is at depths that are comparable to those at Lockheed West. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. The location is not situated within an area to have been subject to anthropogenic disturbances. The nearest industrial use is the Port of Seattle bulk grain loading facility.
- Sampling Location 3 is representative of the eastern portion of Elliott Bay. This location is situated along the central waterfront of Downtown Seattle. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. The location is not situated within an area to have been subject to anthropogenic disturbances. Uses of areas near the sampling location are primarily commercial and maritime transportation.

- Sampling Location 4 is representative of the southeastern portion of Elliott Bay. This location is situated along the large container dock south of the central waterfront of Downtown Seattle. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. The location is situated within an area that was last dredged in 1979. Uses of areas near the sampling location are primarily commercial and maritime transportation.
- Sampling Location 5 is representative of the southern portion of Elliott Bay. This location is situated along the north shore of Harbor Island. The location is not in the immediate vicinity of known outfalls. The nearshore and onshore areas located near the Site are used for maritime commerce purposes such as tug boat storage and shipbuilding. The location is not situated within an area to have been subject to anthropogenic disturbances. Sediment cleanup has been completed at the shipyard facility to the west of the proposed sampling location.
- Sampling Location 6 is representative of southwestern Elliott Bay. This location is situated along the west shore Harbor Avenue. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. Uses of areas near the sampling location are primarily public access, municipal parks, and commercial businesses. The location is not situated within an area to have been subject to anthropogenic disturbances. Sediment cleanup has been completed at the PSR facility to the east of the proposed sampling location.
- Sampling Location 7 is representative of western Elliott Bay. This location is situated along the west shore Harbor Avenue. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. Uses of areas near the sampling location are primarily public access, municipal parks, and commercial businesses. The location is not situated within an area to have been subject to anthropogenic disturbances.

Sampling Approach. Surface sediment samples (0 to 10 cm) were collected from the locations using a grab- type sampling device deployed from a work vessel. On collection, sediment samples were observed to ensure that the sampling objectives (described above) were met. Acceptable samples were submitted to the analytical laboratory for chemical analysis. In the event a given sample location did not yield a sample meeting the above objectives, a second attempt was made at an alternative location in the vicinity of the proposed location. In the event the second sample location did not yield a sample meeting the above objectives, a third attempt was made at an alternative location in the vicinity of the proposed location. In the event the third offset sample is found to be unacceptable then the proposed location was be sampled.

8.2.2 Subsurface Sediment Sampling and Analysis

Subsurface coring was performed primarily using a vibracore system. Sample locations were selected systematically to provide adequate spatial coverage of the Site. The coring system were operated from a work vessel.

Chemistry Sample Collection. Subsurface sediment cores were collected at 37 co-located surface sample locations to determine the vertical extent of chemical concentrations in subsurface sediment exceeding the SQS or CSL chemical criteria and to determine volumes of sediment that may require remediation. The primary objective will be to determine the vertical extent of sediment requiring remediation down to native material or a maximum elevation of -53 MLLW. This is the deepest elevation that would be required for navigation. Therefore, based on site bathymetry and proposed locations, cores ranged from approximately 3 to 20 feet in length. Each subsurface core was logged and subsampled in the field. Sample intervals were generally divided by considering sediment stratigraphy and then into 1-foot intervals or as required volumes for chemical analyses. A minimum of two sample intervals were analyzed from each core. Selection of samples to be submitted for chemical analyses was representative of the various subsurface sediment types observed based on the visual observations and core logs. A relatively uniform subsurface sediment stratigraphy is expected within the Lockheed West Site; therefore, an estimated two to three sediment sample intervals from each core was submitted for chemical analysis (Table 8-3). As co-located surface sediment samples (0 to 10 cm) will be collected at each core location, an estimate of four samples (three core intervals and one surface) may be submitted for analysis at each location. The remaining core intervals were collected and archived and held under chain of custody for determination as to which additional samples may need to be submitted for analysis.

Contaminant Mobility Sample Collection. Two sediment composite samples representative of the potential dredge prism were created from the cores to support sediment contaminant mobility testing. Each composite was volume weighted (equal volume from unit length) from all cores based on chemical analyses and sediment stratigraphy as necessary to create a representative composite. Multiple cores were necessary at any one location to collect adequate volumes for the planned analyses. Further discussion of contaminant mobility is included in Section 8.4.

8.2.3 Marine Biota Tissue Sampling

The relationship between surface sediment chemical concentrations at Lockheed West and the potential for adverse bioaccumulation of COPCs will be evaluated using a literature-based Biota Sediment Accumulation Factor (BSAF) approach consistent with the LDW, as

described in Section 11. Field sampling and analysis of biota tissues collected from the Site may be performed to further refine the BSAF evaluation. Consistent with the tissue sampling approach used at the LDW, clams will be targeted for sampling and analysis, if found to be present in sufficient quantities to provide samples representative of the LW Site.

Due to the relatively steep shorelines, habitat for clams at the site is limited. At EPA's request, LMC has agreed to complete a field reconnaissance survey at the Site to identify the presence and abundance of clams. Detailed plans for the field reconnaissance will be developed in conjunction with EPA. The general approach will be to survey the surface sediments within clam habitats at the site for evidence of their existence and relative abundance.

The field reconnaissance data will be used to determine if tissue sampling is warranted and to develop tissue sampling and analysis plans, should testing be found appropriate. If clam data collection activities are found to be needed, more detail on the sampling approach will be developed in conjunction with EPA.

8.3 PHYSICAL CHARACTERIZATION

8.3.1 Multibeam Bathymetry

Bathymetry work has been completed for the Site to support sampling location control and remedial design planning and evaluations. This work is discussed in Section 4 and included in Appendix B. The bathymetric survey of the open water area, shipways, and underpier areas was performed to provide existing elevations throughout the Site. The new survey is used to develop a basemap for remedial design activities, including volume calculations, debris, area definitions, sampling positioning, etc. The key components of the survey are identified below:

Open Water Bathymetry. High resolution multibeam bathymetry data were collected on May 20, 2006 throughout the Site. Horizontal positioning is based on North American Datum (NAD) 1983 and vertical positioning was based on the Port of Seattle MLLW datum for Elliott Bay.

Location of Existing Piling. The approximate locations of underpier support pilings were determined based on locations of exterior pilings, typical piling spacing.

Shipway Details and Bathymetry. The approximate layout of the shipway and associated piling was identified to the extent possible using field measurements and drawings as available. Elevations of shipway ramp and mudlines below ramp were determined where accessible.

Location of Debris and Large Obstructions. The location of significant debris accumulation and other large obstructions which were encountered during the surveys were noted and identified on the basemaps. Significant debris and/or obstructions can impact the feasibility and cost for dredging and/or capping.

Outfall Locations. This survey identified the location of visible and accessible outfalls on the Site (e.g., Florida Street combined sewer outfall).

8.3.2 Topographic Survey

The purpose of the topographic survey is to document the current upland elevations to tie in the current bathymetry survey. This survey provides additional data that will be used during the FS and design. A survey firm licensed in Washington conducted a full-coverage topographic survey of the upland area adjacent to Lockheed West Site. The survey area extended from the top of the shoreline bank to the water's edge.

8.3.3 Shoreline Conditions Survey

The purpose of the shoreline conditions survey is to document the current physical conditions such as existing habitat and structures along the shoreline at the Lockheed West Site. This survey was conducted in advance of the other RI field efforts to take advantage of the available daytime low tides. The survey was performed August 9, 2006, during a daytime low tide (predicted as -2.6 feet MLLW at 11:26 am) to maximize the extent of the survey. A small vessel was used to access the Site. A field team consisted of three personnel (a senior benthic ecologist, a senior engineer, and an additional environmental scientist or engineer, all with sediment remediation experience). In addition to the small vessel used to access the Site and the required marine safety equipment, the field team were equipped with personal protective equipment, a video camera, a digital camera, a hand-held GPS unit, a surveyor's tape, and field log books. The existing habitat, presence or absence of biota, existing structures, and presence of any groundwater seeps was documented with field notes and digital camera and or video. A technical memorandum summarizing the survey will be included in the RI report.

8.3.4 Physical Testing

Characterization of the physical properties of the Lockheed West sediments was accomplished to provide the information necessary for an evaluation of remedial options. Physical properties analysis of the sediments was conducted on selected samples to identify and estimate the dredge and disposal characteristics of sediments likely requiring removal and confinement. Physical characterization testing included the following:

- PSEP grain size, percent solids, and TOC were determined at all surface and subsurface locations.
- In addition, samples from the subsurface cores (discussed in Section 8.2.2) were submitted for:
  - Atterberg limit determinations by American Society for Testing and Materials (ASTM) Method D4318-84; and
  - Sediment specific gravity determination by ASTM Method D854.

Test results will be used to characterize the sediments, evaluate sediment transport, and assess the feasibility of removing and/or capping impacted sediments. Specifically, these tests will be used to estimate the dredgability, water generation during dredging, and bulking of sediments subjected to different types of removal techniques.

Specific procedures for sediment sampling handling and analysis to support these sediment physical characteristics testing are presented in the SAP (Appendix C) and the QAPP (Appendix D).

8.3.5 Sediment Stability

As discussed in the Data Gap Analysis section, results of high resolution multibeam bathymetry data do not indicate significant erosional features at the Site. There is no evidence of mass sediment redistribution at the site as shown by the presence of historically contoured bottom features, such as drydock areas and former pier areas. Sediment stability is important to evaluate because it impacts the potential remedial actions that can be proposed for the Site. If the sediment is unstable, then contaminated subsurface sediments may become re-exposed or a sediment cap may be subject to erosion.

A radioisotope study was performed for the Harbor Island Sediment OU as part of the Harbor Island SRI to determine sedimentation rates within the West Waterway (EVS 1996). The results of that natural recovery evaluation demonstrated that the West Waterway is a depositional area with sedimentation rates on the order of 1 cm/yr. These results can be applied to Lockheed West, where conditions in the open water areas are similar to those measured and modeled in the West Waterway (e.g., similar water depths, location relative to the bay and river influences). Seafloor conditions at Lockheed West are expected to be more quiescent, thus more suitable for capping. Because routine dredging is not required or necessary at the Lockheed West Site, conditions are favorable for long-term contaminant isolation.

Of primary concern regarding the long-term stability of Lockheed West surface and subsurface sediments is its exposure to erosion forces from Elliott Bay and within the West

Waterway. Erosion from wind-induced waves (including storm events), currents, and vessel wakes (and particularly propeller wash) may disturb bottom sediments and degrade slope stability of the Site. The potential for erosion in the intertidal and subtidal zones will be determined based on current velocities, wave-induced scour, and propeller wash.

The evaluation for erosion will be divided into two main components: evaluate existing physical characteristics and modeling evaluation.

- **Physical Characteristics Evaluation.** Existing and proposed sediment grain size data in the open water areas will be examined to help determine potential cap material type and grain size. The existing grain size will indicate the minimum cap grain size required to prevent significant erosion at the Site.
- **Modeling Evaluation.** Both empirical and numerical models may be used to determine current and wave impacts, and cap erosion potential. These models may include, but are not limited to Coastal Engineering Research Center's Automated Coastal Engineering System, USACE STUDH, propeller wash modeling (PROPWASH), and ship-induced waves (SHIPWAVE). Input parameters for the models will be obtained from existing site information.

Existing information provides typical ranges of current velocities within the West Waterway and in the vicinity of the Lockheed West Site that will be used to evaluate erosion potential.

8.4 ASSESSMENT OF CONTAMINANT MOBILITY

Subtidal cores were archived pending review of sediment chemistry results. A sediment composite was created from archived subsurface cores. Based on a review of sediment stratigraphy, sediment chemistry results, and dredging plan specifics, a volume weighted sediment composite sample (e.g., equal volume of sediment for each depth interval that may require removal) was created that is representative of sediments that may require removal from the subtidal area. The sediment composite sample was submitted for analysis (Table 8-3). Selected contaminant mobility testing was performed on the sediment composite to provide an assessment of contaminant mobility testing during dredging and aquatic confinement and disposal (i.e., thick capping, capped aquatic disposal, or upland disposal).

The tests include a Column Settling Test (CST) and a Dredging Elutriate Test (DRET). These sediment contaminant mobility tests are described below.

8.4.1 Dredging Elutriate Test

The sediment composite will be submitted for the DRET. The DRET will be used to predict the potential short-term contaminant release at the point of dredging. The DRET was performed in accordance with WES-recommended procedures (DiGiano et al. 1995) using a solids concentration of 10 g/L and a settling time of one hour. The elutriate was analyzed for those constituents that have marine acute and chronic water quality criteria.

8.4.2 Column Settling Test

The sediment composite will be submitted for the CST. The CST is used to model the settling behavior of sediments that may be dredged. The objective is to predict the gravity settling rate and behavior of dredged contaminated material. The results of the testing may be used to select an appropriate dredging method, predict potential water quality effects and to design a dredged material disposal/containment area. The test is conducted by placing a known quantity of sediment slurry in a settling column and observing the amount of time necessary to settle different size fractions of the sample. The CST were conducted in general accordance with WES-recommended procedures (USACE 1993) using a solids concentration of 150 g/L.

8.5 ASSESSMENT FOR THE POTENTIAL FOR SEDIMENT RECONTAMINATION

Based on a review of the historical land use information and existing outfalls and surface sediment samples, potential sources that may require further evaluation have been identified. Additional data from previous cleanup actions by the Port in the uplands and by EPA at the PSR sites will be gathered and evaluated. In addition, ongoing inputs from West Waterway will be evaluated:

- Obtain and review available summary reports and groundwater monitoring data for Lockheed West and PSR sites through EPA, Ecology, and the Port. Use this data to evaluate the potential for ongoing upland sources (e.g., compare groundwater contaminant concentrations with water quality criteria and evaluate the potential to impact sediment)
- Determine whether Ecology has issued determination of completion or no further action for Lockheed uplands.
- Verify the current condition and status of previous cleanup actions to assess cleanup performance and potential for sediment recontamination.
- Evaluate potential benefits and impacts of the PSR remediation on Lockheed West.

- Evaluate potential impacts of sediment transport from the West Waterway on the Lockheed West Site by evaluating the contaminant distribution patterns. No specific samples beyond the surface samples discussed above will be collected.

As part of the shoreline survey, if outfalls are located and evidence of active discharge is found, discrete bank/sediment samples will be collected and analyzed for the COIs.

Potentially significant sources identified in Section 4 will be used in conjunction with the waterway bank and adjacent surface sediment evaluations to identify the potential for ongoing upland sources to cause recontamination after the remedy is implemented. Confirmation of ongoing sources may require additional actions by EPA and Ecology or additional data collection and evaluations.

Additional data collection and evaluation requirements may be proposed if potential upland sources are found and may include the following:

- Additional source characterization data, including surface sediments, bank samples, and seep/outfall samples;
- Dispersion and dilution of the input at or near the point of discharge;
- Adsorption, flocculation, settling, sediment deposition, and sediment mixing of discharged contaminants; and
- A request that further evaluation, design, and control of potentially significant sources identified on upland properties not controlled by LMC be addressed by EPA and Ecology.

8.6 ASSESSMENT OF HABITAT DISTRIBUTION AND RESOURCE USE

The objective of this task is to provide general baseline information on habitat type, distribution, and estimated use at the Lockheed West Site to support the implementation of the selected remedy. A shoreline inventory will supplement existing shoreline and benthic habitat assessments and will define the type, distribution, and estimated use by important species of intertidal habitats. The shoreline inventory was conducted as part of the shoreline survey in August 2006 and recorded on color video from the shoreline or from a vessel as it slowly motored along the shoreline during low tide conditions. This color video will be provided in the RI Data Collection Report.

8.7 WATER QUALITY

Surface water samples were collected from representative locations as supply water for the column settling and elutriate tests. The water was collected below the water surface (i.e.,

>3 ft) but above the bottom using a peristaltic pump with weighted Teflon-lined tubing. The water for the column settling test was stored in pre-cleaned polyethylene containers. Water for chemical and elutriate testing was collected and stored in 1-liter amber glass bottles. The bottles were shipped to the lab and analyzed for the chemical parameters (elutriate tests and baseline chemical testing of surface water). Representative surface water collected and used in the elutriate testing were analyzed in duplicate for both dissolved and total contaminants of concern.

8.8 HYDROGEOLOGY

No additional geophysical or hydrogeology data are proposed for collection. If additional data requested from the Port of Seattle are not obtained or are insufficient to evaluate source control, a reevaluation of these data need may be conducted in consultation with EPA.

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Legend

- Abandoned Storm Drain
- Property Boundary
- 10 Foot Contours
- Historic Use Areas

N

0 125 250 500 Feet

Note:
1. Multibeam Bathymetry Survey conducted by TtEC on May 20, 2006 using a RESON SeaBat 8125 system. Datum: State Plane NAD 83, Projection: WA-4601 Washington North, Units: US Survey Feet

1a 1b 2a 2b 3 4 5 6

TETRA TECH EC, INC.

Lockheed West Shipyard No. 2 Seattle, WA

Figure 8-1 Site Bathymetry and Historic Use Areas

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Legend

1998 and Earlier Sampling Locations

- Surface Grab
- Subsurface Core
- PSR RI STNS Points

2003 Sampling Locations

- Surface Grab

2007 Current Sampling Locations

- Surface Grabs
- Subsurface Cores and Co-located Surface Grabs
- Intertidal Sampling Location

Upland MW Locations

- Existing Well Location
- Historical Well Location
- Property Boundary
- 10 Foot Contours
- Abandoned Storm Drain
- Pacific Sound Resources Superfund Site (approx)
- Western Waterway OU (approx)
- Historical Work Areas

N

0 125 250 500 Feet

1. 1998 and earlier sampling locations from SEDQUAL or transposed from plan sheet.
2. Multibeam Bathymetry Survey conducted by TtEC on May 20, 2006 using a RESON SeaBat 8125 system. Datum: State Plane NAD 83, Projection: WA-4601 Washington North, Units: US Survey Feet
3. Vertical Datum: Port of Seattle, MLLW= NAVD88 - 2.59
4. Approximate intertidal sampling locations considering sediment availability and seeps areas. Exact locations to be determined in the field.

TETRA TECH EC, INC.

Lockheed West Shipyard No. 2 Seattle, WA

Figure 8-2 Historical and Current Sediment Sampling Locations

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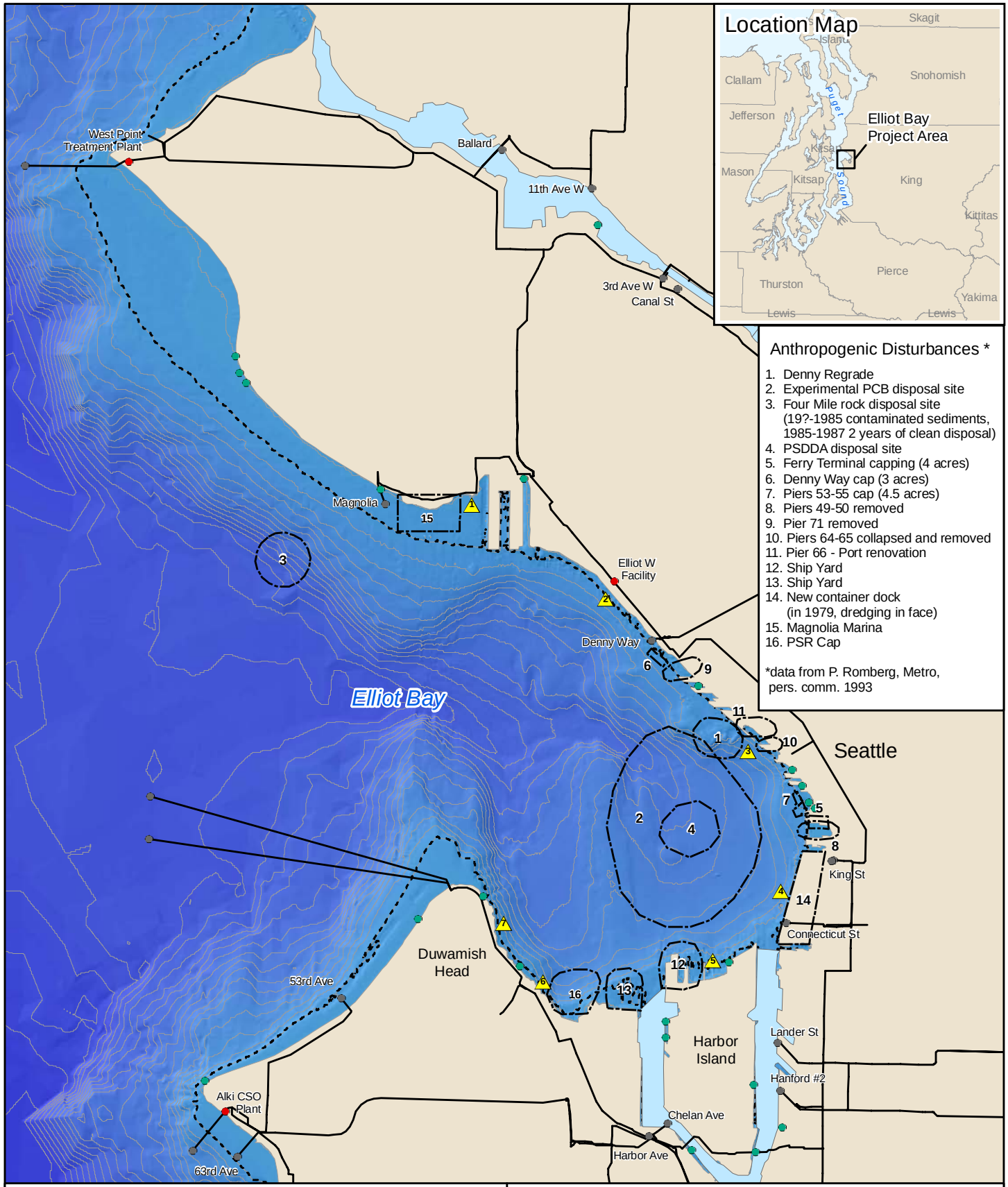

Figure 8-3
Range Finding Background Locations

TETRA TECH EC, INC.

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Table 8-1. Lockheed West Remedial Investigation Data Quality Objectives

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
Confirm existing sediment quality condition and increase data density.	Additional data are required to determine the nature and extent of contamination and evaluate risks.	Collect additional sediment quality samples in the vicinity of existing sampling locations to confirm previous results and potential changes in sediment quality that may have occurred between sampling events. Supplement existing sediment quality data by collecting additional subsurface and surface samples.	Current property boundary reflects the historical ownership and lease areas; it is not intended to imply a nature and extent boundary, additional sampling is planned beyond the former property boundaries.	Collected sediment data will be compared to human health and ecological PRGs, and background concentrations as appropriate.	To ensure proper decisions are made, samples will be analyzed using approved EPA methods and definitive quality levels. Sediment data will be screened against HHRA and ERA PRGs and background data as appropriate. Percent completeness will be evaluated for data collected in support of the work effort.	The additional sampling has been optimized based on the knowledge of the site history and previous site characterization work.

Table 8-1. Lockheed West Remedial Investigation Data Quality Objectives (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
Based on evaluation of existing data, there is uncertainty about the Sediment Stability in the project area.	Additional information is needed to determine if site sediments, in particular subsurface sediments, are stable. Determine if sediments are contaminated will they be disturbed or re-exposed due to sediment instability.	A tiered approach to evaluating sediment stability is proposed: • Compile and review existing sediment transport data for the lower Duwamish River, West Waterway and Elliott Bay; • Evaluate high resolution bathymetry for geomorphic features indicative of sediment erosion and accretion; • Collect subsurface sediment quality data; and • Perform numerical modeling (if necessary) of wind, wave, current and propeller scour conditions.	Sediment stability concerns apply to the entire Site. Samples representative of the Site will be collected.	Evaluation of stability will utilize the multiple tiers to make a stability determination. If necessary, results of the additional modeling (e.g., prop scour, wave and wind generated disturbance) will be used in combination to further evaluate the stability determination.	The collection and analysis of subsurface cores will utilize EPA-approved methods and definitive quality levels. Only valid data will be used to assess sediment stability.	The additional sampling has been optimized based on the knowledge of the site history and previous site characterization work. A registered geologist will be assessing the stratigraphy of the subsurface cores with geotechnical analyses of pertinent sample increments..

Table 8-1. Lockheed West Remedial Investigation Data Quality Objectives (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
Conditions along the Site shoreline have not been characterized and there is uncertainty about the status of current physical conditions (e.g., substrate type, slope, debris, structures, seeps, outfalls) along the shoreline at the Site.	Additional information is required to determine the current status of shoreline conditions. This data will help refine the bank sampling approach and assist in the evaluation of potential remedial actions.	Conduct a preliminary shoreline structure survey to document the location, type, and condition of existing shoreline and over water structures (scheduled for August 2006 low tide period). Conduct a topographic survey of the banks to mesh with the site bathymetry.	The boundaries of this survey will be in the intertidal area from the lowest tide mark to the top of bank along the Site.	Information gathered during the survey will help define similar bank areas for composite sampling; document the conditions of shoreline structures (e.g., bulkheads) for remedial option evaluations, and provide documentation of existing intertidal habitat conditions.	This is a preliminary qualitative survey.	The survey has been designed to gather the maximum amount of information during the low tide survey event.
Current habitat conditions along the Site shoreline have not been characterized.	Documentation of existing intertidal habitat conditions is needed to assess the impacts and benefits of future remedial actions.	Conduct a low-tide video survey of the Site to document habitat conditions for the intertidal area of the Site (scheduled for August 2006 low tide period).	The boundaries of this survey will be in the intertidal area from the lowest tide mark to the top of bank along the Site.	The low tide video survey will be used to document existing site conditions and may be used to evaluate the impacts and benefits of remedial options.	This is a qualitative survey. If additional site-specific habitat quantity and quality are determined to be needed based on this reconnaissance survey, a formal quantitative survey will be performed.	A video survey that documents current intertidal habitat conditions is adequate for the intended purposes. It will be used in conjunction with the other qualitative data collected as part of the shoreline conditions survey.

Table 8-1. Lockheed West Remedial Investigation Data Quality Objectives (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
An assessment of the potential for sediment recontamination is necessary to support the remedial design and to refine the CSM.	Documentation of upland source control is needed to determine the potential for sediment recontamination from upland sources. Determination of ongoing contaminant sources from the West Waterway/ LDW.	Review and evaluation of available groundwater and cleanup action data provided by the Port of Seattle for the site uplands and from EPA on the PSR cleanup. Review information from the West Waterway and LDW sites.	Former shipyard and PSR uplands boundaries. Inputs from West Waterway/Lower Duwamish Waterway at the project's eastern boundary.	If review of existing data shows that the sources have been controlled, then no additional data collection will be required. If ongoing sources are suspected or found, then a request that further evaluation, design, and control of potentially significant sources be addressed by EPA and Ecology	If additional groundwater or discrete outfall or sediment samples are collected, they will be analyzed by EPA approved methods and protocols.	The existing data from EPA and the Port of Seattle will be used to compare groundwater contaminant concentrations with water quality criteria and evaluate the potential to impact sediment. If existing data show no impacts then no additional data will be collected and analyzed.

Table 8-1. Lockheed West Remedial Investigation Data Quality Objectives (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
Existing baseline HHRAs and ERAs are inadequate.	Baseline HHRAs and ERAs will be used as part of the RI/FS to assist in the evaluation of potential remedial alternatives for the Site.	Complete Baseline Human Health and Ecological Risk Assessments Work Plan and determine what assumptions are to be used and to determine if site-specific data are needed. Evaluate conservativeness of literature BSAFs by conducting a clam reconnaissance survey.	Baseline risk assessments apply to the entire Site.	Sediment data from the Site will be used as inputs to the baseline RAs to calculate risks and to assist in establishing PRGs. Results of clam reconnaissance survey and sample collection in intertidal and subtidal areas will be used to develop site-specific BSAFs for comparison with literature BSAFs.	Any data collected as part of the RI that is used for the risk assessments will have been analyzed following EPA-approved methods and QC protocols, and the uncertainties associated with the data identified. All data will be validated prior to use.	The additional sampling has been optimized based on the knowledge of the site history and previous site characterization work.

Table 8-2. Sampling Locations Rationale

Work Area	Sample Number	Type	Rationale (Note: Historical sample information is described in Appendix A)
Area 1a (Future POS Terminal) Area 1b (Eastern Drydock)	1-8, 27, 29, 30 cores 28 grab	Cores to -53 MLLW	• Four cores near shore on slope to assess the combined sewer outfall and depositional area. Currently the slope at the north end of Area 1 is 2:1 (goal is 1:1.75 side cut on slopes). • All 7 cores in and adjacent to the West Waterway go to elevation -53 MLLW or 20 feet maximum for nature and extent plus port development. • Surface grab added to bound surface contamination.
Area 2a (Eastern Drydock)	9, 31 cores	Cores to -53 MLLW	• Core (9) near the 3 cores SB-1, D5, and M1 because of the inconsistencies of previous sample results. • Core (31) adjacent to West Waterway to bound spatial contamination.
Area 2b (North of Eastern Drydock)	10, 11, 32, 33, 42 cores	Cores to -53 MLLW	• Cores (10) to assess the mound north of the dry dock. • Core (11) to characterize in the middle in the deeper area just outside the property boundary to confirm the surface and depth boundary of contamination near some surface samples (no cores collected previously in this vicinity). • Three cores added to bound surface contamination along West Waterway.
Area 3 Western Former dry dock area	12, 13, 15-18 cores 40-41 grabs	Cores to -53 MLLW	• Contains SA8 and SA9 samples under former dry dock. PCBs, PAHs, and metals are issues. • Beyond the dredge cut on the north end has uncharacterized surface sediments. Cores (12 and 13) added at north end to assess surface sediment quality and vertical contamination. • Three in middle of area (15-17) to assess entire dry dock area which is likely to be dredged (and perhaps capped). • Core (18) located close to shore to assess high ground. • Two additional surface grabs are located along historical pier location; no other grabs proposed, as area is well characterized on the surface by the co-located grab/cores.

Table 8-2. Sampling Locations Rationale (continued)

Work Area	Sample Number	Type	Rationale (Note: Historical sample information is described in Appendix A)
Area 4 Former Mooring Area.	14, 19, 22, 23 cores 20, 21 grabs	Cores to -53 MLLW	• Core (14) located to assess historic pier location. • Core (19) added near shore. • Grab (20) added to confirm results from SA6 core, G8 core, and HC-03-06 surface sample area with metals and PCBs on surface. • Core (22) located in deeper hole near G9 surface sample, cores HC-03-17 and 30-1-197 to assess vertical and spatial contamination. • Core (23) added to assess spatial and vertical extent. • Grab (21) on west end to assess surface sediment. • No additional cores are proposed near SA5 since there were no exceedances.
Area 5 (Shipway)	24-26 cores	Cores to -53 MLLW	• Shipway area containing SA3 and SA2 (SA2 is not bound vertically). • Core (24) located to determine spatial and vertical boundary of PAH and SVOC. • Core (25) needed in between pier and mass of pilings in SW corner of Site. • Core (26) added to assess vertical contamination at SA3 in former mooring area.
Area 6 (North boundary)	34,35, 37, 39cores, 36, 38 grabs	Cores to -53 MLLW; surface grabs	• No exceedances found at depth. Cores to assess vertical contamination. • Two surface samples added to bound spatial contamination at surface.
Intertidal	9 surface grabs: IT-1 through IT-9	grabs	• Assess intertidal area between MLLW and Ordinary High Water Mark.

Table 8-3. Sampling Locations and Analyses Summary

Location	Type	Easting[1/]	Northing[1/]	Mudline Elevation (MLLW)	Sample Depth (feet)[2/]	Target Elevation (MLLW)	Conventionals[3/]	metals	SVOC	PCB	Pesticides	TBT bulk	Archive for PCB/Dioxin	Porewater[4/]	Geotechnical[5/]	Contaminant Mobility[6/]	PSDDA Cores
1	Core and Grab	1263235.3	216012.3	-8.3	16	-24.3	x	x	x	x	x	x	x		x		1
2	Core and Grab	1263355.3	216056.9	-40.4	12.6	-53.0	x	x	x	x	x	x	x				1
3	Core and Grab	1263351.9	216274.6	-24.8	28.2	-53.0	x	x	x	x	x	x	x	x	x		1
4	Core and Grab	1263249.0	216267.8	0.0	20	-20.0	x	x	x	x	x	x	x		x		1
27	Core and Grab	1263334.8	216515.7	-14.9	38.1	-53.0	x						x		x		1
28	Grab	1263421.0	215964.3	-51.9	10 cm grab	--	x	x	x	x	x	x	x				
29	Core and Grab	1263446.7	216397.7	-41.4	11.6	-53.0	x	x	x	x	x	x	x		x		
5	Core and Grab	1263211.3	216573.8	-3.3	6.1	-9.4	x	x	x	x	x	x	x		x		1
6	Core and Grab	1263339.9	216644.1	-41.5	11.5	-53.0	x	x	x	x	x	x	x		x	1	
7	Core and Grab	1263202.7	216848.1	-6.4	5	NA	x	x	x	x	x	x	x				
8	Core and Grab	1263398.2	216875.6	-40.1	12.9	-53.0	x	x	x	x	x	x	x		x	1	
30	Core and Grab	1263479.5	216815.7	-51.4	1.6	-53.0	x	x	x	x	x	x	x				
9	Core and Grab	1263319.7	217126.0	-41.1	11.9	-53.0	x	x	x	x	x	x	x	x	x	1	
31	Core and Grab	1263489.1	217144.2	-50.4	2.6	-53.0	x	x	x	x	x	x	x		x		
10	Core and Grab	1263358.7	217312.7	-28.7	24.3	-53.0	x	x	x	x	x	x	x		x	1	
11	Core and Grab	1263355.3	217629.9	-40.0	13.0	-53.0	x	x	x	x	x	x	x			1	
42	Core and Grab	1263524.1	217658.5	-49.9	3.1	-53.0	x	x	x	x	x	x	x	x			
32	Core and Grab	1263476.2	217485.2	-42.2	10.8	-53.0	x	x	x	x	x	x	x				
33	Core and Grab	1263473.0	217836.1	-46.7	6.3	-53.0	x	x	x	x	x	x	x				
12	Core and Grab	1263045.0	217804.8	-41.9	11.1	-53.0	x	x	x	x	x	x	x			1	
13	Core and Grab	1263226.7	217789.3	-45.2	7.8	-53.0	x	x	x	x	x	x	x	x		1	
15	Core and Grab	1263190.7	217485.9	-45.3	7.7	-53.0	x	x	x	x	x	x	x	x	x	1	
16	Core and Grab	1262974.0	217215.4	-35.7	17.3	-53.0	x	x	x	x	x	x	x			1	
17	Core and Grab	1263173.6	217124.1	-43.8	9.2	-53.0	x	x	x	x	x	x	x		x	1	
18	Core and Grab	1263065.6	216957.8	-17.7	10	NA	x	x	x	x	x	x	x				
40	Grab	1263275.8	217499.2	-29.2	10 cm grab	--	x	x	x	x	x	x	x				
41	Grab	1263254.0	217086.8	-31.8	10 cm grab	--	x	x	x	x	x	x	x				
14	Core and Grab	1262951.6	217517.9	-25.0	28.0	-53.0	x	x	x	x	x	x	x				
19	Core and Grab	1262835.8	216971.6	-17.1	10	NA	x	x	x	x	x	x	x				
20	Grab	1262787.8	217299.0	-27.3	10 cm grab	--	x	x	x	x	x	x	x	x			
21	Grab	1262535.8	217309.3	-33.6	10 cm grab	--	x	x	x	x	x	x	x				
22	Core and Grab	1262909.5	217693.3	-42.2	10.8	-53.0	x	x	x	x	x	x	x				
23	Core and Grab	1262647.2	217737.9	-45.4	7.6	-53.0	x	x	x	x	x	x	x				
24	Core and Grab	1262314.6	217455.0	-26.3	10	NA	x	x	x	x	x	x	x				
25	Core and Grab	1262285.5	217268.2	-25.9	10	NA	x	x	x	x	x	x	x	x			
26	Core and Grab	1262410.5	217033.0	-28.7	10	NA	x	x	x	x	x	x	x				

Table 8-3. Sampling Locations and Analyses Summary (continued)

Location	Type	Easting[1/]	Northing[1/]	Mudline Elevation (MLLW)	Sample Depth (feet)[2/]	Target Elevation (MLLW)	Conventionals[3/]	metals	SVOC	PCB	Pesticides	TBT bulk	Archive for PCB/Dioxin	Porewater[4/]	Geotechnical[5/]	Contaminant Mobility[6/]	PSDDA Cores
34	Core and Grab	1263466.5	218102.6	-51.1	1.9	-53.0	x	x	x	x	x	x	x				
35	Core and Grab	1263141.5	218021.3	-47.7	5.3	-53.0	x	x	x	x	x	x	x				
36	Grab	1262978.6	218051.8	-53.9	10 cm grab	--	x	x	x	x	x	x	x				
37	Core and Grab	1262771.1	217930.3	-39.4	13.6	-53.0	x	x	x	x	x	x	x				
38	Grab	1262637.1	217984.6	-66.9	10 cm grab	--	x	x	x	x	x	x	x				
39	Core and Grab	1262481.9	217819.9	-43.6	9.4	-53.0	x	x	x	x	x	x	x				
IT-1	Intertidal Grab[7/]	1263183.4	216096.7	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-2	Intertidal Grab[7/]	1263188.2	216179.1	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-3	Intertidal Grab[7/]	1263242.0	216345.1	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-4	Intertidal Grab[7/]	1263166.8	216686.4	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-5	Intertidal Grab[7/]	1262714.3	216934.3	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-6	Intertidal Grab[7/]	1262330.4	216973.0	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-7	Intertidal Grab[7/]	1262269.1	217020.6	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-8	Intertidal Grab[7/]	1262188.8	217026.5	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-9	Intertidal Grab[7/]	1262149.9	217106.8	NA	10 cm grab	--	x	x	x	x	x	x	x				

[1/] Target locations actual location will be determined in the field.
[2/] Most cores will be pushed to approximately -53 MLLW or to a maximum of 20 feet. Cores along POS Terminal slope will be pushed to slope cut. Cores located in probable cap area will be pushed to 10 ft.
[3/] Conventional analysis includes total solids, grain size, and TOC.
[4/] Analysis of porewater will be conducted on the surface grab sample.
[5/] Atterberg Limits will be analyzed on samples within the potential dredge prism and should primarily consist of clays, therefore to be determined in the field. Specific gravity will be analyzed on each stratigraphy layer of cores located within the dredge prism.
[6/] Contaminant mobility samples will be a composite sample of core increments located within the dredge prism as well as a surface water sample.
[7/] Intertidal Bank Samples (IT-1 though IT-9) will be collected during a daylight low tide in the second phase of field work.

9. DATA MANAGEMENT

A project database will be established that incorporates both historical data and the data resulting from the remedial investigation sampling. The project database will allow efficient management of chemical, biological, and physical data received from the laboratories and will provide electronic data submittals in accordance with the EPA's instructions for formatting digital data (EPA 1993a) and in a format compatible with software currently available within EPA Region 10 (Microsoft® Access format). Electronic data submittals will also allow for entry into Ecology SEDQUAL (or next generation of Ecology database).

The data management system will be used for both past and future data and shall be integrated with knowledge of historical land uses. The data management system will be able to handle physical as well as chemical data so that it will be useful for Remedial Design and Remedial Action work as well as for the RI/FS. The database software for data management will be compatible with Geographic Information System (GIS) software. This GIS compatibility will allow the preparation of a Site base map that includes topographic information, physical features of and near the Site, and the location of all well, sediment, and water samples, both vertically and horizontally.

- Data file structures will be developed to provide the flexibility to meet known and predicted data analysis goals. Data structures will be designed using database normalization techniques to minimize the number and size of files, while considering effective methods of data manipulation for the requirements of data analysis and summarization. Typical files will include the following:
  - Location file identifying where samples were collected, including location identifier numbers;
  - Sample file describing when and what samples were collected, including sample depth and sample collection method;
  - Analytical chemistry results, including concentrations, units of measure, and qualifiers; and
  - Biological test results with identification of test organisms and test conditions.
- A library of routines will be used to translate typical electronic output from laboratory analytical systems and generate data analysis reports. The use of automated routines ensures that all data are consistently converted into the desired data structures and operator time is kept to a minimum. In addition, routines and

methods for quality checks will be used to ensure such translations are correctly applied. Final electronic files will be made available in an agreed upon format.

- Written documentation will be used to clarify how field and laboratory duplicates and QA/QC samples were recorded in the data tables, as well as provide explanations of other issues that may arise. The procedures for data reduction (e.g., handling of duplicate and replicate samples, selection of best results when multiple results exist, approaches to significant figures and rounding, calculating totals for PCBs, PAHs, pesticides) are detailed in the QAPP (Appendix D). The data management task will include keeping accurate records of field and laboratory QA/QC samples so that study team members who use the data will have appropriate documentation. In addition to placing all data and identifiers into an electronic database, hard copies of all original analytical data or study records will be placed into a filing system. Each analytical data set or document will be given a unique code and filed based on that code. A master list of all filed documents will be maintained for easy retrieval.

10. FIELD DATA COLLECTION AND DATA REPORTING

Once the Work Plan documents are approved by EPA, the field investigations identified above in Section 8 will be implemented in accordance with the schedule set forth in Section III of the SOW. After implementation of the EPA-approved field investigation, LMC will submit to EPA a draft and final Data Report for EPA review and approval that presents the results of sampling and analysis activities completed under the SAP. The data report will include:

- A summary of field activities and methods, including a discussion of any discrepancies with the sampling and analysis plan and the effect of such changes upon data usability.
- Data quality assurance/quality control review including how analytical results met specified reporting limits and rules for data reduction and use,
- Tabulated chemical, physical, and biological data,
- A sample identification matrix that relates sample identification numbers to sample locations,
- Maps showing actual sample locations,
- Field logs, and
- Laboratory data sheets.

If requested by EPA, LMC will also make available any additional records generated to support data collection, such as chain-of-custody forms. The Data Collection Report will also include a discussion of data validation conducted in accordance with the EPA-approved QAPP and, if any, QAPP addenda. Once the data have been through the data validation and quality reviews, the quality-assured chemical and biological data will be submitted in an electronic format consistent with the data management plan. In the event multiple data collection events are warranted, results of subsequent sampling and analysis will be presented as addenda to the Data Collection Report or other acceptable format.

11. BASELINE RISK ASSESSMENT PLAN FOR LOCKHEED WEST

Baseline risk assessments (RAs) for the Lockheed West Site will be performed as per Section II, Subtask 1.8 of the Statement of Work (SOW), Appendix A to the Administrative Settlement Agreement and Order on Consent (ASAOC) for the Lockheed West Site. The baseline risk assessments will be performed as streamlined risk assessments, as explained more fully below. This section of the work plan provides the purpose and scope of the streamlined human health risk assessment (HHRA) and streamlined ecological risk assessment (ERA), and presents the technical approach to performing the streamlined RAs that is consistent with the SOW and EPA guidance for performing RAs under CERCLA.

11.1 PURPOSE OF THE STREAMLINED RISK ASSESSMENT

Consistent with the EPA (1991) OSWER Directive 9355.0-30, the overall purposes of the streamlined baseline RAs for the Lockheed West Site are to identify potential human health and ecological risks at the Site, to identify chemicals of concern (COCs), to support remedy selection, and to provide information for selecting risk-based cleanup levels and remediation monitoring criteria. LMC is committed to active remediation of the entire Lockheed West site. At the minimum, remediation plans consist of placing a cap over all contaminated sediments at the Site. Because of the decision to actively remediate the entire Site, the RI/FS work plan does not include an evaluation of the no-action alternative, nor does it include evaluations of any natural recovery alternatives; instead, the plan calls for active remediation of the entire Site to mitigate all assumed human health and ecological risks. Although the placement of a cap will eliminate all exposures of humans and ecological receptors to the sediment contaminants, the presence of Site contamination requires performance of a baseline risk assessment to indicate the potential extent of risk under present site conditions, to support the remedy selection for the sediments that will mitigate the risk, and to assist in interpreting the significance of post remediation monitoring results.

The plan to actively remediate the entire site minimizes the need to calculate site-specific risks at a level of specificity to demonstrate acceptability of the no-action alternative or natural recovery of sediments. The RAs do need to support the decision to remediate the site. Based on preliminary screening-level risk estimates, highly site-specific RAs are expected to demonstrate unacceptable risks to human health and possibly ecological receptors at the Lockheed West Site. The overall approach that will satisfy the risk assessment goals for the Lockheed West Site will not be based on site-specific exposure

parameters, although the RAs will use sediment data collected from the site. Instead, the approaches to estimating risks to human health and ecological receptors from exposures to chemicals in Site sediments will each follow a streamlined process. The streamlined RAs will evaluate potential risk by structuring the assessments to use technical information from the risk assessments performed at the nearby LDW site. In addition to performing baseline risk assessments, sediment cleanup levels need to be identified for the Site in order to select criteria for evaluating the performance of the remedy selection. Section 6 in this work plan identifies preliminary cleanup levels and remediation monitoring criteria consistent with the streamlined approach to the RI and the RAs.

The overall approach to the streamlined RAs is considered to be appropriate for the potential human populations, ecological receptors, potential future exposure conditions, and planned remediation at the Site. In particular, the human health risk assessment will be protective of tribal consumers of seafood, who have treaty rights for seafood collection from the Site, and of children who may play in the intertidal sediment. Similarly, the ecological risk assessment will be protective of ecological receptors, including aquatic organisms and shoreline birds that may use the Site.

11.2 SCOPE

The scope of the RAs will consist of full baseline risk assessments, following USEPA guidance for Superfund sites, described more fully below. Because the exposure scenarios, parameters, ecological receptors, and toxicity data will borrow extensively from the nearby LDW site, the RAs are considered to be streamlined, rather than site-specific. The basic premise for the streamlined approach to the RAs can be summarized as the following:

- The entire sediment Site will be actively remediated, with the result that there will be no surface sediments remaining at present levels of contamination. After remediation, in the absence of contamination of surficial sediments and any associated exposures or risks, there will be no monitoring of natural recovery or changes in baseline risks, although remediation performance will be monitored.
- Risks will be estimated using exposure assumptions developed for the LDW site. In other words, the risk estimates for the Lockheed West Site will not be based on site-specific exposure assumptions, but on exposures assumed for the nearby LDW site. The applicability of the LDW site exposure assumptions and associated exposure parameters to the Lockheed West Site is not evaluated. However, the activities that describe the exposure scenarios are assumed to reflect future potential uses of the Site. Thus, although the Lockheed West Site is substantially smaller than the LDW

site, the methodology for assessment of risks will be the same and subsequent risk-based cleanup levels will be consistent with the larger region of the LDW.

- Furthermore, EPA notes that "The Lockheed West site is one of many cleanup sites within the Duwamish and Elliott Bay and that these sites must be considered holistically in addressing contamination in the system as a whole. Dividing a larger contaminated area into small cleanup sites and then declaring that exposure assumptions suitable for the larger contaminated area are not applicable to small cleanup sites is not appropriate."
- Baseline risks will be estimated for human and ecological receptors at the Site using surface sediment data collected in 2007.
- The risk assessments will focus on the same human populations and ecological receptors that were identified as the risk driver scenarios for the LDW site. The risk assessments will use the same exposure parameter values as the LDW site, and will focus on reasonable maximum exposure (RME) scenarios.

An important consideration under this streamlined approach is that no assumptions are made that the exposure parameter values in the LDW risk assessments are directly applicable to the Lockheed West site, and no site-specific exposure parameters are developed. Only exposure concentration data for sediment will be site-specific. Use of the LDW exposure scenarios and all inherent assumptions and exposure parameters for the Lockheed West site is not considered to reflect all site-specific exposures, particularly with the smaller size of the exposure area, limited access to the Site, and limited available ecological habitat under present conditions. Instead, use of LDW exposure scenarios and assumptions is intended to help ensure consistency in site cleanup approaches between the Lockheed West and LDW sites. As described more fully below, although the LDW site has a stronger freshwater component than the Lockheed West site, though both are considered estuarine sites, the LDW site was evaluated using marine species typical of Puget Sound bays. Thus, although the Lockheed West site environment may be more marine due to the presence of Elliott Bay on the north side, the LDW risk assessments evaluated the same marine species that would be present at the Lockheed West site as food sources for humans and as ecological receptors of concern.

Brief summaries of previous RAs that have been performed on sites in the general area of Lockheed West are presented in Appendix A of this work plan. In particular, the RAs for the LDW site are summarized therein. Local information was considered useful for planning the RAs for the Lockheed West Site because of the similarity in environmental locations, physical characteristics, and biological habitats. However, in reviewing these

other site RAs, note that a number of policy/regulatory initiatives have occurred since the first RA conducted in the area in 1991; these changes focus the RA approaches to the Lockheed West Site relative to those that have been employed in the past. The key initiatives that are of relevance to the Lockheed West Site are as follows:

- For Elliott Bay and the Lower Duwamish Waterway, the Washington Department of Ecology has replaced the default seafood consumption rate and source fraction terms (effective consumption rate 27 grams per day) used in the Model Toxics Control Act with a consumption rate that accounts for the fraction of site affected seafood. That consumption rate is 57 grams per day. http://www.ecy.wa.gov/programs/tcp/SAB/SAB_mtg_info/mtg_060915/02%20RecapAPIFishConsumptionRateDiscussions.pdf
- EPA Region 10 has developed a policy document, "The Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia, August, 2007" that delineates EPA's position on Tribal seafood consumption risk assessment in Puget Sound. The Framework specifies consultation with affected tribes. In consultation with the Suquamish and Muckelshoot Tribes, EPA will determine the best approach for applying the Framework at the Lockheed West site.
- The Lower Duwamish Waterway HHRA has been the most comprehensive and recent effort to assess seafood consumption risks in the Puget Sound area. Consequently, approaches taken in the LDW HHRA document form the starting point for risk assessment considerations at the Lockheed West site.

These recent initiatives establish a framework for the present HHRA in particular, that supersedes the previous approaches to risk assessments in the area.

11.3 BASELINE HUMAN HEALTH RISK ASSESSMENT PLAN

The following presents the plan for the baseline human health risk assessment for the Lockheed West site. The components of the plan include Hazard Identification, Exposure Assessment, Toxicity Assessment, and Risk Characterization (EPA 1989a). The plan for the ecological risk assessment follows this section.

11.3.1 Hazard Identification

For the Lockheed West site, the Hazard Identification step will identify chemicals of potential concern (COPCs) by screening sediment data collected for the RI against

appropriate human health-based screening criteria. COPCs for the HHRA will be identified for each exposure scenario.

11.3.1.1 Chemical Data

The list of chemicals analyzed in sediment is presented earlier in this work plan and serves as the starting point for selecting COPCs. The chemical analyte list for the 2007 sampling event was compiled from existing data and chemicals that were suspected to be present in Lockheed West sediments. For example, hydrophobic organic chemicals, such as organochlorine pesticides, that have been detected in LDW sediments upstream of the Lockheed West site are included in the list of chemical analytes for sediments at the Lockheed West site. Their inclusion is based on the assumption that they could transport downstream as particle-bound constituents that may deposit on Lockheed West site. The methods for data collection and analysis of surficial sediments at the Lockheed West site were generally consistent with reporting limits that best met risk-based analytical concentration goals (RBACGs). This is shown by comparison of the method detection limits for the COIs with RBACGs, as described below and as listed in Table 11-1, presented at the end of this chapter.

Surface sediment chemistry data that will be used in the risk assessments were collected from the top 10 centimeters of the subtidal and intertidal sediment of the site. This depth in the sediment has been identified in the State of Washington as the biological productive zone in Puget Sound sediment, and as such, serves as the standard sampling depth for investigations in Puget Sound. The protectiveness of the 10-cm depth will be briefly discussed in the risk assessment.

For sediments, RBACGs are concentrations of chemicals in sediment that are associated with an acceptable risk level as derived from state standards, the toxicity literature, or human health guidance documents. Sediment RBACGs were taken from the LDW site, which are considered protective of humans and ecological receptors exposed to chemicals via direct contact or incidental ingestion of sediment, and for ingestion of fish and shellfish by humans and by ecological receptors as prey (Windward 2005a). In the development of RBACGs for the LDW site, sediment risk-based concentrations (RBCs) were first identified or derived for the protection of benthic invertebrates, spotted sandpipers, and humans. RBCs for the protection of human health were derived for both direct and indirect (i.e., seafood consumption) exposure pathways. For non-bioaccumulative chemicals, RBCs were calculated for direct exposure pathways. For bioaccumulative chemicals (EPA 2000), RBCs were calculated for the seafood consumption pathway. Sediment RBCs for the seafood consumption pathway were based on modeling acceptable levels from clam tissue

to sediment based on biota-sediment accumulation factor (BSAF) relationships. In other words, acceptable levels in clams were first determined, as based on the tribal consumption rate for clams and other tribal exposure parameters, then those concentrations were used with BSAFs to model acceptable levels in sediment. (The derivation and use of the RBACGs are further discussed below in the identification of screening criteria and exposure estimates for both human health and ecological receptors below and in the following section on the ERA work plan.) The RBACGs for sediment in the LDW were then set equal to the lowest RBC for each chemical. The RBACGs developed for the LDW site but adjusted as described below were used for setting analytical detection goals for the Lockheed West site sediment.

11.3.1.2 Screening Steps

The following steps will constitute the COPC screening process for human health exposures for the Lockheed West site, using the 2007 sediment data:

1. For chemicals that are always undetected, if detection limits are below RBACGs, they will be screened out from further evaluation. Undetected chemicals with detection limits exceeding RBACGs will be noted through the evaluation.
2. Frequency of Detection – Chemicals that are detected in less than 5 percent of sediment samples will be screened out from further evaluation. An infrequently detected contaminant will be rejected if is not found in other environmental media, if there is no reason to believe that the contaminant should be found, and if there is not a unique site feature that may explain the presence of the contaminant. Note that the full sediment data set collected in 2007 contains 51 stations, so only those chemicals detected in only one or two stations would be rejected as below the frequency of detection criterion. No chemicals will be rejected on the basis of frequency of detection for the intertidal data set, since nine sediment station samples comprise the data set.
3. Comparing detected chemicals against background – Chemical concentrations will be compared with available background concentrations for metals. For the purpose of comparison, background will be defined as the concentrations identified in the LDW risk assessments. EPA (2002c) also describes evaluation of background in soils, and the procedure is to compare the site data distribution with the background data distribution. If appropriate background concentrations of chemicals detected at Lockheed West sediments are unavailable, as determined in consultation with EPA, this comparison step will not be performed. No COIs will be eliminated from further evaluation based on a comparison with background.

4. Screening against risk-based screening criteria – Sediment chemicals that pass the above steps will be screened against risk-based screening criteria that are based on acceptable risk levels from direct and indirect contact with sediment. The criteria will be concentrations associated with acceptable risks for human exposures. Maximum concentrations in the surface sediment samples will be screened against the screening criteria, and concentrations above the criteria will be identified as COPCs. Identification of the screening criteria for human exposures is presented below.

Chemicals with the maximum sediment concentrations exceeding risk-based screening criteria will be identified as COPCs. Results of the comparison of sediment chemistry data with the risk-based screening criteria and the identification of COPCs will be presented in tabular format, with sediment concentrations identified as above or below the screening criteria. The presentation will include the rationale for each COPC selection. The primary risk drivers will also be identified, based on the level of exceedance of criteria and possibly other considerations, such as level of certainty in the analytical data or screening criteria, consistent with the approach used in the HHRA for the LDW site. A contaminant may still be a risk driver even if it contributes a small fraction of overall risk yet is associated with high absolute risk.

11.3.1.3 Risk-Based Screening Criteria

Risk-based screening criteria for application to sediment have not been developed by EPA, so each of the sediment exposures will be evaluated with alternative criteria: for the direct sediment contact, surrogate criteria that are considered by EPA to be sufficiently conservative for application to sediment exposures will be used, and consist of soil criteria and sediment thresholds, as developed for the LDW site; for seafood consumption exposures, screening values from the HHRA for the LDW site that have been developed specifically for application to sediment for the protection of consumers of seafood (Windward 2007a) will be used. The sources and development of each of the screening criteria for each exposure pathway are described below.

EPA Screening Criteria for Direct Sediment Exposures

Screening criteria specific to sediment exposures of people have not been developed by EPA; surrogate values will be used instead. EPA has developed risk-based concentrations for the incidental ingestion and dermal contact of soils, and these values were used as COPC screening criteria in the HHRA for the LDW site (Windward 2007a). Soil RBCs are available for both residential and industrial exposure pathways. The source of the RBCs for

soil that were used in the HHRA for the LDW site was the Region 9 PRGs for residential and industrial soil. The Region 9 values were considered at the time to be appropriately conservative for the screening process; e.g., Washington State Model Toxics Control Act (MTCA) residential soil RBCs are higher (i.e., less protective) than the Region 9 values because of different exposure parameter assumptions.

Subsequent to the release of that HHRA, EPA has requested that Region 6 screening levels be used in the screening for COPCs instead of Region 9 PRGs. Region 6 screening levels are intended to be protective of humans exposed to residential soils ("Residential Soils") and to soils during outside work ("Industrial Worker Outdoor"). The equations that are used by Region 6 to calculate the screening levels incorporate the cumulative exposures to soil via ingestion, dermal contact, and inhalation of soil particles.

Residential soil screening levels from EPA Region 6 will be used to screen the beach play and clamming exposures, and the industrial outdoor screening levels from Region 6 will be used to screen the netfishing exposures. Region 6 screening levels for noncarcinogenic toxicity endpoints will be decreased by a factor of 10 to account for the target hazard quotients (HQs) of 0.1 used in screening by EPA Region 10. This approach is consistent with the draft LDW HHRA, with the switch from Region 9 to Region 6 values as recommended in EPA comments on the LDW HHRA. Updated Region 6 screening values for direct exposures to residential soil are included as direct exposure criteria in Table 11-2, with criteria for non-carcinogenic effects modified by a factor of 0.1.

Sediment Criteria for Protection of Seafood Consumption

Screening criteria that are applicable to sediments for the protection of seafood consumption have not been developed by EPA. This pathway of exposure to sediment chemicals is also termed the indirect sediment exposure pathway, since the exposure is not directly to sediments but through the consumption of seafood that has taken up chemicals from sediment. Screening criteria for the indirect sediment exposure pathway were developed as risk-based analytical concentrations goals (RBACGs) for the LDW site in the QAPP for the sediment data collection (Windward 2005a). These criteria will be applied to sediment at the Lockheed West site for the protection of seafood consumption.

The development of the screening criteria for indirect exposure at the LDW site was based on the relationship between chemical concentrations in sediment and those in seafood tissue. The RBACGs were developed from acceptable risk thresholds for seafood consumption, corresponding concentrations of chemicals in the seafood tissue, and the application of BSAF to the tissue concentrations to identify the associated risk-based

sediment concentrations. BSAFs describe the relationship between sediment and tissue as the following:

$$BSAF = \frac{C_{WB} \div F_L}{C_{sed} \div F_{oc}} \qquad \textbf{Equation 1}$$

where:

C_{WB} = chemical concentration in whole-body tissue (mg/kg ww)
C_{sed} = chemical concentration in sediment (mg/kg dw)
F_L = fraction lipid in tissue (kg lipid/kg ww)
F_{oc} = fraction organic carbon in sediment (kg OC/kg dw)

Equation 1 can be rearranged to solve for C_{sed} as follows:

$$C_{sed} = \frac{(C_{WB} \div F_L) \times F_{oc}}{BSAF} \qquad \textbf{Equation 2}$$

The BSAF equation is based on the assumption that the concentration of chemical in sediment (C_{sed}) represents the average chemical concentration in sediment to which the organism is exposed. For animals with very small home ranges, such as clams, this assumption may be reasonable if sediment data are collected concurrently with tissue data at the tissue collection locations. For animals with larger home ranges, such as fish, there is greater uncertainty in this assumption because many fish are highly mobile and are not likely to inhabit all areas of their home range with equal frequency. Consequently, fish BSAFs for a given chemical easily range over at least an order of magnitude (USACE 2003). Given this large uncertainty, BSAFs for clams rather fish were used in the LDW QAPP to derive the sediment screening criteria for seafood consumption. The values for the tissue concentrations in clams (C_{WB}) that were used to derive the sediment criteria (i.e., C_{sed}) were the acceptable risk-based concentrations (i.e., RBACGs) calculated for clam tissue in the benthic invertebrate sampling QAPP for the LDW site (Windward 2004a).

In order to be health protective for this screen, the sediment RBACGs for seafood consumption were calculated in Windward (2005a) with the assumption that all of the seafood consumed is made up of clams, but rather than use a clam consumption rate, the consumption rate for total seafood consumed from Puget Sound was used at 98 g/day. This value includes consumption rates for all tribal seafood categories except salmon, as described below. In other words, the RBACGs calculated for clam tissue were based on the assumption that clams were consumed at the tribal seafood consumption rate of 98 g/day. These clam tissue RBACGs were then used as the values for C_{WB} in Equation 2 to derive C_{sed} as the sediment RBACG for seafood consumption. Assigning the full seafood consumption rate to clams to derive C_{WB} and then using the clam BSAFs in deriving the

RBCAGs was designed to be sufficiently protective of exposures through consumption of combined fish, crabs, and clams as total seafood exposures.

The tribal consumption rate of 98 g/day was developed in the Framework (EPA 2006a) using the following process:

1. The consumption rates of Puget Sound harvested seafood (pelagic fish, benthic/demersal fish, and shellfish) by surveyed Tulalip Tribal members were determined (Toy et al. 1996).
2. These rates were rank ordered and used to determine a 95th percentile consumption rate of 194 g/day.
3. The total rate was allocated to individual market basket fractions by the following calculation:

   Market basket rate = total rate x avg. rate for a market basket fraction ÷ sum of all avg. market basket rates.

Using this process, salmon comprised 96.5 g/day of the total consumption rate. EPA (2006a) decided that salmon did not accumulate a significant site-related contaminant body burden from the LDW. Consequently, the "effective" consumption rate was 194 g/day – 96.5 g/day = 97.5 g/day consumption of species with a site related contaminant body burden. The 95th percentile values are provided in Table 2 of EPA (2005), as taken from Appendix B of the revised Framework document (EPA 2006a).

Because this approach to developing screening criteria was approved by USEPA Region 10 for the LDW human health risk assessment, the screening values from the LDW reports will be used as screening criteria for the Lockheed West site risk assessment. Given that the purpose of the risk assessment is to establish that risks are sufficient to require cleanup and that the entire Site is to be remediated, USEPA Region 10 has recommended that this is a quick and protective approach to assess bioaccumulation. The RBACGs used in the screening are those calculated from BSAFs at the 90th percentiles. Though bivalve BSAFs might be lower than organisms higher on the food chain with greater lipid content, bivalves comprise the majority of seafood consumption in tribal studies. Note that the RBACGs and BSAFs that they are derived from are used only for this screening step to select COPCs. The modeling of tissue concentrations of COPCs for estimating exposures and risks will use updated BSAF values that are more specific to the type of tissue being evaluated. In other words, fish BSAFs will be used for estimating fish tissue concentrations, crab BSAFs will be used for crab tissue concentration, and clam BSAFs will be used for clam tissue concentrations (see Section 11.3.2.4).

The BSAFs used to calculate the seafood-based screening criteria for sediment (i.e., C_{sed} in Equation 2) for the LDW site were taken from four sources:

- US Army Corps of Engineers Environmental Residue-Effects Database (ERED) - http://www.wes.army.mil/el/ered/
- Tracey GA, Hansen DJ. 1996. Use of biota-sediment accumulation factors to assess similarity of nonionic organic chemical exposure to benthically-coupled organisms of differing trophic mode. Arch Environ Contam Toxicol 30:467-475.
- EPA. 1997d. The incidence and severity of sediment contamination in surface waters of the United States. Volume 1: National Sediment Quality Survey. EPA 823-R-97-006. US Environmental Protection Agency, Office of Science and Technology, Washington, DC.
- Washington State Department of Health. 1995. Tier I report, development of sediment quality criteria for the protection of human health. Washington State Department of Health, Olympia, Washington.

Although BSAFs for bivalve mollusks are most appropriate for this screening criteria calculation, some fish BSAFs were used in Windward (2005a) when bivalve BSAFs were not available. The calculated sediment screening values for protection of seafood consumption from Windward (2005a) are included as indirect sediment criteria in Table 11-2.

Note that this procedure differs from the screening procedure used for the risk assessments at the LDW site. At that site, screening was performed using tissue data and appropriate tissue-based screening criteria. The use of sediment RBACGs for screening based on exposure to tissue (i.e., consumption of seafood) is a more conservative approach because of the use of conservative BSAF values in the screening criteria development. The screening process using the more conservative RBACG approach is expected to result in substantially more COPCs for tissue exposures than were identified for the LDW risk assessments.

11.3.1.4 Tissue Screening Criteria for Seafood Consumption

A reconnaissance survey for the presence of clams is presently planned for the Lockheed West site. If clams are determined to be present in sufficient abundance, a SAP for clam tissue collection and analysis will be developed and implemented. However, data will not be available for use in screening chemicals in clams for seafood consumption. Clam tissue data will be collected in parallel with performance of the risk assessment, for use in determining that the BSAFs used in the development of the screening criteria for seafood

consumption are sufficiently conservative. The tissue data will be used with co-located sediment chemistry data to calculate site-specific BSAFs, which will be compared with the values used to develop sediment RBCs for seafood consumption.

If necessary for screening purposes, the available clam tissue data will be screened against the RBACG values developed in the LDW QAPP for analyzing tissue samples (Windward 2004b). The RBACGs for tissue are based on EPA Region 3 risk-based concentrations (RBCs) (EPA 2007a), as adjusted for application to the LDW site to account for tribal exposures (Windward 2007a). Adjustments were made to the RBCs for the LDW site to incorporate Region 10 recommendation of a target HQ of 0.1 to account for cumulative effects from multiple chemicals and pathways, and to account for site-specific tribal exposure assumption differences, as per the EPA Region 10 Framework (EPA 2006).

The adjustments to the exposure parameters used to calculate the Region 3-based RBCs in Windward (2007a) accounted for the tribal seafood consumption rate, exposure frequency, body weight, and exposure duration identified in the EPA Framework (EPA 2005, 2006). The following modifications were made to the Region 3 RBCs; additional details for the modifications can be found in the HHRA for the LDW site (Windward 2007a):

- Consumption rate – 98 g/day, modified from 54 g/day, as described above.
- Exposure frequency – 365 days/yr, modified from 350 days/yr
- Body weight – 81.8 kg modified from 70 kg, as per EPA (2005)
- Exposure duration – 70 years, modified from 30 years, as per EPA (2005).

The results of these modifications were to adjust the Region 3 RBCs for carcinogenic effects by a factor of 0.26, and the RBCs for non-carcinogenic effects by 0.64. These modifications result in more conservative RBCs for the tissue screening criteria than the unmodified Region 3 RBCs.

11.3.2 Exposure Assessment

The Exposure Assessment consists of a description of the exposure scenarios, human receptor populations, pathways of exposure, and exposure parameters to characterize and quantify exposures.

11.3.2.1 Exposure Scenarios and Populations

Identification of potentially exposed populations, pathways of exposure, and exposure media make up the conceptual site model CSM for the baseline HHRA. Because of the similarities in aquatic habitat and potential future human uses between the Lockheed West

and LDW sites, the exposure pathways and exposed populations for Lockheed West will be consistent with the scenarios developed for the LDW HHRA. The exposure scenarios described below are taken from the LDW site based on the assumption that the types of activities could occur under future use of the Site. Presently the Lockheed West site is difficult to access from the upland, but the subtidal and intertidal areas are accessible from the water by boat.

Tribal Uses

The Lockheed West site is located within the boundaries of the federally adjudicated Usual and Accustomed Fishing Area for both the Muckleshoot Indian Tribe and the Suquamish Tribe, which includes rights to harvest seafood, including clams, from the intertidal and subtidal sediments. Access to the intertidal sediment areas can be attained by water vessel. Seafood harvesting is performed by netfishing and clamming. Scenarios related to tribal consumption of seafood, including fish and clams, are identified separately below.

Netfishing – Tribes harvest migrating salmon and other fish by netfishing the waterway. Parameters for this exposure scenario will be taken from the LDW HHRA. Netfishing is assumed to occur throughout the Site, along the West Waterway and Elliott Bay shorelines, with exposures to sediments occurring to the total sediment dataset. For the netfishing scenario, intake from direct contact (dermal absorption) and sediment ingestion will be evaluated.

Clamming – Clamming would occur in the intertidal sediment of the site. During collection of clams, exposures would occur by direct contact with sediment followed by dermal absorption of contaminants, and inadvertent ingestion of sediment. Exposure parameters will include those for the 120 days/yr and 183 days/yr scenarios that were evaluated in the LDW HHRA.

Recreational Uses

Recreational uses of the West Waterway may include boating, fishing, shoreline/riverbank activities, such as clam harvesting, and swimming. However, there are presently no public access points at the Lockheed West site, and access is restricted to the intertidal sediments where clams would be harvested and children would play. However, potential future uses of the Site could include increased recreational uses. Based on results of a qualitative survey of the Site shoreline, access and the presence of intertidal sediment areas for clamming and recreational activities by children will be evaluated. Those areas considered possible for human exposure to intertidal sediment will be evaluated.

A child beach play scenario will be evaluated using the exposure parameters in the LDW HHRA for the beach play areas of highest exposure potential, consisted with the streamlined approach to the risk assessment. Intake routes to be evaluated include dermal contact and sediment ingestion. There are no residential neighborhoods adjacent to the Lockheed West site, and no access to the intertidal sediments by residents would be anticipated. Therefore, no residential-specific scenario for sediment contact will be evaluated. Note that the seafood consumption scenario described below will be more stringent than a recreational scenario in terms of exposure to site-related sediment chemicals.

Direct contact with surface water while swimming is a potential exposure scenario to site-related chemicals. Risks due to direct contact with surface water through swimming have previously been evaluated for the West Waterway and the LDW sites. Those assessments demonstrated the small exposures and risks through this pathway. Consistent with the LDW HHRA, the swimming exposure scenario will not be quantitatively evaluated in the Lockheed West HHRA. Results of the King County risk assessment for swimming in the Duwamish Waterway will be discussed.

Seafood Consumption

Seafood may be consumed by tribal members at higher rates than recreational fishers at the Site. Risks due to public consumption of fish caught at or near the Site have previously been evaluated for the West Waterway and for the LDW. Tribal consumption of fish, crabs, and clams will be evaluated. Consistent with the streamlined approach to the risk assessment, tribal seafood consumption exposure parameters will be taken directly from the LDW HHRA, and will be consistent with the Framework for application to the LDW sites (EPA 2005, 2006). Exposure estimates will be based on the Tulalip and Suquamish tribal parameters as described in the application guidance document, and consistent with the LDW HHRA. Child tribal members will be evaluated at the 40 percent of adult seafood ingestion rates, as per the LDW HHRA.

Industrial Use of the West Waterway

The Duwamish Waterway serves as a major shipping route for containerized and bulk cargo, and the shoreline along the Lockheed West site has been developed for industrial and commercial operations. However, industrial workers in shipping will have minimal contact with sediments at the Lockheed West site, and are not considered a potential human population of concern. Industrial uses by tribes during netfishing activities are described above.

11.3.2.2 Summary of Human Exposure Assessment Scenarios

The uses of the aquatic environment of Lockheed West and populations of concern to be evaluated as exposure scenarios are identified as the following; exposure parameters are taken directly from the LDW assessments without consideration for applicability to the Lockheed West Site, as per the streamlined approach:

Direct exposures

- Netfishing
- Child Beach Play
- Clamming at 183 days/year
- Clamming at 120 days/year

Indirect exposures

Tribal seafood consumption rates will be used (USEPA 2006); other parameters from the LDW HHRA (Windward 2007a).

- Adult tribal seafood consumption parameterized using Tulalip survey parameters
- Child tribal seafood consumption parameterized using 40% of Tulalip consumption rate
- Adult tribal seafood consumption parameterized using Suquamish survey parameters (as per EPA and Tribe request).

Seafood species (same species as evaluated at the LDW site):

- Benthic fish – English sole
- Pelagic fish – perch (shiner, striped, pile)
- Crabs – Dungeness, red rock
- Clams – species uncertain, presence of *Mya* species at the Lockheed West site that were evaluated in the LDW HHRA is uncertain.

In general, the risk assessment will use LDW exposure parameter values (other than exposure point concentrations) to characterize risks across a range of exposures for human populations. Exposures through clam ingestion may be modified to reflect Site conditions that differ from the LDW site. The planned collection of clams at the Lockheed West site will provide supporting data on the presence of suitable habitat and species of clams.

EPA has pointed out that division of a large contaminated area into operable units may result in conclusions that a risk does not exist when if all the operable units were considered together, a substantial risk might exist. Further, small groups of anglers may obtain a large fraction of their seafood from a small area. For these reasons, EPA has concluded in the Framework that site size should not affect the fraction of seafood affected by source specific contamination. As part of the streamlined approach to this risk assessment, exposure parameters and chronic daily intake calculations, including seafood ingestion rates, will be taken from the LDW HHRA and be consistent with the Framework.

11.3.2.3 Conceptual Site Model for Human Exposures

Information on the sources of contamination, exposure pathways, and human receptor populations described above will be depicted in a CSM for the HHRA. A CSM for the Lockheed West HHRA is presented in Figure 11-1. As per the approach to the baseline risk assessments for the Lockheed West site, the CSM is consistent with the HHRA CSM developed for the nearby LDW site.

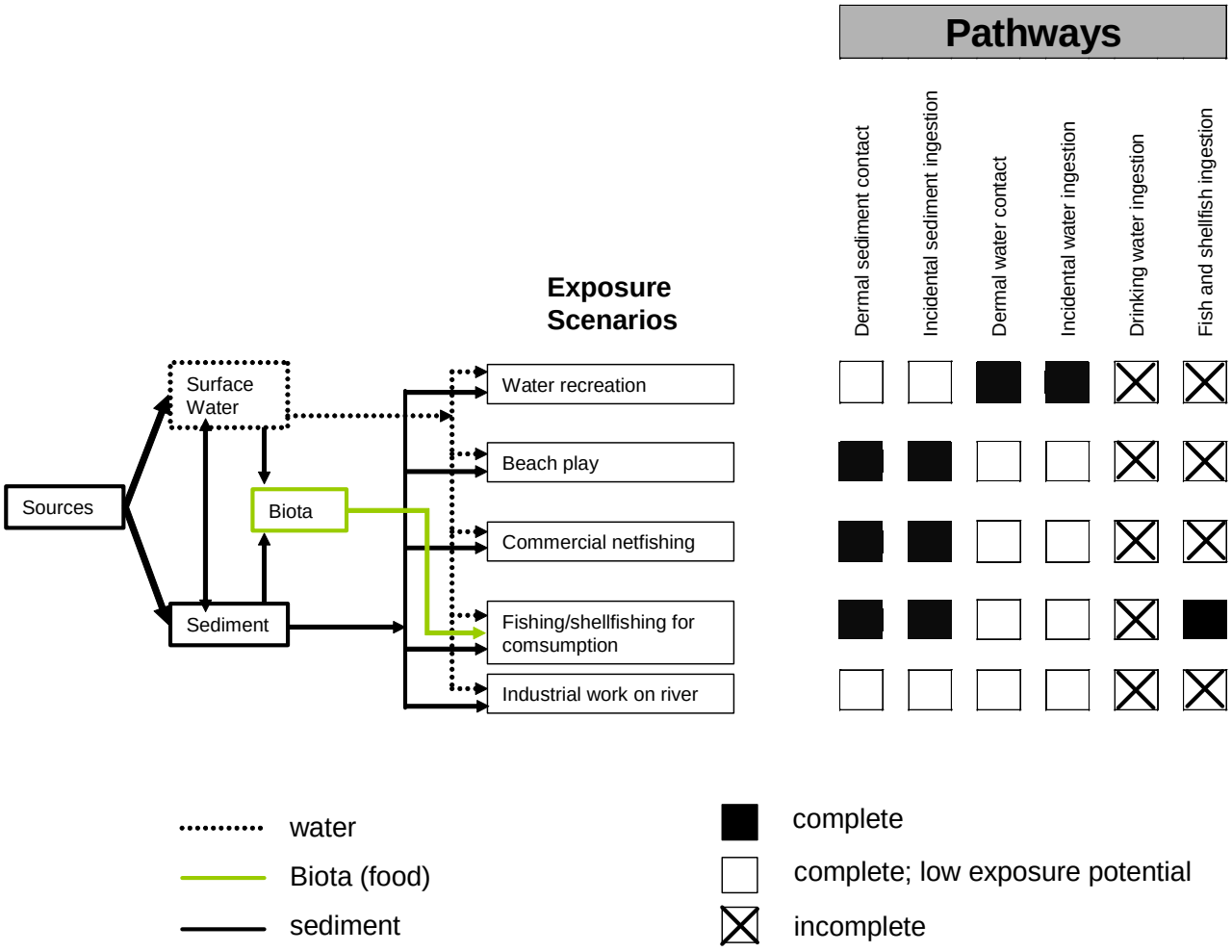


Figure 11-1. Conceptual Site Model for Lockheed West Human Health Risk Assessment

11.3.2.4 Exposure Point Concentrations

Existing chemical contaminant datasets are evaluated in the RI work plan. Only the sediment dataset collected in early 2007 is planned for use in the HHRA; no tissue data have been collected from areas consistent with the sampling boundaries presently identified for the Site. Tissue data that may be collected for clams at the Site will be used to corroborate the conservativeness of the BSAFs that are used to model tissue concentrations, as mentioned above and explained more fully below.

The following describes the sediment chemistry data to be used to evaluate exposures in the Lockheed West HHRA.

- *Netfishing* – The netfishing scenario will be based on COPC data collected from the intertidal and subtidal sediments throughout the Site, i.e., on east side of the Site in the West Waterway and Elliott Bay.
- *Beach Play* - The beach play scenario will be based on COPC data collected from the intertidal sediments along all shoreline areas of the Site.
- *Clamming* - The clamming scenario will be based on COPC data collected from the intertidal sediments along all shoreline areas of the Site.
- *Clam Consumption* - For the consumption of clams, sediment data will be COPC data collected from the intertidal sediments along all shoreline areas of the Site, similar to the clamming scenario.
- *Fish and Crab Consumption* – For the fish and crab consumption scenarios, COPC sediment data will be from combined intertidal and subtidal sediments throughout the Site, i.e., the same data as the netfishing scenario.

Exposure point concentrations (EPCs) will be determined following EPA guidance on calculating the UCL of the mean concentration for a given COPC, using the ProUCL program (EPA 2004b). Rules for the calculation of EPCs for sediment will be consistent with the rules outlined in the LDW HHRA (Windward 2007a). Sediment EPCs will be calculated for the area of exposure identified for the netfishing, clamming, and beach play scenarios. EPCs for tissues will be modeled from BSAFs and sediment areas, as described above in Section 11.3.1.3. BSAFs will be used to relate sediment and tissue concentrations of all COPCs for clams, and will be evaluated for use for fish species. As described earlier in Sections 6 and 8, BSAFs for developing EPCs in tissue will be taken from the literature, and site-specific data that are presently planned for collection on sediment and clam tissue chemical concentrations may also be used to develop BSAFs. Should co-located tissue and sediment data from the LDW site be available for the Lockheed West COPCs, they may be used to develop BSAFs for the Lockheed West site, in consultation with EPA Region 10.

A summary of the types of EPCs that are planned for use in the HHRA is shown in Table 11-3. As mentioned earlier, EPCs are the only data that will be specific to the Lockheed West site; with other exposure data and exposure parameters taken from the LDW HHRA, in the streamlined approach to the HHRA.

11.3.3 Toxicity Assessment

The toxicity assessment will present reference doses and cancer slope factors for the COPCs. Sources of toxicity criteria will be identified following the USEPA hierarchy (EPA 2003b):

- Tier 1 – Integrated Risk Information System (IRIS) database (EPA 2007b)
- Tier 2 – Provisional Peer-Reviewed Toxicity Values (PPRTVs), EPA Office of Research and Development/National Center for Environmental Assessment (NCEA)
- Tier 3 – Other toxicity values. Tier 3 includes additional EPA and non-EPA sources of toxicity information. Priority is given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed. Sources include EPA regional offices, EPA Health Effects Assessment Summary Tables (HEAST) values, California EPA, and Agency for Toxic Substance and Disease Registry (ATSDR) minimal risk levels.

The sources for the PPRTV, NCEA, HEAST, and ATSDR toxicity values are the EPA Region 3 RBC table (EPA 2007a), and the Region 6 screening tables (EPA 2007c). For PAHs, the CalEPA slope factors will be used (CalEPA 1994). These sources will be queried for updated information on toxicity values during the HHRA. Descriptive information on the toxicity of the COPCs responsible for the majority of the risk will be described, based on information provided in the IRIS database and ATSDR toxicological profiles. The toxicity profiles provided in attachment 3 of the LDW HHRA (Windward 2007a) will be included in the Lockheed West HHRA as appropriate.

The toxicity assessment will present the quantitative relationship between estimated exposure (dose) to COPCs and the likelihood of adverse effects. The quantitative relationships are toxicity values used to quantify risk, and are expressed as cancer slope factors (CSFs) for carcinogenic effects and reference doses (RfDs) for non-carcinogenic effects. CSFs are used to estimate the probability that a person would develop cancer given exposure to site-specific contaminants. This site-specific risk is in addition to the risk of developing cancer due to other causes over a lifetime. Consequently, site-specific risk estimates are frequently referred to as "incremental" or "excess lifetime" cancer risks. The CSF is expressed in units of the inverse of chemical intake or dose $(mg/kg\text{-}day)^{-1}$. RfDs represent a daily contaminant intake below which no adverse human health effects are expected to occur.

11.3.4 Risk Characterization

The risk characterization will consist of risk estimations for each exposure scenario and pathway, and discussions of uncertainties in the exposures, toxicity, and risk estimates. Risk estimations will be tabulated, and will be consistent with EPA (1998a) recommendations for results presentation. Risks are estimated by integrating information and data from the exposure and toxicity assessments. Risks will be estimated for cancer

and non-cancer endpoints, and will follow EPA (1989) guidance on risk characterization. Conclusions about cancer and noncarcinogenic risks and exceedances of EPA risk ranges under CERCLA will be presented. Risks will be summed across relevant pathways of exposure, as per the LDW HHRA. A discussion of potential background concentrations of select chemicals will be included; for example, regional or area background on arsenic, PCBs, and PAHs may be available from the LDW RI, or may be developed as part of the Lockheed West RI/FS (see Section 6 for more discussion). The incremental site-related risk above background will be discussed as appropriate.

11.3.4.1 Cancer Risks

For carcinogens, risks will be expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6} or 1E-6). An excess lifetime cancer risk of 1E-6 indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. The EPA generally acceptable cancer risk range under the NCP and CERCLA guidance is 1E-4 to 1E-6.

11.3.4.2 Non-Cancer Risks

The potential for noncarcinogenic effects will be evaluated by the HQ, which compares an exposure level over a specified time period (e.g., lifetime) with an RfD derived for a similar exposure period. An HQ less than 1 indicates that an individual's dose of a single contaminant is less than the RfD and toxic effects from the chemical are unlikely. An HI will be generated by adding the HQs for all COPCs that affect the same target organ (e.g., liver) or act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI less than 1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health, and target organ or effects-specific HQs will be developed.

11.3.5 Uncertainty Assessment

The uncertainty assessment will describe uncertainties in the exposure and toxicity assessments, and the risk characterization for the Site. Uncertainties will be described qualitatively, with an estimate of the impact of the uncertainty on the risk estimates. Risks to human health typically may be over- or underestimated based on the appropriateness of

the assumptions regarding exposure, the availability and assumptions associated with the derivation of toxicity factors, and the use of modeling to represent exposure point concentrations. For the Lockheed West Site, exposure parameters will not be site-specific but will be taken from the LDW HHRA. Their appropriateness to the Lockheed West Site will be discussed. Because of the uncertainties that affect the estimations of risk, EPA (1989) suggests that estimates are only accurate to within an order of magnitude.

11.4 BASELINE ECOLOGICAL RISK ASSESSMENT PLAN

The ERA for the Lockheed West site will be based on EPA guidance for performing ERAs at Superfund sites (EPA 1992, 1997b,c, 1998a,b). The basic format of the ERA will start with the Problem Formulation step, where the ecological receptors to be evaluated, their habitats at the Site, and the sources and pathways of chemical exposures are developed. The Analysis step consists of an evaluation of the potential adverse effects from chemical contamination, and an estimation of the exposures of wildlife receptors to Site chemicals. The Risk Characterization step will present the risk results for the Site, discuss the level of certainty in their estimates, and identify uncertainties in source information.

11.4.1 Problem Formulation

The Problem Formulation will establish the scope of the assessment, including ROCs, selection of COPCs, assessment endpoints, and exposure pathways. The habitat present at the Site will be identified, based on existing information and survey information collected during RI activities.

The aquatic environment at the Lockheed West site consists of marine waters and sediments. Benthic habitats include intertidal habitat (exposed by low tides) and subtidal habitat (never exposed by low tides). Much of the subtidal habitat has been dredged at various times in the past, in both the north and east portions of the Site. The east subtidal habitat includes part of the deeper navigation channel of the West Waterway.

Although the sediments on the east portion of the Site lie in the West Waterway segment of the Duwamish River discharge, and the region of Puget Sound is considered to be an estuary, the sediments and bottom water column layer of all the aquatic habitat of Lockheed West are generally marine in nature. The Duwamish Waterway is characterized by a salt-water wedge that originates in Elliott Bay and moves up and down the Waterway. At moderate freshwater inflows of the river (greater than 1,000 cubic feet per second), the saltwater wedge extends upstream to the East Marginal Way Bridge, approximately 8 miles upstream of Harbor Island, regardless of the tide height (Stoner et al. 1975). Under high-

flow conditions, the saltwater wedge is estimated to be pushed as far downstream as 3 miles above Harbor Island during flood tides and 2 miles above Harbor Island during ebb tides. The Lockheed West site is located across the West Waterway from the downstream end of Harbor Island.

Although freshwater overlies the saltwater wedge in the lower Duwamish, including the waterways around Harbor Island, there is little to no downward movement of water from the upper layer into the saltwater wedge (Santos and Stoner 1972). Also, at any given time and location along the waterways, the salinity at a given depth is nearly the same from one side of the channel to the other (Santos and Stoner 1972). Primary habitat for the aquatic lands can be identified as the intertidal marine sediments along the Site shoreline and the subtidal marine environment adjacent to the Site.

11.4.1.1 Selection of Receptors of Concern

Selection of ROCs for the ERA is based on the habitat present at the Site. For a primarily marine intertidal and subtidal habitat at Lockheed West, the selected ROCs are consistent with the ROCs identified for the nearby LDW site. The recent ERA for the LDW site selected ROCs with a thorough evaluation of potential ecological receptors that may use the Site and a set of criteria for identifying ROCs. The following criteria were used to select ROCs:

- Potential for direct or indirect (e.g., ingestion of fish or invertebrates) exposure to sediment-associated chemicals
- Human and ecological significance
- Available habitat and site usage
- Sensitivity to COPCs at the site
- Susceptibility to biomagnification of COPCs (i.e., higher-trophic-level species)
- Data availability.

The key direct and indirect exposure routes from sediment were identified (e.g., direct exposure to sediment or ingestion of prey associated with sediment either directly or through prey). Groups of organisms that may be exposed via these pathways were then identified, and representative species that were thought to be most exposed were selected from these groups representing the greatest potential for exposure.

Benthic Invertebrates

Benthic invertebrate communities – Benthic invertebrate communities serve as a major food resource for commercially and recreationally important fish and wildlife, and they are active in detrital processing and nutrient cycling. The benthic community as a whole will be evaluated as an ROC. A wide variety of benthic invertebrates would be expected to inhabit the sediments at Lockheed West, similar to population assemblages of Elliott Bay and nearby sediment sites such as the West Waterway and Lower Duwamish Waterway. Most of the marine benthic species are in direct contact with sediment year-round and have a limited home range. Benthic invertebrates are exposed to sediment through several different pathways, such as filter feeding and detritus feeding. Benthic invertebrates include sediment dwellers (benthic infauna, which includes clams) and organisms closely associated with the sediment surface (epibenthos). Species and assemblages have been identified for the lower Duwamish Waterway and Elliott Bay (Windward 2007b).

The benthic invertebrate community is selected as a ROC for the Lockheed West ERA. The community consists of infauna and epibenthic organisms in both intertidal and subtidal habitats.

Crabs – Crabs are selected as an ROC to represent higher-trophic-level benthic invertebrate species present at the Site. Evaluation of benthic invertebrates using SMS and toxicity-based criteria for sediments does not account for exposures or risks to higher trophic benthic organisms. Crabs were selected as ROCs for the LDW ERA to fill the role of higher trophic benthic receptor.

Fish

A diversity of fish species is found in the Duwamish River and Elliott Bay, and available studies documenting fish communities have been summarized in the West Waterway OU risk assessments (ESG 1999, Weston 1994) and the LDW ERA (Windward 2007b). As summarized in Windward 2007b), shiner surfperch, snake prickleback, Pacific sandlance, Pacific staghorn sculpin, longfin smelt, English sole, and starry flounder were particularly abundant in these studies, as were juvenile chinook, chum, and coho salmon.

English sole, Pacific staghorn sculpin, and juvenile chinook salmon were selected as the ROCs for the LDW ERA. English sole was selected to represent benthivorous fish species; Pacific staghorn scuplin was selected to represent upper trophic level fish; and juvenile Chinook salmon were selected to reprensent anadromous fish. English sole and scuplin were selected largely because of their potential for exposure to sediment chemicals, based on their prey preferences and feeding behavior, and because of a high abundance in the

LDW. Juvenile Chinook salmon were selected as a ROC for the LDW because the Puget Sound evolutionary significant unit of chinook salmon is a federally threatened species under ESA, and to serve as a surrogate for other juvenile anadromous salmon species. Their exposure to sediment chemicals at the LDW site was considered to be less than that of sole or scuplin based on feeding behavior. Due to the substantially smaller size than the LDW site, juvenile chinook salmon would not be expected to be present at the Lockheed West Site for as long a duration as at the LDW site, particularly compared with the longer residence times of a non-migratory species such as the sculpin. Their exposures to sediment chemicals would be expected to be significantly less than those of sole or sculpin.

The low exposure of juvenile salmon to sediment chemicals in the Duwamish system was demonstrated in the LDW ERA, where dietary exposure estimates for juvenile salmon exposures to sediment chemicals were below risk thresholds. The screening risk evaluation for juvenile salmon in the LDW particularly focused on exposure to PAHs through dietary sources (Section A.2.5.2, Windward 2007b). The dietary exposure was evaluated through comparison of both maximum PAH concentrations in diet of fish and of PAH concentrations in stomach contents of juvenile salmon with TRVs developed by NOAA based on exposure of juvenile Chinook salmon to a mixture of PAHs. The concentrations of total PAHs in dietary exposure and in the juvenile salmon stomach contents were an order of magnitude less than the juvenile salmon TRV for total PAHs. Also, the maximum total PAH concentration in sediment in the LDW at 133 mg/kg dw is substantially higher than the maximum total PAH concentration in the Lockheed West sediment, at 73 mg/kg dw, which, coupled with the smaller size of the Lockheed West site, suggests lesser exposure of juvenile salmon to PAHs in sediment at Lockheed West. This comparison of maximum total PAH concentrations in sediment of the two waterways and the analysis of PAH risks in the LDW ERA supports a low risk for juvenile Chinook salmon exposed to sediments at the Lockheed West Site.

An addition, at the Lockheed West Site, the exposures of fish to chemicals evaluated by the tissue residue approach will be quantified by modeling from sediment concentrations to whole body using BSAFs for upper trophic level fish, since BSAFs are not available for individual species such as juvenile Chinook salmon. Thus, for each COPC a single BSAF would be used for all fish species, and risks will be presented for fish as an ROC group, including English sole, sculpin, and salmon. For chemicals evaluated by the dietary approach, such as PAHs, English sole are modeled for exposure to sediment and benthic invertebrate ingestion, and sculpin are modeled for ingestion of sediment plus fish plus benthic invertebrates plus crab (see below). The amount of time that juvenile Chinook salmon would be expected to spend foraging at the Lockheed West Site is not known but is

assumed to be low in comparison with the amount of time spent in the much larger upstream LDW, and diet would consist partially of pelagic prey items with much less exposure to sediment chemicals than benthic invertebrate prey of English sole or sculpin. For the above reasons, the exposures of juvenile chinook salmon to Lockheed West sediment will be much lower than those of sole and sculpin, and the risk estimates of English sole and Pacific staghorn sculpin will be protective of lesser exposed species, such as the juvenile salmon.

Based on the above analyses, and in keeping with the streamlined approach to the ERA to focus on risk driver receptors and exposures, English sole and Pacific staghorn sculpin are the two fish species selected as ROCs for the Lockheed West risk assessment.

Fish ROCs are grouped into broad categories based on potential sediment exposure at the Site:

- Benthivorous fish— represented by English sole, and including rock sole and starry flounder. This category was also considered to be protective of fish that prey on pelagic and encrusting organisms, such as Pacific herring and pile perch.
- Upper-trophic-level fish —represented by Pacific staghorn sculpin, and including bull trout and sand sole. Pacific staghorn sculpin is used to represent piscivorous and omnivorous species that prey on other fish.

Wildlife

Potential wildlife uses of the Duwamish River estuary and Elliott Bay include a variety of bird species and waterfowl, and marine mammals. Large carnivorous birds such as osprey and great blue heron forage over a much larger area than the size of the Lockheed West site. Herons also need larger expanses of shallow water than available at the Lockheed West site. Avian exposures that may be more specific to the Site are best represented by waterfowl and shoreline birds that forage primarily in intertidal sediments. Waterfowl may feed on benthic invertebrates and may incidentally ingest sediment while foraging, but this exposure is assumed to be less than that of benthivorous birds such as shorebirds, which may ingest significant amounts of sediment while probing intertidal sediment for benthic invertebrates. Spotted sandpipers are a common bird in Puget Sound, and nests have been observed along the lower Duwamish River. They feed primarily on insects, small crustaceans and mollusks, worms, and other invertebrates. Marine mammals, such as seal and otter, forage over much larger areas than the small habitat available at the Lockheed West site.

Wildlife species that may be exposed to the Site on an intermittent basis include herons, osprey, river otter, and harbor seals, and to a lesser extent, sea lions and orcas. Exposures

of these wildlife species to the Site would be limited due to the small size of the Site and limited availability of wildlife habitat. In addition, the risks to these wildlife species at the LDW site were much smaller than for the species selected as ROCs for the Lockheed West site.

In addition to the bird and mammal species identified above, other species that were evaluated but not selected in the ERA for the LDW site, and hence not considered for the Lockheed West ERA, include rockfish, due to lack of sufficient presence; bull trout because sculpin were evaluated as representative of the feeding guild; aquatic plants, which were evaluated in the Phase 1 ERA for the LDW site and found to be well below any risk concern (Windward 2003a); and reptiles and amphibians, which are not likely to be exposed to sediment contamination because habitat for these species is limited, and their presence has not been reported in any wildlife surveys conducted in the area (Windward 2007b).

11.4.1.2 Summary of ROCs

Consistent with the rationale in the LDW ERA (Windward 2007b), species selected as ROCs for the Lockheed West ERA are identified as the following:

- Benthic invertebrate community
- Crabs – Dungeness or red rock crab
- Fish – English sole, Pacific staghorn sculpin
- Birds – Spotted sandpiper.

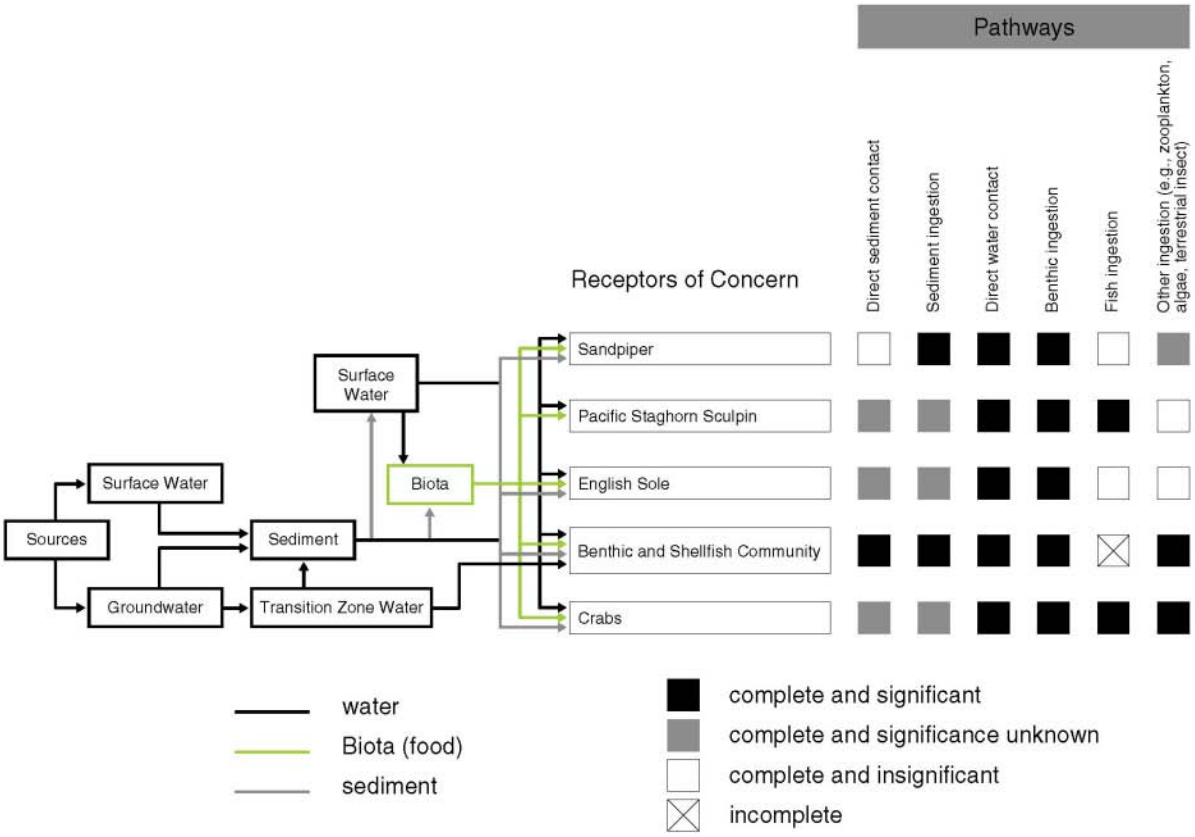
Spotted sandpiper will be included if shoreline habitat is present; 65 percent of the LDW shoreline was found to contain sandpiper habitat, suggesting a high likelihood that habitat will be present at the Lockheed West site. Because of the limited habitat and exposure areas and relatively low risks at the LDW site when compared with the ROCs identified above, ROCs will not include other birds such as bald eagle, osprey, or great blue heron; or mammals such as river otter and harbor seal.

Assessment endpoints are selected in the Problem Formulation step, and are the characteristics of communities and populations that can be affected by chemical exposures and impact the survival or ecological health of that community or population. EPA guidance identifies mortality, growth, and reproduction as appropriate endpoints for evaluating chronic risks to ecological receptors.

11.4.2 Conceptual Site Model for Ecological Exposures

The habitats, ROCs, sources of chemical contamination, and pathways of exposure are graphically depicted in a CSM. A CSM for the ERA for Lockheed West is shown in Figure 11-2. Pathways for the exposure of ROCs to sediment-associated chemicals at Lockheed West can be designated in one of four ways: complete and significant, complete and significance unknown, complete and insignificant, or incomplete. Each of the four designations is defined below, including whether it will be further evaluated in the ERA.

- Complete and significant – There is a direct link between the receptor and chemical via this pathway, and the specific pathway is considered to be potentially important.
- Complete and significance unknown – There is a direct link between the receptor and the chemical via this pathway; however, there is insufficient data available to quantify the significance of the pathway in the overall assessment of exposure.
- Complete and insignificant – There is a direct link between the receptor and the chemical via this pathway; however, the significance of this pathway in terms of overall exposure is considered to be negligible. Pathways classified as complete and insignificant will not be evaluated in the ERA.
- Incomplete – There is no direct pathway between the receptor and the chemical. Pathways classified as incomplete will not be evaluated in the ERA.



Note: Groundwater at the adjacent PSR site may impact sediment benthos through transition zone water.

Figure 11-2. Conceptual Site Model for the Benthic Invertebrate Community, Fish, and Wildlife at Lockheed West

As indicated above, due to lack of habitat and the small size of the Lockheed West site, avian and mammalian wildlife species are not identified as potential ROCs and will not be evaluated in the Lockheed West ERA. Sandpiper is included as a potential ROC, although there is limited availability of habitat. Groundwater and its resulting transition zone water may be a concern for direct toxicity of transition zone water to benthic organisms. Groundwater monitoring will be performed as part of RI activities, particularly the groundwater that may come from the adjacent PSR site. Because the entire contaminated sediment area of the Site will be covered as a remedial measure, groundwater will be evaluated in the FS for its potential to impact the Lockheed West remedial design cap. The CSM will be finalized for the ERA in a format that is consistent with EPA guidance.

11.4.3 Selection of Chemicals of Potential Ecological Concern

Chemicals of potential concern (COPCs) for ecological risk assessment are those contaminants related to the Site that may pose a risk to ecological receptors. COPCs will be

determined through a screen conducted using site-specific exposure data where available. The list of chemicals that were analyzed in sediment is presented elsewhere in the RI work plan and will serve as the starting point for selecting COPCs; the chemical list and risk-based analytical concentration goals for sediment chemicals are shown in Table 11-2. The screen will consist of comparisons of chemical concentrations in environmental media with screening criteria appropriate to the ROCs. Conservative exposure assumptions (e.g., maximum chemical concentrations) will be used in this screen to determine which COPC will be relevant for which ROC.

11.4.3.1 COPC Screening Steps

The process used to screen and select COPCs is taken from the screening criteria developed and approved by EPA for the LDW ERA (Windward 2007b). The screening process will consist of the following steps:

1. For chemicals that are always undetected, if detection limits are below RBACGs, they will be screened out from further evaluation. Undetected chemicals with detection limits exceeding RBACGs will be noted through the evaluation.
2. Frequency of Detection – Chemicals that are detected in less than 5 percent of sediment samples will be screened out from further evaluation. An infrequently detected contaminant will be rejected if is not found in other environmental media, if there is no reason to believe that the contaminant should be found, and if there is not a unique site feature that may explain the presence of the contaminant.
3. Comparing detected chemicals against background – Chemical concentration will be compared with available background concentrations for metals. For the purpose of comparison, background will be defined as the concentrations identified in the LDW risk assessments. EPA (2002c) also describes evaluation of background in soils, and the procedure is to compare the site data distribution with the background data distribution. If appropriate background concentrations of chemicals detected at Lockheed West sediments are unavailable, as determined in consultation with EPA, this comparison step will not be performed. No COIs will be eliminated from further evaluation based on this comparison..
4. Comparison with risk-based screening criteria – Sediment chemicals that pass the above steps will be screened against risk-based screening criteria that are based on acceptable risk levels associated with exposure to sediment chemicals. Maximum concentrations in the top 10 cm of sediment will be screened against the screening

criteria. Identification of the screening criteria for ecological ROCs is presented below.

11.4.3.2 Benthic Invertebrates Screening Criteria

For benthic invertebrates, including clams, maximum concentrations in surface sediments of chemicals that pass the first three screening steps will be compared to SQS (Ecology 2001b). For chemicals with no SQS, maximum concentrations will be compared to DMMP guidelines (USACE et al. 2000) that were determined to be toxicologically based for benthic invertebrates (Windward 2007b). In cases where no DMMP value are available or the available DMMP value is not toxicologically based (i.e., total DDTs), the values identified as toxicologically based in the LDW ERA (Windward 2007b) will be used. Chemicals exceeding the SQS, DMMP guidelines, or toxicologically based values will be identified as COPCs for benthic invertebrates. For TBT, the screening value will be taken from the one calculated in Windward (2005a) for the sediment sampling QAPP.

11.4.3.3 Fish and Crab Sediment Screening Criteria

For fish and crabs, chemicals in Lockheed West sediments that have passed the first three screening steps will be screened by comparison of their maximum sediment concentrations with the following criteria:

1. Bioaccumulative chemical identified in USEPA (2000)
2. Sediment bioaccumulation criteria (PSDDA 1988, USACE et al. 2000, ODEQ 2007).
3. Toxicity-based screening criteria:
   a. Screening values for fish and crab that are calculated from toxicity reference values (TRVs) in the LDW ERA (Windward 2007b)

   OR

   b. Chemical concentrations developed from LDW data on sediment associated with acceptable risk levels for fish or crab.

      The LDW RI developed RBCs for sediment that are protective of risks to ecological receptors, based on results from the baseline ERA. These RBCs are also referred to as risk-based threshold concentrations (RBTCs). The ERA RBTCs provide sediment concentrations specific to the LDW that are associated with regulatory risk levels for ecological receptors. These ERA RBTCs can be used as a source of screening levels for chemical concentrations in Lockheed West site sediments to select COPCs for the ERA.

11.4.3.4 Fish and Crabs Tissue Screening Criteria

Fish or crab tissue data are not planned for collection at the Site. Should any fish or crab tissue data become available for the Site, COPCs will be identified using a critical tissue-residue approach and a two-step process described for the LDW ERA. The first step is an initial screen to select chemicals that meet these criteria:

- Detection in at least 5 percent of surface sediment samples
- Identification as a bioaccumulative chemical in USEPA (2000).

In the second step, the maximum exposure concentration of each chemical passing the above screen will be compared to a NOAEL for that chemical, using the NOAELs developed for fish and crabs in the LDW ERA (Windward 2007b). If the maximum exposure concentration is greater than the NOAEL for fish or crab, the chemical will be identified as a COPC for fish or crab.

11.4.3.5 Sandpiper Screening Criteria

Selection of COPCs for sandpiper will consist of screening of maximum concentrations against NOAEL-based screening values from the LDW ERA. These criteria are listed in Table 11-2.

11.4.4 Analysis

The analysis phase of the ERA consists of an exposure assessment and an effects assessment.

11.4.4.1 Exposure Assessment

Measures of exposure refer to how the exposure of each ROC will be estimated. Measures of exposure must provide data that can be compared directly to toxicity data in the risk characterization. Because toxicity data may be based on chemicals present in the ROC tissue or on chemicals that the ROC is exposed to through dietary intake, the matrix for exposure (e.g., tissue or exposure media such as sediment or prey tissue) is a critical determinant. The measures of tissue chemical concentrations provide an estimate of integrated exposure through all significant pathways.

Measures of exposure will be described for each of the ROCs, and will be the concentrations of COPCs in the medium to which the ROC is exposed, or in tissue for those ROCs that are assessed based on tissue levels of COPCs. Exposure media for this ERA consist of sediment and tissue.

- *Sediment exposures* – will be determined from data collected in 2007 under the RI work plan for the Site.
- *Tissue as exposure media* – may consist of the whole body chemical residue of the particular ROC, or tissue of dietary prey items.

As described below, tissue concentrations of COPCs will be estimated by modeling from sediment concentrations. A summary of the types of exposure data and how they will be used in the ERA for each of the ecological ROCs is provided in Table 11-4.

A summary of the exposure point concentrations to be used in the ERA consist of:

- Benthic Invertebrates – Single point concentrations of the full surface sediment data set for comparison with SMS values.
- Fish and crab exposure – The 95 percent UCL of the full 2007 Lockheed West site surface sediment data set; tissue concentrations of ROCs and prey will be estimated by one of the tissue modeling methods described below.
- Sandpiper exposure – The 95 UCL of the 2007 Lockheed West site intertidal surface sediment data; benthic invertebrate tissue concentrations (as prey) will be estimated by one of the modeling methods described below.

Tissue modeling approaches

Options for modeling tissue concentrations at the Lockheed West site consist of the following, listed in priority of selection.

Option 1 – Literature BSAFs

Tissue data will be modeled using BSAFs and the approach used in the QAPP for collecting sediment samples at the LDW (Windward 2005a). This method has been described above in the derivation of screening criteria. For the exposure assessment for all ROCs, BSAFs will be identified for the various ROC categories, including benthic invertebrates, clams, crabs, and fish. Clam BSAFs will be based only on deposit feeders, unless unavailable. Windward (2005a) found that reliable BSAFs are available only from clam data; BSAFs for fish varied by orders of magnitude (USACE 2003). Nonetheless, fish BSAFs will be taken from available sources as 90th percentile values of the data, or as reported percentiles if data are not presented. In addition to the literature BSAFs, the regression equations developed in the LDW ERA for PCBs, arsenic, and TBT exposures of benthic invertebrates will be used for benthic invertebrate and clam modeling.

Sources of the BSAFs that were used in the LDW QAPP and will be used in the Lockheed West ERA are the following:

> US Army Corps of Engineers Environmental Residue-Effects Database (ERED) - http://www.wes.army.mil/el/ered/
>
> Tracey GA, Hansen DJ. 1996. Use of biota-sediment accumulation factors to assess similarity of nonionic organic chemical exposure to benthically-coupled organisms of differing trophic mode. Arch Environ Contam Toxicol 30:467-475.
>
> EPA. 1997. The incidence and severity of sediment contamination in surface waters of the United States. Volume 1: National Sediment Quality Survey. EPA 823-R-97-006. US Environmental Protection Agency, Office of Science and Technology, Washington, DC.
>
> Washington State Department of Health. 1995. Tier I report, development of sediment quality criteria for the protection of human health. Washington State Department of Health, Olympia, Washington.

In addition to the above sources, BSAFs will be taken from the following:

> PTI. 1995. Bioaccumulation Factor Approach Analysis for Metals and Polar Compounds. Washington Department of Ecology. BSAFs are available for metals as 90th percentile values for deposit feeder clams, or filter feeders if deposit feeder data are unavailable.
>
> Oak Ridge National Laboratory. 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. Bechtel Jacobs Co. BSAFs are available for metals in freshwater clams, as 90th percentile values.
>
> Windward. 2007. Ecological Risk Assessment, Lower Duwamish Waterway, Attachment 11. Regression equations on collocated benthic invertebrates and sediment data were developed for arsenic, PCBs, and TBT using LDW site data.

Option 2 - LDW site data

LDW site data may be reviewed and used to develop BSAFs, following consultation with EPA. BSAFs were not calculated in the LDW risk assessments or the draft RI (Windward 2007b,c). For some risk driver chemicals, derivation of BSAFs from the LDW site may not be possible. For PCBs, a food web model (based on the Gobas model) was used in the LDW RI to model relationships between sediment and tissue of total seafood (fish, crabs, clams) for the derivation of risk-based threshold concentrations (RBTCs). Whether specific and significant relationships may exist between sediment PCBs and PCBs in fish, crab, or clam was not explored. For other chemicals, tissue-to-sediment relationships were evaluated only in clams because their consumption represented the vast majority of risk. However, for arsenic and PAHs, no relationships between tissue and sediment data from the

LDW were found and no BSAFs were derived. Site-specific issues related to modeling tissue concentrations of the ROCs or their prey in the Lockheed West ERA are discussed below.

Option 3 – Other site data

As mentioned in the work plan text for the HHRA, data may be available in the future for collocated clams and sediment. These data could be used for the development of site-specific BSAFs for clams; however the data are planned to be collected in parallel with the risk assessment and may not be available for use in the risk assessment. In addition, data from the adjacent PSR and West Waterway sites may be evaluated for potential use in deriving BSAFs if needed.

Benthic Invertebrate Exposures

Benthic invertebrates will be assessed for risks as a community of organisms. Quantitation of exposures will be based on concentrations of COPCs measured in sediment, which will be compared with sediment quality guidelines as presented in the next section on effects analysis. Intertidal and subtidal sediment data described in this RI work plan will be used to develop exposure concentrations for benthic invertebrates.

Consistent with other ERAs at local sites (e.g., LDW), crabs are used as surrogates for higher-trophic-level benthic invertebrates. Crab exposure to sediment-associated chemicals will be estimated by modeling from sediment concentrations. The modeling method will use sediment concentrations of COPCs and BSAF values for COPCs in crab. BSAF values will be identified as described above, or based on data collected from co-located crab and sediment samples collected in the LDW if such data are available for the suite of COPCs. The LDW ERA collected data on tissue residues in both edible meat and hepatopancreas of Dungeness crab, which were used to estimate whole body concentrations. Chemical concentrations in both edible meat and whole body of crab would be modeled from Lockheed West sediment concentrations, using the appropriate BSAF values derived from the LDW studies.

EPCs for crabs will be used as the exposure term for those COPCs that are evaluated for risk by comparison of the tissue concentration with a tissue-based toxicity value. Modeled tissue data for crab will also be used in the dietary approach for sculpin.

Fish

The approach to determining exposures of fish to site-related chemicals depends on the specific method for evaluating risks. For those COPCs for which risks are evaluated using

tissue concentrations, exposures will be estimated using whole-body tissue residues. Examples of these chemicals include PCBs, mercury, DDT, and TBT. For those COPCs for which risks are assessed through dietary exposures, exposures to fish will be determined through concentrations of COPCs in dietary items. A dietary approach will be used for exposures to PAHs and metals because these chemicals are either metabolized or actively regulated by fish. The selection of tissue residue or dietary method for evaluating fish risks will follow the approach described in the ERA for the LDW site (Windward 2007b).

Tissue Residue Approach

For those COPCs for which risks to fish are evaluated through the tissue residue method, concentrations in fish tissue will be estimated through modeling. Consistent with the streamlined approach to this risk assessment, modeling will be performed following the BSAF method; the food web model developed for PCBs at the LDW site will not be used unless the BSAF method is viewed in consultation with EPA Region 10 as unsatisfactory. The food web model developed for the LDW site predicts concentrations of total PCBs in tissues of a variety of marine species, including the fish and crab ROCs identified for this ERA, from sediment total PCB concentrations. The LDW food web model was developed for predicting reductions in sediment concentrations of total PCBs in fish tissue based on decreases in sediment PCBs following remediation. The parameterization of the LDW food web model was determined through several technical memoranda (Windward 2005b,c). Parameterization was finalized by calibrating the model to known tissue and sediment concentrations, and included parameterization for four areas of the LDW site.

The downstream area closest to Harbor Island is marine at the sediment layer and is parameterized for the marine environment. In addition, the other areas of the LDW that have minimal freshwater influences on sediments may be considered for modeling if sufficient data from the downstream area are not available. For the Lockheed West site, if the food web model is applied to predicting PCB concentrations in tissues, application of the model may consider the established parameterization for the LDW area adjacent to Harbor Island, in addition to the full LDW modeled area. Average concentrations of COPCs from the intertidal and subtidal surficial sediment samples collected from the Site in 2007 will be used as sediment data in any modeling.

The primary method for estimating fish tissue concentrations of COPCs will be the BSAF relationships. BSAFs for COPCs for fish ROCs will be taken from the sources identified above, or they may be derived from co-located sediment and fish tissue data from the LDW, including the area nearest Harbor Island. The BSAFs will be used to predict fish tissue

concentrations of COPCs related to the sediment concentrations at Lockheed West. This approach may be explored for all COPCs at the Lockheed West site.

Dietary Approach

For COPCs that are evaluated by dietary exposures, exposures are typically estimated for all pathways, including prey, sediment ingestion, and water. Prey tissue concentrations of COPCs will be modeled following the BSAF approach discussed above. For benthic invertebrates as dietary components of fish, modeling will be performed using BSAFs. Arithmetic mean concentrations of COPCs in intertidal and subtidal sediments will be used to estimate benthic invertebrate concentrations as prey for English sole and Pacific staghorn sculpin. For sandpiper, average concentrations using the intertidal sediment samples identified in the RI work plan will be used to model benthic invertebrate tissue concentrations.

For clams as potential dietary components of ROCs, tissue concentrations will be determined by modeling from sediment concentrations; in addition, tissue chemistry data may be available in the future from the clam sampling from the Site. For modeling concentrations in clams, tissue concentrations will be estimated using average sediment concentrations and appropriately derived BSAFs, as described above.

For a dietary approach for fish exposures, the procedure for compiling benthic data will follow the procedure used in the LDW ERA. In that procedure, all benthic invertebrates collected from a location were combined and analyzed as a composite sample. Following this approach for English sole, benthic invertebrate tissue data modeled from the full sediment data set would be used to estimate dietary exposure to prey. English sole would also be assumed to incidentally ingest sediment throughout the Lockheed West sediments, at the rate of one percent of total diet, as identified in the LDW ERA. Because the home range or foraging range of English sole exceeds the area of Lockheed West sediment, a site use factor would typically be considered for a site-specific assessment of risk. However, in keeping with the intent of the streamlined approach to the ERA, all site use factors will be set at 1.0.

Sculpin exposures to PAHs and metals will be assessed using similar methods to those described for English sole, but modeled fish tissue and crab tissue data will be included along with benthic invertebrates for the prey ingestion component, using parameters and dietary percentages identified in the LDW ERA. Perch tissue concentrations of COPCs will be estimated by modeling from sediment concentrations using the BSAF approach developed for the LDW site and adapted to the Lockheed West site, as described above.

Wildlife

Sandpiper exposures will be evaluated by exploring relationships between sediment concentrations of COPCs at Lockheed West and sandpiper intake at similar concentrations, using information from the LDW draft ERA. The LDW ERA estimated exposures and risks to sandpiper through a dietary approach, where exposure estimates were based on tissue concentrations in prey, food and water ingestion rates, and body weight.

Based on the assumption that dietary intake of prey and water by sandpiper at Lockheed West are similar to those in the LDW, exposures to sandpiper for the Lockheed West site will be based on exposures parameters used for the LDW ERA. Use of the exposure data from the LDW site will be a linear extrapolation to the Lockheed West site, based on ratios of sediment concentrations related to potential risk to sandpiper.

Intake parameters, assumptions about exposures, and equations for developing intake will be consistent with the LDW ERA. For sandpipers, exposures to site-related chemicals will be based on dietary intake of benthic invertebrates and sediment during forging. The source of sediment data is listed below in Table 11-4; concentrations of COPCs in prey items will be derived by modeling using BSAFs, as described above for fish prey.

For PCBs, data on total PCBs as Aroclors in sediment will form the basis for estimating PCB exposures and risks to ROCs at the Lockheed West site. The LDW draft ERA demonstrated that risks from exposures to PCBs measured as Aroclors and those estimated as congeners, using the TEQ approach, were not substantially different, and hence risks will focus on PCBs as Aroclors.

Bioaccumulation of Sediment COPCs

Several of the ROCs described above address exposures to sediment COPCs by bioaccumulation through the food chain. For example, crabs have been selected to represent benthic organisms that may bioaccumulate sediment COPCs. Similarly, sculpin were selected to represent upper trophic level piscivores that may bioaccumulate chemicals from sediment through ingestion of benthic invertebrates and small fish as prey items.

Bioaccumulation of key COPCs in the LDW has been evaluated based on data on co-located sediment and benthic invertebrate tissue samples (Windward 2007b). Regression equations may be useable for the bioaccumulative COPCs PCBs, TBT, and arsenic. Bioaccumulation tests are not planned in support of the Lockheed West ERA. The evaluation of risks to higher trophic ROCs such as crabs, sandpiper, and sculpin will address the potential bioaccumulation of COPCs and resultant risks to ecological receptors.

Key bioaccumulation issues such as for TBT will be addressed by using the regression relationship established for the LDW (Windward 2007b).

Summary of Biological Resources Evaluated in the Risk Assessments

The following is a brief summary of the biological resources that will be evaluated for both the ecological and the human health risk assessments for the Lockheed West site:

- Benthic invertebrate community, including clams
- English sole as: 1) an ROC in the ERA representing benthic fish that primarily consume invertebrates, and 2) seafood consumed by people
- Pacific staghorn sculpin as: an ROC in the ERA representing fish that consume both invertebrates and small fish
- Shiner surfperch as: 1) prey for wildlife ROCs, and 2) seafood consumed by people
- Crabs as: 1) an ROC in the ERA representing larger and more mobile invertebrates, 2) prey for sculpin, and 3) seafood consumed by people
- Clams as: 1) prey for wildlife ROCs, and 2) seafood consumed by people.

As part of the streamlined approach to this risk assessment, all exposure parameters and dietary intake calculations for the Lockheed West ROCs will be taken from the LDW ERA.

11.4.4.2 Effects Assessment

The effects assessment presents toxicity data on potential adverse effects to ROCs from exposures to site-related COPCs. The effects data are used to estimate risks associated with exposure estimates in the risk characterization. The types of effects data depend on the ROC. For example, fish effects data consist of either tissue concentrations related to toxicity (critical tissue residue approach) or dose related to dietary intake toxicity, whereas benthic invertebrate community effects data consist of sediment data related to effects. Fish tissue data or site-specific toxicity tests can also be used to evaluate effects data, but those data are not planned for collection in the Lockheed West ERA. Clam tissue data, if collected to verify the BSAFs used in tissue modeling, may be useful in a future evaluation of clam tissue residue-based effects.

Benthic Invertebrate Community

For the benthic invertebrate community, sediment quality guidelines will form the basis of effects-based sediment concentrations. Sediment quality guidelines will consist primarily of Washington State SMS, and for any COPCs for which SMS are unavailable, dredge

disposal guidelines (USACE et al. 2000) or other federal agency guidelines for marine sediments will be used (e.g., NOAA). For COPCs lacking sediment quality guidelines, toxicity values compiled recently for application to the LDW site will be used (Windward 2007b).

For evaluating TBT in the benthic community, because of the lack of SMS, tissue concentrations have been used for comparison with tissue-based toxicity criteria, as recommended by EPA (2000) and used in the Phase 1 ERA for the LDW (Windward 2003a). For the tissue-based TBT assessment, all relevant tissue-based TRVs involving survival, growth, and reproduction are available in the LDW draft Phase 2 baseline ERA report (Windward 2006b).

The most common sublethal endpoints from TBT exposures to benthic invertebrates are growth inhibition, shell chambering in oysters, histological and behavioral abnormalities, and imposex in prosobranch gastropods. Molluscs appear to be the most sensitive taxon to TBT, primarily due to their weak ability to metabolize this compound and their high rate of uptake. Studies have noted that many of the sublethal responses reported for TBT exposure would eventually lead to death of the organism in the environment (Meador et al. 2002). NOAA's National Marine Fisheries Service (NMFS) has determined that a threshold concentration of 6 mg/kg OC-norm will result in adverse effects to prey species of salmonids (Meador et al. 2002). The NMFS sediment concentration of TBT will be used as a protective value to compare with concentrations measured in sediment at the Site.

In addition to sediment criteria, toxicity thresholds for imposex in gastropods related to TBT in sediment in the LDW will be applied to Lockheed West sediment. In the LDW ERA, the basis of the assessment of risk to gastropods was the level of imposex observed in field-collected gastropods (Windward 2007b). The range of concentrations of TBT in LDW sediments in areas where gastropods were found was insufficient to result in a level of imposex to present a risk of sterilization, and hence of causing population-level effects. The associated sediment levels of TBT can be assumed to represent a range of field-based imposex endpoint concentrations applicable to the Lockheed West sediments. The results of the gastropod field observations in the LDW will be used as the effects endpoint in the comparison of TBT concentrations in Lockheed West sediments with those in LDW sediments.

Because of the plans to actively remediate the entire sediment Site, sediment toxicity testing will not be conducted as part of the streamlined approach to the ERA. Existing toxicity test results are considered to be out-dated and will not be used in the ERA.

Crabs

For crabs, a critical tissue residue approach will be used to assess effects from exposure to sediment-associated COPCs. Tissue-based TRVs associated with survival, growth, and reproduction will be the TRVs compiled in the LDW Phase 2 ERA (Windward 2007b).

Fish

For fish, toxicity criteria will be selected as concentrations in tissue or as doses associated with adverse effects and with no effects on the population-level endpoints of survival, growth, and reproduction. Toxicity criteria for fish will be the TRVs compiled in the LDW ERA (Windward 2007b).

Wildlife

For sandpiper, dietary intake-based TRVs from the LDW ERA (Windward 2007b) will be used, as developed from recently compiled toxicity data.

11.4.5 Ecological Risk Characterization

The risk characterization section of the Lockheed West baseline ERA will estimate risks to the ROCs that may contact COPCs in sediment, and will present an assessment of uncertainties in the various parts of the RA for each ROC. The typical approach to estimating risks is to compare the effects-based toxicity criteria (i.e., TRVs) with exposure data for the COPC. As per EPA guidance, TRVs based on no effects and on effects will be compared to the EPC to calculate hazard quotients (HQs). For this ERA, where ROCs and COPCs are the same or similar as in the ERA for the LDW site, comparisons of chemical concentration data for Lockheed West sediment will be made with TRVs and toxicity-based criteria identified or developed in the LDW ERA.

The comparison of exposure concentrations to TRVs, and quantitation as HQs, will be performed for each of the benthic invertebrate, fish, and wildlife ROCs. For fish, HQs may be derived from comparison of whole body tissue concentrations of COPCs with appropriate TRVs, or from concentrations of COPCs in dietary items with appropriate dietary TRVs.

For TBT, risks to gastropods will be based on a comparison of sediment levels of TBT at Lockheed West with those in sediments of the LDW in the area nearest Harbor Island that were found to be below risk levels for gastropod reproductive effects. The LDW ERA based the assessment of risk to gastropods on the level of imposex observed in field-collected gastropods (Windward 2007b). Exceedance by Lockheed West sediment TBT

concentrations of the range of endpoint-related concentrations in LDW sediments may constitute a risk to gastropods, but the lower threshold for effects, i.e., a low-observed-effect-concentration for sterility in gastropods collected from the LDW is unknown. In addition, risks to benthic invertebrates will be evaluated by comparing sediment concentrations with the toxicity-based value identified in Meador et al. (2002), as described above as a screening criterion for TBT.

Should TBT concentrations in Lockheed West sediments exceed the gastropod endpoint-related concentrations in LDW sediments, risks to gastropods may be further evaluated, or may be deemed unacceptable under the streamlined approach to the ERA with no further evaluation. Further evaluation could consist of comparison of bulk sediment concentrations of TBT with evidence for a bulk sediment threshold for gastropod effects. Data from the bioaccumulation tests for the West Waterway OU ERA (ESG 1999), and other data from that site, will be examined for possible bulk sediment threshold relationships (EVS 1999a,b). Should further assessment of TBT be necessary, porewater and/or gastropod tissue concentrations of TBT may be determined for comparison with the porewater and tissue residue threshold values recommended by EPA (1999b).

Risks to the benthic invertebrate community from exposures to TBT in sediment will also be evaluated following the approach in the ERA for the LDW site. A regression relationship was established in the draft ERA between sediment TBT and benthic invertebrate TBT concentrations, which can be used to model TBT concentrations in benthic invertebrates related to sediment at Lockheed West. The modeled tissue concentrations could then be compared with the TRV identified for the benthic invertebrates in the LDW ERA and with a tissue-based TRV for gastropods.

11.4.6 Uncertainty Assessment

Uncertainties inherent in the problem formulation, exposure and effects assessment, and risk characterization will be discussed in the uncertainty assessment. The discussion of uncertainties in the problem formulation will focus on selection of ROCs, assessment endpoints, exposure pathways, and quantitation of exposures. The discussion of uncertainties in the exposure assessment will focus on the availability or relevance of site-specific data to estimate or measure exposure, as well as parameters used in modeling exposure. The discussion of uncertainties in the effects assessment will focus on the availability and relevance of toxicological data for COPCs and ROCs evaluated in the ERA. The possible magnitude and direction of the uncertainties will be discussed.

Table 11-1. Laboratory Method Detection Limits and Reporting Limits

Method and Analyte	RL[1/] (mg/kg dw)	MDL[1/] (mg/kg dw)	Sediment ACG[2/] (mg/kg dw)
EPA Method 8270C -low level			
PAHs			
Acenaphthylene	0.02	0.00909	0.33
Benzo(a)anthracene	**0.02**	**0.00834**	0.0052
Benzo(a)pyrene	**0.02**	**0.00731**	0.00076
Benzo(b)fluoranthene	**0.02**	**0.00734**	0.0047
Benzo(k)fluoranthene	0.02	0.0104	0.047
Total benzofluoranthenes[3/]	0.02	0.0104	1.2
Benzo(g,h,i)perylene	0.02	0.00804	0.16
Chrysene	0.02	0.00809	0.48
Dibenzo(a,h)anthracene	0.02	0.00835	0.06
Fluoranthene	0.02	0.00849	0.80
Indeno(1,2,3-cd)pyrene	**0.02**	**0.00854**	0.0029
Phenanthrene	0.02	0.00863	0.50
Pyrene	0.02	0.00872	5.0
Acenaphthene	0.02	0.00936	0.08
Anthracene	0.02	0.00869	1.1
Fluorene	0.02	0.00917	0.12
Naphthalene	0.02	0.00753	0.50
2-Methylnaphthalene	0.02	0.00721	0.19
Dibenzofuran	0.02	0.00795	0.075
Total LPAHs [4/]	0.02	0.00936	1.9
Total HPAHs [5/]	0.02	0.0104	4.8
Total PAHs [6/]	0.02	0.0104	1,410
Other SVOCs			
1-Methylnaphthalene[12/]	0.02	0.00691	na
1,2,4-Trichlorobenzene	**0.02**	**0.00588**	0.0041
1,2-Dichlorobenzene	**0.02**	0.00876	0.012
1,3-Dichlorobenzene	0.02	0.00755	0.17
1,4-Dichlorobenzene	**0.02**	0.00816	0.016
2-Methylnaphthalene[12/]	0.02	0.0183	na
2-Methyl-4,6-dinitrophenol (4,6-dinitro-o-cresol)[12/]	0.2	0.11	na
2-Nitroaniline[l]	0.1	0.0542	na
2-Nitrophenol[l]	0.1	0.00878	na
2,4,5-Trichlorophenol	0.10	0.00834	610
2,4,6-Trichlorophenol	0.10	0.010	0.61
2,4-Dichlorophenol	0.10	0.00773	18
2,4-Dimethylphenol	0.02	0.01052	0.029
2,4-Dinitrophenol	0.20	0.1042	12
2,4-Dinitrotoluene	0.10	0.00897	12
2,6-Dinitrotoluene	0.10	0.01073	6.1
2-Chloronaphthalene	0.02	0.00832	490
2-Chlorophenol	0.20	0.00948	6.3
2-Methylphenol	0.02	0.0138	0.063
3,3'-Dichlorobenzidine	0.10	0.0617	1.1

Table 11-1. Laboratory Method Detection Limits and Reporting Limits (continued)

Method and Analyte	RL[1/] (mg/kg dw)	MDL[1/] (mg/kg dw)	Sediment ACG[2/] (mg/kg dw)
3-Nitroaniline[12/]	0.1	0.0532	na
4-Bromophenyl phenyl ether[12/]	0.02	0.0129	na
4-Chloro-3-methylphenol[12/]	0.1	0.0101	na
4-Chlorophenyl phenyl ether[12/]	0.02	0.012	na
4-Nitroaniline[12/]	0.1	0.0255	na
4-Nitrophenol[12/]	0.1	0.037	na
4-Chloroaniline	0.10	0.0257	24
4-Methylphenol	0.10	0.0135	0.67
Aniline	0.02	0.00912	85
Benzoic acid	0.20	0.105	0.65
Benzyl alcohol	0.40	0.041	0.057
Bis(2-chloroethoxy)methane[12/]	0.02	0.0123	na
Bis(2-chloroethyl)ether	0.02	0.00993	0.21
Bis(2-ethylhexyl)phthalate	0.02	0.0108	0.24
Bis-chloroisopropyl ether	0.02	0.00996	2.9
Butyl benzyl phthalate	0.02	0.0103	0.025
Di-ethyl phthalate	0.02	0.135	0.31
Dimethyl phthalate	0.02	0.0120	0.27
Di-n-butyl phthalate	0.02	0.0135	1.1
Di-n-octyl phthalate	0.02	0.0113	0.29
Hexachlorobenzene[9/]	**0.02**	**0.00928**	0.0019
Hexachlorobutadiene[9/]	0.02	0.00828	0.02
Hexachlorocyclopentadiene[12/]	0.10	0.0445	na
Hexachloroethane	0.02	0.00798	0.12
Isophorone	0.02	0.00738	510
Nitrobenzene	0.02	0.0159	2.0
N-Nitrosodimethylamine	**0.10**	**0.00912**	0.0095
N-Nitrosodi-n-propylamine	**0.10**	0.0102	0.069
N-Nitrosodiphenylamine	0.02	0.0107	0.055
Pentachlorophenol	0.10	0.0371	0.36
Phenol	0.02	0.00947	0.42
EPA Method 8082			
Aroclor 1016	**0.02**	0.00098	0.0061
Aroclor 1221	**0.02**	**0.00098**	0.00021
Aroclor 1232	**0.02**	**0.00098**	0.00021
Aroclor 1242	**0.02**	**0.00098**	0.00021
Aroclor 1248	**0.02**	**0.00098**	0.00021
Aroclor 1254	**0.02**	**0.00098**	0.00021
Aroclor 1260	**0.02**	**0.00098**	0.00021
Total PCBs [7/]	**0.02**	**0.00098**	0.00021
EPA Method 6020 (except as noted)			
Antimony	0.20	0.005	3.1
Arsenic	**0.20**	**0.02**	0.006
Cadmium	**0.20**	**0.02**	0.003
Chromium (EPA 6010B)	0.50	0.09	100
Cobalt	0.30	0.03	900
Copper (EPA 6010B)	0.20	0.04	1.3
Lead	2.00	0.12	40

Table 11-1. Laboratory Method Detection Limits and Reporting Limits (continued)

Method and Analyte	RL[1/] (mg/kg dw)	MDL[1/] (mg/kg dw)	Sediment ACG[2/] (mg/kg dw)
Molybdenum	0.50	0.06	39
Nickel	1.00	0.38	140
Selenium	5.00	0.3	14.9
Silver	0.30	0.03	6.1
Thallium	0.20	0.003	0.52
Vanadium (EPA 6010B)	0.30	0.03	55
Zinc (EPA 6010B)	0.60	0.29	16
EPA Method 7471A			
Mercury	**0.05**	0.003	0.016
TBT Method - Krone 1989			
Di-n-butyltin[12/]	0.006	0. 00479	na
n-Butyltin[12/]	0.006	0.00451	na
Tri-n-butyltin	**0.006**	0.00284	0.00028
EPA Method 8081A			
4,4'-DDD	0.002	0.000320	0.0083
4,4'-DDE	0.002	0.000166	0.0026
4,4'-DDT	**0.001**	0.000284	0.00092
2,4'-DDD	0.002	0.0011	0.0083
2,4'-DDE	0.002	0.000894	0.0026
2,4'-DDT	0.002	0.000870	0.00092
Total DDT[10/]	**0.002**	**0.0011**	0.00092
Aldrin	**0.001**	0.000054	0.000063
alpha-BHC	**0.001**	0.000214	0.09
beta-BHC	0.001	0.000045	0.00063
delta-BHC[12/]	0.001	0.00002	na
alpha-Chlordane	0.001	0.000144	0.01
gamma-Chlordane[12/]	0.001	0.00012	na
Total chlordane[11/]	0.001	0.000964	0.0017
Dieldrin	**0.001**	**0.000049**	0.000033
Endosulfan	0.001	0.000129	0.50
Endrin	0.002	0.00024	0.027
gamma-BHC (Lindane)	**0.001**	0.000141	0.00083
Heptachlor	**0.001**	0.000027	0.00025
Heptachlor epoxide	0.001	0.000122	0.053
Hexachlorobenzene	0.001	0.000034	0.0019
Oxy-chlordane[12/]	0.002	0.00012	na
trans-Nonachlor[12/]	0.002	0.000024	na
cis-Nonachlor[12/]	0.002	0.000055	na
Methoxychlor	0.010	0.000402	0.44
Mirex	0.002	0.00122	0.27
Toxaphene	0.100	0.0297	0.44
EPA Method 1668			
PCB-77 [8/]	2.0E-6	3.9E-7	3.5E-3
PCB-81 [8/]	2.0E-6	3.9E-7	3.5E-3
PCB-105 [8/]	2.0E-6	4.4E-7	3.5E-3
PCB-114 [8/]	2.0E-6	4.6E-7	7.0E-4
PCB-118 [8/]	2.0E-6	3.7E-7	3.5E-3
PCB-123 [8/]	2.0E-6	9.5E-7	3.5E-3
PCB-126 [8/]	2.0E-6	2.1E-7	3.5E-6
PCB-156 [8/]	2.0E-6	6.6E-7	7.0E-4

Table 11-1. Laboratory Method Detection Limits and Reporting Limits (continued)

Method and Analyte	RL[1/] (mg/kg dw)	MDL[1/] (mg/kg dw)	Sediment ACG[2/] (mg/kg dw)
PCB-157 [8/]	2.0E-6	6.6E-7	7.0E-4
PCB-167 [8/]	2.0E-6	3.5E-7	3.5E-2
PCB-169 [8/]	2.0E-6	4.4E-7	3.5E-2
PCB-189 [8/]	2.0E-6	3.4E-7	3.5E-3
EPA Method 1613B			
2,3,7,8-TCDD	1.0E-6	5.9E-8	3.5E-07
1,2,3,7,8-PeCDD[8/]	5.0E-6	1.53E-7	3.5E-07
1,2,3,4,7,8-HxCDD[8/]	5.0E-6	1.72E-7	7.0E-07
1,2,3,6,7,8-HxCDD[8/]	5.0E-6	1.18E-7	3.5E-06
1,2,3,7,8,9-HxCDD[8/]	5.0E-6	1.72E-7	3.5E-06
1,2,3,4,6,7,8-HpCDD[8/]	5.0E-6	1.69E-7	3.5E-06
OCDD[8/]	1.0E-5	5.18E-7	3.5E-06
2,3,7,8-TCDF[8/]	1.0E-6	7.7E-8	3.5E-06
1,2,3,7,8-PeCDF[8/]	5.0E-6	1.32E-7	3.5E-06
2,3,4,7,8-PeCDF[8/]	5.0E-6	1.43E-7	3.5E-06
1,2,3,4,7,8-HxCDF[8/]	5.0E-6	1.48E-7	3.5E-06
1,2,3,6,7,8-HxCDF[8/]	5.0E-6	1.54E-7	7.0E-06
1,2,3,7,8,9-HxCDF[8/]	5.0E-6	1.48E-7	3.5E-05
2,3,4,6,7,8-HxCDF[8/]	5.0E-6	9E-8	3.5E-05
1,2,3,4,6,7,8-HpCDF[8/]	5.0E-6	1.83E-7	3.5E-05
1,2,3,4,7,8,9-HpCDF[8/]	5.0E-6	8.1E-8	0.0035
OCDF[8/]	1.0E-5	3.81E-7	0.0035

Note: RLs or MDLs in BOLD are greater than at least one of their respective ACGs. All of the ACGs that are lower than RLs or MDLs are based on human health RBCs, with the exception of the following four chemicals, which are based on benthic invertebrate RBCs: 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and hexachlorobenzene.
RL – reporting limit
MDL – method detection limit
ACG – analytical concentration goal
mg/kg dw – milligrams per kilogram dry weight
na – not available

[1/] RLs, MDLs, and ACGs from LDWG Surface QAPP (LDWG 2005)
[2/] ACG for sediment is the lowest of the RBCs for benthic invertebrates, spotted sandpipers, and humans.
[3/] Total benzofluoranthenes is the sum of benzo(b)fluoranthene and benzo(k)fluoranthene. RL and MDL are the highest of the RLs and MDLs for benzo(b)fluoranthene or benzo(k)fluoranthene.
[4/] Total LPAHs is the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. RL and MDL are the highest RL and MDL for the LPAHs. 2-methyl naphthalene is not included in the LPAH definition under the SMS and under the DMMP.
[5/] Total HPAHs is the sum of fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. RL and MDL are the highest RL and MDL for the HPAHs.
[6/] Total PAHs is the sum of the LPAHs and the HPAHs. RL and MDL are the highest RL and MDL for either the LPAHs or HPAHs.
[7/] Total PCBs is the sum of the Aroclors. RL and MDL are the highest RL and MDL for the individual Aroclors.
[8/] Dioxin-like PCB and dioxin/furan congeners will be evaluated as toxic equivalents (TEQs) in the risk assessments, rather than as individual congeners. However, because TEQs are calculated, rather than measured by the laboratory, RBCs for individual congeners are presented to facilitate comparison with RLs for those congeners. In reality, risks will be assessed based on sums of these congeners (normalized per their relative toxicity to TCDD), and thus comparison to RLs on a congener-specific basis is somewhat uncertain.
[9/] Hexochlorobenzene and Hexachlorobutadiene are also analyzed with 8081A to obtain lower DLs
[10/] Total DDT is the sum of 4,4'-DDD, 4,4-DDE, 4,4'-DDT, 2,4'-DDD, 2,4-DDE, and 2,4'-DDT. RL and MDL are the highest RL and MDL for the DDT isomers.
[11/] Total chlordane is the sum of oxychlordane, alpha- and gamma-chlordane, and cis- and trans-nonachlor. RL and MDL are the highest RL and MDL for the chlordane-related compounds.
[12/] RLs and MDLs from LDWG Subsurface QAPP (LDWG 2006)

Table 11-2. Receptor-Specific Risk-Based Criteria for Screening Sediment

Analyte	Receptor-Specific Sediment RBC (MG/KG DW)				
	Human Health[1/]			Spotted Sandpiper	
	Indirect Exposure	Direct Exposure[2/]	Benthic Invertebrates[3/]	LOAEL-based	NOAEL-based
PAHs					
Acenaphthene	[4/]	370	0.08	na	na
Acenaphthylene	na	na	0.33	na	na
Anthracene	900	2,200	1.1	na	na
Benzo(a)anthracene	0.0052	0.15	0.55	na	na
Benzo(a)pyrene	0.00076	0.015	0.50	na	na
Benzo(b)fluoranthene	0.0047	0.15	na	na	na
Benzo(g,h,i)perylene	na	na	0.16	na	na
Benzo(k)fluoranthene	0.047	1.5	na	na	na
Benzofluoranthenes (total)	na	Na	1.2	na	na
Chrysene	0.48	62	0.50	na	na
Dibenzo(a,h)anthracene	[4/]	0.015	0.06	na	na
Fluoranthene	2.1	230	0.80	na	na
Fluorene	[4/]	260	0.12	na	na
Indeno(1,2,3-cd)pyrene	0.0029	0.15	0.17	na	na
2-Methylnaphthalene	na	na	0.19	na	na
Naphthalene	na	5.6	0.50	na	na
Phenanthrene	na	na	0.50	na	na
Pyrene	8.9	230	5.0	na	na
Dibenzofuran	na	15	0.075	nd	nd
Total LPAHs	na	na	1.9	na	na
Total HPAHs	na	na	4.8	na	na
Total PAHs	na	na	na	1,410	na
Other SVOCs					
1,2,4-Trichlorobenzene	[4/]	6.8	0.0041	nd	nd
1,2-Dichlorobenzene	370	12	0.012	na	na
1,3-Dichlorobenzene	d	3.5	0.17	nd	nd
1,4-Dichlorobenzene	0.073	3.2	0.016	nd	nd
2,4,5-Trichlorophenol	na	610	na	nd	nd
2,4,6-Trichlorophenol	0.61	44	na	nd	nd
2,4-Dichlorophenol	na	18	na	nd	nd
2,4-Dimethylphenol	na	120	0.029	nd	nd
2,4-Dinitrophenol	na	12	na	nd	nd
2,4-Dinitrotoluene	na	12	na	nd	nd
2,6-Dinitrotoluene	na	6.1	na	nd	nd
2-Chloronaphthalene	na	390	na	nd	nd
2-Chlorophenol	na	6.4	na	nd	nd
2-Methylphenol	na	310	0.063	na	na
3,3'-Dichlorobenzidine	na	1.1	na	nd	nd
4-Chloroaniline	na	24	na	nd	nd
4-Methylphenol	na	31	0.67	nd	nd
Aniline	na	85	na	nd	nd
Benzoic acid	na	24,000	0.65	na	na
Benzyl alcohol	na	1,800	0.057	na	na
Bis(2-chloroethyl)ether	na	0.21	na	nd	nd
Bis(2-chloroisopropyl)ether	na	2.9	na	na	na
Bis(2-ethylhexyl)phthalate	na	35	0.24	12,400	53

Table 11-2. Receptor-Specific Risk-Based Criteria for Screening Sediment (continued)

Analyte	Receptor-Specific Sediment RBC (MG/KG DW)				
	Human Health[1/]			Spotted Sandpiper	
	Indirect Exposure	Direct Exposure[2/]	Benthic Invertebrates[3/]	LOAEL-based	NOAEL-based
Butyl benzyl phthalate	na	1,200	0.025	na	na
Di-ethyl phthalate	na	4,900	0.31	nd	nd
Dimethyl phthalate	na	61,000	0.27	nd	nd
Di-n-butyl phthalate	na	610	1.1	na	na
Di-n-octyl phthalate	na	na	0.29	nd	nd
Hexachlorobenzene	na	0.3	0.0019	110	na
Hexachlorobutadiene	0.023	6.2	0.02	na	166
Hexachloroethane	0.12	35	1.4	nd	nd
Isophorone	na	510	na	nd	nd
Nitrobenzene	na	2	na	nd	nd
N-Nitrosodimethylamine	na	0.0095	na	nd	nd
N-Nitrosodi-n-propylamine	na	0.069	na	nd	nd
N-Nitrosodiphenylamine	na	99	0.055	nd	nd
Pentachlorophenol	na	3	0.36	2,220	775
Phenol	na	1,800	0.42	na	na
PCBs					
Aroclor 1016	0.0061	0.39	na	na	na
Aroclor 1221	0.00021	0.22	na	na	na
Aroclor 1232	0.00021	0.22	na	na	na
Aroclor 1242	0.00021	0.22	na	na	na
Aroclor 1248	0.00021	0.22	na	na	14.5
Aroclor 1254	0.00021	0.11	na	33.2	na
Aroclor 1260	0.00021	0.22	na	na	na
Total PCBs	0.00021	0.22	0.06	na	na
Metals					
Antimony	na	3.1	150	na	na
Arsenic	0.006	0.39	57	1,374	705
Cadmium	0.003	3.9	5.1	1,656	705
Chromium	100	210	260	3,700	271
Cobalt	na	140	na	na	na
Copper	1.3	290	390	2,185	1,656
Lead	na	40	450	707	70.5
Mercury	0.016	2.3	0.41	3.2	na
Molybdenum	na	39	na	1248	na
Nickel	[4/]	160	140	3,771	2,714
Selenium	[4/]	39	na	29	14.9
Silver	[4/]	39	6.1	na	na
Thallium	na	0.55	na	nd	nd
Tri-n-butyltin	0.00028	1.8	0.0085	598	241
Vanadium	na	39	na	na	na
Zinc	16	2,300	410	4,335	2,890
Pesticides					
4,4'-DDD	0.0083	2.4	na	31.8	na
4,4'-DDE	0.0026	1.7	na	9.9	4.6
4,4'-DDT	0.00092	1.7	na	35.4	31.8
Total DDT	0.00092	1.7	0.0069	na	na
Aldrin	0.000063	0.029	0.01	1.41	na

Table 11-2. Receptor-Specific Risk-Based Criteria for Screening Sediment (continued)

Analyte	Receptor-Specific Sediment RBC (mg/kg dw)				
	Human Health[1/]			Spotted Sandpiper	
	Indirect Exposure	Direct Exposure[2/]	Benthic Invertebrates[3/]	LOAEL-based	NOAEL-based
alpha-BHC	[4/]	0.09	na	na	na
beta-BHC	0.00063	0.32	na	na	na
alpha-Chlordane	na	na	0.01	na	na
Chlordane[5/]	0.0017	1.6	na	1,938	49.3
Dieldrin	0.000033	0.03	0.01	16.6	8.46
Endosulfan	0.50	37	na	na	743
Endrin	0.027	1.8	na	9.9	5.66
gamma-BHC (Lindane)	0.00083	0.44	0.01	127	56.6
Heptachlor	0.00025	0.11	0.01	nd	nd
Heptachlor epoxide	[4/]	0.053	na	nd	nd
Methoxychlor	0.44	31	na	na	na
Mirex	[4/]	0.27	na	1,202	636
Toxaphene	[4/]	0.44	na	nd	nd

Note: RBCs for protection of fish and crab are not presented. Sediment risk-based threshold concentrations (RBTCs) associated with acceptable fish or crab tissue concentrations based on critical residue levels will be taken from the RI report for the LDW site, as available.

na – toxicity data not available or not applicable if not a bioaccumulative chemical for indirect sediment exposures, or SQS/SL values were not available

nd – not determined because it was not considered a chemical of interest for spotted sandpipers

[1/] The RBC for a given chemical may be derived from either carcinogenic or non-carcinogenic endpoints. For chemicals with both endpoints, the lower RBC is shown. RBCs for indirect exposures to sediment are based on the clam RBACG from the LDW sediment sampling QAPP, using an ingestion rate of 98 g/day and clam BSAFs to relate acceptable tissue concentrations to sediment.

[2/] RBCs for direct sediment contact are residential-based criteria for child beach play and clamming exposures; industrial-based criteria for application to netfishing are higher than these values and are not shown. Direct exposure screening criteria are updated with Region 6 values for residential exposures to soil (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm); the lower of criteria for carcinogenic or noncarcinogenic effects are shown, with criteria for noncarcinogenic effects modified by a factor of 0.1; lead criterion for direct exposure is based on Region 9 2004 residential value.

[3/] RBCs for benthic invertebrates are equivalent to the SQS/SL for chemicals with standards expressed on a dry weight basis. For chemicals with standards expressed on an organic-carbon normalized basis, an average LDW organic carbon content of 0.5% was assumed to convert the standards to dry weight.

[4/] This chemical was identified as an important bioaccumulative chemical by EPA (2000), but no BSAF is available, so no RBC for indirect exposure was calculated.

[5/] RBCs for chlordane for human health and spotted sandpiper are based on toxicity of mixtures of chlordane-related compounds (e.g., alpha- and gamma-chlordane, cis- and trans-nonachlor).

Source: Adapted from RBACGs in the Quality Assurance Project Plan for sampling sediments at the LDW site (Windward 2005a), as updated with Region 6 RBCs. BSAFs were developed in the LDW document from a mix of sources identified herein in Section 11.3.1.3.

Table 11-3. Exposure Point Concentration Data Types for HHRA

Exposure Scenario	Media of Exposure	Pathway of Exposure	Data Type	Modeling Approach
Tribal Netfishing	Sediment (intertidal + subtidal, site-wide)	Ingestion/Direct Contact	Sampling Data Tetra Tech 2007	na
Beach Play, Clamming	Sediment (intertidal, site-wide)	Ingestion/Direct Contact	Sampling Data Tetra Tech 2007	na
Tribal Seafood Consumption	Fish (benthic, pelagic)	Ingestion	Modeled from site-wide sediment data	BSAF
	Crabs (meat, whole body)	Ingestion	Modeled from site-wide sediment data	BSAF
	Clams	Ingestion	Modeled from intertidal sediments	BSAF

na – not applicable
BSAF – biota-sediment accumulation function

Table 11-4. Measures of Exposure and Data Types for the Lockheed West ERA

Ecological Receptor	Measure of Exposure[1/]	Use in Risk Characterization	Data Type	Modeling Approach[3]
Benthic				
Benthic invertebrates, including clams	Sediment (intertidal + subtidal)	Comparison with sediment criteria	Sampling Data[2/]	na
Crabs	Crab tissue	Comparison with toxicity data for crab tissue	Modeled Tissue	BSAF
Fish				
English sole	Prey (benthic invertebrates)	Dietary exposure, intake calculation	Modeled Tissue	BSAF
	Sediment (intertidal + subtidal)	Dietary exposure, intake calculation	Sampling Data[2/]	na
	Chemicals in English sole tissue	Comparison with toxicity data for fish tissue	Modeled Tissue	BSAF
Pacific staghorn sculpin	Prey (benthic invertebrates, fish)	Dietary exposure, intake calculation	Modeled Tissue	BSAF
	Sediment (intertidal + subtidal)	Dietary exposure, intake calculation	Sampling Data[2/]	na
	Chemicals in sculpin tissue	Comparison with toxicity data for fish tissue	Modeled Tissue	BSAF
Wildlife				
Sandpiper	Prey (benthic invertebrates)	Dietary exposure, intake calculation	Modeled Tissue	BSAF
	Sediment (intertidal)	Dietary exposure, intake calculation	Sampling Data[2/]	na

[1/] Measures of exposure include direct contact or through dietary intake, such as sediment and prey items by fish, or as tissue concentrations in the ROC. Dietary intake measures will be evaluated for those COPCs for which toxicity reference values (TRVs) are based on dietary intake (PAHs and metals except butyltins and mercury), whereas chemicals with whole body tissue TRVs will be evaluated by comparison with tissue levels.
[2/] Sources of sediment sampling data consist of Site data collected in 2007.
[3/] Tissue modeling will use BSAF relationships identified in the LDW ERA or developed from data collected at the LDW site (Windward 2007b,c). For the streamlined approach to this ERA, the FWM that was used in the LDW ERA is not planned for use at the Lockheed West site.

12. SOURCE CONTROL EVALUATION

The Source Control evaluation will identify and assess potential sources of contamination to the Lockheed West Site (Site). The purpose of the source control evaluation is to document the current status of source control and to determine whether there are sources with the potential to recontaminate the Site following its planned remediation.

The objectives of this Source Control Evaluation are to:

1. Identify potential sources and assess the potential pathways and the potential for recontamination of Lockheed West following its remediation.
2. Evaluate whether the resuspension, transport, and deposition of bottom sediments in the adjacent Elliott Bay and West Waterway are a potential ongoing source of chemical contamination that could result in recontamination of Lockheed West after remediation.
3. Qualitatively compare available source information to existing sediment quality data.
4. Identify data gaps that should be resolved so that the status of source control at Lockheed West can be confirmed.
5. Make recommendations to the EPA regarding the need for further investigation or control of identified potential sources.

The Source Control Evaluation approach will be further refined through technical workshops with EPA and the project stakeholders. Details of the Source Control Evaluation approach stemming from the technical workshops will be documented and submitted for review and approval.

12.1 OFFSITE SEDIMENT TRANSPORT AND DEPOSITION AT LOCKHEED WEST

Sediments at Lockheed West can potentially be impacted by a number of potential mechanisms giving rise to elevated chemical concentrations in the sediment including:

- Surface water runoff;
- Outfall discharges of water and sediment to the waterway;
- Direct discharge from vessel leaching and shipyard activities;

- Groundwater flow and discharge within the waterway;
- Transport and deposition of sediment from adjacent Elliott Bay, West Waterway and Lower Duwamish Waterway containing higher concentrations than the Lockheed West cleanup objectives due to resuspension from both natural and vessel induced waves and currents, and
- Atmospheric deposition.

A conceptual model of these mechanisms has been developed as part of the RI/FS Work Plan. Discussion of each of these potential mechanisms for sediment recontamination will be presented. Recontamination potential for each of these potential mechanisms will be evaluated using the available existing data from Lockheed West and the adjacent areas on sediment transport and contaminants of potential concern.

12.2 LOCKHEED WEST UPLANDS SOURCE CONTROL APPROACH

The objective of the source control assessment is to identify if there are uncontrolled sources that will recontaminate the sediments after remediation. For the uplands, the source control assessment will include evaluation of soil, groundwater, storm water, and storm drain sediments. The following approach is proposed for evaluation of these pathways:

- Historical contaminant data for soil and groundwater will be reviewed and summarized to determine a list of potential chemicals of concern and historical ranges of chemical concentrations. These data will be compared against appropriate human health and ecological screening criteria to assist in identifying potential uncontrolled sources.
- A background review of the adjoining PSR superfund site and other nearby sites will be performed to assess potential affects on the Lockheed West remedy.
- A review of storm water drainage information will be performed to determine the locations and conditions of outfalls proximal to the Lockheed West site.
- For selected chemicals, soil partitioning techniques will be used to evaluate potential impacts to marine sediments using maximum groundwater concentrations and accounting for partitioning coefficients.

Based on the findings of the initial source control assessment activities, data collection needs will be summarized and additional data will be collected as appropriate. The findings of the source control assessment will be presented in a report that will be submitted to EPA for approval prior to implementation of the Lockheed West remedy.

13. REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

The Remedial Investigation and Feasibility Study tasks described below will be completed and the results will be presented in a single report, per EPA's direction at the December 18, 2006 planning meeting. Both a draft and final streamlined RI/FS report will be prepared and submitted to EPA for review and approval. The following sections describe the scope of the RI/FS document.

13.1 REMEDIAL INVESTIGATION

An RI section will be prepared that synthesizes the results of all investigations conducted during the RI. All data will be reported in tabular form, and various map overlays and other plots will be used to present the information. The pertinent features of the RI report will be description of the investigations conducted, assessment of data adequacy to meet DQOs (including the rationale and basis for any additional data collection needs, if necessary), summary of the nature and extent of contamination identified, characterization of potential migration pathways, evaluation of contaminant fate and transport and incorporation of the baseline human health and ecological risk assessments. Sources of uncertainty, including internal and external sources, will be documented in the RI report and associated risk assessments. The RI portion of the report outline will follow the EPA guidance.

The RI report will include a summary of all data collected during the remedial investigation and a complete evaluation of the nature and extent of contamination based on RI field data. The final baseline risk assessments for human and ecological health (HHRA and ERA) will also be incorporated into the RI sections and included as appendices. The RI will evaluate the risk implications of potential exposure to subsurface sediments. This discussion will be based on the results of the baseline ERA and HHRA (and data used in these assessments) and subsurface sediment chemistry data. The RI report will specify sediment risk-based goals (RBGs) for cleanup.

The organization of the RI will be very similar to summary of existing data although the content will be updated with additional information and data collected during the RI, results of the risk assessments, and any additional modeling conducted. After the introduction, the main RI section headings will be:

- Environmental setting and previous investigations;
- Summary of nature and extent of contamination;
- Potential contamination sources, pathways, and source control;

- Fate and transport of sediment and sediment-associated chemicals;
- Summaries of baseline ERA and HHRA; and
- Calculation of sediment RBGs for chemical risk drivers.

13.2 REMEDIAL ACTION OBJECTIVES AND REMEDIATION GOALS

A Remedial Action Objective/Remediation Goal (RAO/RG) technical memorandum will be prepared and submitted to EPA for review. It will then be incorporated into the RI/FS report. Its purpose is to revise the preliminary RAOs proposed in the Work Plan and establish site-specific cleanup levels. RAOs will be based on the RGs; ARARs; and the results of the final baseline HHRA and ERA following the approach outlined in Section 6.2. The memorandum will clearly document the rationale and technical basis for the determined clean-up level goals. The memorandum will also identify cleanup area boundaries based on the determined cleanup levels. Areas and volumes of contaminated sediments will be delineated, taking into account requirements for protectiveness as identified in the RAOs. The chemical and physical characterization of the Site will also be taken into account.

13.3 SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS AND ALTERNATIVES ASSEMBLY

Following completion of the baseline HHRA, ERA, the RI and the RAO/RGs sections, remedial alternatives for site sediment cleanup areas will be developed. Identification and screening of remedial technologies and process options and the assembly of representative remedial alternatives for the Lockheed West Site and the methods/results will be documented in the RI/FS Report and limited to capping, dredging, or a combination of dredging and capping as the result of negotiations with EPA. The “no action” alternative and monitored natural recovery will not be considered. The range of alternatives identified will be modified in response to EPA’s comments (if required) to assure identification of a complete and appropriate range of viable alternatives to be considered in the detailed analysis. This deliverable will document the methods, rationale, and results of the technology screening and alternative assembly process.

Remedial alternatives for site sediments will be developed by assembling combinations of sediment-specific technologies into alternatives that address contamination on a site-wide basis. The purpose of this task is to identify and screen remedial technologies for sediments appropriate for conditions at the Site and to assemble representative remedial alternatives to be considered for detailed analysis in the FS section. This process consists of the following four general steps as described below.

- Identify and describe General Response Actions (GRAs) for sediment (the medium of concern), defining removal or containment, singly or in combination, which may be taken to satisfy the RAOs developed for the Site.
- Identify preliminary volumes or areas of sediment to which GRAs might be applied, taking into account the requirements for protectiveness as identified in the RAOs and the specific chemical and physical characteristics of the Site.
- Identify and screen the technologies and process options (e.g., specific processes within each technology type) applicable to each GRA to ensure that only those technologies and process options applicable to the contaminants present, their physical matrix, and other site characteristics will be considered and carried forward into the assembly of alternatives step. This screening will be based primarily on a technologies ability to effectively address the contaminants at the Site, but will also take into account a technology's implementability and cost.
- Combine retained technologies and process options into media-specific or site-wide representative alternatives. The developed alternatives should be defined with respect to size and configuration of the representative process options; time for remediation; rates of flow or treatment; spatial requirements; distances for disposal; and other factors necessary to evaluate the alternatives.

13.3.1 Identification and Description of General Response Actions

GRAs are medium-specific response categories that can be used to satisfy RAOs. GRAs will be developed for sediment, the medium of interest at Lockheed West. The remediation of contaminated sediments can be accomplished using a number of different technologies. As agreed with EPA, GRAs identified for sediment requiring remediation at Lockheed West include:

- Containment (Capping),
- Removal (Dredging),
- Disposal, and
- Beneficial Reuse.

These GRAs will be considered individually during the identification and screening of technology types and process options, and in combination to produce a range of remedial alternatives. Identified GRAs will be briefly introduced in this section.

13.3.2 Determination of Volumes and Areas

Site-specific analytical data will be compared to the PRGs developed for Lockheed West sediment. Areas where sediment contains elevated concentrations of above the PRGs present an unacceptable risk to human and/or ecological receptors at the Site and requires remediation. The estimated areal extent, depth, and volume of sediment requiring remediation will be calculated. These site-specific areas and volumes will be considered during the identification and screening of remedial technologies for this Site.

13.3.3 Identification and Screening of Remedial Technologies and Process Options

Based on site-specific characteristics (including areas and volumes) and GRAs identified above, remedial technologies and process options corresponding to GRAs for contaminated sediment at Lockheed West will be identified, briefly discussed, and screened. Process options are the specific processes within a technology type by which the technology may be implemented. Each process option will be evaluated in a qualitative manner against the evaluation criteria of effectiveness, implementability, and cost following the method suggested by the EPA guidance (EPA 1988a).

Those process options that were ranked “low” in either effectiveness or implementability will be eliminated from further consideration, with the exception of the No Action GRA, which is carried forward into the detailed evaluation in accordance with the NCP.

13.3.4 Assembly of Remedial Alternatives

An array of representative alternatives that ensure protection of human health and the environment will be assembled from retained GRAs, process options, and remedial technologies. The range of alternatives will include but will not be limited too the following:

1. In-place confinement (capping),
2. Dredging with disposal in existing landfills and/or elsewhere, and
3. Options combining aspects of these and/or other alternatives.

The assembled alternatives will be presented in a table listing the corresponding GRA, technology type or process option and the area of volume affected. A detailed description of each alternative will be presented.

13.4 FEASIBILITY STUDY

The FS sections of the RI/FS Report will incorporate applicable results of the RI, the RAO/PRG, and the Screening of Remedial Technologies and Process Options and Alternatives Assembly. The FS section will provide the basis for remedy selection by EPA and will document the development and detailed analysis of remedial alternatives.

Each of the remedial alternatives assembled and presented in the Screening of Remedial Technologies and Process Options and Alternatives Assembly section will be evaluated using the CERCLA evaluation criteria (EPA 1988a).

For each alternative assembled and presented in the described in Screening of Remedial Technologies and Process Options and Alternatives Assembly section, the FS section will include:

- A detailed description of each alternative that outlines the sediment management strategy involved and identifies the degree of protectiveness and key ARARs associated with that alternative; and
- An assessment of each alternative against each of the CERCLA criteria except Criteria 8 (state acceptance) and 9 (community acceptance) which will be addressed by EPA after the RI/FS report has been released to the public.

13.4.1 Alternatives Descriptions

A brief description of each of the remedial alternatives developed to address the sediment RAOs will be presented.

13.4.2 Detailed Analysis of Alternatives

A detailed analysis of each remedial alternative will be performed in accordance with the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988a) with respect to the first seven of the nine CERCLA evaluation criteria. The evaluation criteria include the following:

1. Overall protection of human health and the environment;
2. Compliance with ARARs;
3. Long-term effectiveness and permanence;
4. Reduction in toxicity, mobility, or volume;
5. Short-term effectiveness;

6. Implementability; and
7. Costs.

The capital costs, operation and management (O&M) costs, periodic costs, net present value in 2007 dollars, and the expected range of total present worth in 2007 dollars at the FS level (-30 percent to + 50 percent) of each alternative evaluated for Lockheed West will be calculated. Cost estimate summaries will be provided for each alternative. A discussion of the key assumptions used in the development of the cost estimates is also provided.

13.4.3 Comparative Evaluation of Alternatives

This section will include a comparative analysis of the remedial alternatives. The analysis will evaluate the relative performance of each alternative with respect to the first seven of the nine CERCLA evaluation criteria. The alternative that could perform best overall in each category will presented first, followed by other alternatives discussed in the relative order of potential performance.

13.4.4 Recommended Remedial Alternative for Lockheed West Sediments

Based on the detailed comparative evaluation of the remedial alternatives, one alternative will be recommended to EPA for implementation at Lockheed West. The alternative recommended must score very high with respect to the CERCLA evaluation criteria and must meet the site-specific RAOs and ARARs in addition to being cost-effective.

14. COMMUNITY INVOLVEMENT ACTIVITIES

Participation by Lockheed Martin and their contractors in community involvement activities will be initiated at the request of EPA. EPA is the lead for all these activities. Specific support activities have not been identified, but we anticipate supporting EPA's community involvement activities related to the Lockheed West SOW by 1) providing information and data in formats easily understandable by the public, 2) attending and participating in public meetings which may be held or sponsored by EPA to explain activities at or concerning Work performed pursuant to the ASAOC/SOW, and 3) any other activities requested by EPA.

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1. SUMMARY OF EXISTING ENVIRONMENTAL DATA

This Appendix presents the compilation of existing environmental data relevant for the Lockheed West Site. Most of the data was collected under non-EPA regulatory programs. These data have not been independently validated by LMC and will not be used in isolation of newly acquired data for cleanup decisions. The existing data is assumed however, to have been collected using appropriate quality assurance procedures for the regulatory process for which it they were collected. Therefore, the data is presented for informational purposes in establishing existing site conditions to inform future sampling activities; define the environmental history of the Site; and to summarize relevant, previously completed risk assessments at the Site and the LDW.

Additional historical related data and/or conducted studies are located in Appendices A.1 to A.5 (on attached CD).

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2. SUMMARY OF EXISTING GROUNDWATER AND SOIL CONDITIONS AT THE FORMER SHIPYARD UPLANDS

2.1 GROUNDWATER QUALITY MONITORING DATA

Preliminary groundwater monitoring at the Lockheed West Site began in 1989 by McLaren Engineering and Enviros Corporation (McLaren 1989, Enviros 1989). During the summer of 1990, further groundwater characterization was conducted (McLaren-Hart 1990, Enviros 1990). Groundwater data are summarized in the Enviros Distillation Report (see Appendix A-3) and McLaren Hart and Enviros Remedial Investigation Work at the Former Lockheed Shipyard (Yard II) in West Seattle, Washington.

Currently there are seven groundwater monitoring well locations (Figure A.2-1). Four are located near the Lockheed West areas, including one just south of pier 24, one east of pier 23, and two near the southeast corner of the Site. The Port of Seattle has not performed groundwater quality monitoring at these wells as part of the long-term remediation monitoring. The Port is currently working with Ecology to finalize a long-term groundwater monitoring program for the site.

In summary, groundwater at the Site has had relatively minimal impact from soils contamination with typically only one or two compounds of concern showing up in each affected well. The majority of wells showing concentrations of contamination above MTCA Method A cleanup criteria and drinking water quality standards were located near the west property boundary. Three wells in the interior, one near a former underground storage tank (UST), one near an oil/water separator, and one in a stream cleaning area contained slightly elevated levels of chlorinated or aromatic volatile organics. Results of chemical analyses on groundwater yielded dissolved petroleum hydrocarbons in only one well on site, a deep well near the western boundary; free-phase hydrocarbons were not present in any monitoring wells. Analyses also indicated slightly elevated xylene levels in one of the four wells adjacent to a gasoline UST (now removed) and elevated 1,2-dichloroethylene in two wells. Elevated concentrations of heavy metals were present in wells along the western boundary and exceeded groundwater cleanup criteria for arsenic, cadmium, copper, lead, and zinc. Mercury cleanup criteria were exceeded in one well.

2.2 SOIL QUALITY DATA

The Port's Terminal 5 expansion project, completed in 1998, involved the remediation of the uplands portion of the Site, with the objective of removing the Site as potential source of continuing contamination to the environment and to complete the Port's obligations from the acquisition of the shipyard property from Lockheed. Prior to this, upland remedial

investigation work had been conducted between 1988 and 1992 by McLaren-Hart, on behalf of Lockheed, and Enviros on behalf of the Port. Documents containing and summarizing the RI work and associated data upon which the Terminal 5 uplands remediation activities were based include McLaren-Hart (1992) and Enviros (1991, 1992a,b).

The work by McLaren-Hart, which incorporates data collected by Enviros collected in 1991, was directed towards determining the magnitude and extent of contamination in site upland soil, groundwater, and storm drain sediments. Soil samples were obtained from approximately 222 locations around 35 potential sources areas on site using grab sampling, drill rig, and hand auguring techniques.

Metals and TPH were the most ubiquitous compounds; however, numerous others were detected. The majority of TPH contamination found in soils occurred above the water table and some soils contained hydrocarbons in excess of the state MTCA Method A cleanup criteria of 200 ppm for diesel and heavier hydrocarbons, and 100 ppm for gasoline and light hydrocarbons. Sandblast grit, slag, and soils located on the Site contained metals and in a few instances the concentrations exceeded MTCA Method A cleanup criteria for total metals in industrial soils. Although these contaminated soils were found throughout the Site, they occurred predominantly in the eastern portion of the upland area.

Results of the prior site investigations were used during the feasibility study for the Terminal 5 expansion project to identify COCs and cleanup levels for the Site. Site-wide COCs were identified for the uplands area of the Site based on the chemical toxicity and distribution of the contaminants. Six contaminant assemblages were identified, including five associated with upland vadose zone soils (grit/metals, metals, TPH/CPAHs, slag-THP/metals, and slag-metals) and storm drain sediments (Enviros 1993). Remediation activities included excavation and additional cleanup of vadose zone soils and storm drain sediments, long-term monitoring of site ground water, and the removal of the existing storm drain system. Soil excavation sites are illustrated in Figure A.2-1.

Legend

1998 and Earlier Sampling Locations

- Surface Grab
- Subsurface Core
- PSR RI STNS Points

2003 Sampling Locations

- Surface Grab

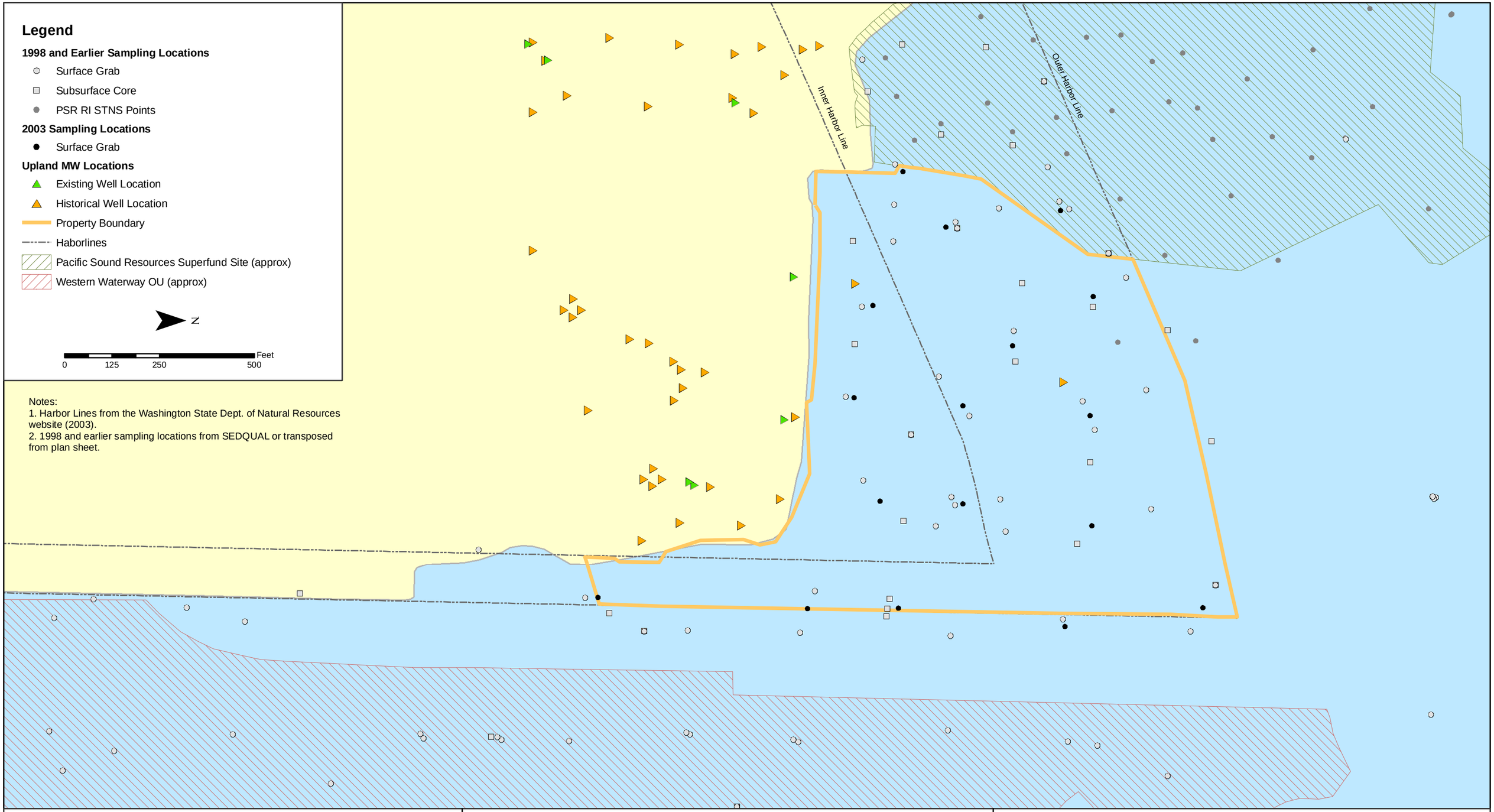
Upland MW Locations

- Existing Well Location
- Historical Well Location
- Property Boundary
- Haborlines
- Pacific Sound Resources Superfund Site (approx)
- Western Waterway OU (approx)

N

0 125 250 500 Feet

Notes:
1. Harbor Lines from the Washington State Dept. of Natural Resources website (2003).
2. 1998 and earlier sampling locations from SEDQUAL or transposed from plan sheet.



TETRA TECH EC, INC.

Lockheed West
Shipyard No. 2
Seattle, WA

Figure A.2-1
Summary of Existing Sediment Sample and Upland Well Locations

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3. SUMMARY OF EXISTING SEDIMENT QUALITY CONDITIONS

Existing sediment quality data for the LW Site are derived from multiple sources as described in Section 4.0. These data were compiled from the Washington Department of Ecology SEDQUAL data base and LMC's 2003 Due Diligence Survey Report (Hart Crowser 2003). Much of the pre-2003 data were used by Ecology to develop a Cleanup Action Plan for the Lockheed West aquatic area. The 2003 Lockheed Martin Due Diligence Survey (Hart Crowser 2003), was intended to evaluate the nature and extent of surface sediment contamination in the Lockheed West aquatic area, to fill gaps in the existing data.

The nature and extent of historical sediment contamination at Lockheed West was evaluated by analyzing the results of pre-1998 surface and subsurface sediment samples as well as the 2003 surface sediment samples. Characterization of the Site based on present surficial sediment data (i.e., 2007) is presented in the work plan text. To facilitate evaluation of the nature and extent of historical sediment contamination at the Site, historical analytical results were compared to SQS and CSL criteria of the SMS. Pre-2003 sediment sample locations and analytical results were obtained from Ecology's Sediment Quality Information System (SEDQUAL) database. The SEDQUAL database was considered sufficiently accurate for the purposes of this review of pre-2003 data. The pre-2003 sediment sampling locations and results for those samples located in the PSR Remediation Area were obtained from the PSR RI Report (Weston 1998a). To evaluate the trends in contaminant concentrations over time, contaminant concentrations from pre-2003 sediment samples were plotted with concentrations detected in 2003 sediment samples collected in co-located areas. The nature and extent of contamination using these approaches is described in the following sections.

3.1 SEDIMENT CHEMICALS OF INTEREST

Chemicals of interest (COIs) are identified as those chemicals that may be present in site sediments, either due to past practices at the Site or from offsite contamination. The list of chemicals that were analyzed in sediment in early 2007 was based on examination of pre-2003 datasets for all previously detected chemicals at the Site, and for chemicals that may have come from sources not previously addressed. The lists of chemicals of potential concern (COPCs) will be selected from the list of COIs in the risk assessments, as per Section 11, following a series of screening steps.

Sediment contaminants at the Lockheed West Site include a variety of metals and organic constituents related to historical ship repair and construction activities and other identified potential sources. Based on historical practices, metal COIs at the Site primarily consist of

arsenic, copper, lead, mercury, and zinc. Organic compounds consist of PAHs and PCBs, and some semivolatile compounds based on historical sampling results (e.g., phthalates, chlorobenzenes, dibenzofuran, and phenol compounds). PAHs are further divided into low-molecular weight polycyclic aromatic hydrocarbons (LPAHs) and high-molecular weight polycyclic aromatic hydrocarbons (HPAHs) for sediment analyses under MTCA. In addition to these historical-based COIs, the full suite of chemicals listed in the Washington State SMS (Chapter 173-204 WAC) plus tributyltin (TBT) and cPAHs for human exposures are identified as COIs for the Site, as described in the work plan text.

3.2 SEDIMENT CONTAMINANT DISTRIBUTION

The areal and vertical distribution of contaminants is relatively complex because of the nature of contributing sources from on-site and off-site historical activities. The timing of specific events contributing to contamination is not well understood. Contaminant distribution is further complicated by natural sedimentation processes and suspected historical maintenance dredging for the shipyard berths.

The extent of historical sediment contamination and distribution is summarized in the following sections. Contaminant distribution was divided into three general categories based on the date of sample collection and whether the samples are surface or subsurface sediment samples. Historical samples are considered to be those that were collected prior to 1998 and those collected in 2003 by Hart Crowser as part of the Lockheed West due diligence investigation (Hart Crowser 2003). No subsurface samples were collected as part of the 2003 due diligence investigation. Contaminant distributions are summarized in Figures A.3-1 through A.3-12. As described above, comparisons are made to the SMS for informational purposes only.

Both exceedance factors and exceedance frequencies relative to the SMS criteria are shown. The exceedance factor is represented by the ratio of the highest exceeding concentration to its SMS criteria for the primary contaminant group. Most simply, the exceedance factor shown represents the greatest criteria exceedance for a given contaminant group. The exceedance frequency represents the number of times a given compound was detected over the respective comparative criteria. Together, mapping the exceedance frequency and exceedance factors for each of the historical sampling locations allows for a summary of the nature and extent of contamination at the Site.

Additionally, sediment contaminant distributions were mapped using EPA's Fields Program. The Fields program was used to contour surface sediment concentrations represented by the pre-2003 sediment quality data for the Site and surrounding areas and are presented in Appendix A-2. These depictions of the pre-2003 surface data are useful for generally

examining pre-2003 contaminant distributions but do not account for temporal differences between sampling events.

3.2.1 Pre-2003 Surface Sediment Contamination

The distribution of surface sediment COIs exceeding the SQS and CSL is shown in Figures A.3-1 and A.3-2. The sediment chemistry data are tabulated in Appendix A-1 and representative COIs ore plotted in Appendix A-2. Analyte statistics were calculated using surface sediment samples located within the Lockheed West property boundary, as well as samples located adjacent to the Site outside of the boundary. Sample locations from within the PSR remediation area were not included in this analysis because the area has been remediated.

3.2.1.1 Metals

The detection and exceedance statistics for the eight SMS metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc) are presented in Table A.3-1. In this sample group, concentrations were detected at levels that exceeded SQS and CSL criteria at most locations, with the exception of the central portion of the Site located between the historical shipway and Pier 23.

Metals were most frequently detected at concentrations that exceeded the SQS and CSL criteria in samples collected near the former dry dock and Pier 21 locations, adjacent to the West Waterway. The maximum CSL exceedance ratio (ER) was 4.5 for copper in Sample NH-05, east of Pier 22, near the locations of historical dry docks. Outside of the Site property boundary in the adjacent West Waterway, mercury was the analyte most frequently detected at concentrations greater than the CSL criteria, followed by cadmium and copper. The maximum CSL ER was 3.7 for mercury in Sample N-19, located along the northern corner of the Site property boundary. In the western portion of the Site, metal concentrations exceeded the SQS and CSL criteria at only one location (G2) near the PSR remediation boundary.

3.2.1.2 Low-molecular Weight Polycyclic Aromatic Hydrocarbons

The detection and exceedance statistics for the seven LPAH compounds are presented in Table A.3-1. In the pre-2003 samples, LPAHs were generally distributed throughout the Site at concentrations exceeding the CSL, with the exception of the central area, surrounding Pier 23. The most frequently detected LPAH compounds that exceeded CSL criteria were acenaphthene and fluorene. The maximum CSL exceedances of 8.2 and 6.2, were for acenaphthene in Sample G-5, located near Pier 24, and Sample G-11, located east of Pier 22, near the historical dry dock location.

3.2.1.3 High-molecular Weight Polycyclic Aromatic Hydrocarbons

The detection and exceedance statistics for the 10 HPAH compounds are presented in Table A.3-1. HPAHs were heterogeneously detected at concentrations that exceeded CSL criteria throughout the Site. All of the HPAH analytes, with the exception of dibenzo(a,h)anthracene and benzo(g,h,i)perylene were detected in all of the analyzed samples. The highest HPAH CSL ER was 3.3 for benzo(g,h,i)perylene in Sample G-14, located on the eastern Site property boundary in the West Waterway.

3.2.1.4 Miscellaneous Semivolatile Organic Compounds

Miscellaneous semivolatile organic compounds (SVOCs) include phthalate, chlorobenzene, dibenzofuran, and phenol compounds. A total of 16 analytes were measured as non-detect in pre-2003 surface sediment samples; however, the detection limit at the time of analysis was greater than the current SQS and CSL criteria. The detection and exceedance statistics for these analytes are presented in Table A.3-1.

SVOCs that were either detected or qualified as not detected, but exceeded the SQS and CSL criteria were distributed throughout the Site and the adjacent West Waterway. The maximum CSL ER within the Lockheed West Site property boundary, regardless of detection, was 64.3 for 1,2,4-trichlorobenzene in Sample N-11, which was located between the historical dry dock location and Pier 22. The maximum CSL ER, outside of the property boundary, regardless of detection, was 66.4 for 1,2,4-trichlorobenzene in Sample N-09, which was located in the West Waterway. The most frequently *detected* SVOC analyte was dibenzofuran, followed by bis(2-ethylhexyl)phthalate, 4-methylphenol, and then pentachlorophenol. The maximum CSL ER of any detected SVOCs was 8.7 for pentachlorophenol in Sample NH-04, which was located between the historical dry dock location and Pier 22.

3.2.1.5 Polychlorinated Biphenyls

Consistent with the contaminant distribution of metals, pre-2003 sampling showed that PCBs were detected most commonly along the western boundary of Lockheed West and the eastern portion of the Site. The detection and exceedance statistics for these analytes are presented in Table A.3-1. There was only one sample with an exceedance of the PCB criterion within the Site property boundary—sample 8500342 at location LTHB01, which is located along the western Site property boundary in the vicinity of the historical shipway. Because a total organic carbon (TOC) value was not reported for the sample taken from this location, the PCB concentration for the sample was compared to lowest apparent effects threshold (LAET) and 2LAET criteria (the dry weight equivalents to the OC-normalized SQS and CSL criteria). The highest OC-normalized PCB concentrations were detected in

Samples N-11 and G-12, which is located between the historical dry dock location and Pier 22. The PCB concentrations in these samples exceeded the SQS criterion, but did not exceed the CSL criterion.

3.2.1.6 Tributyltin

TBT was analyzed for and reported in 18 of the historical surface sediment samples located in and near the Lockheed West Site. The samples with TBT detections were collected from the eastern portion of the Lockheed West Site and in the adjacent West Waterway. The detection and exceedance statistics for these analytes are presented in Table A.3-1.

3.2.1.7 Summary

The frequency distribution of pre-2003 CSL surface sediment exceedances is shown in Figure A.3-1. The detected analytes most frequently exceeding the CSL criteria included metals (arsenic, copper, mercury, and zinc), LPAHs, HPAHs, and dibenzofuran. Detection limits for various SVOCs also exceeded the CSL. As shown in Figure A.3-1, generally, the eastern and western portions of the Site are more heavily contaminated than the central area of the Site. Typically, fewer analytes were detected in the central portion of the Site, and those that were detected were at lower concentrations. Metals and PCB concentrations exceeded CSL criteria in the eastern portion of the Site, near Piers 21 and 22, in the former location of historical dry docks. Contaminant concentrations also generally decrease away from the shoreline, piers, and historical dry docks towards the northern boundary of the Site.

3.2.2 Historical Subsurface Sediment Contamination

The subsurface distribution of COIs exceeding the SQS and CSL criteria is shown in Figures A.3-4, A.3-5, and A.3-6, respectively. The sediment chemistry data is tabulated in Appendix A-1. The distribution of contamination for each COI analyte group is discussed below. Analyte statistics were calculated using all subsurface sediment samples located within the Lockheed West Site property boundary as well as adjacent samples located outside of the Site property boundary. Those samples collected from locations that are currently under the PSR remedial cap were not summarized or used in statistical calculations.

3.2.2.1 Metals

The detection and exceedance statistics for the eight SMS metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc) are presented in Table A.3-2 and Figure A.3-4. The general trend of metals distribution in subsurface sediment samples was similar to that of the surface sediment samples, in that metal contamination was spatially associated with the eastern portion of the Site in the vicinity of historical dry dock operations and adjacent to the West Waterway. Metals were detected at concentrations that exceeded CSL

criteria in one localized area where three co-located cores (D5, SB1, and M1) were collected. These three cores are co-located on the eastern Site property boundary. The metals that exceeded the SQS and CSL criteria in at least one sample collected from these cores were arsenic, copper, lead, zinc, and chromium.

At core location SB1, metals were detected at concentrations that exceed CSL to a depth of 13.5 feet, in the deepest sample interval (7.5 to 13.5 feet). However, in the adjacent cores—D5 and M1—metal CSL exceedances were not detected in sample intervals deeper than 4.0 feet and 7.5 feet, respectively. The maximum metal CSL ER was 4.9 for copper in the surface interval (0 to 2 feet) sample of Core SB1. The detected metal concentrations generally decrease with depth in Core SB1; however, with large sample intervals of up to 6 feet, it is difficult to discern the vertical extent of metals contamination.

3.2.2.2 Low-molecular Weight Polycyclic Aromatic Hydrocarbons

The detection and exceedance statistics for LPAHs are presented in Table A.3-2 and Figure A.3-4. The distribution of LPAHs that exceeded SQS or CSL criteria in historical subsurface cores was limited to two core sampling locations in the western portion of the Site, in the vicinity of the former shipway, and core sampling locations along the eastern Site property boundary, near the locations of the former dry dock and Pier 21. LPAHs were not detected at concentrations that exceed SQS in the central portion of the Site.

The maximum individual LPAH ER for the CSL was 9.5 for acenaphthene in surface interval sample, SB-1A, of Core SB1. In the western portion of the Site, the LPAH concentrations were lower and exceeded the respective CSL criteria by less than a factor of 3. LPAH concentrations were the highest in surface core interval samples and decreased with depth. In Core SB1, LPAHs were detected at concentrations that exceeded the CSL criteria to a depth of 13.5 feet, with the maximum individual CSL ER at the lower interval of 1.8 for acenaphthene.

3.2.2.3 High-molecular Weight Polycyclic Aromatic Hydrocarbons

The detection and exceedance statistics for HPAHs are presented in Table A.3-2 and Figure A.3-4. HPAHs were detected at concentrations that exceeded the SQS criteria in core samples collected from the western and eastern portions of the Site, as well as in samples collected from two cores located at the end of Pier 23 and Pier 24. However, the detected HPAH concentrations only exceeded the CSL criteria in core samples located along the eastern Site property boundary and in the West Waterway. HPAHs were not detected at concentrations that exceeded the SQS and CSL criteria in core samples below the surface interval, except in samples collected from SB1. Similar to LPAHs, HPAH contamination extended to a depth of 13.5 feet in Core SB1, and HPAH concentrations generally decreased

with depth. Dibenzo(a,h)anthracene was the HPAH compound that most frequently exceeded the SQS or CSL criteria.

3.2.2.4 Miscellaneous Semivolatile Organic Compounds

Miscellaneous SVOCs primarily include phthalates, chlorobenzenes, dibenzofuran, and phenols. A total of nine of these analytes were undetected in historical subsurface sediment samples; however, the detection limit at the time of analysis is greater than the current SQS and CSL criteria. The detection and exceedance statistics for these analytes are presented in Table A.3-2 and Figure A.3-4.

Historically, SVOCs that were either detected or non-detect and exceeded SQS and CSL criteria were distributed throughout the Site and the adjacent West Waterway. However, the results show that SVOCs do not exceed the current CSL criteria in cores collected along the northern Site property boundary. Detected concentrations of bis(2-ethylhexyl)phthalate (BEHP) did exceed the CSL criteria in the surface interval samples (0 to 2 feet) collected from Cores D3 and SA7, located near the end of Pier 23 and former Pier 22. The maximum BEHP ER was 1.5 in Sample D3-A. Similar to both HPAHs and LPAHS, the SVOC CSL exceedances extended to a depth of 13.5 feet in Core SB1, and generally decreased with depth. The maximum CSL ER, regardless of detection, is 16.2 for hexachlorobenzene in Sample D5-C (0 to 4 feet interval). The maximum CSL ER of a *detected* SVOC is 15.6 for 1,2,4-trichlorobenzene in Sample SB1-A (0 to 2 feet interval). Both samples were collected from cores located on the eastern Site property boundary.

3.2.2.5 PCBs

The detection and exceedance statistics for PCBs are presented in Table A.3-2 and Figure A.3-4. PCBs were not detected in eight samples, where the detection limit was greater than the SQS and CSL criteria. PCBs were detected throughout the Site, but PCB concentrations were generally higher in the eastern portion of the Site, near the area of the former dry dock, Pier 21, and the West Waterway. Similar to the other analyte groups, the maximum PCB concentrations were detected in Core SB-1, located on the eastern Site property boundary. PCB CSL exceedances extended to a depth of 13.5 feet in Core SB1, and decreased with depth. The maximum CSL ER was 9.1 in the surface interval (0 to 2 feet) sample of Core SB1. Excluding the CSL exceedances in the three co-located cores (D5, SB-1, and M1) there are only three additional core locations where PCBs exceed the CSL. These cores were also located in the eastern portion of the Site and the PCB exceedances were in the surface interval sample (0 to 2 feet), with the maximum PCB CSL exceedance factor of less than 2.

3.2.2.6 Tributyltin

TBT was only analyzed for in one historical subsurface sample. In the surface sample interval (0 to 4 feet) of Core D5, TBT was undetected at a concentration that exceeds the Harbor Island Shipyard confirmational number by a factor of 8.8. Core D5 was collected from the eastern Site property boundary. The detection and exceedance statistics for TBT are presented in Table A.3-2 and Figure A.3-4.

3.2.2.7 Summary

The frequency distribution of historical CSL subsurface sediment exceedances is shown in Figure A.3-7. The historical subsurface data indicates that the average vertical extent of contamination extends to approximately 5 feet below the mudline in the central and western portions of the Site. The magnitude of CSL exceedances generally decreases with depth below mudline in the core samples. LPAHs and other SVOCs are the only analyte groups that exceeded the CSL criteria in the western portion of the Site. In the central portion of the Site, the extent of contamination is limited to two SVOC and one PCB concentrations that exceed the CSL criteria by less than a factor of 2. In three core locations (C5, C7, and D4), along the northern Site property boundary, there were no CSL exceedances. However, along the eastern Site property boundary, particularly in the area of Cores D5, SB-1 and M1, the vertical extent of metal, PAH, SVOC, and PCB contamination extends to 13.5 feet below the mudline. The greater vertical extent of contamination in this area is likely associated with the former dry docks.

3.2.3 2003 Surface Sediment Contamination

Figures A.3-8, A.3-9, and A.3-10 depict the 2003 surface sediment distribution of COIs exceeding the SQS and CSL criteria. The sediment chemistry data is tabulated in Appendix A-1 and representative COIs ore plotted in Appendix A-2. The distribution of contamination for each COI analyte group is discussed below. Analyte statistics were calculated using surface sediment samples located within the Lockheed West Site property boundary, as well as adjacent samples located outside of the Site property boundary, with the exception of those samples collected from locations that are currently under the PSR remedial cap.

3.2.3.1 Metals

The detection and exceedance statistics for the metals in 2003 surface samples are presented in Table A.3-3 and Figure A.3-8. Arsenic, chromium, copper, lead, mercury, and zinc were detected at concentrations that exceed the CSL criteria in at least 1 of the 19 surface samples collected and analyzed. Mercury and copper were the metals that most frequently exceed SQS and CSL criteria, followed by zinc, lead, arsenic, and chromium. The maximum CSL

ERs for mercury and copper were 1.6 and 2.1, respectively. Metals primarily exceed CSL criteria in the Pier 21 and Pier 22 areas, which are in the vicinity of historical dry dock operations and adjacent to the West Waterway. However, the maximum CSL copper exceedance was detected in Sample HC-03-01, which is located at the western Site property boundary in the vicinity of the former shipway.

3.2.3.2 Low-molecular Weight Polycyclic Aromatic Hydrocarbons

The detection and exceedance statistics for LPAHs in 2003 surface samples are presented in Table A.3-3 and Figure A.3-8. Fewer LPAHs were detected at lower concentrations in the central portion of the Site relative to the western and eastern portions of the Site. None of the samples analyzed contained LPAHs at concentrations greater than the CSL criteria and only two samples (HC-03-18 and HC-03-13) contained LPAHs at concentrations that exceeded SQS criteria.

3.2.3.3 High-molecular Weight Polycyclic Aromatic Hydrocarbons

The detection and exceedance statistics for HPAHs in 2003 surface samples are presented in Table A.3-3 and Figure A.3-8. HPAHs were detected at the highest concentrations at one location (HC-03-01) along the western Site property boundary, adjacent to the PSR remediation site, and two locations (HC-03-18, HC-03-13) along the eastern Site property boundary and West Waterway. At least one HPAH compound exceeded SQS criteria at these three locations. Only one HPAH compound exceeded an individual CSL criterion at one location. The CSL ER was 1.1 for indeno(1,2,3-cd)pyrene in Sample HC-03-18, located between the northern end of Piers 21 and 22.

3.2.3.4 Miscellaneous Semivolatile Organic Compounds

The detection and exceedance statistics for miscellaneous SVOCs in 2003 surface samples are presented in Table A.3-3 and Figure A.3-8. Miscellaneous SVOCs include phthalates, chlorobenzenes, dibenzofuran, and phenols. For four of the SVOC analytes (1,2,4-trichlorobenzene, 2,4-dimethylphenol, benzoic acid, hexachlorobenzene), the detection limits in some samples were greater than the SQS and/or CSL criteria. Miscellaneous SVOC analytes were most prevalent in the western portion of the Site in the area of the former shipway and the locations along the eastern Site property boundary.

3.2.3.5 Polychlorinated Biphenyls

The detection and exceedance statistics for PCBs in 2003 surface samples are presented in Table A.3-3 and Figure A.3-8. PCB concentrations were highest in the areas of Pier 21 and Pier 22, near the former dry dock location and those locations nearest to the West Waterway. PCBs were detected at concentrations that exceeded SQS criteria, but did not exceed CSL

criteria in the western portion of the Site. The maximum CSL ER for PCBs was 3.75 in Sample HC-03-18, located along the eastern Site property boundary.

3.2.3.6 Tributyltin

The detection and exceedance statistics for TBT in 2003 surface samples are presented in Table A.3-3 and Figure A.3-8. With the exception of one sample, TBT concentrations were highest along the eastern Site property boundary and stations nearest the West Waterway.

3.2.3.7 Summary

The frequency distribution of SQS and CSL surface sediment exceedances for 2003 surface sediment samples is shown in Figures A.3-11 and A.3-12. Contaminant concentrations are elevated and more frequently detected in the eastern portion of the Site in the vicinity of the former dry dock locations and West Waterway. Metals were detected at concentrations greater than the CSL criteria in 7 of the 19 samples collected, which are located in the eastern portion of the Site and at one location on the western Site boundary. CSL exceedances were also detected in the vicinity of the former shipway. No CSL exceedances were detected in the central portion of the Site. In all of the 2003 samples collected and analyzed, LPAHs were not detected at concentrations greater than their respective CSL criteria and only one HPAH was found to exceed one CSL criterion at only one location (HC-03-18).

3.3 SEDIMENT BIOLOGICAL TOXICITY TESTING

Biological toxicity tests have been conducted as a part of six previous sampling activities. Bioassay tests were performed by EVS (1985), Evans-Hamilton (1987), Enviros (1990), and Parametrix (1993). Studies included various testing methods such as amphipod bioassays, echinoderm larvae, juvenile infaunal *Neanthes*, and Microtox photo-reduction. Figure A.3-13 shows the sampling locations in which biological testing of sediments were performed. Only summary information on the testing was identified; therefore, the actual test procedures utilized and data quality are unknown. As a result, biological testing data are presented for informational purposes only and will not be used to evaluate cleanup options in the RI/FS.

In 1985 EVS performed amphipod bioassays in the vicinity of the northern end of Terminal 5 at sampling locations P1, P2, P3, and P4. Of the eight samples tested, one was a surface sample that showed a 32 percent mortality rate, and was the only sample to fail the SQS criteria.

Amphipod bioassays were also performed as part of the Evans-Hamilton study (1987). A total of nine sampling locations were tested for toxicity throughout and adjacent to

Lockheed West. Of the locations tested, three had amphipod mortalities that exceeded 80 percent. No reference or control data for the testing was identified.

As part of the Enviros study (1990), biological toxicity tests were conducted on sediments collected from six sampling locations and included amphipod bioassays, echinoderm larvae, juvenile infaunal *Neanthes*, and Microtox photo-reduction. Surface sediment samples were tested from three of the sampling locations and subsurface sediment, collected from 5 to 10 feet below the mudline, were tested at three sampling locations. The results of the echinoderm larvae and the juvenile infaunal tests showed no failures when compared to SQS. Three amphipod tests had moralities greater than 30 percent and were statistically different from the reference sediment and control sediment. Three stations also failed Microtox tests, two of which were the same stations that failed the amphipod tests.

During the partial characterization analysis for the proposed Southwest Harbor Project three sediment samples comprised of composite samples from sampling locations PC-1 and PC-3 (Parametrix 1993) were subjected to amphipod bioassays, echinoderm larvae, juvenile infaunal *Neanthes*, and Microtox photo-reduction testing. All three of the sediment samples tested either passed SQS criteria or were not statistically different from the reference stations.

In summary, high amphipod mortalities were observed for locations identified as “north of the shipyard” (Enviros 1990), with variable results from samples collected along the West Waterway. Deeper sediment samples had lower biological toxicity. In general, previous studies concluded that sediment contamination and biological toxicity appear to be greater nearer shore by the former dry docks (Pier 21 and Pier 22) and the shipway.

3.4 EXTENT OF SMS EXCEEDANCES

Contamination above the SQS and CSL occurs primarily in near-surface sediments, with local areas of deeper contamination identified on Figures A.3-5through A.3-10. The overall areal extent and depth distribution of the metals and organic constituents reflect the influence of several factors:

- Proximity of historical on-site and off-site source areas
- Previous dredging and filling activities at the shipyard
- Attenuation from ongoing chemical degradation and further sediment accumulation.

These factors have resulted in a general broad area where constituent concentrations exceed the SMS (Figures A.3-4 through A.3-12). As a general trend, higher constituent concentrations are relatively limited, and are separated by large volume of sediments with lower concentrations. The eastern and western portions of the Site tend to be more heavily contaminated. These areas are located in the vicinity of Pier 21 and 22 on the east, and in

the former shipway area and locations to the west toward the PSR property boundary. Contamination in the eastern portion of the Site in the Pier 21 and Pier 22 area is spatially associated with intensive dry dock activities and suspected off-site contributions from the West Waterway.

Contamination in the western portion of the Site is spatially associated with historical operations at the shipway and the adjacent PSR Site to the west. Constituent concentrations decrease toward the central portion of the Site between Pier 22 and Pier 24. Concentrations also generally decrease away from the piers toward the northern boundary of the Site. Concentrations decrease to below CSL beyond the Site property boundary identified on the figures.

Table A.3-1. Summary Statistics for Historical Surface Samples

Analyte	SQS	CSL	No. of Samples	Analyte Concentration				Percentage of Detections (%)	Percentage of Samples exceeding SQS (%)	Average SQS Exceedance Ratio[1]	Maximum SQS Exceedance Ratio[1]	Percentage of Samples exceeding CSL (%)	Average CSL Exceedance Ratio[1]	Maximum CSL Exceedance Ratio[1]	Location of Highest SQS and/or CSL Exceedance
				Minimum	Average	Maximum	units								
Metals															
Arsenic	57	93	52	4.7	63.3	713	mg/kg-dw	100	21.15	3.52	12.51	11.54	3.32	7.67	197-2
Cadmium	5.1	6.7	52	0.071	2	7.3	mg/kg-dw	94.23	19.23	1.23	1.43	1.92	1.09	1.09	N-10
Chromium	260	270	42	18.3	82.23	260	mg/kg-dw	100	0	NA	NA	0	NA	NA	--
Copper	390	390	52	54	267.66	1770	mg/kg-dw	100	15.38	1.95	4.54	15.38	1.95	4.54	NH-04
Lead	450	530	52	9.3	149.63	500	mg/kg-dw	100	3.85	1.06	1.11	0	NA	NA	197-2-1
Mercury	0.41	0.59	52	0.0005	0.45	2.2	mg/kg-dw	98.08	38.46	2.5	5.37	36.54	1.79	3.73	N-19
Silver	6.1	6.1	37	0.19	0.58	1.3	mg/kg-dw	94.59	0	NA	NA	0	NA	NA	--
Zinc	410	960	52	64.8	369.88	1760	mg/kg-dw	100	21.15	2.35	4.29	11.54	1.37	1.83	197-2
SVOCs															
Naphthalene	99	170	47	1.12	16.89	101.96	mg/kg-ocn	93.62	4.26	1.02	1.03	0	NA	NA	NH-05
Acenaphthylene	66	66	47	0.51	7.31	34.18	mg/kg-ocn	93.62	0	NA	NA	0	NA	NA	--
Acenaphthene	16	57	47	1.21	37.18	466.67	mg/kg-ocn	100	27.66	7.33	29.17	12.77	3.93	8.19	G11
Fluorene	23	79	47	1.68	43.51	433.33	mg/kg-ocn	100	29.79	5.49	18.84	10.64	3.57	5.49	G11
Phenanthrene	100	480	47	10.28	191.35	1518.99	mg/kg-ocn	100	34.04	4.66	15.19	8.51	2.51	3.16	G14
Anthracene	220	1200	47	3.84	61.48	416.67	mg/kg-ocn	100	8.51	1.32	1.89	0	NA	NA	G5
2-Methylnaphthalene	38	64	47	0.47	8.46	77.78	mg/kg-ocn	89.36	4.26	1.65	2.05	2.13	1.22	1.22	G5
Total LPAH	370	780	47	20.28	355.29	2695	mg/kg-ocn	100	21.28	3.27	7.28	10.64	2.48	3.46	G5
Fluoranthene	160	1200	47	24.3	246.82	1898.73	mg/kg-ocn	100	34.04	3.57	11.87	4.26	1.45	1.58	G14
Pyrene	1000	1400	47	16.82	279.75	2151.9	mg/kg-ocn	100	6.38	1.54	2.15	2.13	1.54	1.54	G14
Benzo(a)anthracene	110	270	47	12.15	116.98	696.2	mg/kg-ocn	100	29.79	2.58	6.33	10.64	1.67	2.58	G14
Chrysene	110	460	47	15.66	132.89	772.15	mg/kg-ocn	100	34.04	2.61	7.02	4.26	1.35	1.68	G14
Benzofluoranthenes (total)	230	450	47	24.3	190.84	734.18	mg/kg-ocn	100	25.53	1.93	3.19	10.64	1.31	1.63	G14
Benzo(a)pyrene	99	210	47	10.28	82.52	392.41	mg/kg-ocn	100	27.66	1.83	3.96	8.51	1.34	1.87	G14
Indeno(1,2,3-cd)pyrene	34	88	47	5.7	45.31	227.85	mg/kg-ocn	100	42.55	2.41	6.7	14.89	1.43	2.59	G14
Dibenzo(a,h)anthracene	12	33	47	0.25	26.91	115.75	mg/kg-ocn	76.6	*61.7*	*3.28*	*9.65*	*27.66*	*1.84*	*3.51*	N-11-10-9
Benzo(g,h,i)perylene	31	78	47	5.38	42.93	253.16	mg/kg-ocn	97.87	48.94	2.32	8.17	12.77	1.7	3.25	G14
Total HPAH	960	5300	47	118.41	1156.64	7240.51	mg/kg-ocn	100	34.04	2.61	7.54	2.13	1.37	1.37	G14
1,2-Dichlorobenzene	2.3	2.3	44	0.29 U	18.18	119.43 U	mg/kg-ocn	0	*75*	*10.42*	*51.93*	*75*	*10.42*	*51.93*	N-09
1,4-Dichlorobenzene	3.1	9	44	0.08	21.15	119.43 U	mg/kg-ocn	6.82	*77.27*	*8.75*	*38.53*	*61.36*	*3.61*	*13.27*	N-09
1,2,4-Trichlorobenzene	0.81	1.8	41	0.48 U	21.27	119.43 U	mg/kg-ocn	0	*90.24*	*29.01*	*147.44*	*82.93*	*14.15*	*66.35*	N-09
Hexachlorobenzene	0.38	2.3	47	0.03	20.02	119.43 U	mg/kg-ocn	2.13	*82.98*	*63.45*	*314.29*	*74.47*	*11.62*	*51.93*	N-09
Dimethyl phthalate	53	53	47	0.48 U	17.61	119.43 U	mg/kg-ocn	12.77	*6.38*	*1.89*	*2.25*	*6.38*	*1.89*	*2.25*	N-09
Diethylphthalate	61	110	43	0.05	20.67	119.43 U	mg/kg-ocn	2.33	*9.3*	*1.54*	*1.96*	*4.65*	*1.07*	*1.09*	N-09
Di-n-butyl phthalate	220	1700	43	1.11	16.31	119.43 U	mg/kg-ocn	20.93	0	NA	NA	0	NA	NA	--
Butyl benzyl phthalate	4.9	64	47	0.15	9.47	65.69 U	mg/kg-ocn	38.3	*44.68*	*3.85*	*13.41*	*2.13*	*1.03*	*1.03*	W-40
bis(2-ethylhexyl)phthalate	47	78	43	6.67 U	41.26	209.52	mg/kg-ocn	55.81	23.26	2.39	4.46	16.28	1.7	2.69	G13
Di-n-octyl phthalate	58	4500	47	0.06 U	19.55	119.43 U	mg/kg-ocn	6.38	*8.51*	*1.62*	*2.06*	*0*	NA	NA	N-09
Dibenzofuran	15	58	47	0.84	27.89	325	mg/kg-ocn	97.87	25.53	6.29	21.67	10.64	3.4	5.6	G11
Hexachlorobutadiene	3.9	6.2	47	0.52 U	28.48	261.68 U	mg/kg-ocn	2.13	*72.34*	*9.96*	*67.1*	*65.96*	*6.8*	*42.21*	WW-20
N-Nitrosodiphenylamine	11	11	43	0.48 U	17.93	119.43 U	mg/kg-ocn	2.33	*34.88*	*3.96*	*10.86*	*34.88*	*3.96*	*10.86*	N-09
Phenol	420	1200	41	3.8 U	342.48	1000 U	mg/kg-dw	48.78	*34.15*	*1.64*	*2.38*	*0*	NA	NA	W-53
2-Methylphenol	63	63	47	3.9	186.94	1000 U	mg/kg-dw	8.51	*59.57*	*4.82*	*15.87*	*59.57*	*4.82*	*15.87*	W-53
4-Methylphenol	670	670	47	8.9 U	315.4	1280	mg/kg-dw	21.28	10.64	1.59	1.91	10.64	1.59	1.91	197-1
2,4-Dimethylphenol	29	29	46	5.1 U	197.14	1000 U	mg/kg-dw	4.35	*63.04*	*10.5*	*34.48*	*63.04*	*10.5*	*34.48*	W-53
Pentachlorophenol	360	690	40	7.6 U	1101.32	6000	mg/kg-dw	20	67.5	4.35	16.67	52.5	2.75	8.7	NH-04
Benzyl alcohol	57	73	32	11 U	161.41	510 U	mg/kg-dw	0	*50*	*5.32*	*8.95*	*50*	*4.15*	*6.99*	NH-04
Benzoic acid	650	650	32	17	676.78	2100 U	mg/kg-dw	9.38	*37.5*	*2.38*	*3.23*	*37.5*	*2.38*	*3.23*	G12, G13
PCBs															
PCBs (total)	12	65	47	0.06	29.99	254.08	mg/kg-ocn	100	57.45	3.95	21.17	8.51	2.73	3.91	N-28
Organometallics															
Tributyltin[2]	76	NA	25	6	69.97	275	mg/kg-ocn	88	24	2.66	3.62	NA	NA	NA	W-53

NA: Not applicable because analyte does not exceed criteria.

1) The average and maximum exceedance ratios (ER) were calculated using only sample ER values that were greater than 1.

2) TBT concentrations are compared to the Shipyard Sediment Confirmational Number of 76 mg/kg-OC

3) *Italized* values are for those samples where an analyte was undetected, but the detection limit exceeded the SQS or CSL criteria.

4) Six of approximately 47 historical surface samples (E023, E024, E025, WW-15, 42, 8500342) were not included in the statistic calculations as their TOC values were not reported or outside of the organic-carbon normalization range. Their contaminant concentrations are comparable to those samples statistics shown above. See Table X in Appendix A.

Table A.3-2. Summary Statistics for Historical Subsurface Samples

Analyte	SQS	CSL	No. of Samples	Analyte Concentration				Percentage of Detections (%)	Percentage of Samples exceeding SQS (%)	Average SQS Exceedance Ratio[1]	Maximum SQS Exceedance Ratio[1]	Percentage of Samples exceeding CSL (%)	Average CSL Exceedance Ratio[1]	Maximum CSL Exceedance Ratio[1]	Location of Highest SQS and/or CSL Exceedance
				Minimum	Average	Maximum	units								
Metals															
Arsenic	57	93	37	1.6	29.54	110	mg/kg-dw	100	13.51	1.49	1.93	5.41	1.18	1.18	SB1-A, M1-C
Cadmium	5.1	6.7	37	0.03 U	0.28	1.5	mg/kg-dw	94.59	0			0			
Chromium	260	270	33	9.1	80.25	660	mg/kg-dw	100	3.03	2.54	2.54	3.03	2.44	2.44	SB1-A
Copper	390	390	37	9.2	182.06	1900	mg/kg-dw	100	8.11	3.76	4.87	8.11	3.76	4.87	SB1-A
Lead	450	530	37	3	138.15	2200	mg/kg-dw	86.49	10.81	2.17	4.89	10.81	1.84	4.15	M1-C
Mercury	0.41	0.59	40	0.0005	0.05	0.35	mg/kg-dw	65	0			0			
Silver	6.1	6.1	37	0.02 U	0.28	1.2	mg/kg-dw	56.76	0			0			
Zinc	410	960	37	19.4	285.24	2600	mg/kg-dw	100	13.51	3.34	6.34	8.11	1.87	2.71	D5-C
SVOCs															
Naphthalene	99	170	35	0	66.43	1029.85	mg/kg-ocn	80.0	8.6	6.7	10.4	8.6	3.9	6.1	D5-C
Acenaphthylene	66	66	35	0	11.72	190	mg/kg-ocn	57.1	2.9	2.9	2.9	2.9	2.9	2.9	SB1-A
Acenaphthene	16	57	35	0.27	51.54	540	mg/kg-ocn	80.0	17.1	17.3	33.8	14.3	5.8	9.5	SB1-A
Fluorene	23	79	35	0	58.39	600	mg/kg-ocn	80.0	17.1	13.6	26.1	17.1	4.0	7.6	SB1-A
Phenanthrene	100	480	35	0	239.88	3500	mg/kg-ocn	94.3	20.0	11.1	35.0	14.3	3.1	7.3	SB1-A
Anthracene	220	1200	35	1	72.16	870	mg/kg-ocn	82.9	14.3	1.8	4.0	0.0	NA	NA	SB1-A
2-Methylnaphthalene	38	64	35	0	16.21	238.81	mg/kg-ocn	62.9	8.6	3.7	6.3	5.7	2.9	3.7	D5-C
Total LPAH	370	780	35	0	496.7	6350	mg/kg-ocn	94.3	17.1	7.1	17.2	14.3	3.9	8.1	SB1-A
Fluoranthene	160	1200	35	0	279.81	3500	mg/kg-ocn	88.6	22.9	7.0	21.9	8.6	1.8	2.9	SB1-A
Pyrene	1000	1400	35	0	301.12	3600	mg/kg-ocn	94.3	8.6	2.0	3.6	2.9	2.6	2.6	SB1-A
Benzo(a)anthracene	110	270	35	1	124.43	1900	mg/kg-ocn	80.0	20.0	5.0	17.3	11.4	3.1	7.0	SB1-A
Chrysene	110	460	35	0.9	113.05	1500	mg/kg-ocn	85.7	14.3	5.7	13.6	8.6	1.8	3.3	SB1-A
Benzofluoranthenes (total)	230	450	35	1	175.84	2200	mg/kg-ocn	82.9	11.4	4.8	9.6	11.4	2.5	4.9	SB1-A
Benzo(a)pyrene	99	210	35	1	97.18	1500	mg/kg-ocn	80.0	14.3	5.5	15.2	11.4	3.1	7.1	SB1-A
Indeno(1,2,3-cd)pyrene	34	88	34	1	54.17	890	mg/kg-ocn	79.4	20.6	6.8	26.2	11.8	4.1	10.1	SB1-A
Dibenzo(a,h)anthracene	12	33	35	0 U	26.92	420	mg/kg-ocn	71.4	34.3	6.1	35.0	17.1	3.9	12.7	SB1-A
Benzo(g,h,i)perylene	31	78	35	0	53.11	880	mg/kg-ocn	80.0	20.0	7.5	28.4	11.4	4.6	11.3	SB1-A
Total HPAH	960	5300	35	0	1219.57	16390	mg/kg-ocn	91.4	22.9	4.8	17.1	2.9	3.1	3.1	SB1-A
1,2-Dichlorobenzene	2.3	2.3	35	0 U	3.43	18.03 U	mg/kg-ocn	0.0	*25.7*	*4.4*	*7.8*	*25.7*	*4.4*	*7.8*	M1-C
1,4-Dichlorobenzene	3.1	9	35	0 U	6.68	37.31 U	mg/kg-ocn	0.0	*40.0*	*4.8*	*12.0*	*17.1*	*3.1*	*4.2*	D5-C
1,2,4-Trichlorobenzene	0.81	1.8	35	0 U	3.74	28	mg/kg-ocn	2.9	82.9	5.4	34.6	28.6	5.9	15.6	SB1-A
Hexachlorobenzene	0.38	2.3	35	0 U	6.82	37.31 U	mg/kg-ocn	0.0	*97.1*	*18.5*	*98.2*	*48.6*	*5.5*	*16.2*	D5-C
Dimethyl phthalate	53	53	35	0 U	6.94	37.31 U	mg/kg-ocn	0.0	0.0	NA	NA	0.0	NA	NA	--
Diethylphthalate	61	110	35	0 U	6.94	37.31 U	mg/kg-ocn	0.0	0.0	NA	NA	0.0	NA	NA	--
Di-n-butyl phthalate	220	1700	35	0	7.54	39	mg/kg-ocn	8.6	0.0	NA	NA	0.0	NA	NA	--
Butyl benzyl phthalate	4.9	64	35	0 U	6.94	37.31 U	mg/kg-ocn	0.0	*20.0*	*5.2*	*7.6*	0.0	NA	NA	D5-C
bis(2-ethylhexyl)phthalate	47	78	35	1 U	68.5	1100	mg/kg-ocn	80.0	17.1	7.5	23.4	14.3	5.3	14.1	SB1-A
Di-n-octyl phthalate	58	4500	35	0 U	7.63	37.31 U	mg/kg-ocn	11.4	0.0	NA	NA	0.0	NA	NA	--
Dibenzofuran	15	58	35	0	39.01	432.84	mg/kg-ocn	65.7	20.0	12.0	28.9	11.4	5.0	7.5	D5-C
Hexachlorobutadiene	3.9	6.2	35	1 U	7.07	37.31 U	mg/kg-ocn	0.0	*31.4*	*4.5*	*9.6*	*17.1*	*4.6*	*6.0*	D5-C
N-Nitrosodiphenylamine	11	11	35	0 U	4.45	40.3	mg/kg-ocn	5.7	14.3	1.8	3.7	14.3	1.8	3.7	D5-C
Phenol	420	1200	35	10	157.54	1200	mg/kg-dw	25.7	20.0	1.5	2.9	0.0	NA	NA	SB1-A
2-Methylphenol	63	63	35	0	34.93	170 U	mg/kg-dw	5.7	*20.0*	*2.1*	*2.7*	*20.0*	*2.1*	*2.7*	SA2-C
4-Methylphenol	670	670	35	4 U	83.74	730	mg/kg-dw	11.4	2.9	1.1	1.1	2.9	1.1	1.1	SB1-A
2,4-Dimethylphenol	29	29	35	7 U	36.99	190	mg/kg-dw	2.9	20.0	4.9	6.6	20.0	4.9	6.6	SA2-D
Pentachlorophenol	360	690	35	20 U	343.51	1700 U	mg/kg-dw	0.0	*20.0*	*3.8*	*4.7*	*20.0*	*2.0*	*2.5*	SA2-C
Benzyl alcohol	57	73	35	10 U	53.14	270 U	mg/kg-dw	0.0	*20.0*	*3.6*	*4.7*	*20.0*	*2.8*	*3.7*	SA2-C
Benzoic acid	650	650	35	20	305.51	1700 U	mg/kg-dw	28.6	*17.1*	*2.1*	*2.6*	*17.1*	*2.1*	*2.6*	SA2-C
PCBs															
PCBs (total)	12	65	37	2.79 U	61.69	590	mg/kg-ocn	51.4	51.4	9.3	49.2	13.5	5.6	9.1	SB1-A
Organometallics															
Tributyltin[2]	76	NA	1	671.64 U	671.64	671.64 U	mg/kg-ocn	0.0	*100*	*8.8*	*8.8*	NA	NA	NA	D5-C

NA: Not applicable because analyte does not exceed criteria.

1) The average and maximum exceedance ratios (ER) were calculated using only sample ER values that were greater than 1.

2) TBT concentrations are compared to the Shipyard Sediment Confirmational Number of 76 mg/kg-OC

3) *Italized* values are for those samples where an analyte was undetected, but the detection limit exceeded the SQS or CSL criteria.

4) Twenty-one of approximately 35 historical subsurface samples were not included in the statistic calculations as their TOC values were not reported or outside of the organic-carbon normalization range. Their contaminant concentrations are comparable to those samples statistics shown above. See Table X in Appendix A.

Table A.3-3. Summary Statistics for Recent (2003) Surface Samples

Analyte	SQS	CSL	No. of Samples	Analyte Concentration				Percentage of Detections (%)	Percentage of Samples exceeding SQS (%)	Average SQS Exceedance Ratio[1]	Maximum SQS Exceedance Ratio[1]	Percentage of Samples exceeding CSL (%)	Average CSL Exceedance Ratio[1]	Maximum CSL Exceedance Ratio[1]	Location of Highest SQS and/or CSL Exceedance
				Minimum	Average	Maximum	units								
Metals															
Arsenic	57	93	18	9.8	33.38	165	mg/kg-dw	100	5.6	2.9	2.9	5.6	1.8	1.8	HC-03-13
Cadmium	5.1	6.7	18	0.13	0.46	1.05	mg/kg-dw	100	0.0	NA	NA	0.0	NA	NA	--
Chromium	260	270	18	20	86.42	309	mg/kg-dw	100	5.6	1.2	1.2	5.6	1.1	1.1	HC-03-09
Copper	390	390	18	50.6	259.2	825	mg/kg-dw	100	22.2	1.5	2.1	22.2	1.5	2.1	HC-03-01
Lead	450	530	18	35.7	160.44	1160	mg/kg-dw	100	5.6	2.6	2.6	5.6	2.2	2.2	HC-03-13
Mercury	0.41	0.59	18	0.08	0.42	0.96	mg/kg-dw	100	44.4	1.7	2.3	27.8	1.4	1.6	HC-03-14
Silver	6.1	6.1	18	0.12	0.39	1.31	mg/kg-dw	100	0.0	NA	NA	0.0	NA	NA	--
Zinc	410	960	18	73.7	266.92	661	mg/kg-dw	100	16.7	1.3	1.6	0.0			HC-03-13
SVOCs															
Naphthalene	99	170	18	1.36	5.64	20.61	mg/kg-ocn	100	0.0	NA	NA	0.0	NA	NA	--
Acenaphthylene	66	66	18	1.5	5.41	12.18	mg/kg-ocn	100	0.0	NA	NA	0.0	NA	NA	--
Acenaphthene	16	57	18	1.4	6.04	16.26	mg/kg-ocn	100	5.6	1.0	1.0	0.0	NA	NA	HC-03-18
Fluorene	23	79	18	1.87	9.05	29.27	mg/kg-ocn	100	11.1	1.1	1.3	0.0	NA	NA	HC-03-18
Phenanthrene	100	480	18	11.21	47.19	141.03	mg/kg-ocn	100	11.1	1.4	1.4	0.0	NA	NA	HC-03-13
Anthracene	220	1200	18	4.67	23.88	138.21	mg/kg-ocn	100	0.0	NA	NA	0.0	NA	NA	--
2-Methylnaphthalene	38	64	18	0.57	2.29	6.11	mg/kg-ocn	100	0.0	NA	NA	0.0	NA	NA	--
Total LPAH	370	780	18	22.06	97.21	340.57	mg/kg-ocn	100	0.0	NA	NA	0.0	NA	NA	--
Fluoranthene	160	1200	18	17.81	108.68	455.28	mg/kg-ocn	100	22.2	1.8	2.9	0.0	NA	NA	HC-03-18
Pyrene	1000	1400	18	17.76	100.58	390.24	mg/kg-ocn	100	0.0	NA	NA	0.0	NA	NA	--
Benzo(a)anthracene	110	270	18	8.22	48.63	211.38	mg/kg-ocn	100	11.1	1.5	1.9	0.0	NA	NA	HC-03-18
Chrysene	110	460	18	12.33	78.4	276.42	mg/kg-ocn	100	22.2	1.7	2.5	0.0	NA	NA	HC-03-18
Benzofluoranthenes (total)	230	450	18	21.92	108.96	373.98	mg/kg-ocn	100	11.1	1.4	1.6	0.0	NA	NA	HC-03-18
Benzo(a)pyrene	99	210	18	10.27	49.66	186.99	mg/kg-ocn	100	11.1	1.5	1.9	0.0	NA	NA	HC-03-18
Indeno(1,2,3-cd)pyrene	34	88	18	6.85	28.82	97.56	mg/kg-ocn	100	22.2	1.9	2.9	5.6	1.1	1.1	HC-03-18
Dibenzo(a,h)anthracene	12	33	18	1.85	7.51	24.39	mg/kg-ocn	100	16.7	1.5	2.0	0.0	NA	NA	HC-03-18
Benzo(g,h,i)perylene	31	78	18	6.16	25.06	81.3	mg/kg-ocn	100	22.2	1.8	2.6	5.6	1.0	1.0	HC-03-18
Total HPAH	960	5300	18	103.22	556.31	2097.56	mg/kg-ocn	100	11.1	1.9	2.2	0.0	NA	NA	HC-03-18
1,2-Dichlorobenzene	2.3	2.3	18	0.42 U	0.97	2.06 U	mg/kg-ocn	0	0.0	NA	NA	0.0	NA	NA	--
1,4-Dichlorobenzene	3.1	9	18	0.53 U	1.65	2.97 U	mg/kg-ocn	0	0.0	NA	NA	0.0	NA	NA	--
1,2,4-Trichlorobenzene	0.81	1.8	18	0.26 U	0.72	1.41 U	mg/kg-ocn	0	*27.8*	*1.4*	*1.7*	0.0	NA	NA	HC-03-13
Hexachlorobenzene	0.38	2.3	18	0.23 U	0.92	2.05 U	mg/kg-ocn	0	*77.8*	*2.9*	*5.4*	0.0	NA	NA	HC-03-13, HC-03-01
Dimethyl phthalate	53	53	18	0.53 U	2.67	6.85 U	mg/kg-ocn	0	0.0	NA	NA	0.0	NA	NA	--
Diethylphthalate	61	110	18	0.53 U	2.67	6.85 U	mg/kg-ocn	0	0.0	NA	NA	0.0	NA	NA	--
Di-n-butyl phthalate	220	1700	18	0.49	2.4	6.99 U	mg/kg-ocn	55.56	0.0	NA	NA	0.0	NA	NA	--
Butyl benzyl phthalate	4.9	64	18	0.55	1.92	4.74	mg/kg-ocn	83.33	0.0	NA	NA	0.0	NA	NA	--
bis(2-ethylhexyl)phthalate	47	78	18	4.32	19.71	72.36	mg/kg-ocn	100	11.1	1.3	1.5	0.0	NA	NA	HC-03-18
Di-n-octyl phthalate	58	4500	18	0.53 U	2.59	6.85 U	mg/kg-ocn	5.56	0.0	NA	NA	0.0	NA	NA	--
Dibenzofuran	15	58	18	1.03	4.64	12.2	mg/kg-ocn	100	0.0	NA	NA	0.0	NA	NA	--
Hexachlorobutadiene	3.9	6.2	18	0.53 U	2.1	3.5 U	mg/kg-ocn	0	0.0	NA	NA	0.0	NA	NA	--
N-Nitrosodiphenylamine	11	11	18	0.53 U	2.67	6.85 U	mg/kg-ocn	0	0.0	NA	NA	0.0	NA	NA	--
Phenol	420	1200	18	18	103.06	180	mg/kg-dw	55.56	0.0	NA	NA	0.0	NA	NA	--
2-Methylphenol	63	63	18	7.2 U	36.67	60 U	mg/kg-dw	0	0.0	NA	NA	0.0	NA	NA	--
4-Methylphenol	670	670	18	8.4	57.58	390	mg/kg-dw	55.56	0.0	NA	NA	0.0	NA	NA	--
2,4-Dimethylphenol	29	29	18	8 U	34.26	58 U	mg/kg-dw	0	*55.6*	*1.8*	*2.0*	55.6	1.8	2.0	HC-03-07, HC-03-14
Pentachlorophenol	360	690	18	65	168.39	380	mg/kg-dw	50	5.6	1.1	1.1	0.0	NA	NA	HC-03-18
Benzyl alcohol	57	73	18	7.2 U	32.11	54 U	mg/kg-dw	0	0.0	NA	NA	0.0	NA	NA	--
Benzoic acid	650	650	18	150 U	634.44	1100 U	mg/kg-dw	0	*55.6*	*1.4*	*1.7*	55.6	1.4	1.7	HC-03-14
PCBs															
PCBs (total)	12	65	18	5.84	47.21	243.9	mg/kg-ocn	100	83.3	4.6	20.3	16.7	2.7	3.8	HC-03-18
Organometallics															
Tributyltin[2]	76	NA	18	1.44	34.16	121.95	mg/kg-ocn	100	27.78	1.23	1.6	NA	NA	NA	HC-03-18

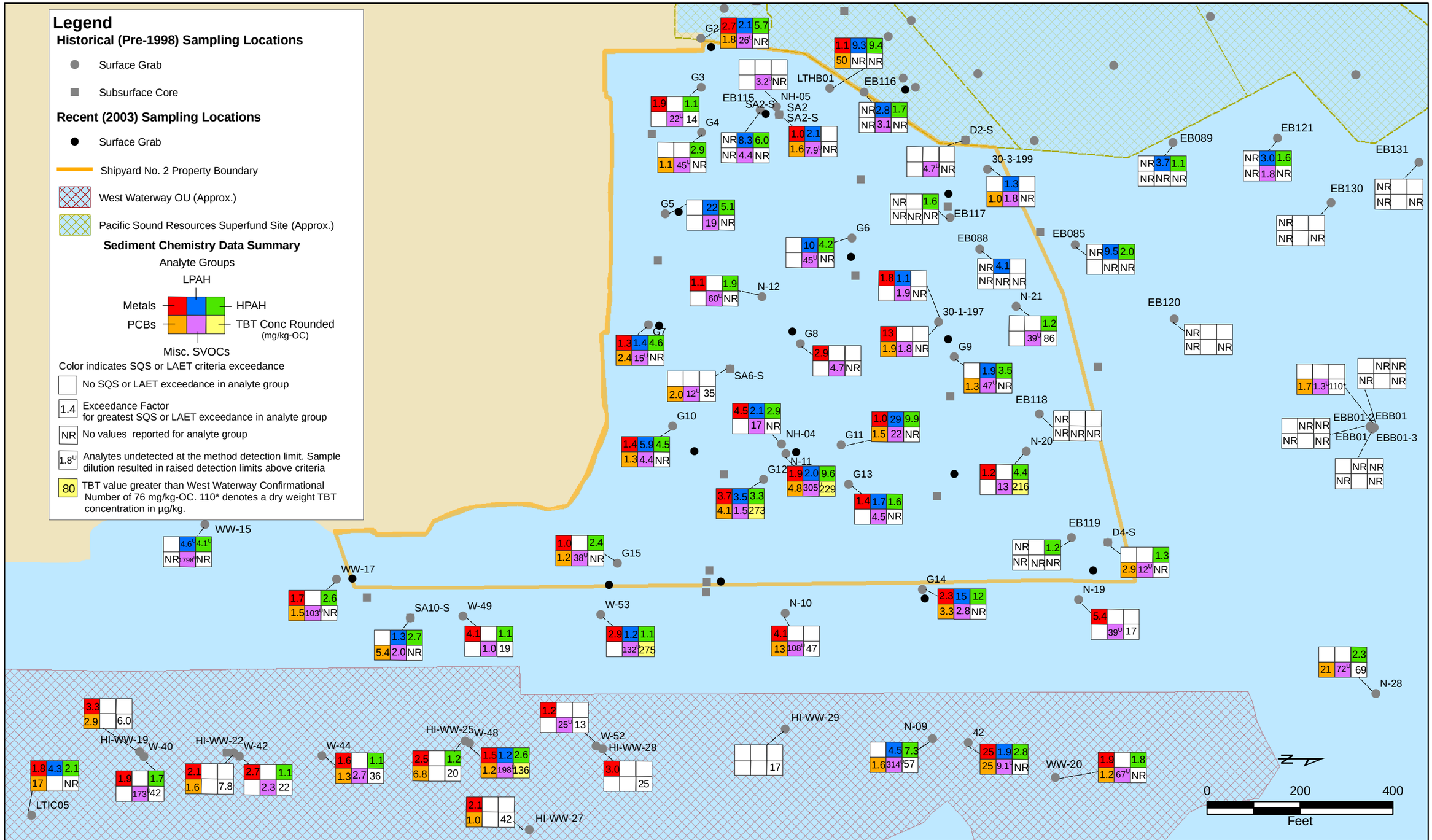
Notes:

NA: Not applicable because analyte does not exceed criteria.

1) The average and maximum exceedance ratios (ER) were calculated using only sample ER values that were greater than 1.

2) TBT concentrations are compared to the Harbor Island Shipyard Sediment Confirmational Number of 76 mg/kg-OC

3) *Italized* values are for those samples where an analyte was undetected, but the detection limit exceeded the SQS or CSL criteria.



TETRA TECH

Lockheed West Seattle Superfund Site Seattle, WA

Figure A.3-1
SQS or LAET criteria Exceedances 1998 and Earlier Surface Samples

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Legend

Historical (Pre-1998) Sampling Locations

- Surface Grab
- Subsurface Core

Recent (2003) Sampling Locations

- Surface Grab
- Shipyard No. 2 Property Boundary
- West Waterway OU (Approx.)
- Pacific Sound Resources Superfund Site (Approx.)

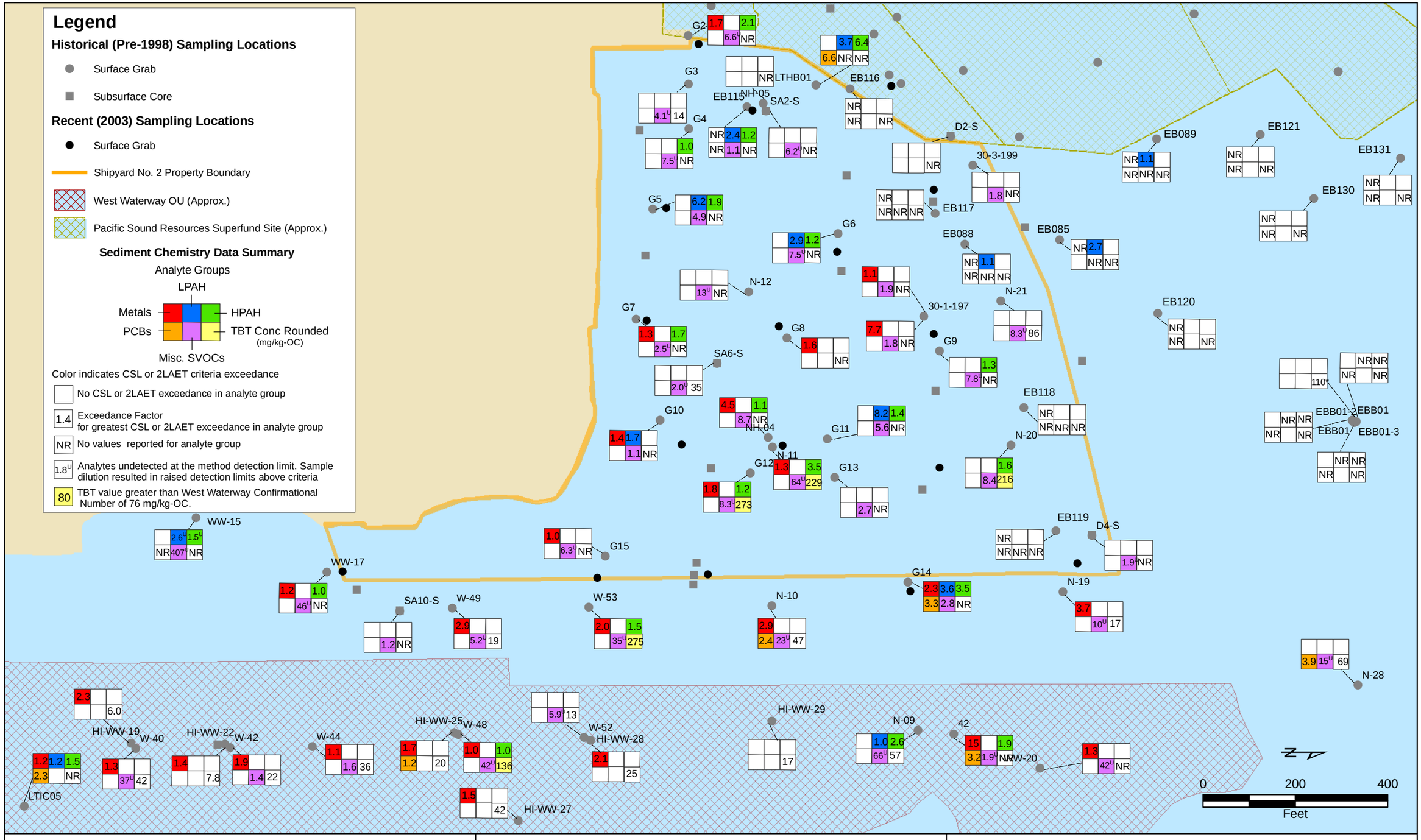
Sediment Chemistry Data Summary

Analyte Groups

LPAH, Metals, HPAH, PCBs, TBT Conc Rounded (mg/kg-OC), Misc. SVOCs

Color indicates CSL or 2LAET criteria exceedance

- No CSL or 2LAET exceedance in analyte group
- 1.4 — Exceedance Factor for greatest CSL or 2LAET exceedance in analyte group
- NR — No values reported for analyte group
- 1.8^{U} — Analytes undetected at the method detection limit. Sample dilution resulted in raised detection limits above criteria
- 80 — TBT value greater than West Waterway Confirmational Number of 76 mg/kg-OC.



TETRA TECH

Lockheed West Seattle
Superfund Site
Seattle, WA

Figure A.3-2
CSL and 2LAET Criteria Exceedances
1998 and Earlier Surface Samples

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Legend

Historical (Pre-1998) Sampling Locations

- Surface Grab
- Subsurface Core

Recent (2003) Sampling Locations

- Surface Grab
- Shipyard No. 2 Property Boundary
- West Waterway OU (Approx.)
- Pacific Sound Resources Superfund Site (Approx.)

Sediment Quality Condition

- No Detected Exceedance
- CSL Exceedance
- SQS Exceedance
- Area Exceeds CSL

Notes:

1. Exceedance frequency is the number of samples exceeding criteria within a given area.
2. Exceedance frequency based on CSL or SQS, except for tributyltin where the shipyard sediment operable unit confirmational number was used.
3. Analytes in *italics* were not detected, although, the reported detection limit exceeds criteria.
4. Exceedances for duplicate samples are included.
5. If analyte concentrations exceed CSL criteria, SQS criteria is automatically exceeded.

Area 2 - Exceeds CSL
Number of Samples = 2

Analyte	Frequency of Exceedance
Dibenzo(a,h)anthracene	1/2
1,2-Dichlorbenzene	2/2
1,4-Dichlorbenzene	2/2
1,2,4-Trichlorbenzene	2/2
Hexachlorbenzene	2/2
Hexachlorobutadiene	2/2
2-Methylphenol	2/2
2,4-Dimethylphenol	2/2
Pentachlorophenol	2/2
Benzyl alcohol	2/2
Benzoic Acid	2/2

Area 1 - Exceeds CSL
Number of Samples = 3

Analyte	Frequency of Exceedance
Copper	1/3
Acenaphthene	2/3
Fluorene	2/3
Phenanthrene	2/3
2-Methylnaphthalene	1/3
Benzo(a)anthracene	2/3
Chrysene	1/3
Benzofluoranthenes (total)	1/3
Benzo(a)pyrene	1/3
Indeno(1,2,3-cd)pyrene	2/3
Dibenzo(a,h)anthracene	3/3
Benzo(g,h,i)perylene	2/3
1,2-Dichlorobenzene	3/3
1,4-Dichlorobenzene	2/3
1,2,4-Trichlorobenzene	3/3
Hexachlorobenzene	3/3
Dibenzofuran	2/3
Hexachlorobutadiene	3/3
2-Methylphenol	3/3
2,4-Dimethylphenol	3/3
Pentachlorophenol	3/3
Benzyl alcohol	3/3
Benzoic Acid	3/3

Area 3 - Exceeds CSL
Number of Samples = 15*

Analyte	Frequency of Exceedance
Arsenic	2/9
Zinc	1/9
Acenaphthylene	1/15
Acenaphthene	2/15
Fluorene	2/15
Phenanthrene	2/15
Anthracene	1/15
Fluoranthene	2/15
Pyrene	1/15
Benzo(a)anthracene	2/15
Chrysene	1/15
Benzofluoranthenes (total)	2/15
Benzo(a)pyrene	2/15
Indeno(1,2,3-cd)pyrene	1/15
Dibenzo(a,h)anthracene	1/15
Benzo(g,h,i)perylene	1/15
1,2-Dichlorobenzene	4/9
1,4-Dichlorobenzene	2/9
1,2,4-Trichlorobenzene	4/9
Hexachlorobenzene	4/9
bis(2-ethylhexyl)phthalate	1/9
Dibenzofuran	1/15
Hexachlorobutadiene	3/9
N-Nitrosodiphenylamine	1/9
2-Methylphenol	2/9
4-Methylphenol	3/9
2,4-Dimethylphenol	2/9
Pentachlorophenol	1/9
Benzyl alcohol	2/9
Benzoic Acid	3/9
PCBs (total)	1/9
TBT**	1/1

** A total of six samples were analyzed for only PAHs and dibenzofuran.*
*** Only one sample reported a TBT concentration.*

Area 4 - Exceeds CSL
Number of Samples = 9

Analyte	Frequency of Exceedance
Arsenic	2/9
Copper	3/9
Mercury	2/9
Zinc	3/9
Acenaphthene	1/9
Fluorene	1/9
Phenanthrene	1/9
Fluoranthene	1/9
Benzo(a)anthracene	1/9
Benzofluoranthenes (total)	1/9
Indeno(1,2,3-cd)pyrene	1/9
Dibenzo(a,h)anthracene	4/9
Benzo(g,h,i)perylene	1/9
1,2-Dichlorobenzene	7/9
1,4-Dichlorobenzene	6/9
1,2,4-Trichlorobenzene	8/9
Hexachlorobenzene	8/9
Dimethyl phthalate	1/9
Diethylphthalate	1/9
bis(2-ethylhexyl)phthalate	2/9
Dibenzofuran	1/9
Hexachlorobutadiene	7/9
N-Nitrosodiphenylamine	4/9
2-Methylphenol	7/9
4-Methylphenol	6/9
2,4-Dimethylphenol	7/9
Pentachlorophenol	6/9
Benzyl alcohol	4/9
Benzoic Acid	2/9
TBT*	3/4

** A total of 4 samples reported TBT concentrations.*

Area 6 - Exceeds CSL
Number of Samples = 1

Analyte	Frequency of Exceedance
Copper	1/1
1,2-Dichlorobenzene	1/1
1,4-Dichlorobenzene	1/1
1,2,4-Trichlorobenzene	1/1
Hexachlorobenzene	1/1
Hexachlorobutadiene	1/1
2-Methylphenol	1/1
2,4-Dimethylphenol	1/1
Pentachlorophenol	1/1
Benzyl alcohol	1/1

Area 5 - Exceeds CSL
Number of Samples = 1

Analyte	Frequency of Exceedance
Copper	1/1
Acenaphthene	1/1
Fluorene	1/1
1,2-Dichlorobenzene	1/1
1,4-Dichlorobenzene	1/1
1,2,4-Trichlorobenzene	1/1
Hexachlorobenzene	1/1
Dibenzofuran	1/1
Hexachlorobutadiene	1/1
2-Methylphenol	1/1
2,4-Dimethylphenol	1/1
Pentachlorophenol	1/1
Benzyl alcohol	1/1

TETRA TECH

Lockheed West Seattle Superfund Site Seattle, WA

Figure A.3-3
Surface Sediment Exceedance Frequency Distribution for Historical Site Conditions

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Legend

1998 and Earlier Sampling Locations

- CORE
- Property Boundary
- Haborlines
- Pacific Sound Resources Superfund Site (approx)
- West Waterway OU (approx)

0 50 100 200 Feet

N

U Concentrations not detected above the labratory detection limit estimated concentration.

E Estimated Concentration

J Estimated value for a detection less than the laboratory's reporting limit but less than or equal to the method detection limit

B Blank Contamination

Notes:
1. Harbor Lines from the Washington State Dept. of Natural Resources website (2003).
2. West Waterway sampling locations from SEDQUAL or transcribed from plan sheet.
3.Analyte in bold black were not detected although the reported detection limit exceeds the CSL.
4. Detected concentration of analyte in red exceeds CSL.
5. For sampling locations where % TOC is <0.5, all concentrations were screened using the LAET criteria (dry weight).
6. For sampling locations were % TOC is >0.5 and < 1.0, concentrations were screened using both SMS and LAET criteria.
7. For sampling locations were % TOC is >1.0, all concentrations were screened using SMS criteria (dry weight and organic carbon normalized).
8. TBT screening value greater than West Waterway Confirmational Number of 76 mg/kg-OC shown as bold.

SA3-A 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.65	
1,2,4-Trichlorobenzene	8 U	1.231 U
1,4-Dichlorobenzene	27 U	4.154 U
Arsenic (mg/kg)	71	
Dibenzo(a,h)anthracene	130	20.000
Hexachlorobenzene	27 U	**4.154 U**
Hexachlorobutadiene	27 U	4.154 U
PCBs (total)	136	20.923

SA3-B 2 - 4.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.52	
1,2,4-Trichlorobenzene	8 U	1.538 U
1,2-Dichlorobenzene	13 U	**2.5 U**
1,4-Dichlorobenzene	25 U	4.808 U
Acenaphthene	95	18.269
Anthracene	1800	346.154
Benzo(a)anthracene	1300	250.000
Chrysene	1100	211.538
Dibenzo(a,h)anthracene	110	21.154
Dibenzofuran	190	36.538
Fluoranthene	3400	653.846
Fluorene	950	**182.692**
Hexachlorobenzene	25 U	**4.808 U**
Hexachlorobutadiene	25 U	4.808 U
PCBs (total)	130	25.000
Phenanthrene	4300	**826.923**
Total HPAH	10370 E	1994.231 E
Total LPAH	7235	**1391.346**

SA3-D 8 - 10.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1	
Hexachlorobenzene	24 U	**2.4 U**

SA2-C 0 - 1 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	2.2	
1,2,4-Trichlorobenzene		**7.727 U**
1,2-Dichlorobenzene		**7.727 U**
1,4-Dichlorobenzene		**15.455 U**
2,4-Dimethylphenol	**170 U**	
2-Methylphenol	**170 U**	
Benzoic acid	**1700 U**	
Benzyl alcohol	**270 U**	
Butyl benzyl phthalate		15.455 U
Dibenzo(a,h)anthracene		20.455 E
Hexachlorobenzene		**15.455 U**
Hexachlorobutadiene		**15.455 U**
PCBs (total)		14.955
Pentachlorophenol	**1700 U**	
Phenol	680 U	
Total HPAH		1085.909 E

SA2-D 2 - 5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	4.3	
1,2,4-Trichlorobenzene		**2.326 U**
1,2-Dichlorobenzene		**3.023 U**
1,4-Dichlorobenzene		7.442 U
2,4-Dimethylphenol	**190**	
2-Methylphenol	**130 U**	
Acenaphthene		**141.860**
Benzyl alcohol	**160 U**	
Butyl benzyl phthalate		7.442 U
Dibenzo(a,h)anthracene		13.721
Dibenzofuran		44.186
Fluoranthene		395.349
Fluorene		**93.023**
Hexachlorobenzene		**7.442 U**
Pentachlorophenol	**1600 U**	
Phenanthrene		181.395
Phenol	650 U	
Total HPAH		1160.697674
Total LPAH		593.0232558

D3-A 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.56	
1,2,4-Trichlorobenzene	13 U	**2.321 U**
1,2-Dichlorobenzene	13 U	**2.321 U**
1,4-Dichlorobenzene	27 U	4.821 U
Benzo(a)anthracene	650	116.071
Benzo(g,h,i)perylene	250	44.643
bis(2-ethylhexyl)phthalate	640	**114.286**
Dibenzo(a,h)anthracene	120	21.429
Hexachlorobenzene	27 U	**4.821 U**
Hexachlorobutadiene	27 U	4.821 U
Indeno(1,2,3-cd)pyrene	270	48.214
PCBs (total)	246	43.929
Zinc (mg/kg)	480 E	

D3-B 2 - 4.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.28	
Hexachlorobenzene	24 U	
Hexachlorobutadiene	24 U	
PCBs (total)	160	

D3-C 10.5 - 12.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.08	
Hexachlorobenzene	24 U	
Hexachlorobutadiene	24 U	

C6 2 - 5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.3682	
1,2,4-Trichlorobenzene		1 U
Hexachlorobenzene		1 U

C6 5 - 8 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.7154	
1,2,4-Trichlorobenzene	7.154 U	1 U
Hexachlorobenzene	7.154 U	1 U

C8 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.7418	
1,2,4-Trichlorobenzene	7.418 U	1 U
Hexachlorobenzene	7.418 U	1 U

C8 2 - 5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.648	
1,2,4-Trichlorobenzene	6.48 U	1 U
Hexachlorobenzene	6.48 U	1 U

C5 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.654	
1,2,4-Trichlorobenzene	6.54 U	1 U
Hexachlorobenzene	6.54 U	1 U

C5 2 - 5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.5702	
1,2,4-Trichlorobenzene	5.702 U	1 U
Hexachlorobenzene	5.702 U	1 U
PCBs (total)	79.828 U	14 U

C5 5 - 8 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.781	
1,2,4-Trichlorobenzene	7.81 U	1 U
Hexachlorobenzene	7.81 U	1 U

C7 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.7092	
TOC (%)	0.1931	
Hexachlorobutadiene	11.586 U	

C7 5 - 8 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.7004	
1,2,4-Trichlorobenzene	7.004 U	1 U
Hexachlorobenzene	7.004 U	1 U

SA9-A 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.63	
1,2,4-Trichlorobenzene	13 U	**2.063 U**
1,4-Dichlorobenzene	27 U	4.286 U
Benzo(a)anthracene	850	134.921
Benzo(a)pyrene	690	109.524
Benzo(g,h,i)perylene	410	65.079
bis(2-ethylhexyl)phthalate	420	66.667
Dibenzo(a,h)anthracene	250	**39.683**
Fluoranthene	1200	190.476
Hexachlorobenzene	27 U	**4.286 U**
Hexachlorobutadiene	27 U	4.286 U
Indeno(1,2,3-cd)pyrene	420	66.667
PCBs (total)	610	**96.825**
Phenanthrene	1100	174.603
Total HPAH	8780	1393.651

SA9-B 2 - 5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.69	
1,2,4-Trichlorobenzene	13 U	**1.884 U**
1,4-Dichlorobenzene	26 U	3.768 U
Hexachlorobenzene	26 U	**3.768 U**
PCBs (total)	143	20.725

SA9-C 9 - 10.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.34	
PCBs (total)	210	

SA9-D 10.5 - 12 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.25	
PCBs (total)	135 U	

SA8-A 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.34	
1,2,4-Trichlorobenzene	**140 U**	
1,2-Dichlorobenzene	**140 U**	
1,4-Dichlorobenzene	**270 U**	
2,4-Dimethylphenol	**140 U**	
2-Methylphenol	**140 U**	
Anthracene	1100	
Benzo(a)anthracene	2500	
Benzo(a)pyrene	2200	
Benzo(g,h,i)perylene	**1600**	
Benzofluoranthenes (total)	**4400**	
Benzoic acid	**1400 U**	
Benzyl alcohol	**220 U**	
bis(2-ethylhexyl)phthalate	1400	
Butyl benzyl phthalate	270 U	
Chrysene	2200	
Dibenzo(a,h)anthracene	**860**	
Diethylphthalate	270 U	
Dimethyl phthalate	270 U	
Fluoranthene	5100	
Fluorene	720	
Hexachlorobenzene	**270 U**	
Hexachlorobutadiene	**270 U**	
Indeno(1,2,3-cd)pyrene	1400	
N-Nitrosodiphenylamine	**140 U**	
PCBs (total)	**1090**	
Pentachlorophenol	**1400 U**	
Phenanthrene	4000	
Phenol	550 U	
Pyrene	8400	
Total HPAH	28660	
Total LPAH	6410	

SA8-C 2 - 3.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.16	
PCBs (total)	235	

SA8-D 3.5 - 5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.61	
PCBs (total)	125	20.492

SA4-C 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.2	
Dibenzo(a,h)anthracene		14.167
Fluoranthene		307.500
Hexachlorobenzene		2.25 U

SA4-D 2 - 4.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.65	
1,2,4-Trichlorobenzene	8 U	1.270 U
1,4-Dichlorobenzene	25 U	3.968 U
Hexachlorobenzene	25 U	**3.968 U**
Hexachlorobutadiene	25 U	3.968 U
PCBs (total)	120 U	19.048 U

SA5-A 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.1	
1,2,4-Trichlorobenzene		1.091 U
Hexachlorobenzene		2.182 U

SA5-C 2 - 4.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.96	
1,2,4-Trichlorobenzene	12 U	1.25 U
Hexachlorobenzene	24 U	**2.5 U**
PCBs (total)	120 U	12.5 U

SA6-C 0 - 1.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.35	
PCBs (total)	135 U	

SA7-A 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1	
1,2,4-Trichlorobenzene		1.3 U
Hexachlorobenzene		**2.5 U**
PCBs (total)		12.500

SA7-B/C 2 - 6 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.38	
Arsenic (mg/kg)	58	
PCBs (total)	125	

SA7-D 7.5 - 9 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	2.4	
Arsenic (mg/kg)	70	

D4-D 0 - 9.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.41	
Hexachlorobenzene	25 U	
Hexachlorobutadiene	18 U	

PC-2A 0 - 4 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.51	
1,2,4-Trichloro	5.6 U	1.098 U
Hexachloroben	11 U	2.157 U
PCBs (total)	220	43.137

PC-2B 4 - 8 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.51	
1,2,4-Trichloro	5.6 U	1 U
Hexachloroben	11 U	1.964 U

PC-2C 8 - 12 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.8	
Hexachlorobenzene	1.091 U	

SA10-A 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.2	
1,2,4-Trichlorobenzene		**11.667 U**
1,2-Dichlorobenzene		**11.667 U**
1,4-Dichlorobenzene		**24.167 U**
2,4-Dimethylphenol	**140 U**	
2-Methylphenol	**140 U**	
Benzo(g,h,i)perylene		**75.000**
Benzoic acid	**1400 U**	
Benzyl alcohol	**230 U**	
Butyl benzyl phthalate		24.167 U
Dibenzo(a,h)anthracene		**50.000**
Dibenzofuran		25 U
Hexachlorobenzene		**24.167 U**
Hexachlorobutadiene		**24.167 U**
Indeno(1,2,3-cd)pyrene		60.833
N-Nitrosodiphenylamine		**11.667 U**
PCBs (total)		21.667
Pentachlorophenol	**1400 U**	
Phenol	580 U	

SA10-B 2 - 5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.1	
1,2,4-Trichlorobenzene		1.091 U
Hexachlorobenzene		2.182 U
PCBs (total)		20.909

SA10-C 9 - 10.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.5	
1,2,4-Trichlorobenzene	15 U	1 U
Hexachlorobenzene		2 U

SA10-D 10 - 12.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.68	
1,4-Dichlorobenzene	26 U	3.824 U
Hexachlorobenzene	26 U	3.824 U
PCBs (total)	120 U	17.647 U

PC-1A 0 - 4 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.8	
Hexachlorobenzene		0.778 U

PC-1B 4 - 8 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.43	
Hexachlorobutadiene	20 U	

PC-1C 8 - 12 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.35	
Hexachlorobutadiene	19 U	

D5-C 0 - 4 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.67	
1,2,4-Trichlorobenzene	**120 U**	**17.910 U**
1,2-Dichlorobenzene	**120 U**	**17.910 U**
1,4-Dichlorobenzene	**250 U**	**37.313 U**
2,4-Dimethylphenol	**120 U**	
2-Methylnaphthalene	**1600**	**238.806**
2-Methylphenol	**120 U**	
Acenaphthene	**3600**	**537.313**
Anthracene	2000	298.507
Arsenic (mg/kg)	64	
Benzo(a)anthracene	3200	**477.612**
Benzo(a)pyrene	2500	**373.134**
Benzo(g,h,i)perylene	1200	**179.104**
Benzofluoranthenes (total)	5100	**761.194**
Benzoic acid	**1200 U**	
Benzyl alcohol	**200 U**	
bis(2-ethylhexyl)phthalate	1900	**283.582**
Butyl benzyl phthalate	250 U	37.313 U
Chrysene	3500	**522.388**
Copper (mg/kg)	**1200 E**	
Dibenzo(a,h)anthracene	550	**82.090**
Dibenzofuran	**2900**	**432.836**
Fluoranthene	9700	**1447.761**
Fluorene	**3500**	**522.388**
Hexachlorobenzene	**250 U**	**37.313 U**
Hexachlorobutadiene	**250 U**	**37.313 U**
Indeno(1,2,3-cd)pyrene	1100	**164.179**
Lead (mg/kg)	**610 E**	
Naphthalene	**6900**	**1029.851**
N-Nitrosodiphenylamine	**270 E**	**40.299 E**
PCBs (total)	**2800**	**417.910**
Pentachlorophenol	**1200 U**	
Phenanthrene	**8000**	**1194.030**
Phenol	500 U	
Pyrene	8000	1194.030
Total HPAH	34850	5201.493
Total LPAH	**24200 E**	**3611.940 E**
Tributyltin	**4500 U**	**671.641 U**
Zinc (mg/kg)	**2600 E**	

D5-D 6 - 12 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.36	
1,2,4-Trichlorobenzene	**120 U**	
1,2-Dichlorobenzene	**130 U**	
1,4-Dichlorobenzene	**250 U**	
2,4-Dimethylphenol	**130 U**	
2-Methylnaphthalene	630	
2-Methylphenol	**130 U**	
Acenaphthene	**1400**	
Acenaphthylene	250 U	
Anthracene	1100	
Benzo(a)anthracene	1100	
Benzo(a)pyrene	980	
Benzo(g,h,i)perylene	410	
Benzofluoranthenes (total)	1800	
Benzoic acid	**1300 U**	
Benzyl alcohol	**200 U**	
bis(2-ethylhexyl)phthalate	610	
Butyl benzyl phthalate	250 U	
Chrysene	1200	
Dibenzo(a,h)anthracene	**260**	
Dibenzofuran	**850**	
Diethylphthalate	250 U	
Dimethyl phthalate	250 U	
Di-n-octyl phthalate	250 U	
Fluoranthene	4400	
Fluorene	**1100**	
Hexachlorobenzene	**250 U**	
Hexachlorobutadiene	**250 U**	
Indeno(1,2,3-cd)pyrene	440	
Naphthalene	2200	
N-Nitrosodiphenylamine	**130 U**	
PCBs (total)	460	
Pentachlorophenol	**1300 U**	
Phenanthrene	3800	
Phenol	500 U	
Total HPAH	13690	
Total LPAH	9600	

M1-C 0 - 7.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.61	
1,2,4-Trichlorobenzene	**110 U**	18.033 U
1,2-Dichlorobenzene	**110 U**	18.033 U
1,4-Dichlorobenzene	**220 U**	36.066 U
2,4-Dimethylphenol	**110 U**	
2-Methylnaphthalene	350	57.377
2-Methylphenol	**110 U**	
Acenaphthene	**1600**	**262.295**
Anthracene	1600	262.295
Arsenic (mg/kg)	**110**	
Benzo(a)anthracene	3200	**524.590**
Benzo(a)pyrene	2200	**360.656**
Benzo(g,h,i)perylene	1200	**196.721**
Benzofluoranthenes (total)	4500	**737.705**
Benzoic acid	**1100 U**	
Benzyl alcohol	**180 U**	
bis(2-ethylhexyl)phthalate	960	**157.377**
Butyl benzyl phthalate	220 U	36.066
Chrysene	2900	**475.410**
Copper (mg/kg)	**1300 E**	
Dibenzo(a,h)anthracene	**490**	**80.328**
Dibenzofuran	**1100**	**180.328**
Fluoranthene	8400	**1377.049**
Fluorene	**1700**	**278.689**
Hexachlorobenzene	**220 U**	**36.066 U**
Hexachlorobutadiene	**220 U**	**36.066 U**
Indeno(1,2,3-cd)pyrene	1100	**180.328**
Lead (mg/kg)	**2200**	
N-Nitrosodiphenylamine	**110 U**	**18.033 U**
PCBs (total)	**2600**	**426.230**
Pentachlorophenol	**1100 U**	
Phenanthrene	**6400**	**1049.180**
Phenol	**440 U**	
Pyrene	7700	1262.295
Total HPAH	31690	5195.082
Total LPAH	12120	**1986.885**
Zinc (mg/kg)	**1700 E**	

M1-D 7.5 - 12.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.19	
1,2,4-Trichlorobenzene	**12 U**	
1,2-Dichlorobenzene	**12 U**	
1,4-Dichlorobenzene	**24 U**	
Arsenic	64	
Benzo(a)anthracene	310	
Hexachlorobenzene	**24 U**	
Hexachlorobutadiene	**24 U**	
PCBs (total)	200 U	

SB1-A 0 - 2 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1	
1,2,4-Trichlorobenzene		**28 E**
1,2-Dichlorobenzene		**14 U**
1,4-Dichlorobenzene		**28 U**
2,4-Dimethylphenol	**140 U**	
2-Methylnaphthalene		**130.000**
2-Methylphenol	**140 U**	
4-Methylphenol	**730**	
Acenaphthene		**540.000**
Acenaphthylene		**190.000**
Anthracene		870.000
Arsenic (mg/kg)	**110**	
Benzo(a)anthracene		**1900.000**
Benzo(a)pyrene		**1500.000**
Benzo(g,h,i)perylene		**880.000**
Benzofluoranthenes (total)		**2200.000**
Benzoic acid	**1400 U**	
Benzyl alcohol	**220 U**	
bis(2-ethylhexyl)phthalate		**1100.000**
Butyl benzyl phthalate		28.000
Chromium (mg/kg)	**660 E**	
Chrysene		**1500.000**
Copper (mg/kg)	**1900 E**	
Dibenzo(a,h)anthracene		**420.000**
Dibenzofuran		**400.000**
Fluoranthene		**3500.000**
Fluorene		**600.000**
Hexachlorobenzene		**28.000**
Hexachlorobutadiene		**28.000**
Indeno(1,2,3-cd)pyrene		**890.000**
Lead (mg/kg)	**550 E**	
Naphthalene		**650.000**
N-Nitrosodiphenylamine		**14 U**
PCBs (total)		**590**
Pentachlorophenol	**1400 U**	
Phenanthrene		**3500**
Phenol	1200	
Pyrene		**3600**
Total HPAH		**16390**
Total LPAH		**6350**
Zinc (mg/kg)	**960 E**	

SB1-C 2 - 7.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.81	
1,2,4-Trichlorobenzene	**120 U**	**14.815 U**
1,2-Dichlorobenzene	**120 U**	**14.815 U**
1,4-Dichlorobenzene	**230**	**28.395**
2,4-Dimethylphenol	**120 U**	
2-Methylphenol	**120 U**	
Acenaphthene	**1300**	**160.494**
Anthracene	2000	246.914
Arsenic (mg/kg)	3400	**419.753**
Benzo(a)anthracene	3000	**370.370**
Benzo(g,h,i)perylene	**1500**	**185.185**
Benzofluoranthenes (total)	5700	**703.704**
Benzoic acid	**1200 U**	
Benzyl alcohol	**180 U**	
bis(2-ethylhexyl)phthalate	**3200**	**395.062**
Butyl benzyl phthalate	230 U	28.395 U
Chrysene	3300	407.407
Dibenzo(a,h)anthracene	**800**	**98.765**
Dibenzofuran	**1100**	**135.802**
Fluoranthene	8800	1086.420
Fluorene	**1600**	**197.531**
Hexachlorobenzene	**230 U**	**28.395 U**
Hexachlorobutadiene	**230 U**	**28.395 U**
Indeno(1,2,3-cd)pyrene	1600	**197.531**
Lead (mg/kg)	**550 E**	
Naphthalene	2400	**296.296**
N-Nitrosodiphenylamine	**120 U**	**14.815 U**
PCBs (total)	**2300**	**283.951**
Pentachlorophenol	**1200 U**	
Phenanthrene	**6800**	**839.506**
Phenol	460 U	
Total HPAH	35700	4407.407
Total LPAH	**14330**	**1769.135802**
Zinc (mg/kg)	**1100 E**	

SB1-D 7.5 - 13.5 ft

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.37	
1,2,4-Trichlorobenzene	**110 U**	
1,2-Dichlorobenzene	**110 U**	
1,4-Dichlorobenzene	**230 U**	
2,4-Dimethylphenol	**110 U**	
2-Methylphenol	**110 U**	
Acenaphthene	1300	
Anthracene	2200	
Arsenic (mg/kg)	82	
Benzo(a)anthracene	3400	
Benzo(a)pyrene	2400	
Benzo(g,h,i)perylene	1400	
Benzofluoranthenes (total)	4600	
Benzoic acid	**1100 U**	
Benzyl alcohol	**180 U**	
bis(2-ethylhexyl)phthalate	3000	
Chrysene	3200	
Copper (mg/kg)	**700 E**	
Dibenzo(a,h)anthracene	**530**	
Dibenzofuran	**1000**	
Fluoranthene	9500	
Fluorene	**1500**	
Hexachlorobenzene	**230 U**	
Hexachlorobutadiene	**230 U**	
Indeno(1,2,3-cd)pyrene	1300	
Lead (mg/kg)	**600 E**	
N-Nitrosodiphenylamine	**110 U**	
PCBs (total)	**2160**	
Pentachlorophenol	**1100 U**	
Phenanthrene	**7200**	
Phenol	460 U	
Pyrene	8100	
Total HPAH	34430	
Total LPAH	**13780 E**	
Zinc (mg/kg)	**1600 E**	

TETRA TECH EC, INC.

Lockheed West
Shipyard No. 2
Seattle, WA

Figure A.3-4
SQS and LAET Criteria Exceedances for Subsurface Sediment Samples

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Legend

Historical (Pre-1998) Sampling Locations

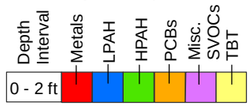
- Subsurface Core
- Subsurface Grab

Recent (2003) Sampling Locations

- Surface Grab
- Shipyard No. 2 Property Boundary
- West Waterway OU (Approx.)
- Pacific Sound Resources Superfund Site (Approx.)

Sediment Chemistry Data Summary

Analyte Groups



Color indicates SQS or LAET criteria exceedance

1.4 Exceedance Factor for greatest SQS or LAET exceedance in analyte group

NR No values reported for analyte group

1.8^U Analytes undetected at the method detection limit. Sample dilution resulted in raised detection limits above criteria

TBT was analyzed for in one subsurface sample collected from Core D5 at the 0-4 feet interval and is compared to the West Waterway Confirmational Number of 76 mg/kg-OC.

TETRA TECH

Lockheed West Seattle
Superfund Site
Seattle, WA

Figure A.3-5
SQS and LAET Criteria Exceedances
1998 and Earlier Subsurface Samples

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Legend

Historical (Pre-1998) Sampling Locations

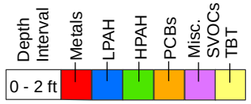
- Subsurface Core
- Subsurface Grab

Recent (2003) Sampling Locations

- Surface Grab
- Shipyard No. 2 Property Boundary
- West Waterway OU (Approx.)
- Pacific Sound Resources Superfund Site (Approx.)

Sediment Chemistry Data Summary

Analyte Groups



Color indicates CSL or 2LAET criteria exceedance

1.4 Exceedance Factor for greatest CSL or 2LAET exceedance in analyte group

NR No values reported for analyte group

1.8^{U} Analytes undetected at the method detection limit. Sample dilution resulted in raised detection limits above criteria

TBT was analyzed for in one subsurface sample collected from Core D5 at the 0-4 feet interval and is compared to the West Waterway Confirmational Number of 76 mg/kg-OC.

TETRA TECH

Lockheed West Seattle Superfund Site Seattle, WA

Figure A.3-6
CSL and 2LAET Criteria Exceedances 1998 and Earlier Subsurface Samples

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MXD NAME: F:\projects\TT-LMC\GIS\Data Summary\Work Plan RI NatureExtent Figures\Finalized TT Work Plan Figures\Figure 4-16 Hist Subsrface CSL Exc.mxd

Legend

- Property Boundary
- Haborlines
- Pacific Sound Resources Superfund Site (approx)
- West Waterway OU (approx)

0 50 100 200 Feet

N

Number of CSL Exceedances
- 0
- 1-4
- 5-9
- > 9

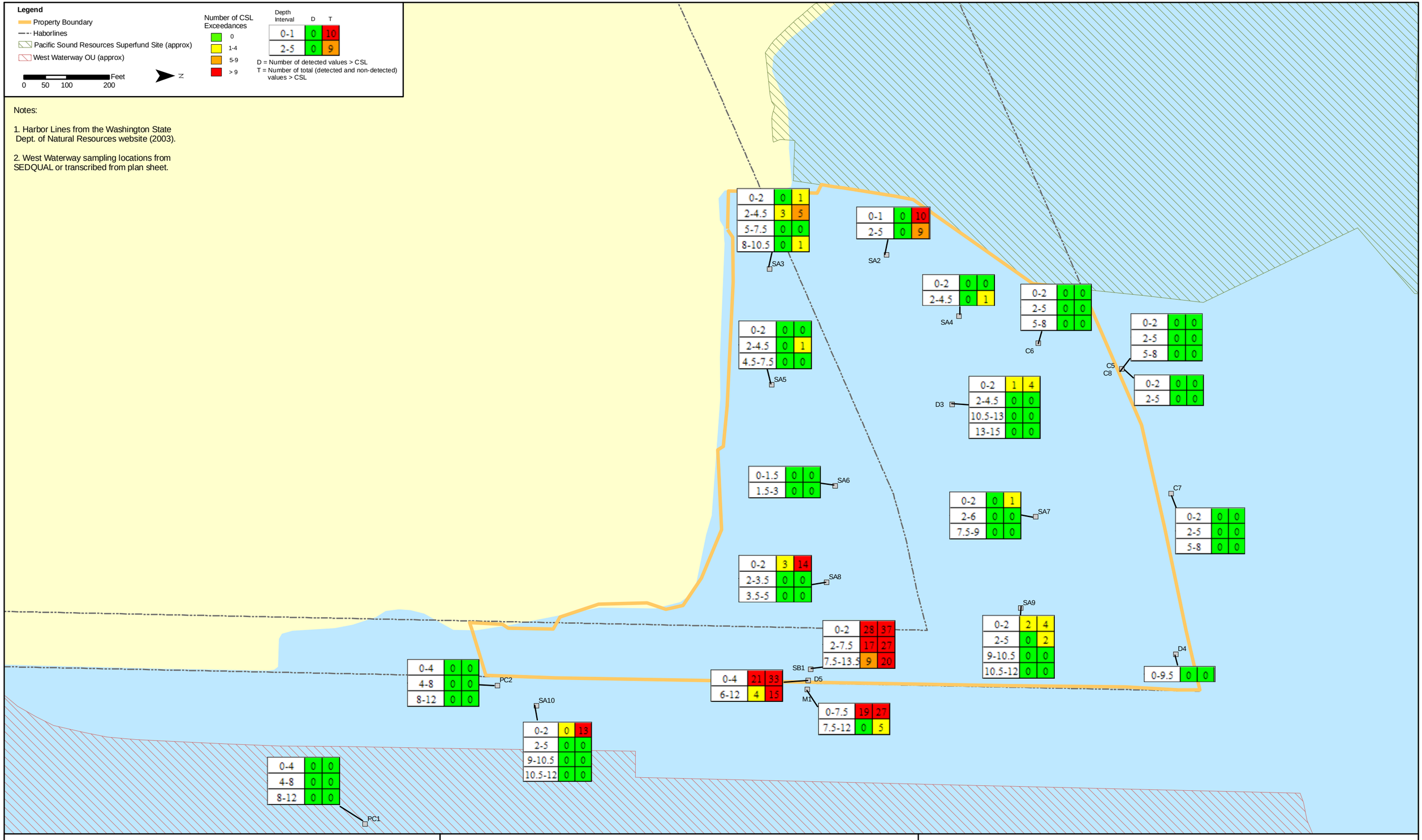
Depth Interval	D	T
0-1	0	10
2-5	0	9

D = Number of detected values > CSL
T = Number of total (detected and non-detected) values > CSL

Notes:

1. Harbor Lines from the Washington State Dept. of Natural Resources website (2003).

2. West Waterway sampling locations from SEDQUAL or transcribed from plan sheet.



TETRA TECH EC, INC.

Lockheed West
Shipyard No. 2
Seattle, WA

Figure A.3-7
Summary of CSL Criteria Exceedances
for Subsurface Sediment Samples

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Legend

1998 and Earlier Sampling Locations

- Surface Grab

2003 Sampling Locations

- Surface Grab
- Property Boundary
- Haborlines
- Pacific Sound Resources Superfund Site (approx)
- West Waterway OU (approx)

U Concentrations not detected above the labratory detection limit estimated concentration.

E Estimated Concentration

J Estimated value for a detection less than the laboratory's reporting limit but less than or equal to the method detection limit

B Blank Contamination

0 50 100 200 Feet

N

Notes:

1. Harbor Lines from the Washington State Dept. of Natural Resources website (2003).
2. West Waterway sampling locations from SEDQUAL or transcribed from plan sheet.
3. Analyte in bold black were not detected although the reported detection limit exceeds the CSL.
4. Detected concentration of analyte in red exceeds CSL.
5. For sampling locations where % TOC is <0.5, all concentrations were screened using the LAET criteria (dry weight).
6. For sampling locations were % TOC is >0.5 and < 1.0, concentrations were screened using both SMS and LAET criteria.
7. For sampling locations were % TOC is >1.0, all concentrations were screened using SMS criteria (dry weight and organic carbon normalized).
8. TBT screening value greater than West Waterway Confirmational Number of 76 mg/kg-OC shown as bold.

W-37 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.52	
1,2,4-Trichlorobenzene		**9.211 UE**
1,2-Dichlorobenzene		**9.211 UE**
1,4-Dichlorobenzene		**9.211 UE**
2,4-Dimethylphenol	**140 UE**	
2-Methylphenol	**140 UE**	
Butyl benzyl phthalate		9.211 UE
Cadmium (mg/kg)	5.4	
Hexachlorobenzene		**9.211 UE**
Hexachlorobutadiene		**9.211 UE**
Mercury (mg/kg)	**0.82 E**	
PCBs (total)		55.329
TBT	2970	**195.400**

W-30 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.27	
1,2,4-Trichlorobenzene		**28.346 U**
1,2-Dichlorobenzene		**28.346 U**
1,4-Dichlorobenzene		**28.346 U**
2,4-Dimethylphenol	**360 U**	
2-Methylphenol	**360 U**	
Benzo(g,h,i)perylene		46.457
bis(2-ethylhexyl)phthalate		69.291 UE
Cadmium (mg/kg)	**7.2**	
Chrysene	1500	118.110
Dibenzo(a,h)anthracene		28.346 U
Fluoranthene		181.102 E
Hexachlorobenzene		**28.346 U**
Hexachlorobutadiene		**28.346 U**
Indeno(1,2,3-cd)pyrene		42.520
Mercury (mg/kg)	**1.3 E**	
N-Nitrosodiphenylamine		**28.346 U**
PCBs (total)		31.417 E
Phenol	**1400**	
TBT	5732	**451.300**

WW-13 0 - 10 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.96	
1,2,4-Trichlorobenzene		**714.286 U**
1,2-Dichlorobenzene		**71.429 U**
1,4-Dichlorobenzene		**147.959 U**
2,4-Dimethylphenol	**6800 U**	
2-Methylnaphthalene		56.122 U
2-Methylphenol	**600 U**	
Acenaphthene		23.469 U
Benzoic acid	**9000 U**	
Benzyl alcohol	**860 U**	
Chrysene		117.347
Dibenzofuran		22.449 U
Hexachlorobenzene		**122.449 U**
Hexachlorobutadiene		**3112.245 U**
Mercury (mg/kg)	0.587 E	
PCBs (total)		25.510 U
Pentachlorophenol	**61000 U**	

W-40 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.02	
1,2,4-Trichlorobenzene		**65.686 UE**
1,2-Dichlorobenzene		**65.686 UE**
1,4-Dichlorobenzene		**65.686 UE**
2,4-Dimethylphenol	**670 UE**	
2-Methylphenol	**670 UE**	
Benzo(g,h,i)perylene		52.941
Butyl benzyl phthalate		**65.686 UE**
Cadmium (mg/kg)	6.2	
Dibenzo(a,h)anthracene		17.647
Diethylphthalate		65.686 UE
Dimethyl phthalate		**65.686 UE**
Di-n-octyl phthalate		65.686 UE
Hexachlorobenzene		**65.686 UE**
Hexachlorobutadiene		**65.686 UE**
Indeno(1,2,3-cd)pyrene		49.020
Mercury (mg/kg)	**0.78 E**	
N-Nitrosodiphenylamine		**65.686 UE**
Pentachlorophenol	**1700**	
TBT	430	42.200

W-44 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.25	
1,2,4-Trichlorobenzene		**12.8 U**
1,2-Dichlorobenzene		**12.8 U**
1,4-Dichlorobenzene		**12.8 U**
2,4-Dimethylphenol	**160 U**	
2-Methylphenol	**160 U**	
bis(2-ethylhexyl)phthalate		**128 B**
Cadmium (mg/kg)	6.5	
Dibenzo(a,h)anthracene		12.8 U
Hexachlorobenzene		**12.8 U**
Hexachlorobutadiene		**12.8 U**
Mercury (mg/kg)	**0.66**	
N-Nitrosodiphenylamine		**12.8 U**
PCBs (total)		15.680
Pentachlorophenol	400	
TBT	450	36.000

W-33 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.55	
1,2,4-Trichlorobenzene		**10.323 U**
1,2-Dichlorobenzene		**10.323 U**
1,4-Dichlorobenzene		**10.323 U**
2,4-Dimethylphenol	**160 U**	
2-Methylphenol	**160 U**	
Cadmium (mg/kg)	**7.4**	
Hexachlorobenzene		**10.323 U**
Hexachlorobutadiene		**10.323 U**
Phenol	620	
TBT	3657	**235.900**

W-29-10-4 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.55	
1,2,4-Trichlorobenzene	**180 UE**	**32.727 UE**
1,2-Dichlorobenzene	**180 UE**	**32.727 UE**
1,4-Dichlorobenzene	**180 UE**	**32.727 UE**
2,4-Dimethylphenol	**180 UE**	
2-Methylphenol	**180 UE**	
bis(2-ethylhexyl)phthalate	850	**154.545**
Butyl benzyl phthalate	180 UE	32.727 UE
Cadmium (mg/kg)	6.4	
Dibenzo(a,h)anthracene	180 UE	32.727 UE
Hexachlorobenzene	**180 UE**	**32.727 UE**
Hexachlorobutadiene	**180 UE**	**32.727 UE**
Mercury (mg/kg)	0.55 E	
N-Nitrosodiphenylamine	**180 UE**	**32.727 UE**
PCBs (total)	188	34.182
Pentachlorophenol	440 UE	
TBT	4205	**764.500**

WW-10 0 - 10 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	2.12	
1,2,4-Trichlorobenzene		**70.755 U**
1,2-Dichlorobenzene		**9.906 U**
1,4-Dichlorobenzene		**15.566 U**
2,4-Dimethylphenol	**52 U**	
2-Methylphenol	**66 U**	
Benzoic acid	**950 U**	
Benzyl alcohol	**99 U**	
Hexachlorobenzene		**43.396 U**
Hexachlorobutadiene		**122.642 U**
Lead (mg/kg)	480	
Mercury (mg/kg)	0.84 E	
PCBs (total)		14.151 E
Pentachlorobenzene	**63000 U**	

W-36 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.14	
1,2,4-Trichlorobenzene		**14.035 UE**
1,2-Dichlorobenzene		**14.035 UE**
1,4-Dichlorobenzene		**14.035 UE**
2,4-Dimethylphenol	**160 UE**	
2-Methylphenol	**160 UE**	
Benzo(g,h,i)perylene		44.737 E
bis(2-ethylhexyl)phthalate		61.404 E
Cadmium (mg/kg)	**7.1**	
Dibenzo(a,h)anthracene		19.298 E
Fluoranthene		289.474
Hexachlorobenzene		**14.035 UE**
Hexachlorobutadiene		**14.035 UE**
Indeno(1,2,3-cd)pyrene		41.228 E
Mercury (mg/kg)	0.43 E	
N-Nitrosodiphenylamine		**14.035 UE**
PCBs (total)		25.439
Pentachlorophenol	400	
Phenol	530 E	
Total HPAH		1022.807 E
TBT	3242	**284.400**

W-42 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.32	
1,2,4-Trichlorobenzene		**12.879 U**
1,2-Dichlorobenzene		**12.879 U**
1,4-Dichlorobenzene		**12.879 U**
2,4-Dimethylphenol	**170 U**	
2-Methylphenol	**170 U**	
bis(2-ethylhexyl)phthalate		**106.061 E**
Butyl benzyl phthalate	7.576 E	
Cadmium (mg/kg)	5.7 E	
Dibenzo(a,h)anthracene		12.879 U
Hexachlorobenzene		**12.879 U**
Hexachlorobutadiene		**12.879 U**
Mercury (mg/kg)	**1.1**	
N-Nitrosodiphenylamine		**12.879 U**
Pentachlorophenol	420 U	
TBT	290	22.000

SA10-S 0 - 10 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.91	
1,2,4-Trichlorobenzene	13 U	1.429 U
Benzo(a)anthracene	1300	142.857
Benzo(a)pyrene	1100	120.879
Benzo(g,h,i)perylene	340	37.363
bis(2-ethylhexyl)phthalate	870	**95.604**
Dibenzo(a,h)anthracene	290	31.868
Fluoranthene	1900	208.791
Hexachlorobenzene	26 U	**2.857 U**
Indeno(1,2,3-cd)pyrene	400	43.956
PCBs (total)	590	64.835
Phenanthrene	1200	131.868
Total HPAH	10700	1175.824

W-48 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.811	
1,2,4-Trichlorobenzene	**610 UE**	**75.216 UE**
1,2-Dichlorobenzene	**610 UE**	**75.216 UE**
1,4-Dichlorobenzene	**610 UE**	**75.216 UE**
2,4-Dimethylphenol	**610 UE**	
2-Methylphenol	**610 UE**	
Benzo(g,h,i)perylene	640 E	**78.915 E**
Chrysene	1000 E	123.305 E
Dibenzo(a,h)anthracene	250 E	30.826 E
Diethylphthalate	610 UE	75.216 UE
Di-n-octyl phthalate	610 UE	75.216 UE
Fluorene	200 E	24.661 E
Hexachlorobenzene	**610 UE**	**75.216 UE**
Hexachlorobutadiene	**610 UE**	**75.216 UE**
Indeno(1,2,3-cd)pyrene	560 E	69.051 E
Mercury (mg/kg)	**0.6 E**	
N-Nitrosodiphenylamine	**610 UE**	**75.216 UE**
PCBs (total)	119 E	14.673 E
Pentachlorophenol	**1500 UE**	
Phenanthrene	1000 E	123.305 E
TBT	1100	**135.600**

W-49 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	2.56	
1,2,4-Trichlorobenzene		**9.375 U**
1,2-Dichlorobenzene		**9.375 U**
1,4-Dichlorobenzene		**9.375 U**
Benzo(g,h,i)perylene		34.375 E
bis(2-ethylhexyl)phthalate		**117.187 E**
Butyl benzyl phthalate		8.984 E
Cadmium (mg/kg)	6.2	
Hexachlorobenzene		**9.375 U**
Hexachlorobutadiene		**9.375 U**
Mercury (mg/kg)	**1.7**	
TBT	490	14.100

W-53 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	2	
1,2,4-Trichlorobenzene		**50 UE**
1,2-Dichlorobenzene		**50 UE**
1,4-Dichlorobenzene		**50 UE**
2,4-Dimethylphenol	**1000 UE**	
2-Methylphenol	**1000 UE**	
4-Methylphenol	**1000 UE**	
Cadmium (mg/kg)	**6.7**	
Chrysene		125.000
Dibenzo(a,h)anthracene		**50 UE**
Fluoranthene		240 E
Hexachlorobenzene		50 UE
Hexachlorobutadiene		50 UE
Mercury (mg/kg)	**1.2**	
N-Nitrosodiphenylamine		**50 UE**
Pentachlorophenol	**2600**	
Phenanthrene		115 E
Phenol	1000 UE	
TBT	5500	**275.000**

HC-03-09 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	0.64	
Chromium (mg/kg)	**309**	
Hexachlorobenzene	5.6 U	0.875 U
PCBs (total)	205	32.031
TBT	23	3.600

HC-03-07 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	2.27	
2,4-Dimethylphenol	**58 U**	
Benzoic acid	**1000 U**	
Hexachlorobenzene		0.969 U
Mercury (mg/kg)	**0.7**	
PCBs (total)		37.885
TBT	1800	79.300

HC-03-14 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	2.32	
2,4-Dimethylphenol	**58 U**	
Benzoic acid	**1100 U**	
Copper (mg/kg)	**455**	
Hexachlorobenzene		0.948 U
Mercury (mg/kg)	**0.96**	
PCBs (total)		26.724
TBT	1200	51.700

HC-03-10 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.66	
1,2,4-Trichlorobenzene		0.904 U
2,4-Dimethylphenol	**55 U**	
Benzoic acid	**960 U**	
Hexachlorobenzene		1.265
Mercury (mg/kg)	**0.63**	
PCBs (total)		26.506
TBT	1400	**84.300**

HC-03-12 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.68	
1,2,4-Trichlorobenzene		0.893
2,4-Dimethylphenol	**52 U**	
Benzo(g,h,i)perylene	820	48.810
Benzoic acid	**910 U**	
Chrysene	2000	119.048
Dibenzo(a,h)anthracene		14.286
Fluoranthene		172.619
Hexachlorobenzene		1.190
Indeno(1,2,3-cd)pyrene		52.381
Mercury (mg/kg)	0.43	
PCBs (total)		29.167
TBT	1300	77.400

W-52 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.83	
1,2,4-Trichlorobenzene		**9.29 UE**
1,2-Dichlorobenzene		**9.29 UE**
1,4-Dichlorobenzene		**9.29 UE**
2,4-Dimethylphenol	**170 UE**	
2-Methylphenol	**170 UE**	
Butyl benzyl phthalate		9.29 UE
Cadmium (mg/kg)	6	
Hexachlorobenzene		**9.29 UE**
Hexachlorobutadiene		**9.29 UE**
TBT	230	12.600

HC-03-08 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.92	
2,4-Dimethylphenol	**55 U**	
Benzoic acid	**960 U**	
Hexachlorobenzene		1.094 U
Mercury (mg/kg)	0.57	
PCBs (total)		27.083
TBT	680	35.400

HC-03-01 0 - 10 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.73	
1,2,4-Trichlorobenzene	8.9 U	1.219 U
2,4-Dimethylphenol	**38 U**	
Benzo(g,h,i)perylene	230	31.507
Benzoic acid	**660 U**	
Chrysene	1100	150.685
Copper (mg/kg)	**825**	
Fluoranthene	1300	178.082
Hexachlorobenzene	15 U	2.055 U
Indeno(1,2,3-cd)pyrene	260	35.616
PCBs (total)	179	24.521
TBT	120	16.400

HC-03-03 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	2.26	
2,4-Dimethylphenol	**53 U**	
Benzoic acid	**920 U**	
Hexachlorobenzene		0.885 U
PCBs (total)	320	14.159
TBT	83	3.700
Zinc	505	

HC-03-15 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	2.62	
2,4-Dimethylphenol	**53 U**	
Benzoic acid	**920 U**	
Hexachlorobenzene		0.763 U
PCBs (total)		14.122
TBT	42	1.600

HC-03-11 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.01	
Hexachlorobenzene		0.644 U
TBT	51	5.100

HC-03-16 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.46	
PCBs (total)		20.548
TBT	21	1.400

HC-03-05 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	0.85	
Hexachlorobenzene	5.8 U	0.682 U
TBT	34	4.000

HC-03-17 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.3	
PCBs (total)		21.538
TBT	190	14.600

HC-03-06 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.06	
Hexachlorobenzene		0.585 U
PCBs (total)		**67.925**
TBT	27	2.500

HC-03-18 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.23	
1,2,4-Trichlorobenzene		1.057 U
2,4-Dimethylphenol	47 U	
Acenaphthene		16.260
Benzo(a)anthracene		211.382
Benzo(a)pyrene		186.992
Benzo(g,h,i)perylene		**81.301**
Benzofluoranthenes (total)		373.984
Benzoic acid	**820 U**	
bis(2-ethylhexyl)phthalate		72.358 J
Chrysene		276.423
Copper (mg/kg)	**463**	
Dibenzo(a,h)anthracene		24.390
Fluoranthene		455.285
Fluorene		29.268
Hexachlorobenzene		1.463 U
Indeno(1,2,3-cd)pyrene		**97.561**
Mercury (mg/kg)	**0.83**	
PCBs (total)		**243.902**
Pentachlorophenol	380 J	
Phenanthrene		138.211
Total HPAH		2097.561
TBT	1500	**122.000**
Zinc (mg/kg)	445	

HC-03-19 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	1.07	
Mercury	0.48	
PCBs (total)		33.645
TBT	42	3.900

N-19 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.98	
1,2,4-Trichlorobenzene		14.646 UE
1,2-Dichlorobenzene		14.646 UE
1,4-Dichlorobenzene		14.646 UE
2,4-Dimethylphenol	**290 UE**	
2-Methylphenol	**290 UE**	
Hexachlorobenzene		**14.646 UE**
Hexachlorobutadiene		**14.646 UE**
Mercury (mg/kg)	**2.2**	
N-Nitrosodiphenylamine		**14.646 UE**
Pentachlorophenol	**740 UE**	
TBT	330	16.700

HC-03-13 0 - 10 cm

Parameter	ug/kg-dry	mg/kg-OC
TOC (%)	0.78	
1,2,4-Trichlorobenzene	11 U	1.410 U
2,4-Dimethylphenol	**40 U**	
Arsenic (mg/kg)	**165**	
Benzo(a)anthracene	930	119.231
Benzo(a)pyrene	910	116.667
Benzo(g,h,i)perylene	500	64.103
Benzofluoranthenes (total)	2020	258.974
Benzoic acid	**700 U**	
bis(2-ethylhexyl)phthalate	380 J	48.718 J
Chrysene	1500	192.308
Copper (mg/kg)	**576**	
Dibenzo(a,h)anthracene	120	15.385
Fluoranthene	2900	371.795
Fluorene	180	23.077
Hexachlorobenzene	16 U	2.051 U
Indeno(1,2,3-cd)pyrene	570	73.077
Lead (mg/kg)	**1160**	
Mercury (mg/kg)	**0.86**	
PCBs (total)	1610	**206.410**
Phenanthrene	1100	141.026
Total HPAH	11850	1519.231
TBT	800	**102.600**
Zinc (mg/kg)	661	

N-10 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.54	
1,2,4-Trichlorobenzene		**40.909 UE**
1,2-Dichlorobenzene		**40.909 UE**
1,4-Dichlorobenzene		**40.909 UE**
2,4-Dimethylphenol	**630 UE**	
2-Methylphenol	**630 UE**	
Arsenic (mg/kg)	**72.1**	
Cadmium (mg/kg)	**7.3**	
Copper (mg/kg)	**415**	
Hexachlorobenzene		**40.909 UE**
Hexachlorobutadiene		**40.909 UE**
Mercury (mg/kg)	**1.7**	
N-Nitrosodiphenylamine		**40.909 UE**
PCBs (total)		**158.442**
Pentachlorophenol	**1600 UE**	
TBT	730	47.400
Zinc (mg/kg)	489	

WW-20 0 - 10 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	1.07	
1,2,4-Trichlorobenzene		**21.495 U**
1,2-Dichlorobenzene		**13.084 U**
1,4-Dichlorobenzene		**13.084 U**
2,4-Dimethylphenol	**320 U**	
Benzo(g,h,i)perylene		38.318 E
Benzyl alcohol	**400 U**	
Hexachlorobenzene		**19.626 U**
Hexachlorobutadiene		**261.682 U**
Indeno(1,2,3-cd)pyrene		61.682 U
Mercury (mg/kg)	**0.776 E**	
PCBs (total)		14.953 U

N-09 0 - 2 cm

Parameter	Concentration ug/kg-dry	mg/kg-OC
TOC (%)	0.494	
1,2,4-Trichlorobenzene	**590 UE**	
1,2-Dichlorobenzene	**590 UE**	
1,4-Dichlorobenzene	**590 UE**	
2,4-Dimethylphenol	**590 UE**	
2-Methylphenol	**590 UE**	
Acenaphthene	290 E	
Benzo(a)anthracene	2000 E	
Benzo(a)pyrene	1200 E	
Benzo(g,h,i)perylene	790 E	
Benzofluoranthenes (total)	3040 E	
Butyl benzyl phthalate	25 E	
Chrysene	2000 E	
Dibenzo(a,h)anthracene	120 E	
Dibenzofuran	590 UE	
Diethylphthalate	590 UE	
Dimethyl phthalate	590 UE	
Di-n-octyl phthalate	590 UE	
Fluoranthene	2300 E	
Fluorene	330 E	
Hexachlorobenzene	**590 UE**	
Hexachlorobutadiene	**590 UE**	
Indeno(1,2,3-cd)pyrene	810 E	
N-Nitrosodiphenylamine	**590 UE**	
PCBs (total)	97 E	
Pentachlorophenol	**1500 UE**	
Phenanthrene	2200 E	
Total HPAH	15970 E	
Total LPAH	3328 E	
TBT	280	

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Lockheed West
Shipyard No. 2
Seattle, WA

Figure A.3-8
SQS or LAET Criteria Exceedances for 2003 and all West Waterway Surface Sampling Locations

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Legend

Historical (Pre-1998) Earlier Sampling Locations

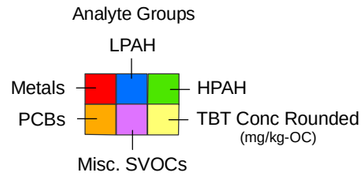
- Subsurface Core
- Surface Grab

Recent (2003) Sampling Locations

- Surface Grab
- Shipyard No. 2 Property Boundary
- West Waterway OU (Approx.)
- Pacific Sound Resources Superfund Site (Approx.)

Sediment Chemistry Data Summary

Analyte Groups



Color indicates SQS criteria exceedance

- No SQS exceedance in analyte group
- 1.4 — Exceedance Factor for greatest SQS exceedance in analyte group
- 1.8^{U} — Analytes undetected at the method detection limit. Sample dilution resulted in raised detection limits above SQS criteria.
- 80 — TBT value greater than West Waterway Confirmational Number of 76 mg/kg-OC.

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Seattle, WA

Figure A.3-9
SQS Criteria Exceedances
2003 Surface Samples

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Legend

Historical (Pre-1998) Earlier Sampling Locations

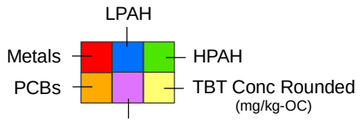
- Subsurface Core
- Surface Grab

Recent (2003) Sampling Locations

- Surface Grab
- Shipyard No. 2 Property Boundary
- West Waterway OU (Approx.)
- Pacific Sound Resources Superfund Site (Approx.)

Sediment Chemistry Data Summary

Analyte Groups



Color indicates CSL criteria exceedance

- No CSL exceedance in analyte group
- 1.4 — Exceedance Factor for greatest CSL exceedance in analyte group
- 1.8^{U} — Analytes undetected at the method detection limit. Sample dilution resulted in raised detection limits above CSL criteria.
- 80 — TBT value greater than West Waterway Confirmational Number of 76 mg/kg-OC.

HC-03-01 2.1 1.3^{U} 16
HC-03-02 2
HC-03-15 1.8^{U} 2
HC-03-03 1.8^{U} 4
HC-03-16 1
HC-03-04 5
5 HC-03-11
HC-03-05 4
HC-03-06 1.0 3
HC-03-17 15
HC-03-14 1.6 2.0^{U} 52
HC-03-08 1.9^{U} 35
HC-03-07 1.2 2.0^{U} 80
HC-03-18 1.4 1.1 3.8 1.6^{U} 122
4 HC-03-19
HC-03-09 1.1 4
HC-03-10 1.1 1.9^{U} 84
HC-03-12 1.8^{U} 77
HC-03-13 2.2 3.2 1.4^{U} 103

10

N

0 200 400
Feet

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Lockheed West Seattle Superfund Site Seattle, WA

Figure A.3-10
CSL Criteria Exceedances
2003 Surface Samples

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Property Boundary
Haborlines
Pacific Sound Resources Superfund Site (approx)
West Waterway OU (approx)

Feet
0 50 100 200

N

Number of CSL Exceedances
0
1-4
5-9
> 9

Detected value > CSL

Total (detected and non-detected) value > CSL

Notes:
1. Harbor Lines from the Washington State Dept. of Natural Resources website (2003).
2. West Waterway sampling locations from SEDQUAL or transcribed from plan sheet.

HC-03-01
HC-03-02
HC-03-03
HC-03-15
HC-03-16
HC-03-04
HC-03-11
HC-03-05
HC-03-06
HC-03-17
HC-03-08
HC-03-07
HC-03-14
HC-03-18
WW-13
W-30
W-37
HC-03-09
HC-03-10
HC-03-12
HC-03-19
SA10-S
W-49
W-53
N-10
HC-03-13
N-19
W-29
W-36
W-40
W-42
W-44
W-48
W-52
N-09
W-33
WW-10
WW-20

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Lockheed West
Shipyard No. 2
Seattle, WA

Figure A.3-11
Summary of CSL Criteria Exceedances for 2003 and all West Waterway Surface Sampling Locations

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Legend

Historical (Pre-1998) Sampling Locations

- Surface Grab
- Subsurface Core

Recent (2003) Sampling Locations

- Surface Grab
- Shipyard No. 2 Property Boundary
- West Waterway OU (Approx.)
- Pacific Sound Resources Superfund Site (Approx.)

Sediment Quality Condition

- No Detected Exceedance
- CSL Exceedance
- No Detected Exceedance in Area
- Area Exceeds CSL
- Area Exceeds SQS

Notes:
1. Exceedance frequency is the number of samples exceeding criteria within a given area.
2. Exceedance frequency based on CSL or SQS criteria, except for tributyltin where the shipyard sediment operable unit confirmational number was used.
3. Analytes in *italics* were not detected, although the reported detection limit exceeds criteria.
4. Exceedances for duplicate samples collected at locations HC-03-03 and HC-03-07 are included.

Area 2 - Exceeds CSL
Number of Samples = 1

Analyte	Frequency of Exceedance
Copper	1/1
2,4-Dimethylphenol	1/1
Benzoic acid	1/1

Area 1 - Only Non-detected Exceeds SQS
Number of Samples = 3

Analyte	Frequency of Exceedance
Hexachlorobenzene	2/3

Area 6 - Exceeds CSL
Number of Samples = 2

Analyte	Frequency of Exceedance
Chromimum	1/2
Mercury	1/2
2,4-Dimethylphenol	1/2
Benzoic acid	1/2
TBT	1/2

Area 3 - Exceeds SQS
Number of Samples = 5

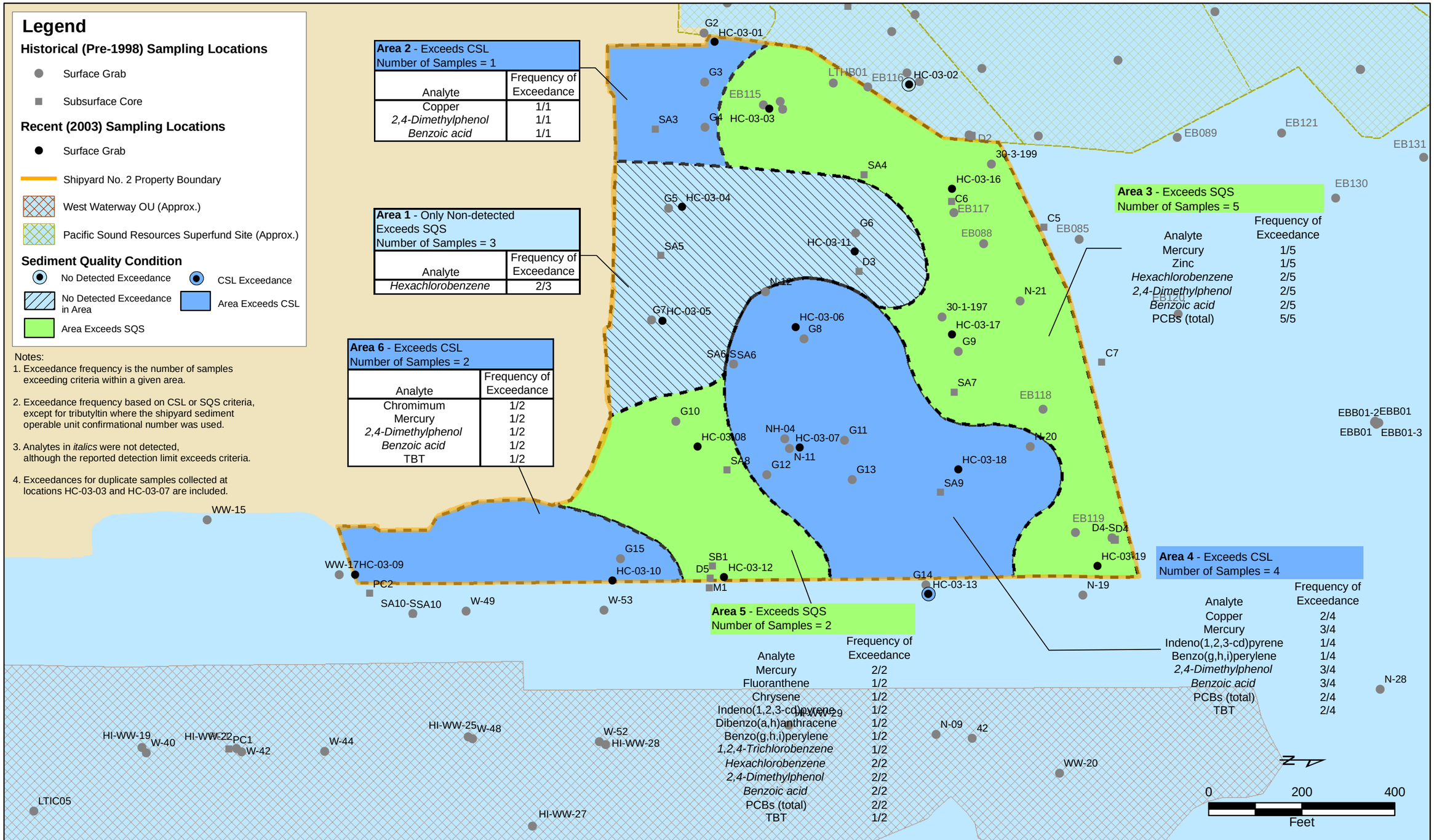
Analyte	Frequency of Exceedance
Mercury	1/5
Zinc	1/5
Hexachlorobenzene	2/5
2,4-Dimethylphenol	2/5
Benzoic acid	2/5
PCBs (total)	5/5

Area 4 - Exceeds CSL
Number of Samples = 4

Analyte	Frequency of Exceedance
Copper	2/4
Mercury	3/4
Indeno(1,2,3-cd)pyrene	1/4
Benzo(g,h,i)perylene	1/4
2,4-Dimethylphenol	3/4
Benzoic acid	3/4
PCBs (total)	2/4
TBT	2/4

Area 5 - Exceeds SQS
Number of Samples = 2

Analyte	Frequency of Exceedance
Mercury	2/2
Fluoranthene	1/2
Chrysene	1/2
Indeno(1,2,3-cd)pyrene	1/2
Dibenzo(a,h)anthracene	1/2
Benzo(g,h,i)perylene	1/2
1,2,4-Trichlorobenzene	1/2
Hexachlorobenzene	2/2
2,4-Dimethylphenol	2/2
Benzoic acid	2/2
PCBs (total)	2/2
TBT	1/2



Lockheed West Seattle Superfund Site
Seattle, WA

Figure A.3-12
Surface Sediment Exceedance Frequency Distribution for Current Site Conditions

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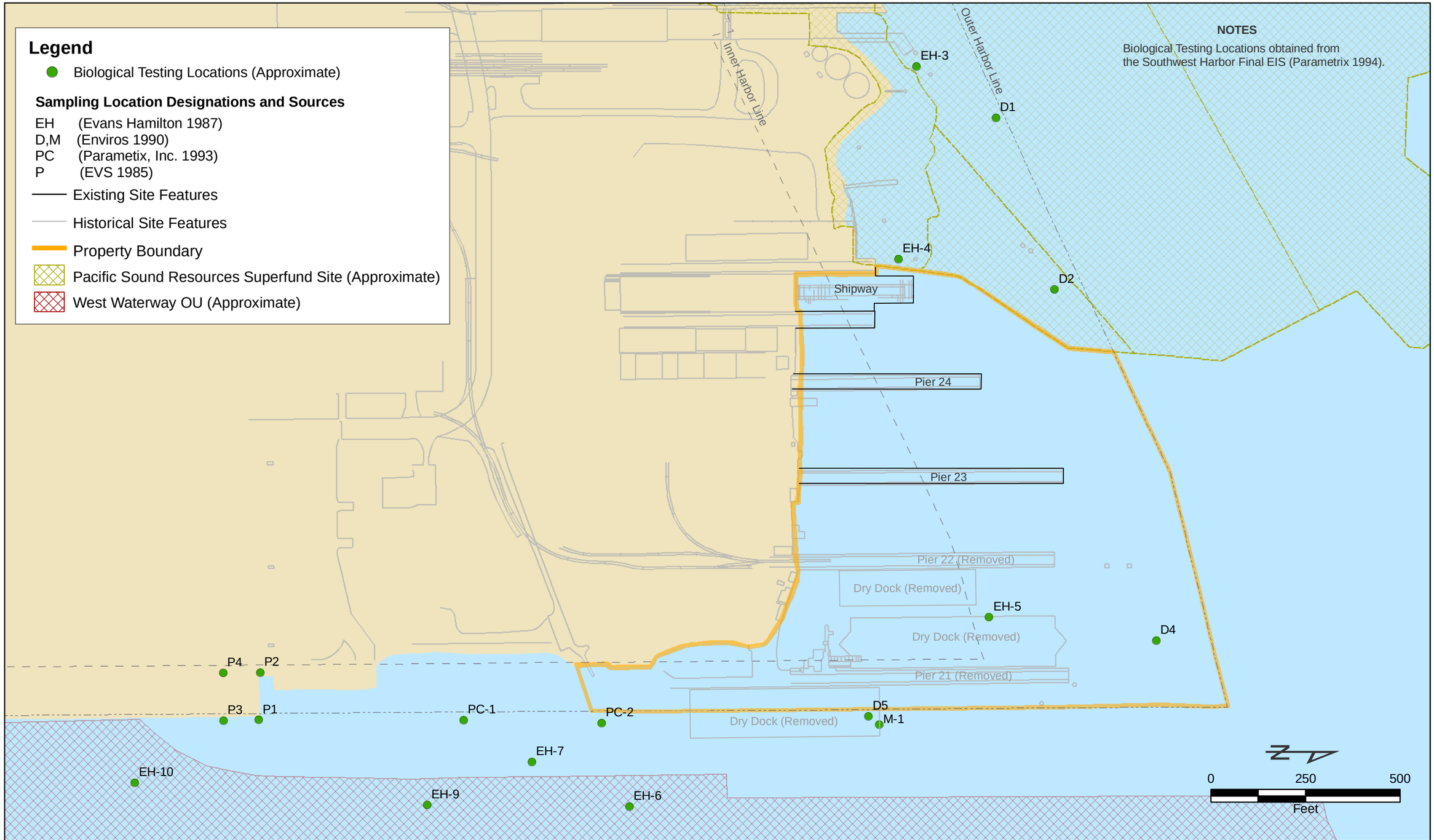

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Lockheed West Seattle Superfund Site Seattle, WA

Figure A.3-13
Biological Testing Sampling Locations in the Vicinity of Lockheed West

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4. SUMMARIES OF PREVIOUS RISK ASSESSMENTS

Both HHRAs and ERAs have been performed for either the Lockheed West property or for sites located in the vicinity of the Lockheed West Site. The aquatic habitats of the Lockheed West Site are marine along the Elliott Bay shoreline, and the lower water column and sediments are marine along the West Waterway shoreline. The sites that are located in the vicinity of the Lockheed West Site for which RAs have been performed in the past are either fully marine habitat, such as the PSR Site located to the west of Lockheed West along Elliott Bay, or may have some minimal influence of freshwater from the Duwamish River outflow, such as the West Waterway Operable Unit (OU) of the Harbor Island Site or the LDW Site, located adjacent to and flowing partly into the West Waterway. For the Harbor Island sites such as Lockheed-Harbor Island and the West Waterway OU, the site-associated sediments have been evaluated as marine sediments. There is minimal influence from the freshwater component of the flow coming in the Duwamish River discharge on the sediment regime of the Harbor Island sites, due to the water depth and presence of the marine waters of Elliott Bay.

Recently, baseline HHRAs and ERAs for the LDW Site were performed for the approximately 6-mile stretch of waterway between Harbor Island and just beyond the turning basin. Both the ERA and HHRA for the LDW include assessments for exposures to sediment areas located in the downstream portion of the waterway near the waterway mouth. Because of the mixed marine and estuarine nature of the LDW, and the evaluation of primarily marine species in both the HHRA and ERA, the approaches to the RAs for the West Waterway and the LDW are considered appropriate for comparison in the development of plans for the Lockheed West streamlined ERA and HHRA. The LDW RAs and those performed previously for Lockheed West and nearby PSR and West Waterway sites provide useful information on approaches and data that were used in planning the RAs for Lockheed West.

The following sections are summaries of the previous RAs conducted at nearby sites and for other media at Lockheed West.

4.1 HUMAN HEALTH AND AQUATIC IMPACTS FOR CURRENT AND FUTURE CONSTRUCTION ACTIVITIES AT LOCKHEED WEST – 1991

An RA was conducted to evaluate potential human health and environmental risks associated with upland soil contamination at the Lockheed West Site (ChemRisk 1991). Human health risks focused on occupational exposures and the consumption of recreationally caught fish from waters adjacent to the Site, under both current and future

conditions. Future conditions were evaluated for occupational exposures during soil remediation construction. Because modeling of releases of chemicals to groundwater and to surface waters did not account for the presence of soil barriers, future exposures of fish to soil-related chemicals were assumed to be the same as current exposures. Ecological risks were evaluated for exposures of aquatic organisms to soil contaminants that may leach to groundwater and surface water in Elliott Bay.

4.1.1 Human Health Risk Assessment

For occupational exposures to contaminants in upland site soils, the HHRA (ChemRisk 1991) concluded that there were no risks to human health, with less than $3x10^{-6}$ total site-related cancer risks associated with all exposure pathways under both current and future conditions. Potential occupational exposures were assessed for inhalation of vapors and airborne soil particles, incidental ingestion of soil, and dermal contact with soil during work activities. Exposures via inhalation of vapors and dusts were evaluated through vapor transfer and air dispersion modeling. Non-cancer risks for occupational exposures under future conditions were assessed at a hazard index (HI) at 0.4, which is below the regulatory threshold of 1.0.

Exposures of recreational fishers to soil-related chemicals in fish tissue were estimated by modeling releases from soil to the nearby surface waters and uptake into fish. Modeling included chemical leaching from soil to groundwater using a partitioning-based model, groundwater transport to Elliott Bay based on groundwater velocity and the area of groundwater assuming no dilution of groundwater concentrations, dispersion of discharge into three zones of the bay, and partitioning between solid and aqueous phases of the chemicals. The dispersion into the bay assumed dilution of the discharge into various water body zones, from 30 feet to 121 feet in depth. Dissolved phase and particle-bound phases were estimated using partition coefficients applied to the modeled concentrations in surface water, in each of the three water body zones. Dispersion into the surface water zones resulted in groundwater leachate being diluted by at least five orders of magnitude in each of the three zones. Following dispersion modeling of discharged chemicals, bioconcentration factors (BCFs) were used to calculate fish tissue concentrations from the dissolved phase water concentrations of the chemicals. Some BCFs were taken from EPA documents, whereas most BCFs for metals and PAHs were obtained from personal communication with the EPA Office of Water Regulations and Standards.

Recreational fishers were assumed to consume fish at a rate of 54 grams per day (g/day) for 30 years with 50 percent of their fish diet consisting of exposed fish coming from the Site, as used in Ecology surface water cleanup regulations. These parameters were used for both the current and future exposure scenarios.

Recreational fish consumption was associated with less than $1x10^{-8}$ cancer risk, based on modeling fish tissue contaminant concentrations from transfer and dilution of sediment porewater to surface water. Non-cancer risks for consumption of recreationally caught fish were assessed at HIs well below regulatory thresholds.

4.1.2 Ecological Risk Assessment

The objective of the ERA for the aquatic environment of the Site was to evaluate the potential for chemicals present in upland soils to impact surface waters and sediments of Elliott Bay. Data were available for soil chemical concentrations; resultant exposures were estimated by fate and transport modeling of the soil chemicals. Ecological impacts on surface water and Elliott Bay sediments were evaluated quantitatively for current conditions and qualitatively for future conditions. Under current conditions, predicted incremental concentrations of chemicals in Elliott Bay surface water and sediment due to groundwater transport of soil-related chemicals were below EPA ambient water quality criteria for surface water, and Ecology SMS and NOAA criteria for sediment.

The modeling of concentrations of soil-related chemicals in surface waters and sediments for the ERA used the modeling described above for the HHRA. The fractions of chemicals modeled for the dissolved phase was assumed to be the ambient water concentrations attributable to the Lockheed West soils that discharged to the bay. The fractions of chemicals modeled to be bound to particulates were used as the sediment concentrations. Organic carbon content used in the modeling was 0.87 percent, based on an Elliott Bay station located near the Site. Results of the modeling showed that upon discharge through groundwater to the bay, dilution in the bay resulted in negligible concentrations of the soil-related chemicals in surface water. The resulting contribution of site-related chemicals to the bay was found to be below the regulatory standards.

4.2 SOUTHWEST HARBOR PROJECT - 1994

The SWHCRP Risk Assessment (Parametrix 1994a) was performed for exposures to sediment contamination under current conditions and for two alternatives for remediating the sediments. The SWHCRP was located along the west side of the West Waterway and included the Lockheed West property as part of the Site. Screening level RAs were performed for human health and for marine organisms. The approaches for both RAs were based on measured concentrations of chemicals in Elliott Bay surface water and modeling of fish tissue contaminant concentrations from transfer and dilution of sediment porewater to surface water following sediment remediation.

4.2.1 Data Sources and Selection of Chemicals of Potential Concern

Chemical concentrations for the human health and marine life RA were based on the following data:

- Elliott Bay water column concentrations at three stations offshore of the SWHCRP,
- Current (1994) site bulk sediment concentrations from three to four stations,
- Current (1994) site sediment porewater concentrations at sediment stations,
- Potential future site sediment porewater concentrations for the Full Buildout Alternative modeled over a 20- and 100-year time period for inorganics and a 6- and 20-year time period for organics,
- Potential future site sediment porewater concentrations for the Aquatic Cap Alternative modeled over a 20- and 100-year time period for inorganics and a 1- and 10-year time period for organics, and
- Potential future incremental site sediment porewater concentrations for the Aquatic Cap Alternative modeled over a 20- and 100-year time period for arsenic using an assumed Elliot Bay water column arsenic concentration of (0) zero milligrams per liter (mg/L).

Elliott Bay water column concentrations were used to assess overall risks from Elliott Bay water, while current (1994) site sediment porewater and bulk sediment concentrations were used to evaluate present and future incremental risks attributable to the Site. The COPCs evaluated were arsenic, copper, lead, fluoranthene, indeno(1,2,3-cd)pyrene, and naphthalene. These compounds were selected because they were historically detected at high levels compared to SMS cleanup levels, their relatively high toxicity, and to include a range of water solubility and mobility enabling an assessment of transport mechanisms.

4.2.2 Human Health Risk Assessment

4.2.2.1 Exposure Human Populations

The general public was identified as the main population of concern because public shoreline access was an integral part of the proposed SWHCRP. Site workers were initially considered as a potential population of concern; however, it was determined unlikely that site workers would be exposed to the sediments under the existing conditions or following implementation of the proposed SWHCRP. The Port's Southwest Harbor Development plans included recreational access for the general public to the shoreline. Therefore, the potential exposure pathways identified for evaluating the risks associated with the cleanup of the Southwest Harbor included incidental ingestion of water while swimming, consumption of recreationally caught shellfish, and consumption of recreationally caught

fish by the general public. Recreational exposure scenarios (swimming, fishing, harvesting of shellfish) were evaluated using methods similar to those in the Model Toxics Control Act (MTCA) under Method B, but modified to reflect more realistic exposure parameters based on projected site use.

Native Americans who subsist on fish harvesting in Elliott Bay were initially considered as a population of concern for the RA. Compared to recreational fisherman, Native Americans were assumed to consume above average amounts of fish, especially salmon. Due to the migratory nature of salmon, the length of time salmonids would spend in Elliott Bay was estimated to be short in length (up to 1 month). It was determined that it was unlikely for chemicals present in site sediments to bioaccumulate and reach equilibrium in salmon tissue. Therefore, recreational fisherman, who were assumed to generally fish for bottom fish, were quantified as the exposure population instead of Native Americans that fish for salmon.

4.2.2.2 Exposure Quantitation

To estimate human exposure to chemicals in sediment porewater, chemical concentrations in surface water were estimated from porewater concentrations. A dilution factor of 100 was assumed to account for the dilution of porewater into the water column. The dilution factor was estimated based on a review of current site sediment porewater and Elliott Bay water column arsenic, copper, and lead concentrations.

MTCA guidelines under WAC 173-340-730(3)(a)(iii)(A) and (B) were used as the basis for calculating chemical concentrations in recreationally caught fish and shellfish. Chemical concentrations in recreationally caught fish and shellfish tissue were estimated based on chemical concentrations in water and BCFs. BCFs were used rather than an assessment of food chain magnification because the chemicals evaluated in the RA were assumed to not biomagnify in aquatic food chains (Parametrix 1994a), and hence any uptake was assumed to be from water rather than food.

For fish and shellfish tissue, chemical concentrations were estimated from chemical-specific and species-specific BCFs, where available from EPA. The highest marine or freshwater chemical-specific fish or shellfish BCFs reported in the EPA Ambient Water Quality Criteria (AWQC) documents were used, when available. The highest arsenic, copper, and lead shellfish BCFs reported in the AWQC documents were used. If no chemical-specific BCF was available (e.g., fluoranthene and indeno[1,2,3-cd]pyrene), one was derived using quantitative structure-activity relationship. Organic chemicals are highly soluble in lipids; therefore, BCFs were adjusted to the mean lipid content of fish and shellfish tissue consumed in the United States.

To estimate exposure from swimming, standard default exposure values for exposure frequency (7 days per year) and exposure time (2.6 hours per day of swimming) were assumed. To estimate exposure to recreationally caught fish and shellfish, it was assumed that an individual may consume 250 grams of fish or shellfish obtained from the Site once per month (12 days per year). MTCA default values assume ingestion of 54 grams of fish per day for 365 days per year, equivalent to consuming approximately 250 grams of fish for 40 days each year. Because the Site is small relative to Elliott Bay the MTCA parameter values were not used.

4.2.2.3 Risk Characterization

Results indicated that based on existing Elliott Bay ambient water column concentrations, total site carcinogenic risks for ingestion of recreationally caught fish was estimated to be equal to the acceptable total site risk of $1x10^{-5}$ under MTCA. The carcinogenic risk for ingestion of recreationally caught shellfish was estimated to be greater than the acceptable total site risk of $1x10^{-5}$ under MTCA. This risk was primarily due to arsenic and indeno(1,2,3-cd)pyrene. Risk estimates for ingestion of fish and incidental ingestion of water while swimming were below the MTCA risk threshold. Risks from exposure to arsenic were determined to be comparable to existing background risks from ambient arsenic concentrations in Elliott Bay and Puget Sound.

All hazard indices for noncarcinogenic health effects were less than 1.0 and considered to be below levels of concern based on Elliot Bay water column concentrations. Noncarcinogenic risks from incidental ingestion of water while swimming were below levels of health concern.

Residual risks (i.e., risk remaining after cleanup) for human consumers of seafood were calculated to allow comparisons between the two proposed alternatives. For the Full Buildout Alternative, all noncarcinogenic health risks were estimated to be below unacceptable levels, whereas the upper end of cancer risks for shellfish consumption were predicted to exceed the MTCA allowable total site cancer risk of 10^{-5}. For the Aquatic Cap Alternative, all noncarcinogenic health risks were estimated to be below unacceptable levels, and cancer risks from all pathways were estimated to be below 10^{-5}.

4.2.3 Marine Life Risk Assessment

A screening level RA was performed for aquatic receptors at the Site. Water exposures were evaluated using Elliott Bay surface water data, porewater concentrations estimated from bulk sediment data, and modeled porewater concentrations for the two remediation alternatives. Sediment exposures were based on the bulk sediment data.

Effects were evaluated using EPA AWQC for water, and the SQSs from the Washington SMS for sediment exposures of benthic communities.

Risks related to water exposures in Elliott Bay, current porewater, and predicted porewater concentrations were all below hazard quotients (HQ) of 1.0. For sediments, arsenic, copper, fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the SQSs. The assessment concluded that some risks existed to the marine benthic community in the area because of these exceedances.

4.2.3.1 Sediment Toxicity and Benthic Invertebrate Community Bioassays

Results of previous sediment toxicity bioassays performed in 1990, 1985, 1991, and 1992 were summarized in the marine life RA for the SWH Project. Three sediment stations had been tested offshore of the Lockheed West property in 1992. No significant responses were observed in test results for amphipods, echinoderms, and *Neanthes* from each of the three stations. One station (PC-1A) showed a toxic response to the Microtox test, suggesting that marine organisms could be at risk from exposure to sediment at that station.

Studies in 1993 demonstrated that the benthic communities in most sediments of the SWH Project site were relatively diverse and had substantial abundance. Benthic infauna from two stations (B5 and B7) located near the Lockheed West property were statistically different from the other stations. Station B5 between Piers 21 and 22 had fewer dominant taxa, which was the polychaete *Aphelochaeta multifilis*, thought to be a pollution tolerant species. Station B5 corresponded with sediment station G13, where chemical SQSs were exceeded for organic compounds. However, it was noted that the results of the remaining benthic surveys did not correlate with the chemical exceedances of SQSs, and showed mostly no impacts. It was assumed that the bioavailability of the chemicals in the surveys was lower than that assumed in the numerical SQSs and, hence, the benthic communities were unaffected by the presence of chemicals above their SQS values.

4.3 PACIFIC SOUND RESOURCES SITE RISK ASSESSMENT - 1998

HHRAs and ERAs were conducted at the Marine Sediments Unit of the PSR Site in 1998 (Weston 1998b). The upland portion of the property had undergone extensive cleanup and redevelopment, so sources of contamination to the human and marine ecological receptors were restricted to existing sediment contamination.

4.3.1 Selection of Chemicals of Potential Concern

COPCs for both human health and ecological risks were selected by the following set of criteria:

Relationship of contaminants in sediments to site activities at PSR – Review of the spatial distribution of chemicals in sediments demonstrated that mercury and PCBs were unrelated to the Site, and they were dropped from further consideration in the RA.

Screening chemicals that were undetected – arsenic and chromium were dropped as being undetected in sediments during the Phase 1 sampling.

Screening chemicals detected at the site against Washington State SMS – Chemicals that were measured below SQS or AET levels in 95 percent of the samples, and not considered bioaccumulative chemicals, were dropped from further evaluation. Copper and zinc were dropped from further evaluation based on this comparison.

Identification of bioaccumulative chemicals – No chemicals were added based on bioaccumulative potential.

Co-occurrence of related contaminants – Phenolic compounds and dibenzofuran co-occurred with PAHs in sediment, and due to their lower toxicity and lower persistence than PAHs, were dropped from further evaluation.

Screening detected chemicals against background – No chemicals in sediment were eliminated based on comparison of concentrations with background sediment concentrations in four Elliott Bay stations. For clam tissues, several PAHs were dropped from further evaluation due to detections not exceeding concentrations in two background clam samples. For fish, background samples consisted of fish caught from two trawling locations associated with the background sediment locations in Elliott Bay. Dioxins and furans were identified as exceeding background concentrations in fish tissue.

For human health, concentrations in fish tissue were finally screened against EPA Region 3 risk-based concentrations for fish tissue, adjusted to account for higher consumption rates from the Toy et al. (1996) study of tribal fish consumption.

From this process, the list of final COPCs was limited to PAHs and 2,3,7,8-TCDD equivalents in shellfish, and only 2,3,7,8-TCDD equivalents in fish, assuming that PAHs are metabolized in fish and would not be present.

4.3.2 Human Health Risk Assessment

4.3.2.1 Human Exposure Scenarios

Human receptors identified in the CSM consisted of tribal fishers who consume fish and shellfish from the Site. Tribal consumption was assumed to be at subsistence levels, and ingestion rates were taken from the study of Toy et al. (1996). Ingestion rates for the adult RME scenario were 15.96 g/day of fish, with an assumption that 21 percent of this comes

from Puget Sound, and 91.56 g/day of shellfish, with an assumption that 67 percent of this comes from Puget Sound. Shellfish consumption was limited to crabs, due to lack of habitat for clams. Exposure frequencies were limited to six months out of the year, assuming that harvest quotas for seafood were reached within six months. Specific guidance on tribal consumption rates for the Site had not been published by EPA.

Fish and shellfish were evaluated for human exposure, with English sole serving as the representative bottom finfish due to abundance, extensive contact with sediment, and limited home range. Based on the tribal consumption survey of Toy et al. (1996), only fillets were evaluated. Other exposure assumptions included a 30-year exposure duration, fractional intake of 100 percent from the Site, and use of arithmetic means to represent the exposure point concentrations (EPCs).

Direct contact with sediment was not evaluated because of the limited amount of intertidal sediment, limited access of the public to intertidal sediment (lack of public beach and presence of fencing around public areas), likely remediation of available sediment, and lack of netfishing or trapping in sediment offshore of the PSR Site.

4.3.2.2 Exposure Point Concentrations

Because available data on COPCs in shellfish and fish under current conditions at the Site could be related to other sources in addition to the PSR Site, all site-specific EPCs for use in assessing risks under current and various future remediation efforts were developed by modeling from sediment concentrations under current and post-remediation conditions. Tissue concentrations in both shellfish and fish were modeled using chemical-specific biota-sediment accumulation factors (BSAFs), which were derived from log Kow values taken from Washington State Department of Health (WDOH) compilations (PTI 1995a,b; WDOH 1995). Because it was assumed that PAHs are metabolized by fish, no fish tissue concentrations of PAHs were modeled; modeling was limited to PAH and dioxin concentrations in shellfish and dioxin concentrations in fish.

4.3.3 Risk Characterization

Current excess cancer risks to the tribal fisher from consuming dioxins in fish and PAHs and dioxins in shellfish were estimated to total 4×10^{-4}, with dioxins and PAHs contributing about equally to the risk estimate. Following remediation of sediments, these risks were estimated to decrease to 3×10^{-5}, which still exceeded the MTCA cancer risk threshold of 1×10^{-5}. All non-cancer risks were below a HQ of 1.0. Total background cancer risk for fishers using Elliott Bay fish and shellfish tissue data was estimated at 3×10^{-5}.

4.3.4 Ecological Risk Assessment

Ecological receptors were identified as benthic invertebrates, including clams, amphipods, and sand dollars; and bottom fish (English sole). Marine birds and marine mammals were excluded as ecological receptors due to their migratory behavior and extensive range, and were assumed to spend little time within the Site area.

4.3.4.1 Approach

Benthic invertebrates were evaluated through toxicity bioassays for amphipods, sand dollars, and clams. Clams were also evaluated for uptake of site-related contaminants as compared with uptake into clams from background areas in Elliott Bay. Bottom fish were evaluated in two ways: (1) comparison of measured tissue levels of contaminants in English sole with those reported in the literature to cause toxicity; and (2) modeling of transfer of site contaminants from a fish to its eggs, with subsequent comparison of the egg concentrations to egg effects data from the literature.

Sediment toxicity to benthic invertebrates was based on comparison of sediment contaminant concentrations with chemical SMS and AET values. In addition, sediment toxicity bioassays were performed using the mortality endpoint for the amphipod *Ampelisca abdita*, the abnormal embryo development for the echinoderm *Dendraster excentricus*, and mortality and growth rates for the clam *Macoma nasuta*, as described in SMS. Carr Inlet served as the reference sediment location; Elliott Bay served as background locations.

Benthic infauna were collected from the nine site stations and two Elliott Bay stations as background that were sampled for toxicity testing, and various community metrics and structure were evaluated. Stations at Alki and Magnolia served as Elliott Bay background sediment stations.

The 28-day clam bioaccumulation test was performed with site sediments and Elliott Bay background station sediments for comparison of uptake with background; concentrations in clams were not evaluated with effects-based data. Concentrations of COPCs in the co-located sediment samples were also measured for use in evaluating tissue and sediment associations in site sediments.

Fish toxicity values for dioxins (based on 2,3,7,8-TCDD toxicity equivalents) were compiled from the literature on tissue concentrations in fish and eggs. Both the highest no-observed-adverse-effect-level (NOAEL) and lowest lowest-observed-adverse-effect-level (LOAEL) were used as toxicity values.

4.3.4.2 Benthic Risk Characterization

A preponderance-of-evidence approach was used to characterize risks to benthos at the nine sediment stations at the Site. Sediment chemistry was used to determine the presence of potentially toxic chemicals and to predict toxicity by comparison with SMS; toxicity bioassays were used to evaluate the toxicity of sediment; and benthic community analyses were used to provide an *in situ* measure of community effects. Clam laboratory bioaccumulation studies were used to provide an indication of potential bioavailability and bioaccumulation.

Multiple PAHs in the nine sediment stations of the Site were found to exceed SQS by a range of 6 to 8. 2,3,7,8-TCDD concentrations in the nine stations exceeded Elliott Bay background concentrations by 10-fold, and individual PAHs exceeded background by a range of 3 to 106-fold.

Toxicity in the bioassays was observed at all stations. Echinoderm larvae effective mortality showed the strongest correlation with individual and total PAHs. Higher toxicity was found in stations located in sediments in the north and northeast areas of the Site. No toxicity was found in the clam bioassays. In the benthic infauna community analyses, pollution intolerant species were lower in site sediments than background sediments, which suggested that all PSR Site sediments stations were impacted relative to background.

In the clam bioaccumulation test, COPCs in site clams exceeded background levels by less than 7 to 43-fold. Clam tissues showed strong correlations with sediments for total PAHs, several individual PAHs, and 2,3,7,8-TCDD. These findings supported the ability of benthic invertebrates to take up COPCs, and provided data on the relationships between clam and sediment levels for PAHs and 2,3,7,8-TCDD at the Site.

4.3.4.3 Fish Risks

Fish risks were evaluated for 2,3,7,8-TCDD in tissues. Concentrations of 2,3,7,8-TCDD measured in English sole tissue from the two trawl stations were below the tissue residue-based effect level. No risks were apparent from 2,3,7,8-TCDD in English sole tissue.

4.4 WEST WATERWAY RISK ASSESSMENTS

The West Waterway OU is one of seven OUs for the Harbor Island Superfund Site, and consists of the West Waterway of the Lower Duwamish River. The East Waterway is a separate OU. RAs have been completed for the West Waterway OU for both ecological effects and human health. A Record of Decision (ROD) was signed in 2003 (EPA 2003a) based on the RAs.

4.4.1 Human Health Risk Assessment

Human health risks for West Waterway OU were evaluated in multiple documents. The seafood ingestion pathway HHRA included risk evaluations for consumption of fish from the West Waterway as well as from contiguous waterbodies (Environmental Solutions Group 1999), whereas direct contact with sediment in the West Waterway was evaluated in the RI report (Weston 1994). In general, the HHRAs for the West Waterway examined two main scenarios of potential exposure to sediment-related chemicals: tribal netfishing and tribal seafood consumption. Within those scenarios, three pathways of exposure to contaminated sediments were evaluated: 1) dermal contact with sediment, 2) incidental ingestion of sediment, and 3) consumption of fish and shellfish that may contain chemicals bioaccumulated from sediments.

4.4.2 Tribal Net Fisher Scenario

The tribal netfishing scenario evaluated potential risk due to ingestion and dermal contact with subtidal sediments under the reasonable maximum exposure (RME) scenario. For the dermal exposure pathway, the 1994 RI stated that, because of the considerable uncertainty associated with this pathway, dermal contact was only considered in the sensitivity analysis portion of the RA. Further, the original RI stated that PAHs were not assessed by the dermal route because the carcinogenic effects of these contaminants could not be quantified using oral slope factors, and dermal risks from inorganics were not assessed because of their negligible percutaneous absorption.

In 1999, at the request of the Muckleshoot Tribe, EPA completed a re-evaluation of the RI HHRA. This revised assessment in the supplemental RI (EPA 2002a) also included inorganics in the calculation of dermal risks and revised toxicity values for PCBs, certain PAHs, and arsenic, and revised dermal absorption factors. The dermal contact and incidental ingestion of sediment pathways were evaluated using data from subtidal surface (0 to 2 centimeters) sediment. Six chemicals were selected as COPCs for the sediment ingestion pathway and three chemicals were retained for the sediment dermal exposure. EPCs were calculated based on the 95 percent upper confidence limit of the arithmetic mean for each chemical (Table A.4-1).

Excess cancer risk estimates for tribal net fishers in the supplemental RI were 1×10^{-5}. All total HIs were below 1.0, indicating that non-cancer health effects were not expected from contaminant exposure to sediments at the Site.

4.4.2.1 Tribal Seafood Consumption Scenario

The 1999 HHRA for tribal seafood consumption (Environmental Solutions Group 1999) consists of a site-specific baseline RA for current and future seafood consumption scenarios

for the West Waterway OU, as well as additional information on risk characterization of contiguous waterbodies (i.e., East Waterway, Elliott Bay, Lower Duwamish River, Upper Duwamish River). It was assumed that all seafood consumed, except for seafood consumed from grocery stores, restaurants, or outside of Puget Sound, was caught only from the West Waterway OU and not from any other Puget Sound area, for the 30 years duration. It was also assumed that all seafood consumed had the equivalent of the maximum concentration measured in tissue of fish collected from the West Waterway OU.

Fish and shellfish species that may be present in the West Waterway were categorized as either anadromous fish (salmon), pelagic fish (perch), benthic fish (English sole), or shellfish (crab). Specific species were selected for collection and analysis after reviewing consumption studies conducted in the study area and in Puget Sound to determine what species were most likely to be consumed. Perch, English sole, and crab were used as surrogates to represent pelagic, benthic, and shellfish categories, respectively. For the baseline HHRA, consumption of anadromous fish was excluded because bioaccumulation of contaminants in salmon was attributable primarily to dietary sources outside the West Waterway OU Superfund Site.

Other seafood consumption scenarios were evaluated as part of the uncertainty analysis section of the HHRA, and included a tribal central tendency scenario, a non-tribal RME scenario, and an Asian and Pacific Islander seafood consumption scenario. Consumption rates for those scenarios were taken from Toy et al. (1996) and from Landolt et al. (1985). Other exposure pathways, such as swimming, were recognized as relevant but were evaluated in other studies of the Duwamish River (King County 1999, Weston 1994) and were not quantified in the HHRA. Each section of the study area of the West Waterway was evaluated separately and, for each evaluation, it was assumed that all of the seafood was consumed from only that section 365 days per year for 30 years. An exposure duration of 70 years was also used to evaluate tribal fishers in the uncertainty analysis.

For the seafood consumption RA, COPCs consisted of mercury, tributyltin (TBT), and PCBs. EPCs for fish tissue collected from the West Waterway are shown in Table A.4-2. Based on Toy et al. (1996), the seafood ingestion rates were 7 g/day for pelagic fish, plus 8.5 g/day benthic fish, plus 61 g/day shellfish, for a total of 76.5 g/day seafood. The evaluation of seafood consumption was based on the “market basket” approach, where individual fish species are consumed at separate rates, with the total of the different species equaling the total fish consumption rate. The fish consumption rate was adjusted for anadromous, pelagic, and benthic fish by application of a fractional intake value. No adjustment was made to the shellfish consumption rate because it was represented by a single species of crab. Clams were not evaluated for the shellfish category due to limited habitat and unlikely

future habitat under the assumed industrial use of the waterway, and there was no evidence of clam consumption from the lower Duwamish estuary. It was pointed out that the home ranges of the key species (English sole, perch, and crab) are not known for the study area, but they do demonstrate some site fidelity. The species were thus assumed to have spent more time in the section of the study area they were captured in than in other sections of the study area.

For the baseline RME scenario, excess cancer risk for PCBs in seafood was 1×10^{-4}. This level of risk was identified as being within EPA's acceptable risk range of 1 in 10,000 to 1 in 1,000,000 (i.e., 10^{-4} to 10^{-6}). Excess cancer risk estimates for the consumption of perch from other study area sections were similar to the West Waterway, and Elliott Bay and the Duwamish River were lower than or similar to the West Waterway for the consumption of English sole. Cancer risks associated with the consumption of crabs were lower in the West Waterway than for the lower or upper Duwamish River, East Waterway, or Elliott Bay. Although it was assumed for the West Waterway OU that all seafood was consumed from that waterway, a lower fraction of consumption was considered more appropriate because the home ranges of each species is larger than the area of the waterway, and fish habitat and access points to the waterway are poor.

The non-cancer risk (HQ) for PCBs was 6.5. Non-cancer risk estimates for mercury and TBT were below 1. The HQs for PCBs and TBT were summed because the reference doses are both based on immunological endpoints. The non-cancer risk (HI) for summed PCB and TBT HQs was 6.5, which was the same value as for the HQ for PCBs.

The NCP does not set a numeric target range for non-cancer risks, but states that acceptable exposure levels shall represent concentrations at which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Because of the protective assumptions built into the exposure estimates and into the reference dose used to calculate the HQ, EPA determined that sediments in the West Waterway are protective of non-cancer risks.

4.4.3 Ecological Evaluation

The ecological evaluation for the West Waterway OU focused on the effects of sediment contaminants on marine animals (Weston 1994). The ecological evaluation consisted of an assessment of sediment toxicity throughout the waterway and an assessment of bioaccumulation potential for PCBs, TBT, and mercury. The assessment of sediment toxicity focused on the direct impact of contaminants on the benthic community. The assessment of bioaccumulation potential focused on the potential for adverse impacts to organisms due to accumulation of chemicals from sediments to tissues.

4.4.4 Sediment Toxicity Assessment

The sediment toxicity assessment was based on 1) comparisons between concentrations of chemicals in surface sediments and the cleanup screening level (CSL) criteria of SMS, and 2) results of surface sediment toxicity tests. Bulk sediment and porewater were measured for TBT at 30 stations.

Comparison with Chemical SMS – The original RI included 33 surface sediment stations within the West Waterway OU, which were supplemented with 25 stations from the supplementary RI. Certain stations in the supplemental RI were co-located with the original 1991 RI sample locations. For the original RI samples, there were only four chemicals that exceeded the state's chemical CSL at more than one station. Mercury exceeded the CSL at 11 stations, BEHP exceeded the CSL at 8 stations, benzo(g,h,i)pyrelene exceeded the CSL at 2 stations, and phenol exceeded the CSL at 2 stations.

Total PCB concentrations in sediment ranged from undetected to 0.6 parts per million dry weight (ppm dw), with a single outlier value of 1.46 ppm dw. Using all of the combined data from the RI and supplemental RI (including the single outlier value at Station WW-25), the area-weighted average concentration for total PCBs in West Waterway OU sediment was 0.206 ppm dw and 14 ppm-organic carbon, based on inverse distance weighting performed with the EPA FIELDS system. Total PCB sediment concentrations were calculated using a sum of individual Aroclors; undetected individual Aroclors were assumed to be zero.

Sediments at the RI stations were also analyzed for pesticides and volatile organic compounds (VOCs), and these chemicals were not identified as COCs based on comparison of results to background concentrations, sediment criteria used by other regulatory programs, or cleanup criteria selected at other Superfund sites. No state sediment standards exist for pesticides and VOCs.

For the 25 stations in the supplementary RI, mercury exceeded the CSL at 14 stations, and zinc exceeded the CSL at 2 stations. For 45 other chemicals, the CSL was not exceeded or was only exceeded at one station. The previous CSL exceedances of bis(2-ethylhexyl)phthalate, benzo(g,h,i)pyrelene, and phenol that were found during the initial RI were not found during the supplemental RI. As noted below, subsequent sediment toxicity testing showed no exceedances of the CSL criteria, which was used to override any concerns identified solely by the chemical data.

Sediment Toxicity Testing – The supplementary RI included 18 stations (co-located with bulk sediment stations), each tested with the 10-day amphipod acute mortality test using *Rhepoxynius abronius*, the 20-day juvenile polychaete growth test using *Neanthes*

arenaceodentata, and the 60-hour bivalve larvae mortality/abnormality test using the mussel *Mytilus* spp. Results demonstrated that even though some individual sediment stations had chemical concentrations that exceeded the CSL criteria, the CSL biological criteria were not exceeded at any station. Under the SMS decision-making provisions, no remediation was required for chemicals that exceeded SMS numeric standards.

4.4.4.1 Assessment of Bioaccumulation Potential

Because the long-term effects of TBT, mercury, and PCB bioaccumulation were not addressed with the toxicity tests, EPA required two additional sediment and tissue investigations: 1) a TBT field and laboratory study, and 2) a literature review of tissue residue effects data for PCBs, TBT, and mercury in marine organisms.

A Region 10 interagency work group for TBT evaluated available sediment and tissue data sets and concluded that bulk sediment concentrations appeared to be poor predictors of the bioavailable TBT fraction or responses in benthic communities (EPA 2003b). The group recommended that interstitial water and bulk sediment concentrations be measured and that in situ or laboratory bioaccumulation testing be conducted to confirm the ecological significance of measured interstitial water and bulk sediment concentrations. A porewater trigger value for TBT of 0.15 micrograms per liter (μg/L) was established as the point above which laboratory bioaccumulation tests should be performed to assess potential ecological risk to benthic organisms.

Subsequently, EPA Region 10 approved a site-specific, effects-based tissue trigger level for TBT of 3.0 ppm dw in benthic invertebrates, which could be used in comparison with site-specific laboratory bioaccumulation test results to determine the need for cleanup of TBT-contaminated sediments in the West Waterway OU (EPA 1999b). The sublethal tissue residue threshold was based on the application of an acute-to-chronic ratio (based on water-only effects data) to tissue residue effects data for mortality.

At the West Waterway OU, sediment samples from 20 of the 30 stations were used for bioaccumulation testing in a laboratory using the clam (*Macoma nasuta*) and worm (*Nephtys caecoides*), exposed to sediments for 45 days under flow-through conditions with periodic additions of site sediments. The resulting measured concentrations of TBT in the tissues of both test organisms were all below the site-specific TBT tissue trigger value of 3.0 ppm dw. Therefore, although TBT was found at elevated concentrations in the sediments, it was not bioaccumulating to levels of concern in the test animals. Based on this assessment, TBT in sediments in the West Waterway OU was not found to cause adverse effects on marine animals, and cleanup of sediments containing TBT was not considered necessary to protect the environment.

The literature review of tissue residue effects data for PCBs and mercury in aquatic organisms determined that tissue concentrations of PCBs and mercury in fish and shellfish determined to be protective of human health (via the seafood consumption pathway) would also be protective of aquatic receptors.

4.4.5 Record of Decision

The ROD for the West Waterway OU of the Harbor Island Site was signed in 2003. For the West Waterway OU, EPA determined that no action was necessary, based on the finding that chemical concentrations in marine sediments within the OU do not pose unacceptable risks to human health and the environment. In 2000, EPA decided to delay the final decision for the West Waterway OU until the NPL listing decision was made for the LDW Superfund Site, because of the proximity to the West Waterway OU. After the LDW listing in September 2001, EPA waited until the tribal seafood consumption exposure parameters were identified for the Phase 1 HHRA for the LDW Site, and EPA incorporated that information into the final West Waterway OU risk evaluation. EPA concluded that these re-evaluations did not change the RA conclusions presented in the 1999 Proposed Plan for the West Waterway OU, and in 2003 concluded that a No Action ROD is appropriate.

4.5 LOWER DUWAMISH WATERWAY SUPERFUND SITE

The LDW Site was listed as a Superfund site in September 2001 and is presently in the Remedial Investigation/Feasibility Study process under CERCLA. The key parties involved in the LDW RI/FS are the City of Seattle, King County, the Port of Seattle, and The Boeing Company, working together as the LDW Group. As part of the RI, documents on the baseline HHRA and ERA have recently been released (Windward 2007a,b); the draft RI report released in June 2007 (Windward 2007c). The Phase 1 HHRA and ERA were completed in 2003 and were based on existing data; the recently released final baseline RAs are based on the Phase 1 data and further data collections since the Phase 1 documents.

The LDW Site encompasses approximately the lower 6 miles of the waterway, from upstream of the Norfolk CSO to the south end of Harbor Island. The Site consists of the sediments of the waterway, and includes a complex mix of shoreline and in-water industrial uses, two residential neighborhoods, recreational use areas, and aquatic and shoreline wildlife habitat, particularly at Kellogg Island in the lower reach of the LDW.

4.5.1 Human Health Risk Assessment

The HHRA for the LDW Site evaluated risks under a variety of scenarios for people that may come in contact with contaminated sediments of the LDW (Windward 2007a). The

estimation of exposures was based primarily on empirical data from a number of field data collection efforts at the Site.

4.5.1.1 Exposure Scenarios

Exposures to sediment were evaluated for direct contact during commercial netfishing by tribal members, beach play by tribal and non-tribal children, and clam harvesting by children and adults. Exposures of tribal, Asian-Pacific Islanders, and one-meal-per-week consumers of seafood were evaluated for indirect exposure to sediment chemicals taken up by seafood in the LDW. Tribal exposures were developed for the Muckleshoot and Suquamish Tribes, who have treaty rights to collect seafood from the LDW, based on the tribal framework document (EPA 2006) as applied by EPA to the LDW Site (EPA 2005). Risks from contact with sediment chemicals while swimming in the LDW were also included by summarizing risk estimates provided in the King County Water Quality Assessment HHRA (King County 1999).

Exposure assumptions for the evaluation of direct sediment exposure under the commercial netfishing scenario were based on recommendations provided by the Muckleshoot Tribe. Values for the beach play and clam harvesting scenarios were based on EPA guidance and best professional judgment.

Assumptions used in the seafood consumption scenarios were developed by EPA based on data collected from several surveys. For the adult tribal seafood consumption scenario, a total consumption rate of 98 grams of seafood per day (3 meals/week, assuming 227 grams [8 ounces] per meal) was assumed based on consumption of resident species from the Puget Sound region. The consumption rate of 98 grams per day was developed using the following process:

1. The consumption rates of Puget Sound harvested seafood by surveyed Tulalip Tribal members were determined.
2. These rates were rank ordered and used to determine a 95th percentile consumption rate of 194 g/day.
3. The total rate was allocated to individual market basket fractions by the following calculation:

   Market basket rate = total rate x avg. rate for a market basket fraction ÷ sum of all avg. market basket rates.

Using this process, salmon comprised 96.5 g/day of the total consumption rate. EPA decided that salmon did not accumulate a significant site-related contaminant body burden from the LDW. Consequently, the “effective” consumption rate for the LDW was 194 g/day

– 96.45 g/day = 97.5 g/day consumption of species with a site related contaminant body burden.

Seafood ingestion was also evaluated for other groups: adult Asian and Pacific Islanders at 46.9 g /day based on a survey of residents in King County, tribal children were assumed to consume seafood at 40 percent of the rate of adults, adult Suquamish tribal members at 597.4 g/day based on a tribal survey, and one-meal-per-week anglers with an assumed consumption rate of 7.5 g/day, equivalent to one meal per week, of either pelagic fish, benthic fish, crabs, or clams. For each of these groups, except the one-meal-per-week anglers, the total seafood consumption rates were divided into the same seafood categories indicated above, based on the respective surveys.

4.5.1.2 Chemicals of Potential Concern and EPCs

COPCs were identified by screening concentrations in sediment and seafood tissue collected from the site against EPA risk-based concentrations or preliminary remediation goals (PRGs), which were adjusted for specific exposure parameters of the Site. The PRGs consisted of EPA Region 9 screening values for exposure to soil; residential soils were used for beach play and clamming scenarios, and industrial soils were used for screening the netfishing scenario. The Region 3 risk-based concentrations (RBCs) for fish ingestion were modified to account for differences in seafood ingestion, body weight, and age between the tribal consumers from the tribal framework guidance document and those values used to derive the Region 3 RBCs. The following modifications were made to the Region 3 RBCs:

- Consumption rate – 98 g/day, modified from 54 g/day. The 95th percentile values are provided in Table 2 of EPA (2005), as taken from Appendix B of the revised tribal framework document (EPA 2006).
- Exposure frequency – 365 days/yr, modified from 350 days/yr.
- Body weight – 81.8 kg modified from 70 kg, as per EPA (2005).
- Exposure duration – 70 years, modified from 30 years, as per EPA (2005).

From the screen, 20 chemicals were identified as COPCs for netfishing, 28 chemicals for beach play and clamming, and 59 chemicals for seafood consumption, based on tissue concentrations. Of the COPCs, chemicals that were never detected in either sediment or tissue (or both) but were included only because reporting limits (RLs) were above the screening criteria were evaluated in the uncertainty analysis. The QA review of analytical data for organochlorine pesticides, particularly in tissue, determined that the data were highly uncertain due to interferences with high concentrations of PCBs in the samples. Several tissue analyses were eventually re-analyzed to address the interferences by PCBs, with resultant pesticide concentrations being lowered substantially.

All EPCs were derived from site-specific data, modeling was not performed. EPCs for the direct sediment exposure scenarios (i.e., netfishing, beach play, and clam harvesting) were calculated for the sediment area over which the exposure could potentially occur. The following describes the exposure scenarios and the EPCs derived for each.

Netfishing scenario – The netfishing scenario assumed that people engaged in commercial netfishing could be exposed to both intertidal and subtidal sediment adhering to their nets because the nets may extend through both zones. Exposures were assumed to occur for 119 days to sediments in the entire waterway, and the full sediment dataset was used to develop EPCs. EPCs for PCBs were calculated as spatially weighted average concentrations (SWACs).

Beach play scenario – For the beach play scenario, EPCs were based on intertidal sediment data from eight areas that were considered accessible to the public, and were calculated as upper 95 percent confidence limits on arithmetic means.

Exposure frequencies were set 65 days/year based on a King County survey of shoreline freshwater beaches in the county, and beaches are segregated into beaches with easy access for nearby residents and beaches of difficult access that are evaluated only for adult recreational use.

Clamming scenario – The clam harvesting scenario assumed that people are exposed to COPCs in sediment as they dig. Two clamming scenarios included all potential clam habitat areas (as identified by survey) that could be accessed either by boat or on foot from the bank, and the EPC was based on SWAC. Based on comments from EPA, the frequency of exposure for the tribal clamming scenario in the revised draft final HHRA was increased to 120 days per year. The Muckleshoot and Suquamish tribes requested a specific exposure scenario of 183 days per year. A recreational clamming scenario used a lower exposure frequency of 7 days/year and included only potential clam habitat areas that could be accessed from the bank.

A summary of the exposure parameters for the direct sediment contact scenarios for the LDW Site is presented in Table A.4-3.

Seafood consumption scenarios – For the seafood consumption scenarios, seven consumption categories were developed based on seafood tissue types available for the LDW: pelagic fish, fillets of benthic fish, whole bodies of benthic fish, edible meat of crabs, whole bodies of crabs, clams, and mussels. A COPC intake rate was then calculated for each consumption category using the COPC tissue dataset and the consumption rate for each category. The chemical intakes for each consumption category were then summed within each seafood consumption scenario to yield an overall COPC intake for that scenario. For

the recreational angler, COPC intake was evaluated separately for each seafood category, assuming that the number of meals consumed per year applied to each category. A summary of the ingestion rates for the RME seafood consumption scenarios in the final HHRA for the LDW Site is presented in Table A.4-4.

4.5.1.3 Risk Characterization

Estimated excess cancer risks in the LDW HHRA were highest for the tribal seafood consumption scenarios. The cumulative risk for all carcinogenic chemicals exceeded 10^{-3} for the adult tribal seafood consumption scenario, with the primary contributors being PCBs and inorganic arsenic. The excess cancer risks from inorganic arsenic were largely attributable to the arsenic concentrations in clams. Inorganic arsenic concentrations in fish and crabs were much lower and were very similar to background concentrations. Cumulative excess cancer risks for the other seafood consumption scenarios were factors of 2 to 70 lower than those for the adult tribal scenario. The risks for the Suquamish scenario were 10 times higher than risks for the adult tribal scenario, reflecting the much higher seafood consumption rate (almost 3 meals per day) used in the Suquamish scenario.

For the direct sediment exposure scenarios, all excess cancer risk estimates for direct sediment exposure scenarios were less than 1×10^{-4} (i.e., about a factor of 100 lower than the adult tribal seafood consumption scenario), except for the tribal clamming at 183 days per year, with risks at 2×10^{-4}. Risks for netfishing and clamming direct sediment contact scenarios were driven by dioxins, PCBs, and arsenic, whereas each play risks to childred were driven by carcinogenic PAHs (cPAHs). In the evaluation of non-cancer hazards, arsenic and PCBs had HQs greater than 1 for one or more seafood consumption scenarios, indicating some potential for adverse effects other than cancer.

Contributors to risk were defined as chemicals with excess cancer risk estimates greater than 1×10^{-6} or an HQ greater than 1 for any exposure scenario. Risk drivers that were frequently detected in either sediment or tissue were arsenic, PCBs, cPAHs, and dioxins/furans. A number of other chemicals, primarily organochlorine pesticides, pentachlorophenol, bis(2-ethylhexly)phthalate, and TBT, were detected less frequently in tissue, but exceeded risk thresholds for seafood consumption. Dioxins/furans were identified as COCs in sediment because their concentrations were elevated in a few relatively small areas within the LDW. Outside of these areas, dioxin/furan concentrations were similar to concentrations in background sediment locations in the greater Seattle area. Background sediment concentrations were determined from stations located in urban waterways of the greater Seattle area. These locations were determined to represent urban background for dioxins/furans.

In the seafood consumption scenarios, elevated risk estimates for CPAHs and arsenic are largely attributed to clams. For PCBs, risks from seafood consumption are more evenly divided among consumption categories.

4.5.2 Ecological Risk Assessment

The final baseline ERA for the LDW Site evaluated risks to a variety of ecological communities and receptors that may come in contact with contaminated sediments of the LDW (Windward 2007b). The ERA presents risk estimates for benthic invertebrate, fish, and wildlife species that may be exposed to COPCs found in sediment, water, and aquatic biota from the LDW. The dataset for the baseline ERA consisted of both historical data collected since 1990 and sediment, tissue, and porewater chemistry data collected from the LDW during the RI. Site-specific effects data primarily collected by LDW Group were also available for benthic invertebrates, including gastropods, a species particularly sensitive to TBT.

4.5.2.1 Problem Formulation

Representative receptors of concern (ROCs) selected for the draft ERA were the benthic invertebrate community, crabs, English sole, Pacific staghorn sculpin, great blue heron, spotted sandpiper, osprey, river otter, and harbor seal. In addition, juvenile chinook salmon was selected as an ROC because they are a federally protected species that use the LDW during outmigration to the Puget Sound, and may be exposed to LDW sediment chemicals during passage through the LDW.

In addition to sediment chemistry data for direct contact exposures, tissue chemistry data were collected for benthic invertebrates (including benthic infauna and epifauna, crabs, clams and mussels), English sole, Pacific staghorn sculpin, shiner surfperch, and juvenile chinook salmon.

COPCs were selected separately for each ROC. For benthic invertebrates, maximum concentrations in surface sediments were compared to SQS. For chemicals with no SQS and detected in at least 5 percent of surface sediment samples, maximum concentrations were compared to Dredged Material Management Program (DMMP) guidelines (USACE et al. 2000) that were determined to be toxicologically based. In cases where no DMMP value was available or the available DMMP value was not toxicologically based (i.e., total DDTs), toxicologically-based values were developed. Chemicals exceeding the SQS, DMMP guidelines, or toxicologically based values were identified as COPCs for benthic invertebrates.

COPCs for fish and crab were identified by screening tissue data, in two steps. The first step identified a list of COIs by meeting at least two of the following three criteria:

- Detection in at least 5 percent of surface sediment samples
- Identification as a bioaccumulative chemical in EPA (2000)
- Detection in any LDW-collected fish or crab tissue sample.

In the second step, the maximum exposure concentration of each COI in fish or crab tissue was compared to a NOAEL for that chemical; NOAELs were developed for all chemicals that passed the first screening steps. If the maximum exposure concentration was greater than the NOAEL for fish or crab, the chemical was identified as a COPC for fish or crab.

Final COPCs consisted of TBT, metals, PCBs and other organic compounds; total PCBs and zinc for crabs); arsenic, cadmium, copper, total PCBs, TBT, and vanadium for at least one fish ROC; and arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, total PCBs, zinc, and vanadium for at least one wildlife ROC.

4.5.2.2 Exposure Assessment

Exposure of benthic invertebrates to COPCs was assessed primarily by evaluating the distribution, concentration, and co-occurrence of COPCs in surface sediment. To assess exposure of the benthic invertebrate community to TBT, co-located benthic invertebrate tissue and sediment samples were collected and analyzed, and a regression relationship was established between sediment concentrations and tissue concentrations of TBT in benthic invertebrates.

Risks to gastropods from exposure to TBT were evaluated separately in field studies, where gastropods were collected and degrees of imposex were measured as the most sensitive endpoint. Collection locations were based on sediment TBT concentrations to ensure specimens from the highest sediment TBT concentration. Risks to benthic invertebrates from exposure to VOCs were assessed using porewater data.

Exposures of fish and crabs to COPCs were characterized based either on COPC concentrations in tissue, for those chemicals for which effects data are based on tissue residues (PCBs for English sole and sculpin, and TBT for sculpin only), or on COPC concentrations in likely prey for those chemicals for which effects data are based on dietary exposures (arsenic, cadmium, copper, vanadium).

For wildlife ROCs, the exposure assessment quantified the ingested dose of COPCs. Dietary doses for wildlife were estimated using available information on ROC biology and life histories, including body weight, feeding behavior, site usage, and diet. A sandpiper

survey of the LDW, documented in the LDW ERA, found that approximately 65 percent of the LDW shoreline contained sandpiper foraging habitat, with about 40 percent of the shoreline considered to be high-quality habitat and about 25 percent considered to be poor-quality habitat. Three hypothetical exposure areas were identified, and within each, two foraging scenarios were assessed; one in which spotted sandpipers forage only in high-quality habitat and another in which they forage in both high- and poor-quality habitats. These two foraging scenarios in each of the three areas resulted in a total of six exposure scenarios for sandpipers.

4.5.2.3 Effects Assessment

Potential adverse effects (i.e., mortality, reduced growth, or impaired reproduction) were identified in the effects assessment. For the benthic invertebrate community, direct measures of sediment toxicity provided by site-specific sediment toxicity tests were given primary consideration over comparisons of sediment chemistry to chemical criteria. For locations without site-specific toxicity information, chemical criteria provided in the Washington SMS (Washington Administrative Code [WAC] 173-204) were used to set benthic invertebrate effects levels for most of the COPCs. For COPCs without chemical-specific sediment criteria, toxicologically based guidelines or toxicity information from the literature were used. For gastropods, a direct site-specific assessment of effects was performed, based on collection of gastropods from areas of the waterway with TBT in sediment followed by examination for degrees of imposex. For assessment of the effects of VOCs in porewater on benthic invertebrates, aquatic toxicity data from the literature were used.

For crabs, fish, and wildlife, an evaluation was conducted of studies in the scientific literature documenting effects of COPCs on the ROCs or similar species. The literature review identified COPC concentrations in receptor tissue or doses associated with NOAEL and LOAEL, from which toxicity reference values (TRVs) were derived.

4.5.2.4 Ecological Risk Characterization

The results of the draft baseline ERA are summarized below for each of the ROCs.

Benthic Invertebrate Community – Sediment chemistry and site-specific toxicity test results indicated that no adverse effects to benthic invertebrates living in intertidal and subtidal sediments were predicted for 75 percent of the LDW area (i.e., all concentrations of COPCs were less than or equal to SQS). A higher likelihood for adverse effects was predicted for approximately 7 percent of the LDW area, which was designated as greater than CSL. The remaining 18 percent of the LDW area was greater than SQS and less than or equal to CSL,

indicating that risks in these areas were uncertain. A total of 39 chemicals were found to exceed SQS and CSL criteria at the LDW site.

Risks to the benthic invertebrate community from all VOCs detected in sediment porewater were negligible, except for cis-1,2-dichloroethene, for which the concentration was 21 times the no-effects-concentration in a small area; however, all concentrations were less than the concentration associated with adverse effects. It was concluded that there was uncertainty whether exposure to VOCs within the LDW was sufficiently high to result in adverse effects in a small area.

Risks to benthic invertebrates from TBT were negligible with HQs based on NOAELs at less than 1. In addition, field-collected gastropods were absent any imposex indications, except females of one neogastropod species (*N. mendicus*) where imposex was characterized as Stage 2, which is a stage that is not expected to impact reproduction and hence not a population-level concern. The stage 2 imposex was observed in females collected at locations with sediment TBT concentrations ranging from 34 to 358 micrograms per kilogram (µg/kg) dw.

Crabs – Exposure concentrations of total PCBs in tissue were equal to concentrations associated with adverse effects in crabs, indicating a potential for adverse effects. Exposure concentrations of zinc in tissue were greater than concentrations associated with no effects but less than those associated with adverse effects, indicating there was uncertainty whether exposure within the LDW is sufficiently high to result in adverse effects.

Fish – Risks were estimated for the three fish ROCs:

> *Juvenile chinook salmon* – For juvenile chinook salmon, dietary exposure concentrations of copper and cadmium were greater than concentrations associated with adverse effects in any fish species but lower than concentrations associated with adverse effects in salmonids. Exposure concentrations of arsenic and vanadium in the diet of juvenile chinook salmon were greater than their respective no-effect concentrations but less than concentrations associated with adverse effects.
>
> *English sole* – Dietary exposure concentrations for three of the six COPCs for fish (copper, cadmium, and vanadium) were greater than concentrations associated with adverse effects for English sole. These results indicate a potential for adverse effects to English sole, although the toxicity information was considered to be uncertain. Estimated exposures of English sole to two additional COPCs (arsenic via diet and total PCBs via tissue residue) were greater than their respective no-effects levels but were lower than the adverse effect levels associated with survival, growth, or

reproduction, indicating there is uncertainty whether exposure within the LDW is sufficiently high to result in adverse effects to English sole.

Pacific staghorn sculpin – Dietary exposure concentrations of copper for Pacific staghorn sculpin were greater than the concentration associated with adverse effects, indicating a potential for adverse effects. The exposure concentrations of TBT (tissue residue) and cadmium and vanadium (dietary) for this ROC were greater than their respective no-effects concentrations but less than those associated with effects, thus the potential for adverse effects is uncertain.

Birds – Risks were evaluated for three bird species:

Spotted sandpiper – Estimated exposures of spotted sandpiper to 6 of the 12 COPCs (copper, chromium, lead, mercury, PCB toxic equivalency quotient [TEQ], and vanadium) were slightly greater than the dietary doses associated with adverse effects on survival, growth, or reproduction in at least one of the three exposure areas within the LDW. A small potential for adverse effects from these COPCs was indicated.

Great blue heron – Estimated doses to great blue heron of all four COPCs (chromium, lead, mercury, and total PCBs) were less than no-effects levels, indicating negligible risk.

Osprey – Estimated doses of PCBs were greater than no-effect levels for osprey using a TEQ approach but less than those levels using a total PCBs approach; however, the TEQ approach was considered to be uncertain. Therefore, the potential for adverse effects from PCBs is uncertain for osprey. Estimated doses of the remaining three COPCs to osprey (chromium, lead, and mercury) were less than the doses associated with no-effects, indicating negligible risk.

Mammals – Risks were evaluated for the two mammalian species discussed below.

River otter – Estimated dietary doses of total PCBs were greater than doses associated with adverse effects for river otters. Estimated exposure of river otters to mercury was greater than a no-effects level but was less than adverse effects levels associated with survival, growth, or reproduction, indicating that the potential for effects is uncertain. Exposures of otter to the remaining three COPCs (arsenic, cobalt, and selenium) were less than their respective no-effects levels, indicating negligible risk.

Harbor seal – Estimated doses of harbor seals to both COPCs (mercury and total PCBs) were less than no-effects levels, indicating negligible risks.

Table A.4-5 provides a summary of COPCs for crabs, fish or wildlife for which either the NOAEL-based HQ or LOAEL-based HQ were greater than or equal to 1.0. Table A.4-6 lists the COPCs for benthic invertebrates that exceeded SMS criteria, DMMP guidelines, or TRVs.

Risk estimates in the final ERA were based on a surface sediment dataset that included sediment data collected prior to cleanup actions in the LDW. In the time period since the field data were collected, cleanup activities have been conducted at two locations in the LDW (Duwamish/Diagonal and the Boeing Developmental Center south storm drain in the Norfolk area), and actions are also currently being planned at three additional locations (Slip 4, Boeing Plant 2, and Terminal 117). Therefore, the estimated risks in the draft ERA likely represent an overestimate of current risks for those ROCs whose exposures included contaminant concentrations from those areas.

4.5.3 Remedial Investigation for the LDW

The Phase 2 RI for the LDW Site was recently released to the regulatory agencies in June 2007. Components of the Phase 2 RI may provide useful information to assist in performance of the risk assessments for the Lockheed West Site.

4.5.4 Food Web Model

As part of the RI, LDW Group has been developing a food web model (FWM) that predicts total PCB concentrations in tissue of fish and crabs from sediment PCB concentrations in the LDW, as documented in recent reports (Windward 2005a,b, 2006c). The FWM will be used in the RI to translate acceptable risk-based concentrations in fish and crab tissue that will be developed from the results of the ERA and HHRA into associated sediment quality thresholds, also referred to as risk-based threshold concentrations (RBTCs). The food web model is based on the model developed by Arnot and Gobas (2004), which is considered to be well suited for modeling PCBs, and may be used to model other hydrophobic organic compounds in the LDW (Windward 2005b).

The FWM will model the uptake of total PCBs from sediment and water through the food chain for five target species (slender and Dungeness crabs, English sole, shiner surfperch, and Pacific staghorn sculpin) in the LDW. In addition, concentrations of PCBs in the tissues of four other groups of organisms (phytoplankton, zooplankton, benthic invertebrates, and juvenile fish) that are prey for the target species are also modeled. The model calibration is presently being refined based on the results of preliminary sensitivity/uncertainty analyses and updated dietary scenarios (Windward 2006c).

4.5.5 Risk-Based Threshold Concentrations

RBTCs are sediment and tissue concentrations that are protective of risks to receptors for a particular exposure route. RBTCs were developed in the Phase 2 RI for the LDW Site (Windward 2007c), and are expected to provide sediment and tissue concentrations in the LDW that are at regulatory risk levels (i.e., 10^{-6} human cancer risk and HQs of 1.0) for each of the human health exposure scenarios and each of the ecological receptor exposure pathways. RBTCs for PCBs are being developed through a FWM; remaining RBTCs may be developed by regression analyses using associated sediment and tissue data, or other statistical correlation analyses. The FWM is also being used to determine the influence of background PCB concentrations in the water column on the ability to set a sediment cleanup level.

Table A.4-1. EPCs for Sediment COPCs in the West Waterway OU HHRA for Sediment Contact

Chemical	EPC for West Waterway OU Study Area (mg/kg)
Bis(2-ethylhexyl)phthalate (BEHP)	4.4
PAHs	2
Heptachlor	0.002
PCBs	0.039 – 0.079
Arsenic	20
Beryllium	0.16

Note: mg/kg = milligrams per kilogram; PAHs = polycyclic aromatic hydrocarbons; PCBs = polychlorinated biphenyls
EPCs are based on ingestion and dermal contact, not bioaccumulation.

Table A.4-2. EPCs for Fish Tissue in the West Waterway OU HHRA for Seafood Consumption

	Number of Data Points	Mean (ppb wet weight)	Standard Deviation (ppb ww)	95% UCL (ppb ww)	Maximum Detected Concentration (ppb ww)	EPC (ppb ww)
Total PCBs						
Perch w/skin	3	136	58	233	184	184
Perch w/o skin	3	94	28	141	121	121
English sole	3	336	110	842	462	462
Red rock crab	3	51	15	75	63	63
Total Mercury						
Perch w/skin	3	NC	NC	NC	30	30
Perch w/o skin	3	NC	NC	NC	20	20
English sole	3	23	5.3	39	29	29
Red rock crab	3	30	20	127	50	50
TBT (ion)						
Perch w/skin	3	9.3	2.1	13	11	11
Perch w/o skin	3	16	5.5	26	20	20
English sole	3	1.4	0.9	3.2	2.1	2.1
Red rock crab	3	NC	NC	NC	1.0	1.0

Note: All fish samples were composites of skinless filets unless otherwise noted; all shellfish samples were edible muscle meat; all samples uncooked. Means, maxima, and standard deviations calculated assuming one-half detection limit for non-detect values.
NC = not calculated, due to fewer than two detected concentrations in this group; ww = wet wet

Table A.4-3. Summary of Sediment Exposure Scenarios for the LDW Site

Scenario	Incidental Sediment Ingestion Rate (g/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Skin Surface Area Exposed (cm^2)
Netfishing RME	0.05	119	44	3,600
Netfishing CT	0.05	63	29	3,600
Child beach play	0.2	65	6	varies with age
Adult clamming (7 days/yr)	0.1	7	30	6,040
Adult clamming (120 days/yr)	0.1	120	64	6,040
Adult clamming (183 days/yr)	0.1	183	70	6,040

Table A.4-4. Summary of Seafood Ingestion Scenarios for the LDW Site

Scenario	Ingestion Rate (IR) (g/day)						Exposure Duration (years)
	Pelagic Fish	Benthic Fish	Crab	Clams	Mussels	Total	
Adult Tulalip – RME	8.1	7.5	33	37.7	0.82	97.5	70
Child Tulalip RME	3.2	3	13.2	15.1	0.33	55.9	6
Adult Suquamish – RME	56	25.9	41.6	438.6	5.0	597.7	70
Adult API - RME	4.9	2.0	5.7	29.0	4.6	51.5	30
Adult one meal a month[a]	7.5	7.5	7.5	7.5	na	na	30

[a] Adult one meal a month consumption was evaluated by individual seafood categories independently to reflect different fishing and consumption practices.

Crap – edible meat
API – Asian and Pacific Islander
RME – reasonable maximum exposure

Table A.4-5. List of COPCs and ROCs with HQs ≥ 1.0 in the LDW ERA

COPC	ROC	NOAEL HQ	LOAEL HQ
COPCs with LOAEL HQs ≥ 1.0[a]			
Total PCBs	crab	**10**	**1.0**
	river otter	**5.8**	**2.9**
	English sole	**4.9 – 25**	0.98 – **5.0**
	Pacific staghorn sculpin	**1.5 – 19**	0.30 – **3.8**
PCB TEQs	spotted sandpiper	**1.9 - 15**	0.18 – **1.5**
Cadmium	juvenile chinook salmon	**5.0**	**1.0**
	English sole	**6.1**	**1.2**
	Pacific staghorn sculpin	**3.0 – 5.2**	0.60 – **1.0**
Chromium	spotted sandpiper	**1.3 – 8.8**	0.26 – **1.8**
Copper	spotted sandpiper	0.62 – **1.5**	0.45 – **1.1**
Lead	spotted sandpiper	0.58 – **19**	0.17 – **5.5**
Mercury	spotted sandpiper	**1.1 – 5.3**	0.21 – **1.0**
	English sole	**5.9**	**1.2**
Vanadium	Pacific staghorn sculpin	**3.2 – 5.9**	0.65 **– 1.2**
	spotted sandpiper	**2.0 – 2.7**	**1.0 – 1.4**
COPCs with NOAEL HQs ≥ 1.0 and LOAEL HQs < 1.0[b]			
Total PCBs	spotted sandpiper	0.51 – **2.0**	0.18 – 0.71
	osprey	**1.6**	0.16
PCB TEQs	river otter	**4.5**	0.59
	juvenile chinook salmon	**1.1**	0.73
Arsenic	English sole	**1.2**	0.80
	crab	**3.9**	not available
Benzoic acid	English sole	**1.5**	not available
	Pacific staghorn sculpin	**2.1**	not available
Cadmium	Pacific staghorn sculpin	**3.0 – 4.9**	0.60 – 0.98
Chromium	juvenile chinook salmon	**2.1**	not available
	English sole	**1.1**	not available
Copper	juvenile chinook salmon	**1.9**	0.93
	English sole	**1.9**	0.93
	Pacific staghorn sculpin	0.9 **– 1.5**	0.45 – 0.77
Mercury	river otter	**2.8**	0.57
TBT	Pacific staghorn sculpin	**1.6** – **2.9**	0.81 – 0.33
Vanadium	juvenile chinook salmon	**4.0**	0.79
Zinc	crab	**2.5**	0.91

[a] The LOAEL-based HQs for endrin were 1.2 and 3.1 for English sole and Pacific staghorn sculpin, respectively. Analytical interferences from PCB Aroclors in the pesticide analyses resulted in uncertainties in identification and a high bias in pesticide concentrations.

[b] The NOAEL-based HQs were ≥1 for the following COPC/ROC pairs: 1) total DDTs and spotted sandpiper (2.6-4.3), 2) endrin and juvenile chinook salmon (3.6), 3) alpha-endosulfan and English sole (6.8) and Pacific staghorn sculpin (2.3), 4) beta-endosulfan and English sole (29) and Pacific staghorn sculpin (6.6), 5) endrin and juvenile chinook salmon (3.6), 6) methoxychlor and crab (3.6). Analytical interferences from PCB Aroclors in the pesticide analyses resulted in uncertainties in identification and a high bias in pesticide concentrations.

Note: HQs for fish are the highest HQs in cases where more than one approach was used.
COPC – chemical of potential concern
HQ – hazard quotient
LOAEL – low-observed-adverse-effect level
NOAEL – no-observed-adverse-effect level
PCB – polychlorinated biphenyl
ROC – receptor of concern
TBT – tributyltin
TEQ – toxic equivalent
Bold identifies HQs greater than or equal to 1.0.

Table A.4-6. List of Benthic Invertebrate Community COPCs with Detected Concentrations Greater than Sediment Criteria at the LDW Site

COPC	Number of Detected Concentrations > SQS and ≤ CSL	Number of Detected Concentrations > CSL
Total PCBs	301	173
Bis(2-ethylhexyl) phthalate	48	58
Mercury	14	23
Lead	2	19
Zinc	26	16
Total chlordane[a]	19	14
Copper	0	12
Cadmium	2	11
Silver	0	10
Fluoranthene	31	8
Butyl benzyl phthalate	69	8
Indeno(1,2,3-cd)pyrene	15	8
Chromium	1	8
Arsenic	5	8
Phenol	18	7
Benzo(g,h,i)perylene	9	7
Benzoic acid	0	7
Dibenzo(a,h)anthracene	15	4
Nickel[b]	9	4
Total benzofluoranthenes	5	4
4-Methylphenol	0	4
Phenanthrene	24	3
Total HPAH	21	3
Acenaphthene	16	3
Fluorene	11	3
Benzo(a)anthracene	9	3
Dibenzofuran	7	3
Benzo(a)pyrene	5	3
Total LPAH	3	3
Pyrene	1	3
1,4-Dichlorobenzene	0	3
1,2-Dichlorobenzene	0	3
2-Methylnaphthalene	0	3
Dimethyl phthalate	0	2
Naphthalene	0	2
N-Nitrosodiphenylamine	0	2
Hexachlorobenzene	4	2
Benzyl alcohol	2	2
Chrysene	23	1
Total DDTs[a]	1	1
1,2,4-Trichlorobenzene	0	1
2,4-Dimethylphenol	0	1
Anthracene	2	0
Pentachlorophenol	1	0

[a] SMS criteria do not exist for these chemicals; number of exceedances was based on a comparison of sediment chemistry to a TRV.

COPC – chemical of potential concern
CSL – cleanup screening level
HPAH – high-molecular-weight polycyclic aromatic hydrocarbon
LPAH – low-molecular-weight polycyclic aromatic hydrocarbon
PCB – polychlorinated biphenyl
SQS – sediment quality standards

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APPENDIX A.1

TABULATED SEDIMENT QUALITY DATA

Lockheed Shipyard No. 2 Subsurface Samples
Data Evaluation Summary Compared to SQS and CSL

Parameter	Units	SQS	CSL	Sample Locations within Yard 2											
			Location	C6	C6	C6	D5	SB1	SB1	D2	D3	SA8	SA9	SA9	SA5
			Sample ID	C6 (0-2)	C6 (2-5)	C6 (5-8)	D5-C	SB1-A	SB1-C	D2-C	D3-A	SA8-D	SA9-A	SA9-B	SA5-A
			Sample Date	12/1/1991	12/1/1991	12/1/1991	9/13/1989	9/12/1989	9/12/1989	9/7/1989	9/5/1989	9/1/1989	9/1/1989	9/1/1989	8/31/1989
			Sample Depth	0-2 ft	2-5 ft	5-8 ft	0-4 ft	0-2 ft	2-7.5 ft	0-4 ft	0-2 ft	3.5-5 ft	0-2 ft	2-5 ft	0-2 ft
Conventionals															
Total Organic Carbon	%	NA	NA	1.4762	1.3682	0.7154	0.67	1	0.81	1.1	0.56	0.61	0.63	0.69	1.1
Metals															
Arsenic	mg/kg	57	93	12.2	8.44	3.19	**64**	**110**	42	55	46	27	36	20	37
Cadmium	mg/kg	5.1	6.7	0.41	0.415	0.08	1.3 E	0.2 E	0.52 E	0.16 E	0.36 E	0.11 E	0.35 E	0.24 E	0.2 E
Chromium	mg/kg	260	270	29.8	29.2	16.6	190 E	**660** E	230 E	33 E	110 E	33 E	92 E	50 E	100 E
Copper	mg/kg	390	390	61.8 J	46.3 J	20.9 J	**1200** E	**1900** E	110 E	35 E	210 E	100 E	220 E	93 E	91 E
Lead	mg/kg	450	530	32	18	3	**610** E	**550** E	**550** E	6.1 E	100 E	30 E	120 E	20 E	18 E
Mercury	mg/kg	0.41	0.59	0.34	0.27	0.06 U	0.032	0.012	0.011	0.001	0.0008	0.001	0.0038	0.001	0.0005
Silver	mg/kg	6.1	6.1	0.27	0.17	0.03 U	1.2 E	0.64 E	0.76 E	0.1 U	0.23 E	0.1 U	0.24 E	0.1 U	0.14 E
Zinc	mg/kg	410	960	95.8	62.4	29.1	**2600** E	**960** E	**1100** E	48 E	**480** E	100 E	380 E	85 E	120 E
SVOCs															
Naphthalene	mg/kg-OCN	99	170	6.0	24	0.02	**1029.85**	**650**	**296.3**	3.27	17.86	NR	11.75	3.19 E	11.82
Acenaphthylene	mg/kg-OCN	66	66	1.0	7	0 J	29.85 E	**190**	28.4	0.82 E	10	NR	15.4	2.9 E	2.36
Acenaphthene	mg/kg-OCN	16	57	4.0	15	0.02	**537.31**	**540**	**160.49**	1.45 E	12.14	NR	13.49	6.09	6.55
Fluorene	mg/kg-OCN	23	79	3.0	13	0.02	**522.39**	**600**	**197.53**	1.55 E	16.96	NR	20.63	9.13	6.36
Phenanthrene	mg/kg-OCN	100	480	14.0	40	0.05	**1194.03**	**3500**	**839.51**	6	80.36	NR	**174.6**	63.77	20.91
Anthracene	mg/kg-OCN	220	1200	6.0	21	0.02	**298.51**	**870**	**246.91**	5.09	37.5	NR	23.81	20.29	10
2-Methylnaphthalene	mg/kg-OCN	38	64	1.0	5	0.01 J	**238.81**	**130**	33.33	2.27 U	4.82 E	NR	5.08	1.59 E	2.27
Total LPAH	mg/kg-OCN	370	780	34.0	120	0.13 J	**3611.94** E	**6350**	**1769.14**	18.18 E	174.82	NR	259.68	105.36 E	58
Fluoranthene	mg/kg-OCN	160	1200	14.0	31	0.05	**1447.76**	**3500**	**1086.42**	8.09	96.43	NR	**190.48**	63.77	34.55
Pyrene	mg/kg-OCN	1000	1400	35.0	95	0.15	**1194.03**	**3600**	938.27	18.18	285.71	NR	476.19	110.14	50 E
Benzo(a)anthracene	mg/kg-OCN	110	270	7.0	15	0.02	**477.61**	**1900**	**419.75**	3.82	**116.07**	NR	**134.92**	27.54	17.27
Chrysene	mg/kg-OCN	110	460	12.0	29	0.02	**522.39**	**1500**	**407.41**	5	100	NR	104.76	26.09	20.91
Benzofluoranthenes (total)	mg/kg-OCN	230	450	37.0	54	0.05	**761.19**	**2200**	**703.7**	17.27	146.43	NR	206.35	47.83	32.73
Benzo(a)pyrene	mg/kg-OCN	99	210	16.0	26	0.02	**373.13**	**1500**	**370.37**	6.82	75	NR	**109.52**	27.54	14.55
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88	10.0	12	0.01 J	**164.18**	**890**	**197.53**	3.45	**48.21**	NR	**66.67**	17.39	8
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33	4.0	5	0.01 U	**82.09**	**420**	**98.77**	2.18 E	**21.43**	NR	**39.68**	10.87	3.73
Benzo(g,h,i)perylene	mg/kg-OCN	31	78	3.0	4	0.01	**179.1**	**880**	**185.19**	3.64	**44.64**	NR	**65.08**	21.74	8.45
Total HPAH	mg/kg-OCN	960	5300	138.0	271	0.33 J	**5201.49**	**16390**	**4407.41**	68.45 E	933.93	NR	**1393.65**	352.9	190.18 E
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3	0.0 U	1 U	0.01 U	***17.91*** U	***14*** U	***14.81*** U	1.18 U	***2.32*** U	NR	2.06 U	1.88 U	1.09 U
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9	0.0 U	1 U	0.01 U	***37.31*** U	***28*** U	***28.4*** U	2.27 U	***4.82*** U	NR	***4.29*** U	***3.77*** U	2.18 U
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8	0.0 U	***1*** U	0.01 U	***17.91*** U	**28** E	***14.81*** U	***1.18*** U	***2.32*** U	NR	***2.06*** U	***1.88*** U	***1.09*** U
Hexachlorobenzene	mg/kg-OCN	0.38	2.3	0.0 U	***1*** U	0.01 U	***37.31*** U	***28*** U	***28.4*** U	***2.27*** U	***4.82*** U	NR	***4.29*** U	***3.77*** U	***2.18*** U
Dimethyl phthalate	mg/kg-OCN	53	53	0.0 U	1 U	0.01 U	37.31 U	28 U	28.4 U	2.27 U	4.82 U	NR	4.29 U	3.77 U	2.18 U
Diethylphthalate	mg/kg-OCN	61	110	0.0 U	1 U	0.01 U	37.31 U	28 U	28.4 U	2.27 U	4.82 U	NR	4.29 U	3.77 U	2.18 U
Di-n-butyl phthalate	mg/kg-OCN	220	1700	0.0 M	1 U	0.01 U	37.31 U	39	28.4 U	2.27 U	4.82 U	NR	14.13	3.77 U	2.18 U
Butyl benzyl phthalate	mg/kg-OCN	4.9	64	0.0 U	1 U	0.01 U	***37.31*** U	***28*** U	***28.4*** U	2.27 U	4.82 U	NR	4.29 U	3.77 U	2.18 U
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78	3.0	1 M	0.01 U	**283.58**	**1100**	**395.06**	2.27 U	**114.29**	NR	**66.67**	30.43	15.45
Di-n-octyl phthalate	mg/kg-OCN	58	4500	0.0 U	1 U	0.01 U	37.31 U	28 U	28.4 U	2.27 U	9.29 E	NR	4.29 U	3.77 U	2.18 U
Dibenzofuran	mg/kg-OCN	15	58	2.0	10	0.01	**432.84**	**400**	**135.8**	1.18 E	10.36	NR	12.54	5.51	4.36
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2	1.0 U	1 U	0.02 U	***37.31*** U	***28*** U	***28.4*** U	2.27 U	***4.82*** U	NR	***4.29*** U	3.77 U	2.18 U
N-Nitrosodiphenylamine	mg/kg-OCN	11	11	0.0 U	1 U	0.01 U	**40.3** E	***14*** U	***14.81*** U	1.18 U	2.32 U	NR	2.06 U	1.88 U	1.09 U
Phenol	µg/kg	420	1200	10	20 M	10 U	***500*** U	**1200**	***460*** U	51 U	63	NR	54 U	52 U	47 U
2-Methylphenol	µg/kg	63	63	10 U	10 U	10 U	***120*** U	**140** E	***120*** U	13 U	13 U	NR	13 U	13 U	12 U
4-Methylphenol	µg/kg	670	670	10 M	20 M	10 U	250 U	**730**	230 U	4 U	31	NR	27 U	26 U	24 U
2,4-Dimethylphenol	µg/kg	29	29	10 U	20 U	10 U	***120*** U	***140*** U	***120*** U	13 U	13 U	NR	13 U	13 U	12 U
Pentachlorophenol	µg/kg	360	690	30 U	30 U	30 U	***1200*** U	***1400*** U	***1200*** U	130 U	130 U	NR	130 U	130 U	120 U
Benzyl alcohol	µg/kg	57	73	10 U	20 U	10 U	***200*** U	***220*** U	***180*** U	20 U	22 U	NR	21 U	21 U	19 U
Benzoic acid	µg/kg	650	650	40	40	20 M	***1200*** U	***1400*** U	***1200*** U	130 U	130 U	NR	130 U	28 E	120 U
PCBs															
PCBs (total)	mg/kg-OCN	12	65	12	6 U	0.11 U	**417.91**	**590**	**283.95**	5.45 U	**43.93**	20.49	**96.83**	**20.72**	11

Notes:

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Subsurface Samples
Data Evaluation Summary Compared to SQS and CSL

Parameter	Units	SQS	CSL	Location	Sample Locations within Yard 2									
				Location	SA5	SA7	SA7	SA3	SA3	SA3	SA4	SA4	SA2	SA2
				Sample ID	SA5-C	SA7-A	SA7-D	SA3-A	SA3-B	SA3-D	SA4-C	SA4-D	SA2-C	SA2-D
				Sample Date	8/31/1989	8/31/1989	8/31/1989	8/30/1989	8/30/1989	8/30/1989	8/30/1989	8/30/1989	8/29/1989	8/29/1989
				Sample Depth	2-4.5 ft	0-2 ft	7.5-9 ft	0-2 ft	2-4.5 ft	8-10.5 ft	0-2 ft	2-4.5 ft	0-1 ft	2-5 ft
Conventionals														
Total Organic Carbon	%	NA	NA		0.96	1	2.4	0.65	0.52	1	1.2	0.63	2.2	4.3
Metals														
Arsenic	mg/kg	57	93		36	55	**70**	**71**	31	1.6	3.6	7.5	11	40
Cadmium	mg/kg	5.1	6.7		0.092 E	0.15 E	0.31 E	0.2 E	0.15 E	0.18 E	0.27 E	0.098 E	1.5 E	0.49 E
Chromium	mg/kg	260	270		26 E	22 E	20 E	180 E	51 E	19 E	24 E	24 E	110 E	51 E
Copper	mg/kg	390	390		77 E	100 E	72 E	150 E	77 E	40 E	63 E	42 E	150 E	64 E
Lead	mg/kg	450	530		18 E	35 E	9 E	160 E	58 E	6.1 E	53 E	3.7 E	150 E	31 E
Mercury	mg/kg	0.41	0.59		0.0005 U	0.0005 U	0.0006	0.0006	0.0005	0.0005 U	0.0005	0.0005 U	0.0019	0.0011
Silver	mg/kg	6.1	6.1		0.13 E	0.15 E	0.13 E	0.34 E	0.1 U	0.12 E	0.1 U	0.1 U	1.1 E	0.17 E
Zinc	mg/kg	410	960		80 E	130 E	71 E	390 E	200 E	390 E	110 E	64 E	250 E	85 E
SVOCs														
Naphthalene	mg/kg-OCN	99	170		8.44	34	NR	10.77	11.15	2.4 U	27.5	2.86 E	24.09	23.26
Acenaphthylene	mg/kg-OCN	66	66		2.5 U	6 E	NR	6	6.15	2.4 U	6.25	3.97 U	15.45 U	7.44 U
Acenaphthene	mg/kg-OCN	16	57		4.06	13 E	NR	13.08	**18.27**	2.4 U	15	1.59 E	13.64 E	**141.86**
Fluorene	mg/kg-OCN	23	79		3.44	16 E	NR	15.23	**182.69**	2.4 U	19.17	1.75 E	17.27	**93.02**
Phenanthrene	mg/kg-OCN	100	480		11.46	97	NR	61.54	**826.92**	1.6 E	62.5	6.03	63.64	**181.4**
Anthracene	mg/kg-OCN	220	1200		3.54	35	NR	49.23	**346.15**	2.4 U	25.83	4.13	59.09	153.49
2-Methylnaphthalene	mg/kg-OCN	38	64		2.29 E	8 E	NR	3.54 E	6.15	2.4 U	7.92	0.63 E	5.91 E	7.21 E
Total LPAH	mg/kg-OCN	370	780		30.94	201 E	NR	155.85	**1391.35**	1.6 E	156.25	16.35 E	177.73 E	**593.02**
Fluoranthene	mg/kg-OCN	160	1200		16.67	**170**	NR	136.92	**653.85**	1.6 E	**307.5**	8.73	90.91	**395.35**
Pyrene	mg/kg-OCN	1000	1400		16.67 E	260	NR	135.38 E	538.46 E	1.6 E	116.67 E	14.92 E	545.45	395.35 E
Benzo(a)anthracene	mg/kg-OCN	110	270		4.48	56	NR	78.46	**250**	2.4 U	30.83	5.08	54.55	100
Chrysene	mg/kg-OCN	110	460		5.21	83	NR	78.46	**211.54**	0.9 E	50	7.3	77.27	102.33
Benzofluoranthenes (total)	mg/kg-OCN	230	450		7.81	120	NR	153.85	211.54	2.4 U	91.67	19.05	168.18	83.72
Benzo(a)pyrene	mg/kg-OCN	99	210		3.44	62	NR	61.54	80.77	2.4 U	40	8.1	68.18	34.88
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88		1.88 E	28	NR	33.85	NR	2.4 U	20	4.29	31.36	17.44
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33		1.15 E	12 E	NR	**20**	**21.15**	2.4 U	**14.17**	3.02 E	**20.45** E	**13.72**
Benzo(g,h,i)perylene	mg/kg-OCN	31	78		2.19 E	30	NR	29.23	26.92	2.4 U	11.67	3.65 E	29.55	17.91
Total HPAH	mg/kg-OCN	960	5300		59.48 E	821 E	NR	727.69 E	**1994.23** E	4.1 E	682.5 E	74.13 E	**1085.91** E	**1160.7** E
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3		1.25 U	***13*** U	NR	2 U	***2.5*** U	1.2 U	1.08 U	2.06 U	***7.73*** U	***3.02*** U
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9		2.5 U	***25*** U	NR	***4.15*** U	***4.81*** U	2.4 U	2.25 U	***3.97*** U	***15.45*** U	***7.44*** U
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8		***1.25*** U	***13*** U	NR	***1.23*** U	***1.54*** U	0.7 U	0.67 U	***1.27*** U	***7.73*** U	***2.33*** U
Hexachlorobenzene	mg/kg-OCN	0.38	2.3		***2.5*** U	***25*** U	NR	***4.15*** U	***4.81*** U	***2.4*** U	***2.25*** U	***3.97*** U	***15.45*** U	***7.44*** U
Dimethyl phthalate	mg/kg-OCN	53	53		2.5 U	25 U	NR	4.15 U	4.81 U	2.4 U	2.25 U	3.97 U	15.45 U	7.44 U
Diethylphthalate	mg/kg-OCN	61	110		2.5 U	25 U	NR	4.15 U	4.81 U	2.4 U	2.25 U	3.97 U	15.45 U	7.44 U
Di-n-butyl phthalate	mg/kg-OCN	220	1700		2.5 U	25 U	NR	4.15 U	4.81 U	2.4 U	2.25 U	3.97 U	15.45 U	7.44 U
Butyl benzyl phthalate	mg/kg-OCN	4.9	64		2.5 U	***25*** U	NR	4.15 U	4.81 U	2.4 U	2.25 U	3.97 U	***15.45*** U	***7.44*** U
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78		6.88	**92**	NR	46.15	36.54	5.1	12.5	6.03	15.45 U	7.44 U
Di-n-octyl phthalate	mg/kg-OCN	58	4500		2.5 U	**66**	NR	4.15 U	11.35	2.4 U	10.83 U	3.97 U	15.45 U	7.44 U
Dibenzofuran	mg/kg-OCN	15	58		2.71	12 E	NR	9.08	36.54	2.4 U	12.5	1.11 E	10 E	44.19
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2		2.5 U	***25*** U	NR	4.15 U	4.81 U	2.4 U	2.25 U	***3.97*** U	***15.45*** U	3.72 U
N-Nitrosodiphenylamine	mg/kg-OCN	11	11		1.25 U	***13*** U	NR	2 U	7.31 E	2.2 U	2 U	3.65 U	7.73 U	3.02 U
Phenol	µg/kg	420	1200		50	75 E	NR	53 U	51 U	48 U	58 E	51 U	***680*** U	***650*** U
2-Methylphenol	µg/kg	63	63		12 U	13 U	NR	10 U	9 U	9 U	10 U	9 U	***170*** U	***130*** U
4-Methylphenol	µg/kg	670	670		24 U	25 U	NR	27 U	25 U	24 U	27 U	25 U	340 U	320 U
2,4-Dimethylphenol	µg/kg	29	29		12 U	13 U	NR	8 U	8 U	7 U	8 U	8 U	***170*** U	**190**
Pentachlorophenol	µg/kg	360	690		120 U	120 U	NR	132 U	130 U	120 U	130 U	130 U	***1700*** U	***1600*** U
Benzyl alcohol	µg/kg	57	73		20 U	20 U	NR	16 U	15 U	14 U	16 U	15 U	***270*** U	***160*** U
Benzoic acid	µg/kg	650	650		120 U	120 U	NR	130 U	130 U	120 U	130 U	130 U	***1700*** U	230 U
PCBs														
PCBs (total)	mg/kg-OCN	12	65		**12.5**	**125**	5 U	**20.92**	NR	12 U	10.92	***19.1*** U	**15**	2.79

Notes:

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated qua

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Subsurface Samples
Data Evaluation Summary Compared to SQS and CSL

				Sample Locations North of Yard 2							West Waterway	
			Location	C5	C5	C5	C5	C5	C7	PC1	PC2	PC2
			Sample ID	C5 (0 - 2)	C5 (2-5)	C5 (5-8)	C8 (0 - 2)	C8 (2-5)	C7 (2-5)	PC-1A	PC-2A	PC-2B
			Sample Date	12/1/1991	12/1/1991	12/1/1991	12/1/1991	12/1/1991	12/1/1991	9/1/1992	9/1/1992	9/1/1992
			Sample Depth	0-2 ft	2-5 ft	5-8 ft	0-2 ft	2-5 ft	2-5 ft	0-4 ft	0-4 ft	4-8 ft
Parameter	**Units**	**SQS**	**CSL**									
Conventionals												
Total Organic Carbon	%	NA	NA	0.654	0.5702	0.781	0.7418	0.648	0.7004	1.8	0.51	0.56
Metals												
Arsenic	mg/kg	57	93	2.5	2.03	2.1	2.83	2.25	1.68	17	10	8.9
Cadmium	mg/kg	5.1	6.7	0.08	0.06	0.04	0.09	0.07	0.03 U	NR	0.1 U	0.13
Chromium	mg/kg	260	270	16.9	15	13.6	18.3	15.9	9.1	0.22	NR	NR
Copper	mg/kg	390	390	17.9 J	14.4 J	12.9 J	19.9 J	16.1 J	9.2 J	82	29	25
Lead	mg/kg	450	530	4	3 U	3 U	3 U	3 U	3 U	130	39	27
Mercury	mg/kg	0.41	0.59	0.1 U	0.07 U	0.05 U	0.06 U	0.06 U	0.05 U	0.019	0.056	0.16
Silver	mg/kg	6.1	6.1	0.03 U	0.03 U	0.02 U	0.03 U	0.02 U	0.03 U	0.4	0.2 U	0.2 U
Zinc	mg/kg	410	960	29.5	26.1	24.6	39	27.1	19.4	240	93	75
SVOCs												
Naphthalene	mg/kg-OCN	99	170	1.0 J	1.0 U	1 U	1	1.0 U	0.0 J	7.78	3.73	8.75
Acenaphthylene	mg/kg-OCN	66	66	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	1.44	3.73 U	3.39 U
Acenaphthene	mg/kg-OCN	16	57	1.0 U	1.0 U	1 U	1 J	1.0 U	1.0 U	4.39	3.92	3.57
Fluorene	mg/kg-OCN	23	79	1.0 U	1.0 U	1 U	0 J	1.0 U	1.0 U	4.94	4.31	5.18
Phenanthrene	mg/kg-OCN	100	480	1.0	1.0 J	1 U	2	1.0 J	0.0 J	25	27.45	19.64
Anthracene	mg/kg-OCN	220	1200	1.0 J	1.0 U	1 U	1 J	1.0 U	1.0 U	7.22	7.84	8.21
2-Methylnaphthalene	mg/kg-OCN	38	64	1.0 U	1.0 U	1 U	0 M	1.0 U	1.0 U	3.11	3.73 U	3.39 U
Total LPAH	mg/kg-OCN	370	780	3.0 J	1.0 J	1 U	5 J	1.0 J	0.0 J	50.78	47.25	45.36
Fluoranthene	mg/kg-OCN	160	1200	1.0	0.0 J	1 U	2	1.0 U	1.0 U	33.89	50.98	35.71
Pyrene	mg/kg-OCN	1000	1400	2.0	0.0 J	1 U	4	0.0 J	1.0	105.56	145.1	73.21
Benzo(a)anthracene	mg/kg-OCN	110	270	1.0 J	1.0 U	1 U	1 J	1.0 U	1.0 U	19.44	33.33	19.64
Chrysene	mg/kg-OCN	110	460	1.0	1.0 U	1 U	1	1.0 U	1.0 U	29.44	45.1	26.79
Benzofluoranthenes (total)	mg/kg-OCN	230	450	3.0	2.0 U	1 U	4	1.0 U	1.0 U	55	121.57	42.14
Benzo(a)pyrene	mg/kg-OCN	99	210	1.0	1.0 U	1 U	1	1.0 U	1.0 U	25.56	52.94	21.43
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88	1.0	1.0 U	1 U	1	1.0 U	1.0 U	11.67	21.57	11.43
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33	1.0 M	1.0 U	1 U	1 U	0.0 U	1.0 U	2.06	3.92	3.75
Benzo(g,h,i)perylene	mg/kg-OCN	31	78	1.0 M	1.0 U	1 U	0 M	1.0 U	1.0 U	10.56	19.61	11.61
Total HPAH	mg/kg-OCN	960	5300	12.0 JM	0.0 J	1 U	14 JM	0.0 J	1.0 U	293.17	494.12	245.71
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	0.17	0.2 U	0.36 U
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	0.17	0.39 U	0.36 U
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8	***1.0*** U	***1.0*** U	***1*** U	***1*** U	***1.0*** U	***1.0*** U	0.38	***1.1*** U	***1*** U
Hexachlorobenzene	mg/kg-OCN	0.38	2.3	***1.0*** U	***1.0*** U	***1*** U	***1*** U	***1.0*** U	***1.0*** U	**0.78**	***2.16*** U	***1.96*** U
Dimethyl phthalate	mg/kg-OCN	53	53	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	1.28	3.73 U	3.39 U
Diethylphthalate	mg/kg-OCN	61	110	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	1.28	3.73 U	3.39 U
Di-n-butyl phthalate	mg/kg-OCN	220	1700	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	1.28	3.73 U	3.39 U
Butyl benzyl phthalate	mg/kg-OCN	4.9	64	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	1.28	3.73 U	3.39 U
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78	2.0	3.0	1 J	1 J	1.0	1.0 U	4.67	15.88	3.39 U
Di-n-octyl phthalate	mg/kg-OCN	58	4500	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	1.28	3.73 U	3.39 U
Dibenzofuran	mg/kg-OCN	15	58	1.0 U	1.0 U	1 U	0 J	1.0 U	1.0 U	3.83	3.73 U	3.39 U
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2	2.0 U	2.0 U	2 U	2 U	2.0 U	2.0 U	1.28	3.73 U	3.39 U
N-Nitrosodiphenylamine	mg/kg-OCN	11	11	1.0 U	1.0 U	1 U	1 U	1.0 U	1.0 U	0.78	2.16 U	1.96 U
Phenol	µg/kg	420	1200	10 M	10 U	10 U	20	10 U	10 U	23 U	19 U	19 U
2-Methylphenol	µg/kg	63	63	10 U	10 U	10 U	0 M	10 U	10 U	11 U	9.3 U	9.3 U
4-Methylphenol	µg/kg	670	670	10 U	10 U	10 U	10 U	10 U	10 U	23 U	19 U	19 U
2,4-Dimethylphenol	µg/kg	29	29	10 U	10 U	10 U	10 U	10 U	10 U	11 U	9.3 U	9.3 U
Pentachlorophenol	µg/kg	360	690	30 U	30 U	30 U	30 U	30 U	20 U	68 U	56 U	56 U
Benzyl alcohol	µg/kg	57	73	10 U	10 U	10 U	10 U	10 U	10 U	14 U	11 U	11 U
Benzoic acid	µg/kg	650	650	20 J	40	20 M	30	20 J	20 J	110 U	93 U	93 U
PCBs												
PCBs (total)	mg/kg-OCN	12	65	12 U	***14*** U	10 U	11 U	12 U	11 U	9.56	**43.14**	6.61 U

Notes:

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated qua

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Subsurface Samples
Data Evaluation Summary Compared to SQS and CSL

				Sample Locations in the West Waterway					
			Location	PC2	SA10	SA10	SA10	SA10	M1
			Sample ID	PC-2C	SA10-A	SA10-B	SA10-C	SA10-D	M1-C
			Sample Date	9/1/1992	9/16/1989	9/16/1989	9/16/1989	9/16/1989	9/12/1989
			Sample Depth	8-12 ft	0-2 ft	2-5 ft	9-10.5 ft	10.5-12 ft	0-7.5 ft
Parameter	**Units**	**SQS**	**CSL**						
Conventionals									
Total Organic Carbon	%	NA	NA	1.1	1.2	1.1	1.5	0.68	0.61
Metals									
Arsenic	mg/kg	57	93	12	28	36	42	28	**110**
Cadmium	mg/kg	5.1	6.7	0.11	0.19 E	0.085 E	0.12 E	0.15 E	1.2 E
Chromium	mg/kg	260	270	NR	78	60 E	59 E	42 E	220 E
Copper	mg/kg	390	390	34	150 E	38 E	39 E	26 E	**1300** E
Lead	mg/kg	450	530	27	63 E	13 E	7 E	5.8 E	**2200** E
Mercury	mg/kg	0.41	0.59	0.085	0.0039	0.0009	0.0005	0.0005 U	0.011
Silver	mg/kg	6.1	6.1	0.2 U	0.87 E	0.64 E	0.12 E	0.27 E	0.75 E
Zinc	mg/kg	410	960	77	170 E	78 E	67 E	58 E	**1700** E
SVOCs									
Naphthalene	mg/kg-OCN	99	170	5.82	25 U	1.55 E	2 U	3.82 U	91.8
Acenaphthylene	mg/kg-OCN	66	66	2.27	5.08 E	1.36 E	2 U	3.82 U	42.62
Acenaphthene	mg/kg-OCN	16	57	2.09	4.92 E	2.73	0.27 E	3.82 U	**262.3**
Fluorene	mg/kg-OCN	23	79	3	5.42 E	3.73	0.4 E	3.82 U	**278.69**
Phenanthrene	mg/kg-OCN	100	480	11.82	65.83	21.82	2.13	3.82 U	**1049.18**
Anthracene	mg/kg-OCN	220	1200	5.73	27.5	7.09	1.4 E	3.82 U	**262.3**
2-Methylnaphthalene	mg/kg-OCN	38	64	1.91 U	24.17 U	0.91 E	2 U	3.82 U	**57.38**
Total LPAH	mg/kg-OCN	370	780	30.73	108.75 E	38.27 E	4.2 E	3.82 U	**1986.89**
Fluoranthene	mg/kg-OCN	160	1200	21.82	133.33	19.09	5.73	3.82 U	**1377.05**
Pyrene	mg/kg-OCN	1000	1400	30	250	44.55	8.67	3.82 U	**1262.3**
Benzo(a)anthracene	mg/kg-OCN	110	270	10	70 U	13.64	2.33	3.82 U	**524.59**
Chrysene	mg/kg-OCN	110	460	13.64	73.33	10	2.2	3.82 U	**475.41**
Benzofluoranthenes (total)	mg/kg-OCN	230	450	16.91	175	25.45	3.13	3.82 U	**737.7**
Benzo(a)pyrene	mg/kg-OCN	99	210	8.09	83.33	10.91	2 U	3.82 U	**360.66**
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88	4	**60.83**	7.55	2 U	3.82 U	**180.33**
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33	1.91 U	**50**	3.36	2 U	3.82 U	**80.33**
Benzo(g,h,i)perylene	mg/kg-OCN	31	78	4	**75**	8.18	2 U	3.82 U	**196.72**
Total HPAH	mg/kg-OCN	960	5300	108.45	900.83	142.73	22.07	3.82 U	**5195.08**
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3	0.27 U	***11.67*** U	1.09 U	1 U	1.91 U	***18.03*** U
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9	0.27 U	***24.17*** U	2.18 U	2 U	***3.82*** U	***36.07*** U
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8	0.56 U	***11.67*** U	***1.09*** U	***1*** U	0.74 U	***18.03*** U
Hexachlorobenzene	mg/kg-OCN	0.38	2.3	***1.09*** U	***24.17*** U	***2.18*** U	***2*** U	***3.82*** U	***36.07*** U
Dimethyl phthalate	mg/kg-OCN	53	53	1.91 U	24.17 U	2.18 U	2 U	3.82 U	36.07 U
Diethylphthalate	mg/kg-OCN	61	110	1.91 U	24.17 U	2.18 U	2 U	3.82 U	36.07 U
Di-n-butyl phthalate	mg/kg-OCN	220	1700	1.91 U	24.17 U	2.18 U	2 U	3.82 U	36.07 U
Butyl benzyl phthalate	mg/kg-OCN	4.9	64	1.91 U	***24.17*** U	2.18 U	2 U	3.82 U	***36.07*** U
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78	1.91 U	32.5	7.45	3.4	3.82	**157.38**
Di-n-octyl phthalate	mg/kg-OCN	58	4500	1.91 U	24.17 U	2.45	2 U	3.82 U	36.07 U
Dibenzofuran	mg/kg-OCN	15	58	1.91 U	***25*** U	1.09 E	2 U	3.82 U	**180.33**
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2	1.91 U	***24.17*** U	2.18 U	2 U	3.82 U	***36.07*** U
N-Nitrosodiphenylamine	mg/kg-OCN	11	11	1.09 U	***11.67*** U	1.09 U	1 U	1.91 U	***18.03*** U
Phenol	µg/kg	420	1200	21 U	***580*** U	48 U	60 U	51 U	***440*** U
2-Methylphenol	µg/kg	63	63	10 U	***140*** U	12 U	15 U	10 U	***110*** U
4-Methylphenol	µg/kg	670	670	21 U	290 U	24 U	30 U	26 U	220 U
2,4-Dimethylphenol	µg/kg	29	29	10 U	***140*** U	12 U	15 U	10 U	***110*** U
Pentachlorophenol	µg/kg	360	690	62 U	***1400*** U	119 U	150 U	130 U	***1100*** U
Benzyl alcohol	µg/kg	57	73	12 U	***230*** U	19 U	24 U	10 U	***180*** U
Benzoic acid	µg/kg	650	650	100 U	***1400*** U	119 U	150 U	130 U	***1100*** U
PCBs									
PCBs (total)	mg/kg-OCN	12	65	3.82 U	**21.67**	**20.91**	8 U	***17.65*** U	**426.23**

Notes:

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quai

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Subsurface Samples
Data Evaluation Summary Compared to LAET and 2LAET

Parameter	Units	LAET	2LAET	Sample Locations within Yard 2															
Location				D5	SB1	D4	D2	D3	D3	D3	SA8	SA8	SA9	SA9	SA5	SA6	SA6	SA7	SA3
Sample ID				D5-D	SB1-D	D4-D	D2-D	D3-B	D3-C	D3-D	SA8-A	SA8-C	SA9-C	SA9-D	SA5-D	SA6-C	SA6-D	SA7-B/C	SA3-C
Sample Date				9/13/1989	9/12/1989	9/8/1989	9/7/1989	9/5/1989	9/5/1989	9/5/1989	9/1/1989	9/1/1989	9/1/1989	9/1/1989	8/31/1989	8/31/1989	8/31/1989	8/31/1989	8/30/1989
Sample Depth				6-12 ft	7.5-13.5 ft	0-9.5 ft	4-10.5 ft	2-4.5 ft	10.5-12.5 ft	13-15 ft	0-2 ft	2-3.5 ft	9-10.5 ft	10.5-12 ft	4.5-7.5 ft	0-1.5 ft	1.5-3 ft	2-6 ft	5-7.5 ft
Conventionals																			
Total Organic Carbon	%	NA	NA	0.36	0.37	0.41	0.4	0.28	0.08	0.23	0.34	0.16	0.34	0.25	0.25	0.35	0.26	0.38	0.48
Metals																			
Arsenic	mg/kg	57	93	48	**82**	47	50	50	23	26	49	44	23	20	38	43	28	**58**	3.9
Cadmium	mg/kg	5.1	6.7	0.27 E	0.98 E	0.089 E	0.11 E	0.11 E	0.067 E	0.053 E	0.39 E	0.11 E	0.17 E	0.11 E	0.091 E	0.13 E	0.079 E	0.008 E	0.14 E
Chromium	mg/kg	260	270	2.2 E	110 E	14 E	32 E	62	34 E	36 E	62 E	53 E	38 E	44 E	34 E	22 E	20 E	19 E	22 E
Copper	mg/kg	390	390	170 E	**700** E	43 E	45 E	68 E	26 E	22 E	250 E	110 E	71 E	62 E	40 E	160 E	50 E	61 E	38 E
Lead	mg/kg	450	530	140 E	**680** E	14 E	5.9 E	28 E	11 E	6.7 E	140 E	32 E	61 E	15 E	13 E	46 E	6 E	13 E	38 E
Mercury	mg/kg	0.41	0.59	0.0008	0.005	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0033	0.0017	0.001	0.0005 U	0.0005 U	0.0005 U	0.0005	0.0005 U	0.0005 U
Silver	mg/kg	6.1	6.1	0.1 U	0.67 E	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.16 E	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Zinc	mg/kg	410	960	380 E	**1600** E	56 E	55 E	140 E	56 E	57 E	250 E	110 E	98 E	72 E	110 E	160 E	71 E	85 E	65 E
SVOCs																			
Naphthalene	µg/kg	2100	2400	611.11	1400	26	24 U	43	24 U	NR	270 U	33	24	47	62	25 U	22 U	21 E	3.54 E
Acenaphthylene	µg/kg	1300	1300	69.44 U	180 E	25 U	24 U	24 U	24 U	NR	290	36	24 E	61	25 U	25 E	22 U	24 U	5.21 U
Acenaphthene	µg/kg	500	730	388.89	**1300**	16 E	24 U	23 E	24 U	NR	300	34	17 E	45	23 E	15 E	22 U	8 E	2.5 E
Fluorene	µg/kg	540	1000	305.56	**1500**	22 E	24 U	24	24 U	NR	**720**	52	32	110	21 E	28	22 U	8 E	5.21 U
Phenanthrene	µg/kg	1500	5400	1055.56	**7200**	110	24 U	120	19 E	NR	**4000**	480	320	1000	75	200	22 U	64	11.04
Anthracene	µg/kg	960	4400	305.56	**2200**	57	24 U	34	24 U	NR	**1100**	86	63	89	24 E	61	22 U	20 E	3.33 E
2-Methylnaphthalene	µg/kg	670	1400	175	220 E	15 E	24 U	14 E	24 U	NR	270 U	10 E	7 E	20 E	15 E	8 E	22 U	10 E	5.21 U
Total LPAH	µg/kg	5200	13000	2666.67	**13780** E	231 E	24 U	244 E	19 E	NR	**6410**	721	480 E	1352	205 E	329 E	22 U	121 E	20.42 E
Fluoranthene	µg/kg	1700	2500	1222.22	**9500**	240	24 U	160	24 U	NR	**5100**	590	500	850	120	380	46	96	18.75
Pyrene	µg/kg	2600	3300	861.11	**8100**	220	12 E	240	24 U	NR	**8400**	1400	750	930	140 E	410 E	48 E	150	20.62 E
Benzo(a)anthracene	µg/kg	1300	1600	305.56	**3400**	60	40	58	24 U	NR	**2500**	330	220	270	37	150	22 U	54	6.25
Chrysene	µg/kg	1400	2800	333.33	**3200**	85	24 U	71	24 U	NR	**2200**	310	200	300	40	170	20 E	41	7.5
Benzofluoranthenes (total)	µg/kg	3200	3600	500	**4600**	170	24 U	120	24 U	NR	**4400**	650	300	410	53	250	22 U	80	10.62
Benzo(a)pyrene	µg/kg	1600	3000	272.22	**2400**	140	24 U	40	24 U	NR	**2200**	320	160	230	45	140	22 U	40	4.38 E
Indeno(1,2,3-cd)pyrene	µg/kg	600	690	122.22	**1300**	60	24 U	31	24 U	NR	**1400**	210	99	140	25 U	77	22 U	21 E	1.67 E
Dibenzo(a,h)anthracene	µg/kg	230	540	72.22	**530**	40	24 U	17 E	24 U	NR	**860**	93	43	55	25 U	32	22 U	15 E	0.62 E
Benzo(g,h,i)perylene	µg/kg	670	720	113.89	**1400**	67	24 U	33	24 U	NR	**1600**	230	120	160	25 U	89	22 U	22 E	1.67 E
Total HPAH	µg/kg	12000	17000	3802.78	**34430**	1082	52 E	770 E	24 U	NR	**28660**	4133	2392	3345	435 E	1698 E	114 E	519 E	72.08 E
1,2-Dichlorobenzene	µg/kg	35	50	***36.11*** U	***110*** U	13 U	12 U	12 U	12 U	NR	***140*** U	13 U	12 U	12 U	12 U	13 U	11 U	12 U	2.5 U
1,4-Dichlorobenzene	µg/kg	110	120	69.44 U	***230*** U	25 U	24 U	24 U	24 U	NR	***270*** U	26 U	24 U	24 U	25 U	25 U	22 U	24 U	5.21 U
1,2,4-Trichlorobenzene	µg/kg	31	51	***33.33*** U	***110*** U	1 U	12 U	12 U	12 U	NR	***140*** U	13 U	12 U	12 U	12 U	13 U	11 U	12 U	1.46 U
Hexachlorobenzene	µg/kg	22	70	***69.44*** U	***230*** U	***25*** U	***24*** U	***24*** U	***24*** U	NR	***270*** U	***26*** U	***24*** U	***24*** U	***25*** U	***25*** U	22 U	***24*** U	5.21 U
Dimethyl phthalate	µg/kg	71	160	69.44 U	***230*** U	25 U	24 U	24 U	24 U	NR	***270*** U	26 U	24 U	24 U	25 U	25 U	22 U	24 U	5.21 U
Diethylphthalate	µg/kg	200	200	69.44 U	***230*** U	25 U	24 U	24 U	24 U	NR	***270*** U	26 U	24 U	24 U	25 U	25 U	22 U	24 U	5.21 U
Di-n-butyl phthalate	µg/kg	1400	1400	69.44 U	230 U	25 U	24 U	24 U	24 U	NR	270 U	26 U	24 U	17	25 U	25 U	22 U	24 U	5.21 U
Butyl benzyl phthalate	µg/kg	63	900	***69.44*** U	***230*** U	25 U	24 U	24 U	24 U	NR	***270*** U	26 U	24 U	24 U	25 U	25 U	22 U	24 U	5.21 U
bis(2-ethylhexyl)phthalate	µg/kg	1300	1900	169.44	**3000**	25 U	24 U	150	69	NR	**1400**	150	77	200	43	75	22 U	31	10.83
Di-n-octyl phthalate	µg/kg	6200	6200	69.44 U	230 U	140	60	79	160	NR	270 U	36	26 E	30 E	52	47	22 U	24 U	5.21 U
Dibenzofuran	µg/kg	540	700	236.11	**1000**	15 E	24 U	19 E	24 U	NR	300	31	18 E	80	16 E	13 E	22 U	8 E	1.25 E
Hexachlorobutadiene	µg/kg	11	120	***69.44*** U	***230*** U	***18*** U	***24*** U	***24*** U	***24*** U	NR	***270*** U	***26*** U	***24*** U	***24*** U	***25*** U	***25*** U	***22*** U	***24*** U	5.21 U
N-Nitrosodiphenylamine	µg/kg	28	40	***36.11*** U	***110*** U	13 U	12 U	12 U	12 U	NR	***140*** U	13 U	12 U	12 U	12 U	13 U	11 U	12 U	4.58 U
Phenol	µg/kg	420	1200	***500*** U	***460*** U	50 U	49 U	47 U	48 U	NR	***550*** U	52 U	49 U	47 U	50 U	51 U	44 U	73 E	49 U
2-Methylphenol	µg/kg	63	72	***130*** U	***110*** U	10 U	12 U	12 U	12 U	NR	***140*** U	13 U	12 U	12 U	12 U	13 U	11 U	12 U	9 U
4-Methylphenol	µg/kg	670	1,800	250 U	230 U	25 U	24 U	24 U	24 U	NR	140 U	26 U	24 U	7 E	25 U	25 U	22 U	24 U	25 U
2,4-Dimethylphenol	µg/kg	29	72	***130*** U	***110*** U	10 U	12 U	12 U	12 U	NR	***140*** U	13 U	12 U	12 U	12 U	13 U	11 U	12 U	7 U
Pentachlorophenol	µg/kg	360	690	***1300*** U	***1100*** U	130 U	120 U	120 U	120 U	NR	***1400*** U	130 U	120 U	120 U	120 U	130 U	110 U	120 U	120 U
Benzyl alcohol	µg/kg	57	73	***200*** U	***180*** U	15 U	20 U	19 U	19 U	NR	***220*** U	21 U	20 U	19 U	20 U	20 U	17 U	19 U	15 U
Benzoic acid	µg/kg	650	650	***1300*** U	***1100*** U	8 E	120 U	120 U	120 U	NR	***1400*** U	130 U	120 U	120 U	120 U	130 U	110 U	120 U	120 U
PCBs																			
PCBs (total)	µg/kg	130	1000	127.78	**2160**	93	60 U	**160**	120 U	120 U	**1090**	**235**	**210**	54	120 U	***135*** U	120 U	125	25 U

Notes:

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the LAET.

Boxed concentrations indicate an exceedance of the 2LAET.

Italicized concentrations indicate a detection limit exceedance of either LAET or 2LAET.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Subsurface Samples
Data Evaluation Summary Compared to LAET and 2LAET

				North of Yard 2		West Waterway		
			Location	C7	C7	PC1	PC1	M1
			Sample ID	C7 (0 - 2)	C7 (5-8)	PC-1B	PC-1C	M1-D
			Sample Date	12/1/1991	12/1/1991	9/1/1992	9/1/1992	9/12/1989
			Sample Depth	0-2 ft	5-8 ft	4-8 ft	8-12 ft	7.5-12 ft
Parameter	**Units**	**LAET**	**2LAET**					
Conventionals								
Total Organic Carbon	%	NA	NA	0.1931	0.4234	0.43	0.35	0.19
Metals								
Arsenic	mg/kg	57	93	1.36	1.64	6.3	5.8	**64**
Cadmium	mg/kg	5.1	6.7	0.02 U	0.02 U	NR	NR	0.11 E
Chromium	mg/kg	260	270	10	11.1	0.11	0.1 U	2.1 E
Copper	mg/kg	390	390	10.1 J	8.1 J	24	22	100 E
Lead	mg/kg	450	530	3 U	2 U	26	26	71 E
Mercury	mg/kg	0.41	0.59	0.06 U	0.05 U	0.034	0.034	0.0007
Silver	mg/kg	6.1	6.1	0.02 U	0.02 U	0.2 U	0.2 U	0.1 U
Zinc	mg/kg	410	960	20.3	20	81	79	110 E
SVOCs								
Naphthalene	µg/kg	2100	2400	5.793 U	4.234 U	125.58	5.43 U	24
Acenaphthylene	µg/kg	1300	1300	5.793 U	4.234 U	4.65 U	5.43 U	13 E
Acenaphthene	µg/kg	500	730	5.793 U	4.234 U	10	5.43 U	130
Fluorene	µg/kg	540	1000	5.793 U	4.234 U	8.14	5.43 U	90
Phenanthrene	µg/kg	1500	5400	5.793 J	4.234 J	20.47	5.43 U	540
Anthracene	µg/kg	960	4400	1.931 J	4.234 U	6.05	5.43 U	140
2-Methylnaphthalene	µg/kg	670	1400	5.793 U	4.234 U	9.07	5.43 U	9 E
Total LPAH	µg/kg	5200	13000	7.724 J	4.234 J	170.23	5.43 U	937 E
Fluoranthene	µg/kg	1700	2500	11.586	4.234 J	13.49	10.86	750
Pyrene	µg/kg	2600	3300	11.586	16.936	16.05	12.57	810
Benzo(a)anthracene	µg/kg	1300	1600	5.793 J	4.234 U	4.65 U	5.43 U	310
Chrysene	µg/kg	1400	2800	9.655	4.234 U	4.65 U	5.43 U	350
Benzofluoranthenes (total)	µg/kg	3200	3600	13.517	4.234 J	4.65 U	5.43 U	430
Benzo(a)pyrene	µg/kg	1600	3000	5.793	4.234 U	4.65 U	5.43 U	230
Indeno(1,2,3-cd)pyrene	µg/kg	600	690	1.931 J	4.234 U	4.65 U	5.43 U	140
Dibenzo(a,h)anthracene	µg/kg	230	540	5.793 U	4.234 U	4.65 U	5.43 U	52
Benzo(g,h,i)perylene	µg/kg	670	720	1.931 J	4.234 U	4.65 U	5.43 U	160
Total HPAH	µg/kg	12000	17000	61.792 J	25.404 J	29.53	23.43	3232
1,2-Dichlorobenzene	µg/kg	35	50	5.793 U	4.234 U	0.7 U	0.86 U	12 U
1,4-Dichlorobenzene	µg/kg	110	120	5.793 U	4.234 U	0.7 U	0.86 U	24 U
1,2,4-Trichlorobenzene	µg/kg	31	51	5.793 U	4.234 U	1.37 U	1.66 U	12 U
Hexachlorobenzene	µg/kg	22	70	5.793 U	4.234 U	2.79 U	3.43 U	***24*** U
Dimethyl phthalate	µg/kg	71	160	5.793 U	4.234 U	4.65 U	5.43 U	24 U
Diethylphthalate	µg/kg	200	200	5.793 U	4.234 U	4.65 U	5.43 U	24 U
Di-n-butyl phthalate	µg/kg	1400	1400	5.793 U	4.234 U	4.65 U	5.43 U	20 E
Butyl benzyl phthalate	µg/kg	63	900	3.862 M	4.234 U	4.65 U	5.43 U	24 U
bis(2-ethylhexyl)phthalate	µg/kg	1300	1900	5.793 J	4.234 J	4.65 U	5.43 U	210
Di-n-octyl phthalate	µg/kg	6200	6200	5.793 U	4.234 U	4.65 U	5.43 U	130
Dibenzofuran	µg/kg	540	700	5.793 U	4.234 U	5.81	5.43 U	54
Hexachlorobutadiene	µg/kg	11	120	***11.586*** U	***12.702*** U	4.65 U	5.43 U	***24*** U
N-Nitrosodiphenylamine	µg/kg	28	40	5.793 U	4.234 U	2.79 U	3.43 U	12 U
Phenol	µg/kg	420	1200	0 M	10 U	20 U	19 U	47 U
2-Methylphenol	µg/kg	63	72	10 U	10 U	9.9 U	9.6 U	12 U
4-Methylphenol	µg/kg	670	1,800	10 U	10 U	20 U	19 U	24 U
2,4-Dimethylphenol	µg/kg	29	72	10 U	10 U	9.9 U	9.6 U	12 U
Pentachlorophenol	µg/kg	360	690	20 U	20 U	59 U	58 U	120 U
Benzyl alcohol	µg/kg	57	73	10 U	10 U	12 U	12 U	19 U
Benzoic acid	µg/kg	650	650	20 J	30	99 U	96 U	120 U
PCBs								
PCBs (total)	µg/kg	130	1000	79.171 U	80.446 U	9.3 U	11.14 U	***200*** U

Notes:

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the LAET.

Boxed concentrations indicate an exceedance of the 2LAET.

Italicized concentrations indicate a detection limit exceedance of either LAET or 2LAET.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Surface Samples
Data Evaluation Summary Compared to SQS and CSL

Parameter	Units	SQS	CSL	Sample Locations within Yard 2													
Location				HC-03-16	HC-03-17	HC-03-18	HC-03-19	HC-03-01	HC-03-02	HC-03-03	HC-03-04	HC-03-05	HC-03-06	HC-03-07	HC-03-08	HC-03-09	HC-03-10
Sample ID				HC-03-16	HC-03-17	HC-03-18	HC-03-19	HC-03-01	HC-03-02	HC-03-03	HC-03-04	HC-03-05	HC-03-06	HC-03-07	HC-03-08	HC-03-09	HC-03-10
Sample Date				11/11/2003	11/11/2003	11/11/2003	11/11/2003	9/27/2003	9/27/2003	9/27/2003	9/27/2003	9/27/2003	9/27/2003	9/27/2003	9/27/2003	9/27/2003	9/27/2003
Sample Depth				0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm
Conventionals																	
Total Organic Carbon	%	NA	NA	1.46	1.3	1.23	1.07	0.73	2.05	2.26	1.88	0.85	1.06	2.27	1.92	0.64	1.66
Metals																	
Arsenic	mg/kg	57	93	10.2	16.5	50.3	10.7	34.8	8.7	32	20.5	18.9	25.7	32.6	20.7	10.4	25.2
Cadmium	mg/kg	5.1	6.7	0.24	0.29	0.42	0.13	0.44	0.35	1.05	0.62	0.24	0.31	0.44	0.61	0.35	0.42
Chromium	mg/kg	260	270	30.2	31.4	89.9	20	166	23.7	196	59.4	35.8	67.6	51.3	46.5	**309**	39.8
Copper	mg/kg	390	390	61.8	169	**463**	71.2	**825**	46.7	204	151	159	111	374	164	123	177
Lead	mg/kg	450	530	45.2	49.1	226	47.3	93	52.6	144	85.8	55.2	76.8	157	118	57.8	109
Mercury	mg/kg	0.41	0.59	0.26	0.35	**0.83**	**0.48**	0.08	0.25	0.29	0.21	0.08	0.11	**0.7**	**0.57**	0.32	**0.63**
Silver	mg/kg	6.1	6.1	0.25	0.32	0.47	0.21	0.4	0.23	0.4	0.2	0.17	1.31	0.41	0.38	0.12	0.37
Zinc	mg/kg	410	960	78.8	120	**445**	84	356	73.7	**505**	238	202	140	306	175	202	173
SVOCs																	
Naphthalene	mg/kg-OCN	99	170	3.84	1.38	8.05	1.4	12.88	15.61	11.95	2.77	3.06	3.11	2.95	3.12	1.36 J	3.07 J
Acenaphthylene	mg/kg-OCN	66	66	1.58	2.69	10.57	1.5	6.16 J	3.46	7.52	2.82	3.65	2.26	5.29	6.77	3.12	5.3
Acenaphthene	mg/kg-OCN	16	57	3.15	1.69	**16.26**	1.4	9.04	8.29	10.62	2.5	3.06	2.45	4.32	4.79	2.97 J	4.58
Fluorene	mg/kg-OCN	23	79	3.22	2.62	**29.27**	1.87	16.44	9.76	13.72	4.52	4.71	3.4	6.17	6.77	3.59	6.63
Phenanthrene	mg/kg-OCN	100	480	13.01	28.46	**138.21**	11.21	75.34	35.61	44.25	19.15	31.76	17.92	39.21	38.02	25	42.17
Anthracene	mg/kg-OCN	220	1200	5.82	9.23	138.21	4.67	39.73	16.59	26.99	11.7	11.76	8.96	14.54	18.23	8.28	15.66
2-Methylnaphthalene	mg/kg-OCN	38	64	1.16	0.57 J	5.12	0.6 J	3.84 J	5.37	3.89	1.01 J	1.18 J	1.13 J	1.54 J	1.61 J	0.72 J	1.57 J
Total LPAH	mg/kg-OCN	370	780	30.62	46.08	340.57	22.06	159.59 J	89.32	115.04	43.46	58	38.11	72.47	77.71	44.33 J	77.41 J
Fluoranthene	mg/kg-OCN	160	1200	17.81	76.92	**455.28**	19.63	**178.08**	42.44	61.95	37.23	74.12	43.4	70.48	67.71	65.62	72.29
Pyrene	mg/kg-OCN	1000	1400	17.81	55.38	390.24	17.76	126.03	46.83	79.65	35.11	61.18	44.34	88.11	72.92	54.69	84.34
Benzo(a)anthracene	mg/kg-OCN	110	270	8.22	20	**211.38**	12.15	91.78	20.49	42.04	20.74	22.35	16.98	37.89	40.62	21.88	41.57
Chrysene	mg/kg-OCN	110	460	12.33	44.62	**276.42**	15.89	**150.68**	36.59	79.65	43.09	45.88	29.25	57.27	67.71	48.44	66.27
Benzofluoranthenes (total)	mg/kg-OCN	230	450	21.92	52.31	**373.98**	28.04	172.6	59.51	119.47	52.66	50.59	36.79	90.75	107.81	53.12	99.4
Benzo(a)pyrene	mg/kg-OCN	99	210	10.27	20.77	**186.99**	14.95	68.49	26.83	53.1	20.74	20	15.09	44.05	48.44	20.31	49.4
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88	6.85	13.08	**97.56**	10.28	**35.62**	15.12	28.76	12.77	12.94	9.43	27.75	29.17	12.19	30.12
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33	1.85	3.38	**24.39**	2.52	10	4.44	7.96	3.62	3.29	2.36	7.05	7.81	3.91	7.83
Benzo(g,h,i)perylene	mg/kg-OCN	31	78	6.16	11.54	**81.3**	9.07	**31.51**	13.66	23.89	11.17	11.06	7.36	23.79	26.56	6.72	27.11
Total HPAH	mg/kg-OCN	960	5300	103.22	298	**2097.56**	130.28	864.79	265.9	496.46	237.13	301.41	205	447.14	468.75	286.88	478.31
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3	0.53 U	0.62 U	0.98 U	0.67 U	1.22 U	0.98 U	0.58 U	1.06 U	0.42 U	1.89 U	0.62 U	0.99 U	0.55 U	0.78 U
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9	0.53 U	0.62 U	1.38 U	0.67 U	1.78 U	0.98 U	2.39 U	1.06 U	2.35 U	1.89 U	2.64 U	2.97 U	0.8 U	1.14 U
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8	0.53 U	0.62 U	***1.06*** U	0.67 U	***1.22*** U	0.24 U	0.66 U	0.26 U	0.48 U	0.42 U	0.7 U	0.78 U	0.62 U	***0.9*** U
Hexachlorobenzene	mg/kg-OCN	0.38	2.3	0.23 U	0.27 U	***1.46*** U	0.29 U	***2.05*** U	0.34 U	***0.88*** U	0.35 U	***0.68*** U	***0.58*** U	***0.97*** U	***1.09*** U	***0.88*** U	***1.27*** U
Dimethyl phthalate	mg/kg-OCN	53	53	0.53 U	0.62 U	3.5 U	0.67 U	6.85 U	0.98 U	2.39 U	1.06 U	2.35 U	1.89 U	2.64 U	2.97 U	3.12 U	3.43 U
Diethylphthalate	mg/kg-OCN	61	110	0.53 U	0.62 U	3.5 U	0.67 U	6.85 U	0.98 U	2.39 U	1.06 U	2.35 U	1.89 U	2.64 U	2.97 U	3.12 U	3.43 U
Di-n-butyl phthalate	mg/kg-OCN	220	1700	0.66 U	3.69	6.99 U	1.4 U	6.85 U	0.43 J	2.39 U	0.49 J	1.18 J	0.94 J	2.64 U	1.56 J	1.72 J	2.53 J
Butyl benzyl phthalate	mg/kg-OCN	4.9	64	0.55	0.85	3.33 J	2.34	1.51 U	0.98 U	0.84 J	0.96 J	0.91 J	1.89 U	1.98 J	1.51 J	1.88 J	1.63 J
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78	4.32 J	10.77 J	**72.36** J	14.02 J	43.84 J	4.88 J	10.62 J	5.21 J	6.59 J	8.3 J	18.06 J	15.1 J	12.34 J	24.7 J
Di-n-octyl phthalate	mg/kg-OCN	58	4500	0.53 U	0.62 U	3.5 U	0.67 U	6.85 U	0.98 U	2.39 U	1.06 U	2.35 U	1.89 U	2.64 U	2.97 U	3.12 U	3.43 U
Dibenzofuran	mg/kg-OCN	15	58	2.33	1.38	12.2	1.03	8.49	7.32	8.41	2.07	2.71	1.98	2.51 J	2.81 J	1.72 J	2.65 J
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2	0.53 U	0.62 U	3.5 U	0.67 U	1.32 U	0.98 U	2.39 U	1.06 U	2.35 U	1.89 U	2.64 U	2.97 U	3.12 U	3.43 U
N-Nitrosodiphenylamine	mg/kg-OCN	11	11	0.53 U	0.62 U	3.5 U	0.67 U	6.85 U	0.98 U	2.39 U	1.06 U	2.35 U	1.89 U	2.64 U	2.97 U	3.12 U	3.43 U
Phenol	µg/kg	420	1200	51	47	18 J	33	150 U	85	170 U	60 U	100	49 J	180 U	180	60 U	140 J
2-Methylphenol	µg/kg	63	63	7.7 U	8.1 U	43 U	7.2 U	50 U	20 U	54 U	20 U	20 U	20 U	60 U	57 U	20 U	57 U
4-Methylphenol	µg/kg	670	670	23	21	27 J	8.4	50 U	62	54 U	20 U	49	36	60 U	32 J	20 U	85
2,4-Dimethylphenol	µg/kg	29	29	8.5 U	9.1 U	***47*** U	8 U	***38*** U	19 U	***53*** U	18 U	15 U	17 U	***58*** U	***55*** U	15 U	***55*** U
Pentachlorophenol	µg/kg	360	690	77 U	81 U	**380** J	65 J	250 U	100 U	270 U	100 U	100 U	100 U	250 J	210 J	70 J	240 J
Benzyl alcohol	µg/kg	57	73	7.7 U	8.1 U	43 U	7.2 U	50 U	20 U	54 U	20 U	20 U	20 U	39 U	37 U	20 U	37 U
Benzoic acid	µg/kg	650	650	160 U	170 U	***820*** U	150 U	***660*** U	400 U	***920*** U	400 U	400 U	400 U	***1000*** U	***960*** U	400 U	**960** U
PCBs																	
PCBs (total)	mg/kg-OCN	12	65	**20.55**	**21.54**	**243.9**	**33.64**	**24.52**	6.63	**14.16**	9.79	8	**67.92**	**37.89**	**27.08**	**32.03**	**26.51**
Organometallics																	
TBT*	mg/kg-OCN	76	76	1.4	14.6	**122**	3.9	16.4	2.3	3.7	5.3	4.0	2.5	**79.3**	35.4	3.6	**84.3**

Notes:

* TBT concentrations are compared to the West Waterway Confirmational Number.

* The TBT concentration for sample EBB01C is reported in ug/kg-dry weight rather than mg/kg-OCN

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Surface Samples
Data Evaluation Summary Compared to SQS and CSL

Parameter	Units	SQS	CSL	Location	HC-03-11	HC-03-12	HC-03-07	HC-03-03	30-1-197	30-1-197	30-3-199	EB117	EB118	EB119	EB115	EB116	EB088	N-11
				Sample ID	HC-03-11	HC-03-12	HC-03-14	HC-03-15	197-1	197-2	199-1	SD3-EB117-	SD3-EB118-	SD3-EB119-	SD3-EB115-	SD3-EB116-	SD2-EB88-0000	N-11-10-9
				Sample Date	9/27/2003	9/27/2003	9/27/2003	9/27/2003	6/24/1998	6/24/1998	6/24/1998	7/29/1997	7/29/1997	7/29/1997	7/29/1997	7/29/1997	1996	10/9/1991
				Sample Depth	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-2 cm	0-2 cm	0-2 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-2 cm
					Sample Locations within Yard 2													
Conventionals																		
Total Organic Carbon	%	NA	NA		1.01	1.68	2.32	2.62	0.68	0.7	1.7	2	0.85	0.76	2.1	2.8	1.4	0.743
Metals																		
Arsenic	mg/kg	57	93		9.8	53.6	34.4	29.5	**102**	**713**	10.8	NR	NR	NR	NR	NR	NR	29.9
Cadmium	mg/kg	5.1	6.7		0.29	0.55	0.52	0.86	0.3	1.6	0.26	NR	NR	NR	NR	NR	NR	**6.5**
Chromium	mg/kg	260	270		33.7	35.8	61.2	155	49	203	30.7	NR	NR	NR	NR	NR	NR	NR
Copper	mg/kg	390	390		50.6	380	**455**	151	155	349	71.8	NR	NR	NR	NR	NR	NR	331
Lead	mg/kg	450	530		35.7	146	162	120	128	**453**	45.9	NR	NR	NR	NR	NR	NR	99.3
Mercury	mg/kg	0.41	0.59		0.1	**0.43**	**0.96**	0.27	0.1	0.11	0.28	NR	NR	NR	NR	NR	NR	**0.77**
Silver	mg/kg	6.1	6.1		0.18	0.43	0.42	0.45	0.31	1 U	0.33	NR	NR	NR	NR	NR	NR	NR
Zinc	mg/kg	410	960		73.7	403	372	270	322	**1760**	92.2	NR	NR	NR	NR	NR	NR	270
SVOCs																		
Naphthalene	mg/kg-OCN	99	170		3.07	6.55	2.03 J	20.61	20.15	18.86	67.06	10.50	4.45	15.92	**126.19**	**166.07**	**168.57**	9.15 E
Acenaphthylene	mg/kg-OCN	66	66		3.47	10.12	3.92	8.4	5.44	5.14	6.59	3.06	1.48	4.41	12.38	7.93	12.07	5.11 E
Acenaphthene	mg/kg-OCN	16	57		2.57	10.12	3.62	11.45	**17.21**	11.57	**21.12**	5.55	3.58	13.00	**63.81**	**45.00**	**65.36**	**20.19** E
Fluorene	mg/kg-OCN	23	79		3.76	13.1	4.74	15.27	22.06	13.86	19.71	7.40	6.05	12.38	**191.90**	**49.29**	**53.64**	**26.92** E
Phenanthrene	mg/kg-OCN	100	480		16.83	77.38	37.07	53.44	96.03	62.86	61.18	34.00	28.94	66.71	**647.62**	**252.86**	**147.14**	**201.88** E
Anthracene	mg/kg-OCN	220	1200		9.9	31.55	12.07	27.86	32.06	22.86	26.18	14.40	7.68	21.32	**576.19**	58.21	60.64	59.22 E
2-Methylnaphthalene	mg/kg-OCN	38	64		1.19 J	3.21 J	1.03 J	6.11	9.56	7	15	3.32	7.35	5.39	28.10	27.75	**42.21**	6.33 E
Total LPAH	mg/kg-OCN	370	780		39.6	148.81	63.45 J	137.02	192.94	135.14	201.82	74.91	52.18	133.74	**1618.10**	**579.36**	**507.43**	322.48 E
Fluoranthene	mg/kg-OCN	160	1200		33.66	**172.62**	68.97	68.7	110.88	84.57	52	**252.50**	47.41	100.79	**952.38**	**275.36**	151.43	**417.23** E
Pyrene	mg/kg-OCN	1000	1400		31.68	190.48	68.97	83.97	113.53	87.71	62.94	174.50	43.88	123.16	823.81	410.71	171.43	349.93 E
Benzo(a)anthracene	mg/kg-OCN	110	270		19.8	71.43	35.34	41.98	50	42	31.12	41.75	16.00	43.42	**315.71**	103.57	42.71	**228.8** E
Chrysene	mg/kg-OCN	110	460		37.62	**119.05**	56.03	68.7	80.88	64	46.24	96.00	30.82	63.29	**428.57**	**163.57**	60.93	**255.72** E
Benzofluoranthenes (total)	mg/kg-OCN	230	450		50.5	184.52	85.78	122.14	104.26	84.14	87.65	75.00	41.27	123.68	**472.38**	**281.14**	100.79	**417.23** E
Benzo(a)pyrene	mg/kg-OCN	99	210		21.78	89.29	40.09	53.44	45.74	37.57	40.76	32.50	18.47	70.53	**260.95**	**151.79**	43.79	**161.51** E
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88		13.86	**52.38**	25.86	27.1	24.85	20.71	21.41	14.30	10.68	**36.84**	**64.76**	**38.21**	19.86	**59.22** E
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33		3.56	**14.29**	6.9	9.16	6.47	5.43	5.35	4.68	5.04	**12.01**	**15.48**	9.86	5.57	***115.75*** UE
Benzo(g,h,i)perylene	mg/kg-OCN	31	78		11.88	**48.81**	24.57	24.43	21.18	17.57	18.59	14.05	10.38	**38.55**	**64.76**	**36.43**	18.79	**51.14** E
Total HPAH	mg/kg-OCN	960	5300		224.36	942.86	412.5	499.62	557.79	443.71	366.06	705.28	223.95	612.28	**3398.81**	**1470.64**	615.29	**1940.78** E
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3		1.98 U	0.77 U	0.6 U	2.06 U	0.81 U	0.73 U	0.38 U	NR	NR	NR	NR	NR	NR	***115.75*** UE
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9		1.98 U	1.07 U	2.59 U	2.06 U	0.08 J	0.09 J	0.1 J	NR	NR	NR	NR	NR	NR	***115.75*** UE
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8		0.46 U	***0.89*** U	0.69 U	0.57 U	***0.81*** U	0.73 U	0.38 U	NR	NR	NR	NR	NR	NR	***115.75*** UE
Hexachlorobenzene	mg/kg-OCN	0.38	2.3		***0.64*** U	***1.19*** U	***0.95*** U	***0.76*** U	0.02 J	0.08 U	0.01 NJ	NR	NR	NR	NR	NR	NR	***115.75*** UE
Dimethyl phthalate	mg/kg-OCN	53	53		1.98 U	3.21 U	2.59 U	2.06 U	0.81 U	0.73 U	0.19 J	NR	NR	NR	NR	NR	NR	***115.75*** UE
Diethylphthalate	mg/kg-OCN	61	110		1.98 U	3.21 U	2.59 U	2.06 U	0.81 UJ	0.73 UJ	0.38 UJ	NR	NR	NR	NR	NR	NR	***115.75*** UE
Di-n-butyl phthalate	mg/kg-OCN	220	1700		0.81 J	1.85 J	2.59 U	2.06 U	15.44	11	4.59 UJ	NR	NR	NR	NR	NR	NR	115.75 UE
Butyl benzyl phthalate	mg/kg-OCN	4.9	64		2.08	3.99	1.47 J	2.06 U	3.38 UJ	1.4 UJ	0.38 U	NR	NR	NR	NR	NR	NR	**7.81** E
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78		8.22 J	30.95 J	13.36 J	7.25 J	26.62 UJ	8 UJ	13.47 UJ	NR	NR	NR	NR	NR	NR	***95.56*** UE
Di-n-octyl phthalate	mg/kg-OCN	58	4500		1.98 U	1.73 J	2.59 U	2.06 U	0.81 U	0.73 U	0.38 U	NR	NR	NR	NR	NR	NR	***115.75*** UE
Dibenzofuran	mg/kg-OCN	15	58		2.08	6.55	1.9 J	11.45	**17.35**	12.71	**22.18**	7.70	8.27	9.55	**66.19**	**46.07**	NR	13.46 E
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2		1.98 U	3.21 U	2.59 U	2.06 U	0.81 U	0.73 U	0.38 U	NR	NR	NR	NR	NR	NR	***115.75*** UE
N-Nitrosodiphenylamine	mg/kg-OCN	11	11		1.98 U	3.21 U	2.59 U	2.06 U	0.81 U	0.73 U	0.38 U	NR	NR	NR	NR	NR	NR	***115.75*** UE
Phenol	µg/kg	420	1200		30 J	160 U	180 U	97 J	53	23 UJ	75	NR	NR	NR	NR	NR	NR	410 E
2-Methylphenol	µg/kg	63	63		20 U	54 U	60 U	54 U	3.9 NJ	4.7 J	13	NR	NR	NR	NR	NR	NR	***860*** UE
4-Methylphenol	µg/kg	670	670		20 U	33 J	60 U	390	**1280**	**1200**	**1110**	NR	NR	NR	NR	NR	NR	***860*** UE
2,4-Dimethylphenol	µg/kg	29	29		17 U	***52*** U	***58*** U	***53*** U	5.5 U	5.1 U	11	NR	NR	NR	NR	NR	NR	***860*** UE
Pentachlorophenol	µg/kg	360	690		97 U	280	200 J	81 U	116 J	104 NJ	150 J	NR	NR	NR	NR	NR	NR	***2200*** UE
Benzyl alcohol	µg/kg	57	73		20 U	54 U	39 U	54 U	16 UJ	11 UJ	13 UJ	NR	NR	NR	NR	NR	NR	NR
Benzoic acid	µg/kg	650	650		390 U	***910*** U	***1100*** U	***920*** U	**1220** J	**744** J	**1150** J	NR	NR	NR	NR	NR	NR	NR
PCBs																		
PCBs (total)	mg/kg-OCN	12	65		5.84	**29.17**	**26.72**	**14.12**	10.88	**22.71**	**12**	NR	NR	NR	NR	NR	NR	**58.01**
Organometallics																		
TBT*	mg/kg-OCN	76	76		5.0	**77.4**	51.7	1.6	NR	NR	NR	NR	NR	NR	NR	NR	NR	**228.8**

Notes:

* TBT concentrations are compared to the West Waterway Confirmational Number.

* The TBT concentration for sample EBB01C is reported in ug/kg-dry weight rather than mg/kg-OCN

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Surface Samples
Data Evaluation Summary Compared to SQS and CSL

Parameter	Units	SQS	CSL	Sample Locations within Yard 2													
			Location	N-12	N-20	N-21	D2-S	D4-S	G12	G2	G3	G4	G5	G6	G7	G8	G9
			Sample ID	N-12	N-20	N-21	D2-S	D4-S	G12	G2	G3	G4	G5	G6	G7	G8	G9
			Sample Date	10/9/1991	10/9/1991	10/9/1991	8/31/1989	8/31/1989	8/31/1989	8/31/1989	8/31/1989	8/31/1989	8/31/1989	8/31/1989	8/31/1989	8/31/1989	8/31/1989
			Sample Depth	0-2 cm	0-2 cm	0-2 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm
Conventionals																	
Total Organic Carbon	%	NA	NA	0.708	1.11	1.07	1.8	0.56	2.2	3.8	2.87	1.8	1.8	2.1	0.45	1.9	1.9
Metals																	
Arsenic	mg/kg	57	93	12.6	17.9	4.7	31	21	**160**	**58**	48	40	44	18	31	48	41
Cadmium	mg/kg	5.1	6.7	**5.8**	**5.9**	3.8	0.16 E	0.071 E	1.7 E	1.3 E	1.6 E	0.51 E	0.5 E	0.44 E	0.26 E	0.87 E	0.52 E
Chromium	mg/kg	260	270	106	NR	29.8	58 E	48 E	100 E	**260** E	92 E	31 E	19 E	74 E	120 E	96 E	55 E
Copper	mg/kg	390	390	152	137	55.3	97 E	87 E	**690** E	**670** E	210 E	160 E	120 E	150 E	**490** E	**610** E	340 E
Lead	mg/kg	450	530	45.1 E	42.3	9.3 E	69 E	24 E	370 E	260 E	190 E	150 E	130 E	210 E	75 E	250 E	77 E
Mercury	mg/kg	0.41	0.59	0.14 E	0.33	0.13 E	0.0018	0.0008	0.0024	0.0024	0.0026	0.0012	0.0012	0.0012	0.0005 U	0.0012	0.001
Silver	mg/kg	6.1	6.1	NR	NR	0.34 E	0.32 E	0.21 E	0.88 E	1.3 E	1.1 E	0.44 E	0.37 E	0.5 E	0.41 E	0.57 E	0.8 E
Zinc	mg/kg	410	960	197	139	64.8	120 E	99 E	**1500** E	**1100** E	**760** E	230 E	160 E	180 E	**410** E	**1200** E	190 E
SVOCs																	
Naphthalene	mg/kg-OCN	99	170	3.25 E	2.52 E	1.12 E	32.22	7.68	19.09 U	42.11	8.36 E	17.22 U	**100**	80.95	6	2.79	9.47 E
Acenaphthylene	mg/kg-OCN	66	66	1.69 E	0.99 E	0.56 E	4.72	3.75 E	7.73 E	12.89	5.92 E	13.33 E	17.22 E	10 E	10	5.26	9.47 E
Acenaphthene	mg/kg-OCN	16	57	3.95 E	3.15 E	1.21 E	13.33	5.71	15.91 E	**34.21**	8.71	7.22 E	**355.56**	**166.67**	10.44	6.32	**21.05**
Fluorene	mg/kg-OCN	23	79	6.36 E	4.5 E	1.68 E	13.89	7.5	**38.64**	**47.37**	11.15	14.44 E	**416.67**	**209.52**	16.89	9.47	**34.21**
Phenanthrene	mg/kg-OCN	100	480	31.07 E	35.14 E	10.28 E	44.44	55.36	**345.45**	**157.89**	52.26	94.44	**1388.89**	**666.67**	**142.22**	63.16	**194.74**
Anthracene	mg/kg-OCN	220	1200	24.01 E	11.71 E	5.42 E	18.33	15.54	150	168.42	48.78	100	**416.67**	**228.57**	48.89	18.42	110.53
2-Methylnaphthalene	mg/kg-OCN	38	64	1.27 E	1.17 E	0.47 E	5.56	2.68 E	19.09 U	7.89 E	8.36 U	17.22 U	**77.78**	**47.62**	2.89 E	2	4.84 E
Total LPAH	mg/kg-OCN	370	780	70.34 E	58.02 E	20.28 E	126.94	95.54 E	**557.73** E	**462.89**	135.19 E	229.44 E	**2695** E	**1362.38** E	234.44	105.42	**379.47** E
Fluoranthene	mg/kg-OCN	160	1200	77.68 E	78.38 E	24.3 E	51.67	85.71	**500**	**247.37**	73.17	**466.67**	150	**666.67**	**355.56**	136.84	**526.32**
Pyrene	mg/kg-OCN	1000	1400	62.15 E	58.56 E	16.82 E	77.78 E	92.86 E	545.45	342.11 E	306.62 E	405.56 E	**1388.89** E	761.9	444.44	105.26	489.47
Benzo(a)anthracene	mg/kg-OCN	110	270	48.02 E	28.83 E	12.15 E	21.11	39.29	**245.45**	**215.79**	52.26	**183.33**	**511.11**	**271.43**	**244.44**	68.42	**184.21**
Chrysene	mg/kg-OCN	110	460	63.56 E	42.34 E	18.69 E	21.11	37.5	**359.09**	**315.79**	87.11	**216.67**	**472.22**	**295.24**	**148.89**	63.16	**231.58**
Benzofluoranthenes (total)	mg/kg-OCN	230	450	76.27 E	68.47 E	24.3 E	46.67	78.57	**368.18**	**526.32**	219.51	**311.11**	**611.11**	**385.71**	**311.11**	68.42	**310.53**
Benzo(a)pyrene	mg/kg-OCN	99	210	31.07 E	27.03 E	10.28 E	23.33	37.5	**145.45**	**215.79**	87.11	**122.22**	**277.78**	**166.67**	**142.22**	27.37	**131.58**
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88	15.54 E	9.91 E	5.7 E	13.89	26.79	**81.82**	**102.63**	**34.84**	**61.11**	**116.67**	**76.19**	**95.56**	17.37	**68.42**
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33	***22.6*** UE	***52.25*** UE	***14.95*** UE	8.33	**15.18**	**30.45**	**68.42**	**22.65**	**34.44**	**61.11**	**40**	**55.56**	9.47	**41.58**
Benzo(g,h,i)perylene	mg/kg-OCN	31	78	14.12 E	***52.25*** UE	6.17 E	12.78	30.36	**90.91**	**94.74**	**34.84**	**55.56**	**116.67**	**76.19**	**64.44**	14.74	**68.42**
Total HPAH	mg/kg-OCN	960	5300	388.42 E	313.51 E	118.41 E	276.67 E	443.75 E	**2366.82**	**2128.95** E	918.12 E	**1856.67** E	**3705.56** E	**2740**	**1862.22**	511.05	**2052.11**
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3	***22.6*** UE	***52.25*** UE	***14.95*** UE	0.89 U	***2.32*** U	***9.55*** U	***5*** U	***4.18*** U	***8.33*** U	***10.56*** U	***8.57*** U	***2.89*** U	0.89 U	***8.95*** U
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9	***22.6*** UE	***52.25*** UE	***14.95*** UE	1.78 U	***4.46*** U	***19.09*** U	***10*** U	***8.36*** U	***17.22*** U	***21.11*** U	***17.14*** U	***5.78*** U	1.79 U	***17.89*** U
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8	***22.6*** UE	***52.25*** UE	***14.95*** UE	***0.89*** U	***2.32*** U	***9.55*** U	***5*** U	***4.18*** U	***8.33*** U	***10.56*** U	***8.57*** U	***2.89*** U	***0.89*** U	***8.95*** U
Hexachlorobenzene	mg/kg-OCN	0.38	2.3	***22.6*** UE	***52.25*** UE	***14.95*** UE	***1.78*** U	***4.46*** U	***19.09*** U	***10*** U	***8.36*** U	***17.22*** U	***21.11*** U	***17.14*** U	***5.78*** U	***1.79*** U	***17.89*** U
Dimethyl phthalate	mg/kg-OCN	53	53	22.6 UE	52.25 UE	14.95 UE	1.78 U	4.46 U	19.09 U	10 U	8.36 U	17.22 U	21.11 U	17.14 U	5.78 U	1.79 U	17.89 U
Diethylphthalate	mg/kg-OCN	61	110	22.6 UE	52.25 UE	14.95 UE	1.78 U	4.46 U	19.09 U	10 U	8.36 U	17.22 U	21.11 U	17.14 U	5.78 U	1.79 U	17.89 U
Di-n-butyl phthalate	mg/kg-OCN	220	1700	22.6 UE	2.34 E	14.95 UE	2.39	4.46 U	19.09 U	10 U	8.36 U	17.22 U	21.11 U	17.14 U	5.78 U	1.79 U	17.89 U
Butyl benzyl phthalate	mg/kg-OCN	4.9	64	2.4 E	***52.25*** UE	0.84 E	1.78 U	4.46 U	***19.09*** U	***10*** U	***8.36*** U	***17.22*** U	***21.11*** U	***17.14*** U	***5.78*** U	1.79 U	***17.89*** U
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78	14.12 UE	13.51 UE	9.16 UE	6.67	23.21	**72.73**	39.47	11.5	26.11	22.22	**52.38**	33.33	11.58	**68.42**
Di-n-octyl phthalate	mg/kg-OCN	58	4500	22.6 UE	52.25 UE	14.95 UE	1.78 U	4.46 U	19.09 U	10 U	8.36 U	17.22 U	21.11 U	17.14 U	5.78 U	1.79 U	17.89 U
Dibenzofuran	mg/kg-OCN	15	58	3.11 E	2.43 E	0.84 E	11.11	4.46	12.73 E	**28.95**	6.27 E	6.11 E	**283.33**	**147.62**	5.78 U	5.79	**17.89**
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2	***22.6*** UE	**52.25**	***14.95*** UE	1.78 U	***4.46*** U	***19.09*** U	***10*** U	***8.36*** U	***17.22*** U	***21.11*** U	***17.14*** U	***5.78*** U	1.79 U	***17.89*** U
N-Nitrosodiphenylamine	mg/kg-OCN	11	11	***22.6*** UE	***52.25*** UE	***14.95*** UE	0.89 U	2.32 U	9.55 U	5 U	4.18 U	8.33 U	10.56 U	8.57 U	2.89	0.89 U	8.95 U
Phenol	µg/kg	420	1200	**430** E	***580*** UE	280 E	200	50 U	***840*** U	***760*** U	***490*** U	***620*** U	***760*** U	***720*** U	160	140	360 E
2-Methylphenol	µg/kg	63	63	***160*** UE	***580*** UE	***160*** UE	16 U	13 U	***210*** U	***190*** U	***120*** U	***150*** U	***190*** U	***180*** U	13 U	17 U	***170*** U
4-Methylphenol	µg/kg	670	670	160 UE	580 UE	160 UE	83	25 U	420 U	380 U	240 U	310 U	380 U	360 U	90	80	340 U
2,4-Dimethylphenol	µg/kg	29	29	***160*** UE	***580*** UE	***160*** UE	16 U	13 U	***210*** U	***190*** U	***120*** U	***150*** U	***190*** U	***180*** U	13 U	17 U	***170*** U
Pentachlorophenol	µg/kg	360	690	***390*** UE	***1400*** UE	***390*** UE	58 E	130 U	***2100*** U	***1900*** U	***1200*** U	***1500*** U	***1900*** U	***1800*** U	128 U	63 E	***1700*** U
Benzyl alcohol	µg/kg	57	73	NR	NR	NR	25 U	20 U	***330*** U	***300*** U	***190*** U	***250*** U	***300*** U	***290*** U	21 U	28 U	***270*** U
Benzoic acid	µg/kg	650	650	NR	NR	NR	158 U	130 U	***2100*** U	***1900*** U	***1200*** U	***1500*** U	***1900*** U	***1800*** U	128 U	172 U	***1700*** U
PCBs																	
PCBs (total)	mg/kg-OCN	12	65	5.23	2.63	9.16 E	10.56	**34.82**	**48.64**	**21.05**	9.13	**12.78**	10.33	8.19	**28.67**	7.79	**15.84**
Organometallics																	
TBT*	mg/kg-OCN	76	76	NR	**216.2**	**86.0**	NR	NR	**272.7**	NR	13.9	NR	NR	NR	NR	NR	NR

Notes:

* TBT concentrations are compared to the West Waterway Confirmational Number.

* The TBT concentration for sample EBB01C is reported in ug/kg-dry weight rather than mg/kg-OCN

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Surface Samples
Data Evaluation Summary Compared to SQS and CSL

				Sample Locations within Yard 2								Sample Locations North of Yard 2					
			Location	SA2-S	SA6-S	G13	G10	G11	G15	NH-04	NH-05	EBB01	EBB01	EBB01	EBB01	EB121	EB130
			Sample ID	SA2-S	SA6-S	G13	G10	G11	G15	NH-04	NH-05	EBB01-A	EBB01-B	EBB01-C	EBB01C	SD3-EB121-0000	SD3-EB130-0000
			Sample Date	8/31/1989	8/31/1989	8/31/1989	8/29/1989	8/29/1989	8/29/1989	10/15/1985	10/15/1985	7/3/2002	7/3/2002	7/3/2002	5/19/1988	7/29/1997	7/29/1997
			Sample Depth	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-5 cm	0-10 cm	0-10 cm
Parameter	**Units**	**SQS**	**CSL**														
Conventionals																	
Total Organic Carbon	%	NA	NA	2.5	0.54	2.1	1.8	1.2	2.5	2.04	2.55	NR	NR	NR	1	1.2	0.88
Metals																	
Arsenic	mg/kg	57	93	40	52	**77**	46	**57**	15	**174**	22.6	NR	NR	NR	12	NR	NR
Cadmium	mg/kg	5.1	6.7	0.53 E	0.16 E	0.65 E	0.42 E	0.2 E	0.45 E	0.71	0.93	NR	NR	NR	0.98 B	NR	NR
Chromium	mg/kg	260	270	95 E	82 E	34 E	85 E	150 E	170 E	127 E	212 E	NR	NR	NR	NR	NR	NR
Copper	mg/kg	390	390	140 E	160 E	170 E	**550** E	270 E	**390** E	**1770**	163	NR	NR	NR	56	NR	NR
Lead	mg/kg	450	530	160 E	80 E	190 E	190 E	210 E	240 E	349	137	NR	NR	NR	38	NR	NR
Mercury	mg/kg	0.41	0.59	0.0013	0.0005	0.0014	0.0013	0.0008	0.0057	**0.866** E	**0.426** E	0.284	0.383	0.225	0.2	NR	NR
Silver	mg/kg	6.1	6.1	0.34 E	0.19 E	0.43 E	0.57 E	0.68 E	0.65 E	0.93 E	0.48 E	NR	NR	NR	0.22	NR	NR
Zinc	mg/kg	410	960	170 E	160 E	240 E	**430** E	380 E	300 E	**994** E	304 E	NR	NR	NR	140	NR	NR
SVOCs																	
Naphthalene	mg/kg-OCN	99	170	14	6.67	12.86 E	9.44 E	42.5	14.4 U	24.51 E	**101.96**	NR	NR	NR	1.4 E	74.00	28.98
Acenaphthylene	mg/kg-OCN	66	66	6.4	5	20 U	7.78 E	29.17 U	14.4 U	27.45 E	11.76 E	NR	NR	NR	1.2 E	9.33	4.09
Acenaphthene	mg/kg-OCN	16	57	8.8	5.19	**20.95**	**94.44**	**466.67**	9.2 E	**32.84** E	**34.12** E	NR	NR	NR	1.3 E	**32.92**	8.38
Fluorene	mg/kg-OCN	23	79	10.8	8.89	**33.33**	**111.11**	**433.33**	13.2 E	**45.1** E	**38.04** E	NR	NR	NR	2.2 E	**32.08**	9.36
Phenanthrene	mg/kg-OCN	100	480	40	53.7	**166.67**	**438.89**	**1250**	88	**166.67**	78.43	NR	NR	NR	11	**295.83**	43.07
Anthracene	mg/kg-OCN	220	1200	29.6	20.37	80.95	161.11	**275**	76	73.53 E	70.59 E	NR	NR	NR	4.6	57.42	23.86
2-Methylnaphthalene	mg/kg-OCN	38	64	2.92	2.59 E	4.76 E	11.67 E	34.17	14.4 U	9.8 E	17.25 E	NR	NR	NR	0.5 E	19.83	8.31
Total LPAH	mg/kg-OCN	370	780	109.6	99.81	314.76 E	**822.78** E	**2467.5**	186.4 E	**370.1** E	334.9 E	NR	NR	NR	21.7 E	**501.58**	117.74
Fluoranthene	mg/kg-OCN	160	1200	60	90.74	**261.9**	**722.22**	**1583.33**	**252**	**328.43** E	90.2 E	NR	NR	NR	25	**262.50**	57.73
Pyrene	mg/kg-OCN	1000	1400	88 E	90.74	252.38 E	611.11	**1083.33** E	208 E	210.78	90.2	NR	NR	NR	26	397.50	86.82
Benzo(a)anthracene	mg/kg-OCN	110	270	44	42.59	90.48	**172.22**	**366.67**	**112**	88.24	43.14	NR	NR	NR	19	62.92	45.57
Chrysene	mg/kg-OCN	110	460	48	59.26	109.52	**222.22**	**366.67**	**164**	93.14	47.06	NR	NR	NR	21	85.00	83.18
Benzofluoranthenes (total)	mg/kg-OCN	230	450	88	81.48	133.33	**272.22**	**466.67**	220	205.88	109.8 E	NR	NR	NR	51	127.00	87.73
Benzo(a)pyrene	mg/kg-OCN	99	210	72	35.19	66.67	**105.56**	**133.33**	96	88.24 E	39.22 E	NR	NR	NR	16	76.00	39.09
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88	26.8	16.67	31.9	**50.56**	**53.33**	**48**	**88.24** E	23.92 E	NR	NR	NR	9.5	**34.08**	18.30
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33	11.6	7.59	**18.57** E	**31.11**	**33.33**	**28.8**	**35.29** E	8.63 E	NR	NR	NR	3.8 E	10.42	6.48
Benzo(g,h,i)perylene	mg/kg-OCN	31	78	20.4	13.89	**31.9**	**47.22**	19.17 E	**48**	**73.53** E	19.61 E	NR	NR	NR	6.6	**39.33**	18.41
Total HPAH	mg/kg-OCN	960	5300	458.8 E	438.15	**996.67** E	**2234.44**	**4105.83** E	**1176.8** E	**1211.76** E	471.76 E	NR	NR	NR	177.9 E	**1094.75**	443.30
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3	0.6 U	2.22 U	***10*** U	***6.67*** U	***11.67*** U	**6** U	***8.33*** U	***5.88*** U	0.34 UJ	0.29 UJ	0.33 UJ	0.48 U	NR	NR
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9	1.2 U	***4.63*** U	***20*** U	***17.22*** U	***29.17*** U	***14.4*** U	***8.33*** U	***5.88*** U	0.34 UJ	0.29 UJ	0.33 UJ	0.48 U	NR	NR
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8	0.6 U	***2.22*** U	***10*** U	***5*** U	***8.33*** U	***4.4*** U	***6.86*** U	***3.45*** U	NR	NR	NR	0.48 U	NR	NR
Hexachlorobenzene	mg/kg-OCN	0.38	2.3	***1.2*** U	***4.63*** U	***20*** U	***17.22*** U	***29.17*** U	***14.4*** U	***6.37*** U	***2.86*** U	NR	NR	NR	***0.48*** U	NR	NR
Dimethyl phthalate	mg/kg-OCN	53	53	1.2 U	4.63 U	20 U	17.22 U	29.17 U	14.4 U	3.28 E	0.75 E	NR	NR	NR	0.48 U	NR	NR
Diethylphthalate	mg/kg-OCN	61	110	1.2 U	4.63 U	20 U	17.22 U	29.17 U	14.4 U	NR	NR	NR	NR	NR	0.48 U	NR	NR
Di-n-butyl phthalate	mg/kg-OCN	220	1700	1.2 U	4.63 U	20 U	17.22 U	29.17 U	14.4 U	NR	NR	NR	NR	NR	2.8 E	NR	NR
Butyl benzyl phthalate	mg/kg-OCN	4.9	64	1.2 U	4.63 U	**20** U	***17.22*** U	***29.17*** U	***14.4*** U	0.17 B	0.15 B	NR	NR	NR	1.6 E	NR	NR
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78	9.2	18.52	**209.52**	15 E	29.17 U	20	NR	NR	NR	NR	NR	7.9 Z	NR	NR
Di-n-octyl phthalate	mg/kg-OCN	58	4500	1.2 U	4.63 U	20 U	17.22 U	29.17 U	14.4 U	4.22 E	0.06 U	NR	NR	NR	0.5 U	NR	NR
Dibenzofuran	mg/kg-OCN	15	58	7.2	5	**17.14** E	**66.67**	**325**	5.2 E	**17.65** E	**22.35** E	NR	NR	NR	1.3 E	**26.33**	8.58
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2	1.2 U	***4.63*** U	***20*** U	***8.33*** U	***14.17*** U	***7.2*** U	***24.51*** U	***13.33*** U	NR	NR	NR	0.52 U	NR	NR
N-Nitrosodiphenylamine	mg/kg-OCN	11	11	0.6 U	2.22 U	10 U	6.67 U	***11.67*** U	6 U	NR	NR	NR	NR	NR	0.48 U	NR	NR
Phenol	µg/kg	420	1200	60 U	50 U	***840*** U	***610*** U	***700*** U	***730*** U	110 E	3.8 U	NR	NR	NR	54	NR	NR
2-Methylphenol	µg/kg	63	63	15 U	12 U	***210*** U	***120*** U	***140*** U	***150*** U	**240** E	8.8 U	NR	NR	NR	4.8 U	NR	NR
4-Methylphenol	µg/kg	670	670	30 U	25 U	420 U	310 U	350 U	360 U	**1000** E	8.9 U	NR	NR	NR	23 E	NR	NR
2,4-Dimethylphenol	µg/kg	29	29	15 U	12 U	***210*** U	***92*** U	***110*** U	***110*** U	**39** E	5.8 U	NR	NR	NR	NR	NR	NR
Pentachlorophenol	µg/kg	360	690	150 U	120 U	***2100*** U	***1500*** U	***1700*** U	***1800*** U	**6000** X	***440*** U	NR	NR	NR	7.6 U	NR	NR
Benzyl alcohol	µg/kg	57	73	24 U	20 U	***340*** U	***150*** U	***170*** U	***180*** U	***510*** U	***450*** U	NR	NR	NR	20 U	NR	NR
Benzoic acid	µg/kg	650	650	150 U	120 U	***2100*** U	210 U	240 U	260 U	92 U	56 U	NR	NR	NR	17 E	NR	NR
PCBs																	
PCBs (total)	mg/kg-OCN	12	65	8.08	**24.44**	9.38	**15.56**	**18.33**	**14.4**	7.84	**19.61**	NR	NR	NR	**20**	NR	NR
Organometallics																	
TBT*	mg/kg-OCN	76	76	NR	35.2	NR	NR	NR	NR	NR	NR	NR	NR	NR	180**	NR	NR

Notes:

* TBT concentrations are compared to the West Waterway Confirmational Number.

* The TBT concentration for sample EBB01C is reported in ug/kg-dry weight rather than mg/kg-OCN

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Surface Samples
Data Evaluation Summary Compared to SQS and CSL

Parameter	Units	SQS	CSL	Location	Sample Locations North of Yard 2			Sample Locations in the West Waterway									
					EB131	EB120	EB089	EB085	HC-03-13	N-28	N-09	N-10	N-19	W-52	W-53	W-40	W-42	W-44
				Sample ID	SD3-EB131-0000	SD3-EB120-0000	SD2-EB89-0000	SD2-EB85-0000	HC-03-13	N-28	N-09	N-10	N-19	W-52	W-53	W-40	W-42	W-44
				Sample Date	7/29/1997	7/29/1997	1996	1996	9/27/2003	10/9/1991	10/8/1991	10/8/1991	10/8/1991	10/8/1991	10/8/1991	10/7/1991	10/7/1991	10/7/1991
				Sample Depth	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm	0-2 cm	0-2 cm	0-2 cm	0-2 cm	0-2 cm	0-2 cm	0-2 cm	0-2 cm	0-2 cm
Conventionals																		
Total Organic Carbon	%	NA	NA		1.4	2.1	1.5	1.8	0.78	0.551	0.494	1.54	1.98	1.83	2	1.02	1.32	1.25
Metals																		
Arsenic	mg/kg	57	93		NR	NR	NR	NR	**165**	8.1	10.9 E	**72.1**	10	16.7 E	37.4	15.5 E	24 E	23.4
Cadmium	mg/kg	5.1	6.7		NR	NR	NR	NR	0.47	3.9	2.3	**7.3**	4.3	**6**	**6.7**	**6.2**	**5.7** E	**6.5**
Chromium	mg/kg	260	270		NR	NR	NR	NR	127	NR	18.3 E	NR	NR	50.1 E	NR	58.3 E	NR	NR
Copper	mg/kg	390	390		NR	NR	NR	NR	**576**	90.3	54	**415**	107	132	358	175	176 E	264
Lead	mg/kg	450	530		NR	NR	NR	NR	**1160**	25.1	22.4	217	33.4	64.5	105	99.2	101	134
Mercury	mg/kg	0.41	0.59		NR	NR	NR	0.24	**0.86**	0.37	0.11 E	**1.7**	**2.2**	0.03 E	**1.2**	**0.78** E	**1.1**	**0.66**
Silver	mg/kg	6.1	6.1		NR	NR	NR	NR	0.49	NR	0.28 E	NR	NR	NR	NR	2 U	NR	NR
Zinc	mg/kg	410	960		NR	NR	NR	NR	**661**	95.6	65.5	**489**	108	174	271	370	235	277
SVOCs																		
Naphthalene	mg/kg-OCN	99	170		15.79	3.32	**107.33**	**403.33**	10.38	3.27 E	13.77 E	3.96 E	1.46 E	4.97 E	2 E	5.2 E	1.82 E	3.12 E
Acenaphthylene	mg/kg-OCN	66	66		1.86	0.68	6.22	8.06	12.18	1.09 E	2.02 E	1.56 E	0.51 E	1.91 E	1.85 E	1.86 E	1.21 E	1.84 E
Acenaphthene	mg/kg-OCN	16	57		6.22	1.45	**59.93**	**151.11**	14.1	3.27 E	**58.7** E	7.79 E	1.97 E	2.79 E	6 E	6.47 E	3.41 E	6 E
Fluorene	mg/kg-OCN	23	79		5.74	2.13	**49.60**	**148.89**	**23.08**	4.36 E	**66.8** E	9.09 E	2.42 E	3.39 E	8.5 E	9.02 E	4.09 E	7.2 E
Phenanthrene	mg/kg-OCN	100	480		23.57	9.86	**130.00**	**422.78**	**141.03**	36.3 E	**445.34** E	71.43 E	17.17 E	21.86 E	**115** E	59.8 E	37.12 E	60
Anthracene	mg/kg-OCN	220	1200		9.21	4.55	40.13	106.67	34.62	10.16 E	87.04 E	14.29 E	3.84 E	10.93 E	20.5 E	22.55 E	9.09 E	12.8
2-Methylnaphthalene	mg/kg-OCN	38	64		4.19	1.12	37.33	**124.44**	5.77 J	1.63 E	8.91 E	2.14 E	1.06 E	1.64 E	1.55 E	3.04 E	1.59 E	1.92 E
Total LPAH	mg/kg-OCN	370	780		62.39	21.99	**393.22**	**1240.83**	235.38	58.44 E	**673.68** E	108.12 E	27.37 E	45.85 E	153.85 E	104.9 E	56.74 E	90.96 E
Fluoranthene	mg/kg-OCN	160	1200		35.50	19.10	111.33	**323.33**	**371.79**	67.15 E	**465.59** E	110.39 E	25.25 E	47.54 E	**240** E	147.06 E	56.06 E	88 E
Pyrene	mg/kg-OCN	1000	1400		44.64	16.05	200.00	351.11	307.69	49 E	688.26 E	97.4 E	21.21 E	41.53 E	180 E	156.86 E	71.21 E	120 E
Benzo(a)anthracene	mg/kg-OCN	110	270		13.71	11.71	25.93	50.11	**119.23**	29.04 E	**404.86** E	56.49 E	12.63 E	21.86 E	80 E	71.57 E	31.06 E	46.4
Chrysene	mg/kg-OCN	110	460		20.57	16.24	35.13	58.89	**192.31**	39.93 E	**404.86** E	64.94 E	15.66 E	20.77 E	**125**	107.84 E	31.82 E	53.6
Benzofluoranthenes (total)	mg/kg-OCN	230	450		43.21	27.33	68.93	102.00	**258.97**	68.97 E	**615.38** E	123.38 E	27.78 E	52.46 E	145 E	120.59 E	59.09 E	96
Benzo(a)pyrene	mg/kg-OCN	99	210		21.14	12.86	29.27	39.39	**116.67**	27.22 E	**242.91** E	52.6 E	11.62 E	20.77 E	55 E	62.75 E	18.94 E	34.4
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88		13.57	6.19	13.87	16.28	**73.08**	11.43 E	**163.97** E	25.32 E	6.06 E	9.29 E	25.5 E	**49.02** E	6.29 E	10.4 E
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33		4.74	2.54	1.35 J	4.71	**15.38**	***27.22*** UE	**87.04** E	1.36 E	0.25 E	9.29 UE	***50*** UE	**17.65** E	***12.88*** U	***12.8*** U
Benzo(g,h,i)perylene	mg/kg-OCN	31	78		12.14	5.24	14.87	15.67	**64.1**	11.8 E	**159.92** E	23.38 E	5.56 E	10.38 E	23 E	**52.94** E	5.38 E	8.8 E
Total HPAH	mg/kg-OCN	960	5300		209.24	117.26	500.68	**961.48**	**1519.23**	304.54 E	**3232.79** E	555.26 E	126.01 E	224.59 E	873.5 E	786.27 E	279.85 E	457.6 E
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3		NR	NR	NR	NR	1.22 U	***27.22*** UE	***119.43*** UE	***40.91*** UE	***14.65*** UE	***9.29*** UE	***50*** UE	***65.69*** UE	***12.88*** U	***12.8*** U
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9		NR	NR	NR	NR	1.79 U	***27.22*** UE	***119.43*** UE	***40.91*** UE	***14.65*** UE	***9.29*** UE	***50*** UE	***65.69*** UE	***12.88*** U	***12.8*** U
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8		NR	NR	NR	NR	***1.41*** U	***27.22*** UE	***119.43*** UE	***40.91*** UE	***14.65*** UE	***9.29*** UE	***50*** UE	***65.69*** UE	***12.88*** U	***12.8*** U
Hexachlorobenzene	mg/kg-OCN	0.38	2.3		NR	NR	NR	NR	***2.05*** U	***27.22*** UE	***119.43*** UE	***40.91*** UE	***14.65*** UE	***9.29*** UE	***50*** UE	***65.69*** UE	***12.88*** U	***12.8*** U
Dimethyl phthalate	mg/kg-OCN	53	53		NR	NR	NR	NR	6.15 U	27.22 UE	***119.43*** UE	40.91 UE	14.65 UE	9.29 UE	50 UE	***65.69*** UE	12.88 U	0.8 E
Diethylphthalate	mg/kg-OCN	61	110		NR	NR	NR	NR	6.15 U	27.22 UE	***119.43*** UE	40.91 UE	0.05 E	9.29 UE	50 UE	***65.69*** UE	12.88 U	12.8 U
Di-n-butyl phthalate	mg/kg-OCN	220	1700		NR	NR	NR	NR	2.82 J	27.22 UE	119.43 UE	2.34 E	14.65 UE	9.29 UE	50 UE	1.76 E	12.88 U	12.8 U
Butyl benzyl phthalate	mg/kg-OCN	4.9	64		NR	NR	NR	NR	4.74 J	**5.08** E	**5.06** E	1.43 E	0.71 E	***9.29*** UE	1.75 E	***65.69*** UE	**7.58** E	2.56 E
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78		NR	NR	NR	NR	**48.72** J	23.59 UE	32.39 UE	29.22 UE	9.09 UE	13.66 E	20.5 UE	27.45 UE	**106.06** E	**128** B
Di-n-octyl phthalate	mg/kg-OCN	58	4500		NR	NR	NR	NR	6.15 U	27.22 UE	***119.43*** UE	40.91 UE	14.65 UE	9.29 UE	50 UE	***65.69*** UE	12.88 U	12.8 U
Dibenzofuran	mg/kg-OCN	15	58		6.44	1.90	NR	NR	11.28	2.54 E	**24.29** E	4.94 E	1.21 E	2.13 E	3.5 E	4.02 E	2.2 E	3.68 E
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2		NR	NR	NR	NR	1.41 U	***27.22*** UE	***119.43*** UE	***40.91*** UE	***14.65*** UE	***9.29*** UE	***50*** UE	***65.69*** UE	***12.88*** U	***12.8*** U
N-Nitrosodiphenylamine	mg/kg-OCN	11	11		NR	NR	NR	NR	6.15 U	***27.22*** UE	***119.43*** UE	***40.91*** UE	***14.65*** UE	9.29 UE	***50*** UE	***65.69*** UE	***12.88*** U	***12.8*** U
Phenol	µg/kg	420	1200		NR	NR	NR	NR	150 U	290 E	120 E	160 E	21 E	170 E	***1000*** UE	240 E	170 U	280
2-Methylphenol	µg/kg	63	63		NR	NR	NR	NR	48 U	***150*** UE	***590*** UE	***630*** UE	***290*** UE	***170*** UE	***1000*** UE	***670*** UE	***170*** U	***160*** U
4-Methylphenol	µg/kg	670	670		NR	NR	NR	NR	48 U	150 UE	590 UE	630 UE	290 UE	170 UE	***1000*** UE	670 UE	170 U	160 U
2,4-Dimethylphenol	µg/kg	29	29		NR	NR	NR	NR	***40*** U	***150*** UE	***590*** UE	***630*** UE	***290*** UE	***170*** UE	***1000*** UE	***670*** UE	***170*** U	***160*** U
Pentachlorophenol	µg/kg	360	690		NR	NR	NR	NR	180 J	***380*** UE	***1500*** UE	***1600*** UE	***740*** UE	NR	***2600*** UE	***1700*** UE	***420*** U	***400*** U
Benzyl alcohol	µg/kg	57	73		NR	NR	NR	NR	48 U	NR	NR	NR	NR	NR	NR	NR	NR	NR
Benzoic acid	µg/kg	650	650		NR	NR	NR	NR	***700*** U	NR	NR	NR	NR	NR	NR	NR	NR	NR
PCBs																		
PCBs (total)	mg/kg-OCN	12	65		NR	NR	NR	7.60	**206.41**	**254.08**	**19.64** E	**158.44**	6.06	0.06 E	0.25 E	1.14 E	2.07 E	**15.68** E
Organometallics																		
TBT*	mg/kg-OCN	76	76		NR	NR	NR	NR	**102.6**	69	56.7	47.4	16.7	12.6	**275**	42.4	22	36

Notes:

* TBT concentrations are compared to the West Waterway Confirmational Number.

* The TBT concentration for sample EBB01C is reported in ug/kg-dry weight rather than mg/kg-OCN

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Surface Samples
Data Evaluation Summary Compared to SQS and CSL

				Sample Locations in the West Waterway					
			Location	W-48	W-49	G14	SA10-S	WW-17	WW-20
			Sample ID	W-48	W-49	G14	SA10-S	WW-17	WW-20
			Sample Date	10/7/1991	10/7/1991	8/31/1989	8/31/1989	10/3/1985	10/3/1985
			Sample Depth	0-2 cm	0-2 cm	0-10 cm	0-10 cm	0-10 cm	0-10 cm
Parameter	**Units**	**SQS**	**CSL**						
Conventionals									
Total Organic Carbon	%	NA	NA	0.811	2.56	0.79	0.91	2.04	1.07
Metals									
Arsenic	mg/kg	57	93	16.6 E	34.7	**88**	33	26.5	39.6
Cadmium	mg/kg	5.1	6.7	4.6	**6.2**	0.45 E	0.36 E	0.59	0.38
Chromium	mg/kg	260	270	44.7 E	NR	150 E	100 E	96 E	67 E
Copper	mg/kg	390	390	112	297	**900** E	160 E	265	167
Lead	mg/kg	450	530	220	116	180 E	130 E	223	101
Mercury	mg/kg	0.41	0.59	**0.6** E	**1.7**	0.0016	0.0018	**0.716** E	**0.776** E
Silver	mg/kg	6.1	6.1	NR	NR	0.75 E	0.25 E	0.56 E	0.36 E
Zinc	mg/kg	410	960	143	308	**580** E	190 E	297 E	259 E
SVOCs									
Naphthalene	mg/kg-OCN	99	170	6.91 E	5.08 E	72.15	9.23	15.2 XE	19.63 XE
Acenaphthylene	mg/kg-OCN	66	66	8.26 E	2.73 E	34.18 E	9.01	10.29 XE	7.01 E
Acenaphthene	mg/kg-OCN	16	57	11.96 E	9.38 E	**202.53**	12.09	11.27 E	4.95 E
Fluorene	mg/kg-OCN	23	79	**24.66** E	10.55	**240.51**	16.48	12.25 E	7.38 E
Phenanthrene	mg/kg-OCN	100	480	**123.3** E	85.94 E	**1518.99**	**131.87**	83.33	60.75 E
Anthracene	mg/kg-OCN	220	1200	10.97 E	16.02	**240.51**	31.87	36.76 E	22.43 E
2-Methylnaphthalene	mg/kg-OCN	38	64	4.93 E	3.01 E	26.58 E	3.74	2.7 E	3.55 E
Total LPAH	mg/kg-OCN	370	780	186.07 E	129.69 E	**2308.86** E	210.55	169.12 E	122.15 E
Fluoranthene	mg/kg-OCN	160	1200	123.3 E	140.62 E	**1898.73**	**208.79**	132.35 E	86.92 E
Pyrene	mg/kg-OCN	1000	1400	172.63 E	152.34 E	**2151.9** E	296.7	151.96	121.5
Benzo(a)anthracene	mg/kg-OCN	110	270	101.11 E	85.94 E	**696.2**	**142.86**	78.43	48.6 E
Chrysene	mg/kg-OCN	110	460	**123.3** E	78.12 E	**772.15**	106.59	**112.75**	68.22 E
Benzofluoranthenes (total)	mg/kg-OCN	230	450	161.53 E	167.97 E	**734.18**	186.81	196.08	119.63 E
Benzo(a)pyrene	mg/kg-OCN	99	210	93.71 E	58.59	**392.41**	**120.88**	73.53 E	45.79 E
Indeno(1,2,3-cd)pyrene	mg/kg-OCN	34	88	**69.05** E	32.42 E	**227.85**	**43.96**	**88.24** E	**61.68** E
Dibenzo(a,h)anthracene	mg/kg-OCN	12	33	**30.83** E	9.38 UE	**113.92**	**31.87**	**21.57** XE	11.5 UX
Benzo(g,h,i)perylene	mg/kg-OCN	31	78	**78.91** E	**34.38** E	**253.16**	**37.36**	**58.82** E	**38.32** E
Total HPAH	mg/kg-OCN	960	5300	954.38 E	750.39 E	**7240.51** E	**1175.82**	913.73 E	590.65 E
1,2-Dichlorobenzene	mg/kg-OCN	2.3	2.3	***75.22*** UE	***9.38*** U	***17.72*** U	1.43 U	***8.33*** U	***13.08*** U
1,4-Dichlorobenzene	mg/kg-OCN	3.1	9	***75.22*** UE	***9.38*** U	***36.71*** U	2.53 E	***8.33*** U	***13.08*** U
1,2,4-Trichlorobenzene	mg/kg-OCN	0.81	1.8	***75.22*** UE	***9.38*** U	***17.72*** U	***1.43*** U	***83.33*** U	***21.5*** U
Hexachlorobenzene	mg/kg-OCN	0.38	2.3	***75.22*** UE	***9.38*** U	***36.71*** U	***2.86*** U	***17.16*** U	***19.63*** U
Dimethyl phthalate	mg/kg-OCN	53	53	1.48 E	9.38 U	36.71 U	2.86 U	4.85 E	1.03 E
Diethylphthalate	mg/kg-OCN	61	110	***75.22*** UE	9.38 U	36.71 U	2.86 U	NR	NR
Di-n-butyl phthalate	mg/kg-OCN	220	1700	1.85 E	3.52 E	36.71 U	2.86 U	NR	NR
Butyl benzyl phthalate	mg/kg-OCN	4.9	64	3.58 E	**8.98** E	***36.71*** U	2.86 U	0.69 B	1.03 B
bis(2-ethylhexyl)phthalate	mg/kg-OCN	47	78	36.99 UE	**117.19** E	**177.22**	**95.6**	NR	NR
Di-n-octyl phthalate	mg/kg-OCN	58	4500	***75.22*** UE	8.98 U	36.71 U	2.86 U	4.22 E	7.1 E
Dibenzofuran	mg/kg-OCN	15	58	10.6 E	5.86 E	**164.56**	8.35	5.88 E	3.74 E
Hexachlorobutadiene	mg/kg-OCN	3.9	6.2	***75.22*** UE	***9.38*** U	***36.71*** U	2.86 U	***166.67*** U	***261.68*** U
N-Nitrosodiphenylamine	mg/kg-OCN	11	11	***75.22*** UE	9.38 U	***17.72*** U	1.43 U	NR	NR
Phenol	µg/kg	420	1200	280 E	400	***580*** U	220	66 U	11 U
2-Methylphenol	µg/kg	63	63	***610*** UE	17 E	***140*** U	13 U	***100*** U	29 U
4-Methylphenol	µg/kg	670	670	610 UE	21 E	290 U	350	110 U	29 U
2,4-Dimethylphenol	µg/kg	29	29	***610*** UE	13 E	***140*** U	13 U	***400*** U	***320*** U
Pentachlorophenol	µg/kg	360	690	***1500*** UE	230 E	***1400*** U	46 E	**360** XE	280 U
Benzyl alcohol	µg/kg	57	73	NR	NR	***230*** U	21 U	***490*** U	***400*** U
Benzoic acid	µg/kg	650	650	NR	NR	***1400*** U	130 U	***1000*** U	140 U
PCBs									
PCBs (total)	mg/kg-OCN	12	65	**14.67** E	0.73 E	**216.46**	**64.84**	**17.65**	**14.95** E
Organometallics									
TBT*	mg/kg-OCN	76	76	**135.6**	19.1	NR	NR	NR	NR

Notes:

* TBT concentrations are compared to the West Waterway Confirmational Number.

* The TBT concentration for sample EBB01C is reported in ug/kg-dry weight rather than mg/kg-OCN

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.

NA Not available

NR Not reported

U The analyte was undetected at reported detection limit.

Bold concentrations indicate an exceedance of the SQS.

Boxed concentrations indicate an exceedance of the CSL.

Italicized concentrations indicate a detection limit exceedance of either SQS or CSL.

Additional qualifier definitions for the various sampling events are unknown.

Lockheed Shipyard No. 2 Surface Samples
Data Evaluation Summary Compared to LAET and 2LAET

				Within Yard 2	Sample Locations North of Yard 2			West Waterway		
			Location	LTHB01	EBB01-1	EBB01-2	EBB01-3	WW-15	42	LTIC05
			Sample ID	8500342	E023	E024	E025	WW-15	42	8500364
			Sample Date	1/7/1985	7/6/2000	7/6/2000	7/6/2000	10/8/1985	7/26/1983	1/8/1985
			Sample Depth	0-10 cm	0-11 cm	0-9 cm	0-11.5 cm	0-10 cm	0-10 cm	0-10 cm
Parameter	**Units**	**LAET**	**2LAET**							
Conventionals										
Total Organic Carbon	%	NA	NA	NR	NR	NR	NR	0.12	NR	NR
Metals										
Arsenic	mg/kg	57	93	26.5	NR	NR	NR	31.2	**1420**	45.8
Cadmium	mg/kg	5.1	6.7	1.63	NR	NR	NR	0.21	2.2	0.813
Chromium	mg/kg	260	270	53.1	NR	NR	NR	178 E	165	47.9
Copper	mg/kg	390	390	98	NR	NR	NR	86.2	**1050**	229
Lead	mg/kg	450	530	100	NR	NR	NR	136	**2179**	177
Mercury	mg/kg	0.41	0.59	**0.469**	0.4	0.3	0.25	0.041 E	0.219	**0.729**
Silver	mg/kg	6.1	6.1	NR	NR	NR	NR	0.083 E	1.72	NR
Zinc	mg/kg	410	960	245	NR	NR	NR	253 E	**4810**	229
SVOCs										
Naphthalene	µg/kg	2100	2400	NR	NR	NR	NR	133.33 U	100 U	NR
Acenaphthylene	µg/kg	1300	1300	**3100**	NR	NR	NR	49.17 U	100 U	NR
Acenaphthene	µg/kg	500	730	NR	NR	NR	NR	74.17 U	100 U	NR
Fluorene	µg/kg	540	1000	**3700**	NR	NR	NR	83.33 U	100 U	NR
Phenanthrene	µg/kg	1500	5400	**14000**	NR	NR	NR	82.5 U	**2900**	**6500**
Anthracene	µg/kg	960	4400	**4900**	NR	NR	NR	77.5 U	640	**1700**
2-Methylnaphthalene	µg/kg	670	1400	NR	NR	NR	NR	166.67 U	100 U	NR
Total LPAH	µg/kg	5200	13000	**25700**	NR	NR	NR	133.33 U	3540	8200
Fluoranthene	µg/kg	1700	2500	**16000**	NR	NR	NR	9.17 E	**4800**	8100
Pyrene	µg/kg	2600	3300	**17000**	NR	NR	NR	10.83 E	**4400**	8500
Benzo(a)anthracene	µg/kg	1300	1600	**1900**	NR	NR	NR	26.67 U	**1800**	1000
Chrysene	µg/kg	1400	2800	**3300**	NR	NR	NR	30.83 U	**2400**	2000
Benzofluoranthenes (total)	µg/kg	3200	3600	**11000**	NR	NR	NR	41.67 U	**3600**	5600
Benzo(a)pyrene	µg/kg	1600	3000	**3900**	NR	NR	NR	33.33 U	**2100**	NR
Indeno(1,2,3-cd)pyrene	µg/kg	600	690	**980**	NR	NR	NR	30 U	100 U	NR
Dibenzo(a,h)anthracene	µg/kg	230	540	NR	NR	NR	NR	49.17 U	100 U	NR
Benzo(g,h,i)perylene	µg/kg	670	720	**800**	NR	NR	NR	29.17 U	**780**	NR
Total HPAH	µg/kg	12000	17000	**54880**	NR	NR	NR	20 E	**19880**	**25200**
1,2-Dichlorobenzene	µg/kg	35	50	NR	1.3 U	1.3 U	1.3 U	***175*** U	***100*** U	NR
1,4-Dichlorobenzene	µg/kg	110	120	NR	1.3 U	1.3 U	1.3 U	***383.33*** U	100 U	NR
1,2,4-Trichlorobenzene	µg/kg	31	51	NR	6.5 U	6.5 U	6.7 U	***733.33*** U	***100*** U	NR
Hexachlorobenzene	µg/kg	22	70	NR	NR	NR	NR	***683.33*** U	***100*** U	NR
Dimethyl phthalate	µg/kg	71	160	NR	NR	NR	NR	42.5 U	***100*** U	NR
Diethylphthalate	µg/kg	200	200	NR	NR	NR	NR	NR	100 U	NR
Di-n-butyl phthalate	µg/kg	1400	1400	530	NR	NR	NR	NR	100 U	NR
Butyl benzyl phthalate	µg/kg	63	900	NR	NR	NR	NR	29.17 U	***100*** U	NR
bis(2-ethylhexyl)phthalate	µg/kg	1300	1900	**1300**	NR	NR	NR	NR	100 U	NR
Di-n-octyl phthalate	µg/kg	6200	6200	NR	NR	NR	NR	19.17 U	100 U	2400
Dibenzofuran	µg/kg	540	700	NR	NR	NR	NR	166.67 E	100 U	NR
Hexachlorobutadiene	µg/kg	11	120	NR	NR	NR	NR	***1500*** U	***100*** U	NR
N-Nitrosodiphenylamine	µg/kg	28	40	NR	NR	NR	NR	NR	NR	NR
Phenol	µg/kg	420	1200	NR	NR	NR	NR	190 E	50 U	NR
2-Methylphenol	µg/kg	63	72	NR	NR	NR	NR	***75*** U	NR	NR
4-Methylphenol	µg/kg	670	1,800	NR	NR	NR	NR	180 E	50 U	NR
2,4-Dimethylphenol	µg/kg	29	72	NR	NR	NR	NR	***63*** U	***50*** U	NR
Pentachlorophenol	µg/kg	360	690	NR	NR	NR	NR	***900*** U	50 U	NR
Benzyl alcohol	µg/kg	57	73	NR	NR	NR	NR	***1700*** U	***100*** U	NR
Benzoic acid	µg/kg	650	650	NR	NR	NR	NR	520 U	50 U	NR
PCBs										NR
PCBs (total)	µg/kg	130	1000	**6560**	NR	NR	NR	NR	**3200**	**2270**

Notes:

J The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quanity.
NA Not available
NR Not reported
U The analyte was undetected at reported detection limit.
Bold concentrations indicate an exceedance of the LAET.
Boxed concentrations indicate an exceedance of the 2LAET.
Italicized concentrations indicate a detection limit exceedance of either LAET or 2LAET.
Additional qualifier definitions for the various sampling events are unknown.

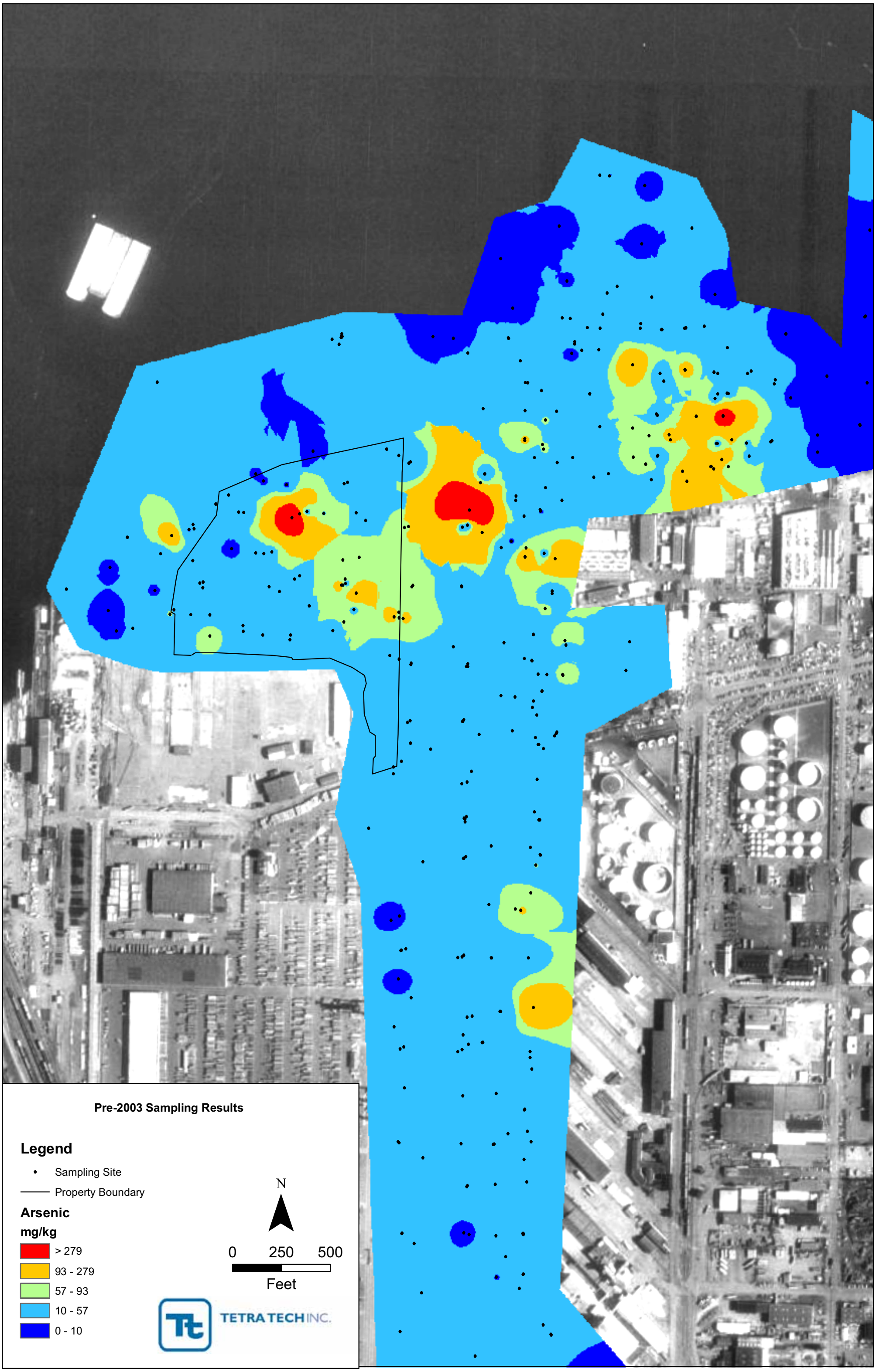
APPENDIX A.2

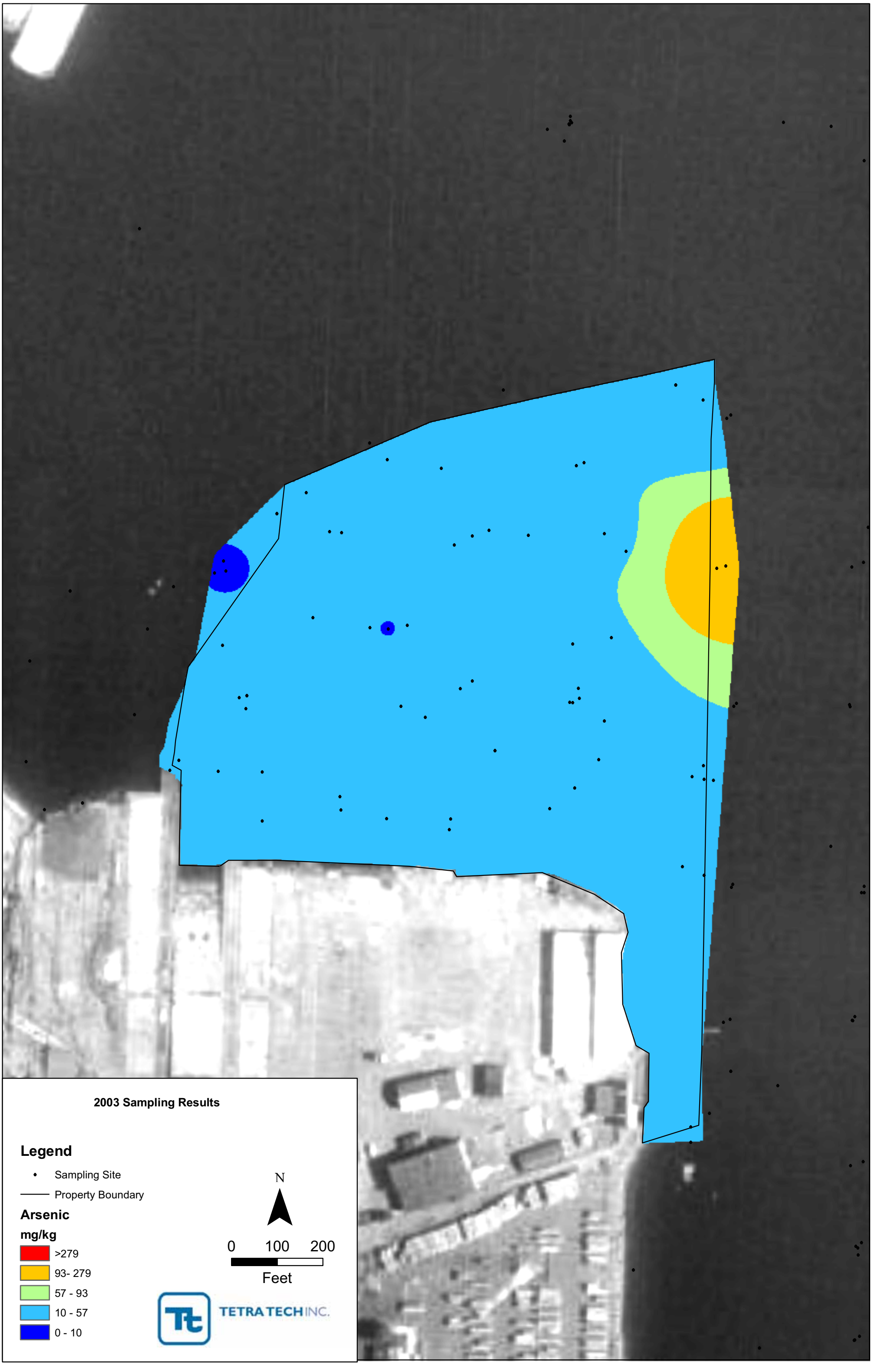
FIELDS OUTPUT

(on CD)

Sediment contaminant distributions were mapped using EPA's Fields Program. The Fields program was used to contour surface sediment concentrations represented by the historical (Pre 1998) sediment quality data for the site and surrounding areas and the recent (2003) surface sediment distribution. These depictions of the historical surface data are useful for generally examining historical contaminant distributions but do not account for temporal differences between sampling events. The historical sediment quality data Fields contours are shown in the West Waterway as well as south Elliot Bay including the area within the Lockheed West property boundary. The recent (2003) data was only collected within the Lockheed West property boundary. A comparison was made between the Fields program contours of the historical data and the 2003 data contours by putting an overlay of the 2003 contours within the Lockheed West property boundary on top of the Historical Fields program contours. This overlay shows the difference in spatial contamination contours between historical data and the recent data. The two data sets were independently contoured and overlain for comparison; new contours were not generated between the two data sets.

The map sets are organized by COI starting with the historic fields contours, then the recent 2003 fields contours, followed by the overly of the 2003 contours within the Lockheed West project boundary on top of the historic fields contours. The COI are in order of discussion in Section 4.6: metals (arsenic, cadmium, chromium, copper, lead, mercury, and zinc), Low-molecular Weight Polycyclic Aromatic Hydrocarbons (LPAH), High-molecular Weight Polycyclic Aromatic Hydrocarbons (HPAH), Polychlorinated Biphenyls (PCBs), and Tributyltin (TBT).


Pre-2003 Sampling Results
Legend
Sampling Site
Property Boundary
Arsenic
mg/kg
> 279
93 - 279
57 - 93
10 - 57
0 - 10
N
0
250
500
Feet
TETRA TECH INC.


2003 Sampling Results
Legend
Sampling Site
Property Boundary
Arsenic
mg/kg
>279
93- 279
57 - 93
10 - 57
0 - 10
N
0
100
200
Feet
TETRA TECH INC.

Pre-2003 and 2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

Arsenic

mg/kg

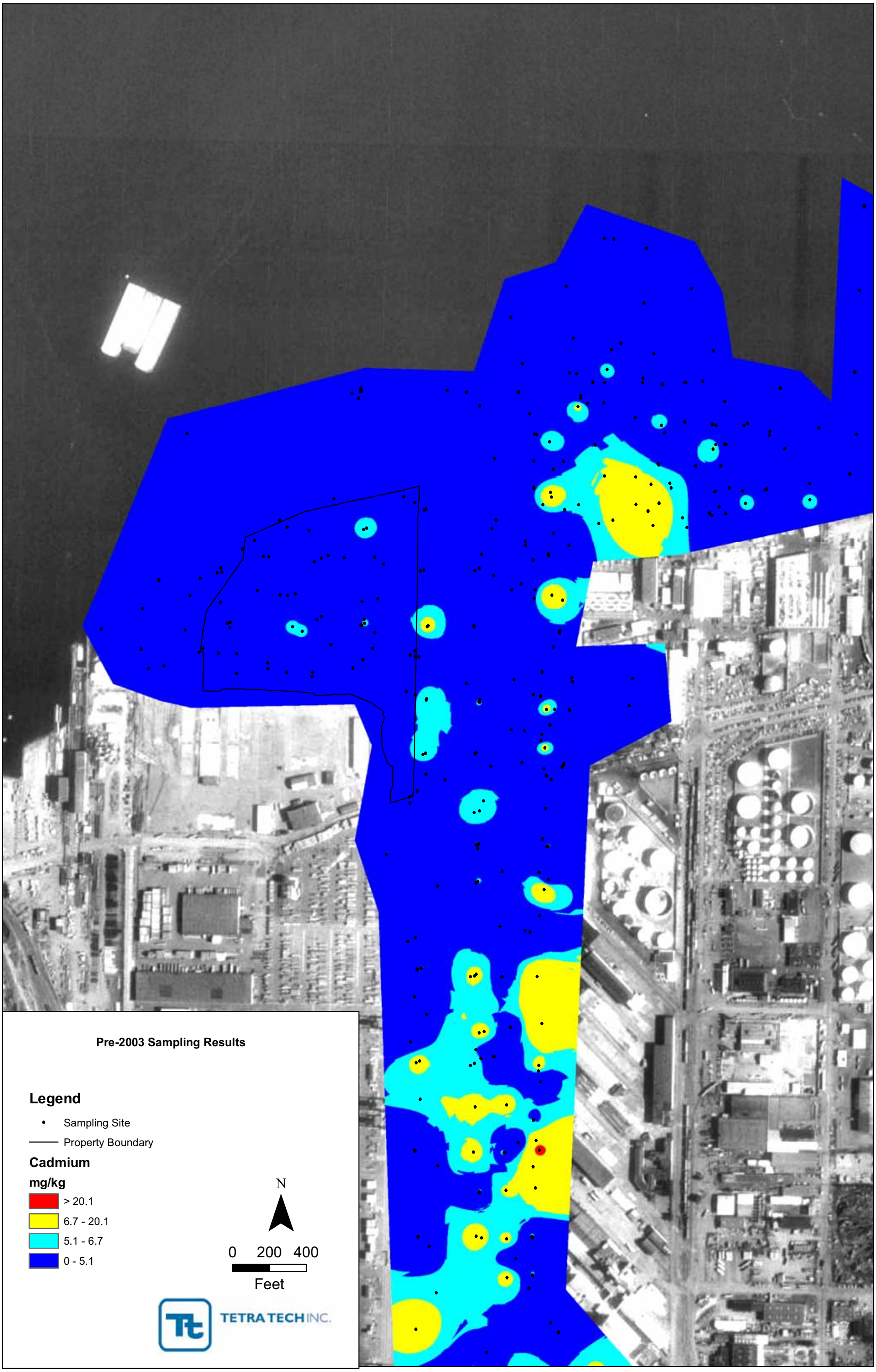
- >279
- 93- 279
- 57 - 93
- 10 - 57
- 0 - 10

N

0 250 500

Feet

TETRA TECH INC.


Pre-2003 Sampling Results
Legend
Sampling Site
Property Boundary
Cadmium
mg/kg
> 20.1
6.7 - 20.1
5.1 - 6.7
0 - 5.1
N
0 200 400
Feet
TETRA TECH INC.

2003 Sampling Results

Legend

- Sampling Site

Property Boundary

Cadmium

mg/kg

- > 20.1
- 6.7 - 20.1
- 5.1 - 6.7
- 0 - 5.1

N

0 100 200

Feet

TETRA TECH INC.

Pre-2003 and 2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

Cadmium

mg/kg

- > 20.1
- 6.7 - 20.1
- 5.1 - 6.7
- 0 - 5.1

N

0 200 400

Feet

TETRA TECH INC.

Pre-2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

Chromium

mg/kg

- > 810
- 270 - 810
- 260 - 270
- 0 - 260

N

0 200 400

Feet

TETRA TECH INC.


2003 Sampling Results
Legend
Sampling Site
Property Boundary
Chromium
mg/kg
> 810
270 - 810
260 - 270
0 - 260
N
0
100
200
Feet
TETRA TECH INC.

Pre-2003 and 2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

Chromium

mg/kg

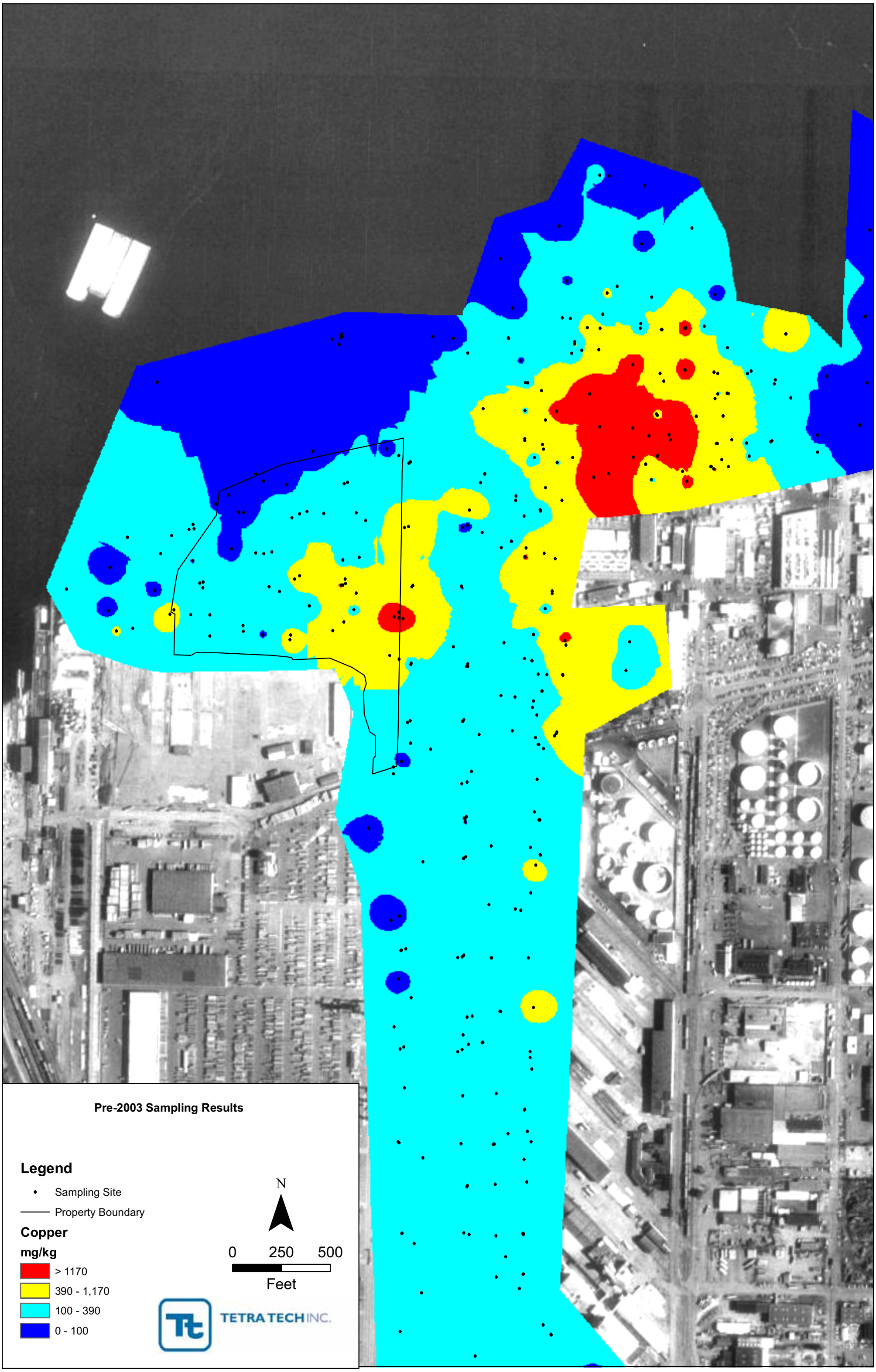
- > 810
- 270 - 810
- 260 - 270
- 0 - 260

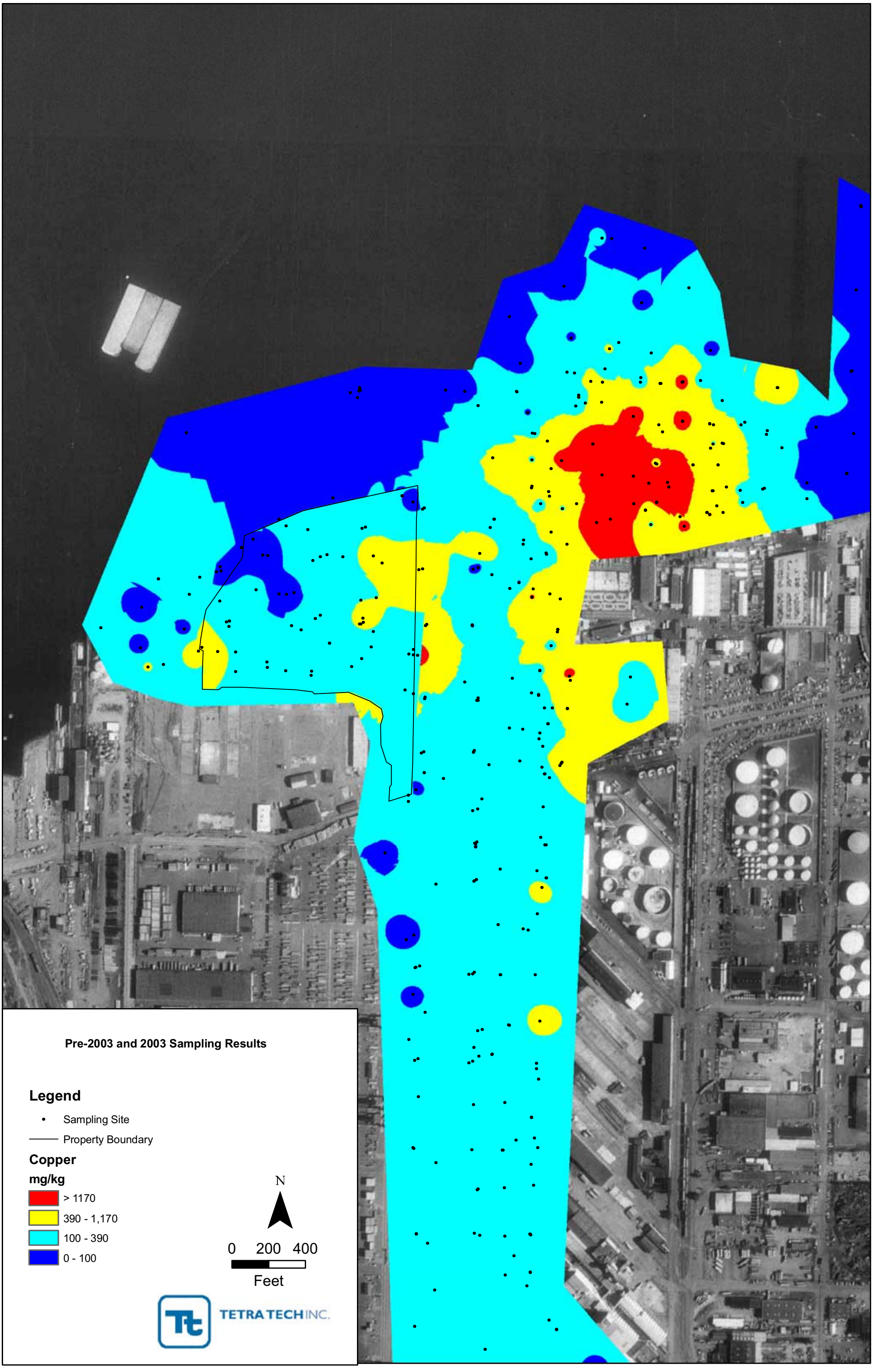
N

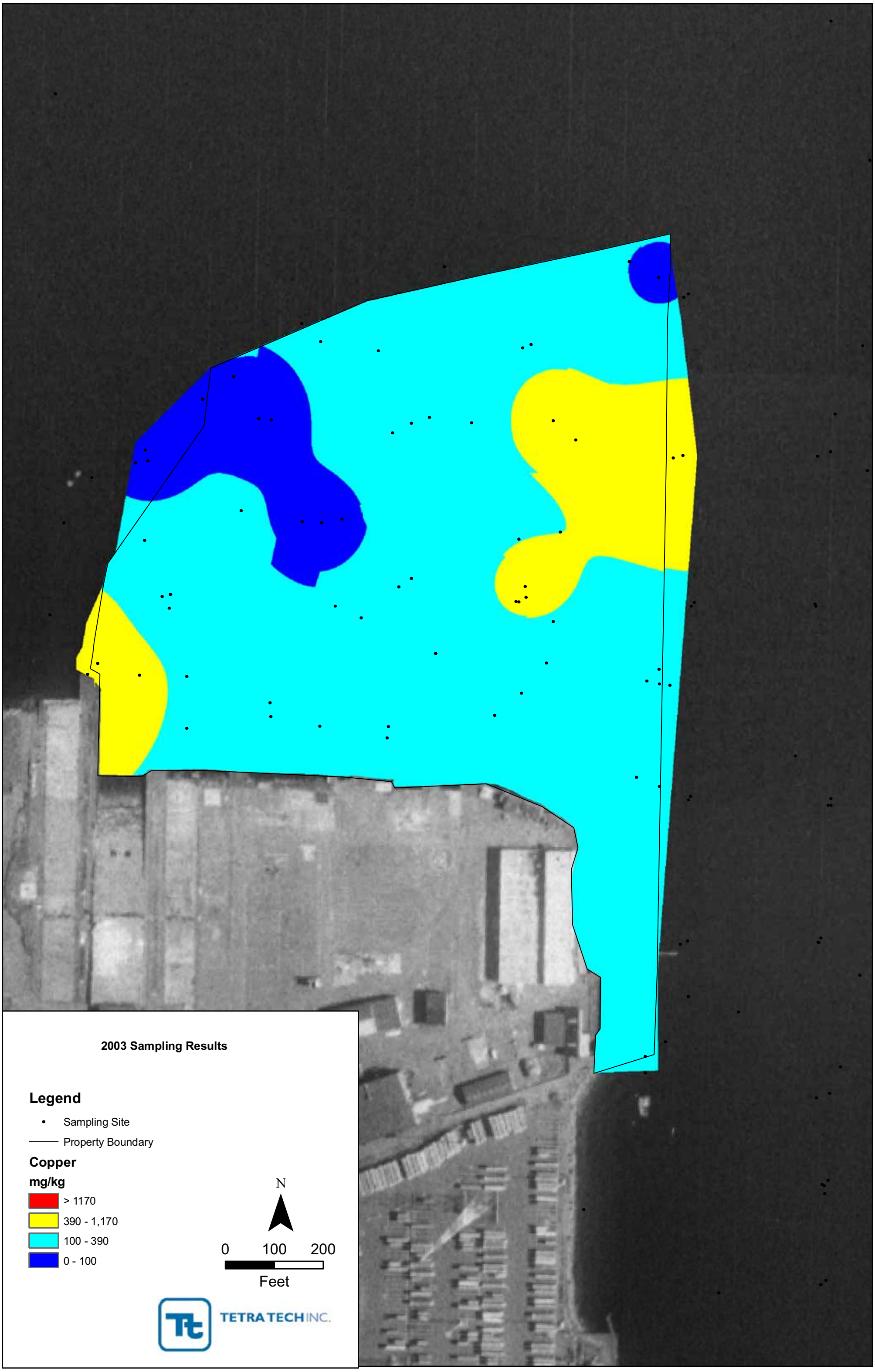
0 200 400

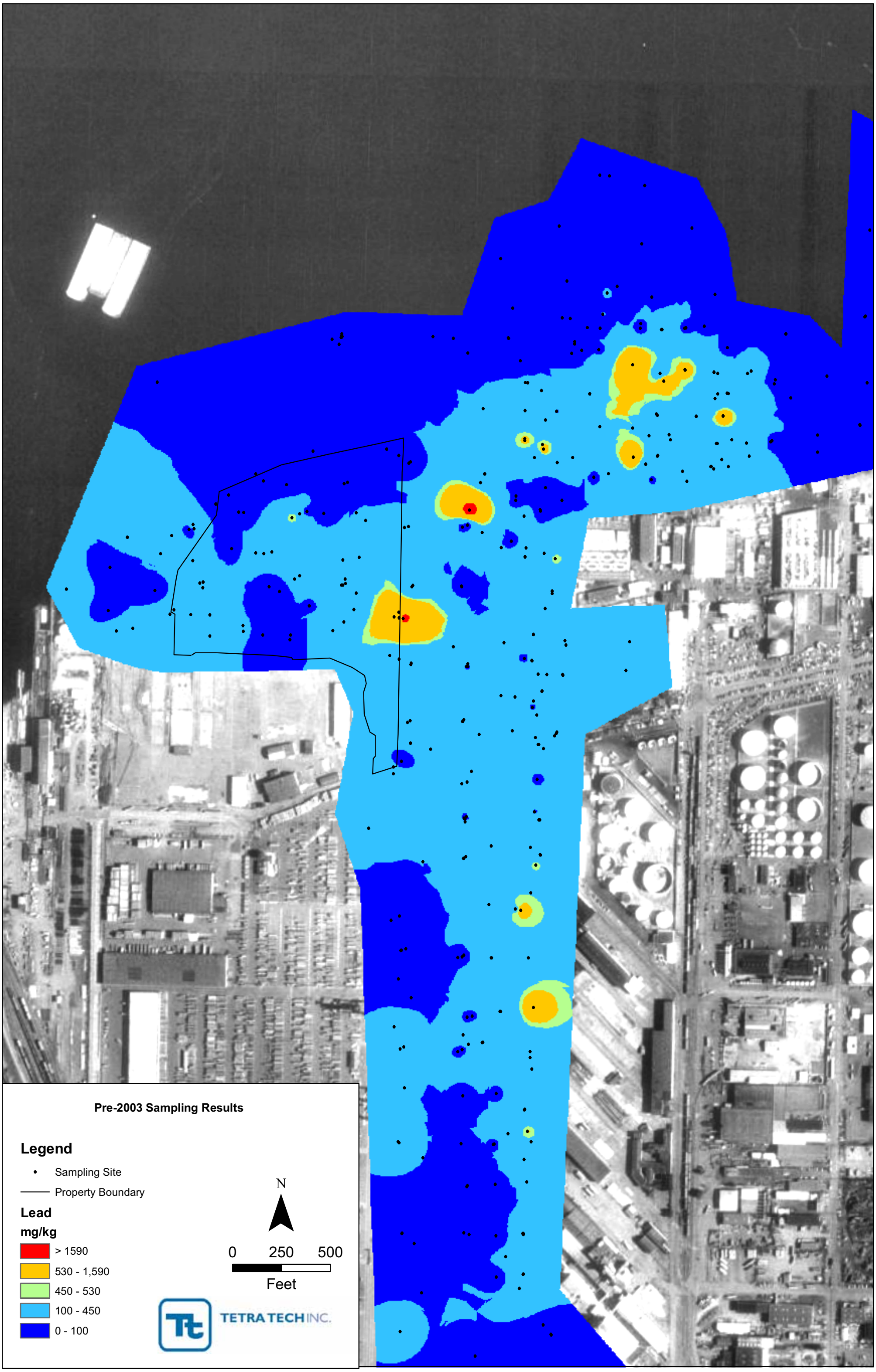
Feet

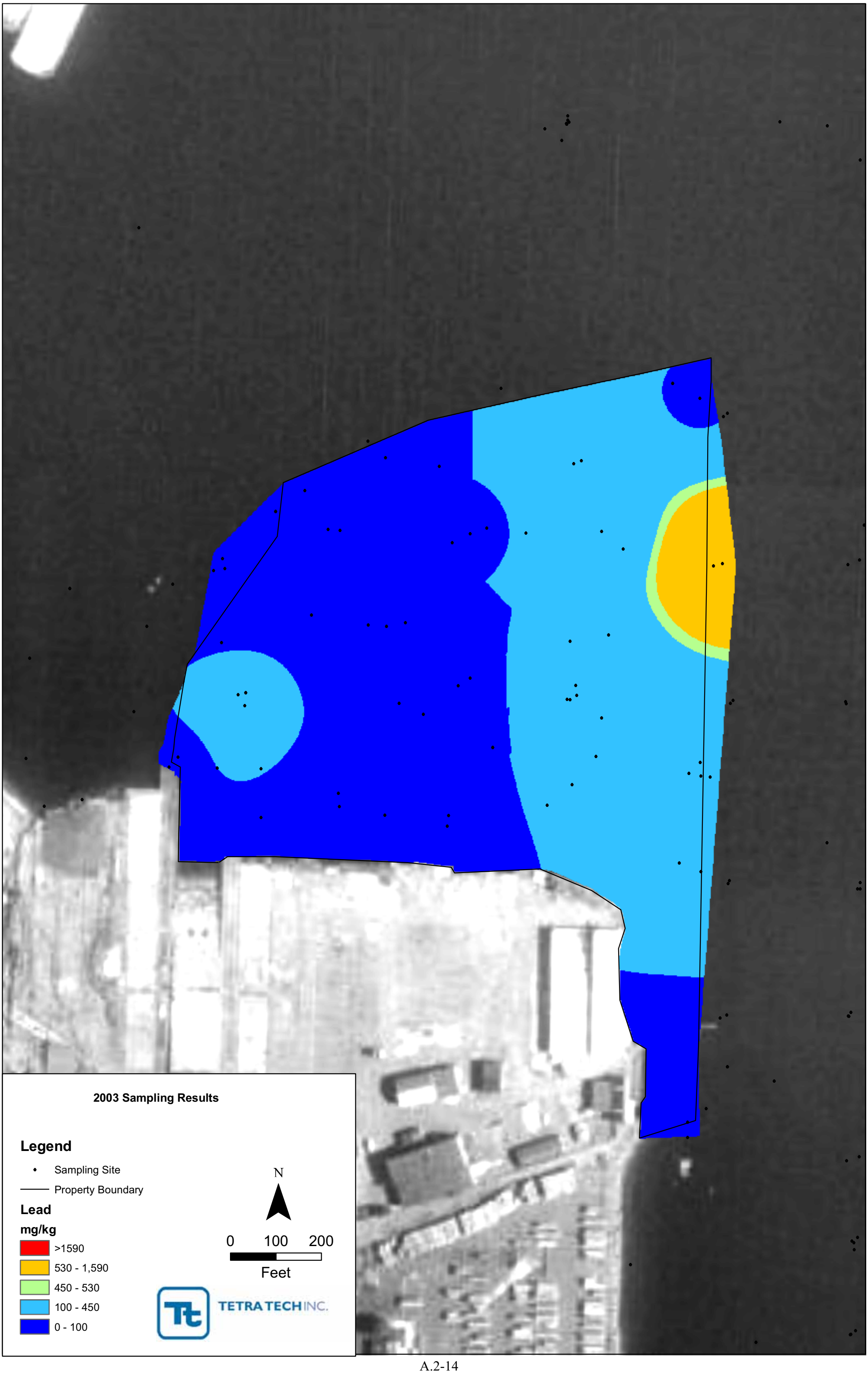
TETRA TECH INC.

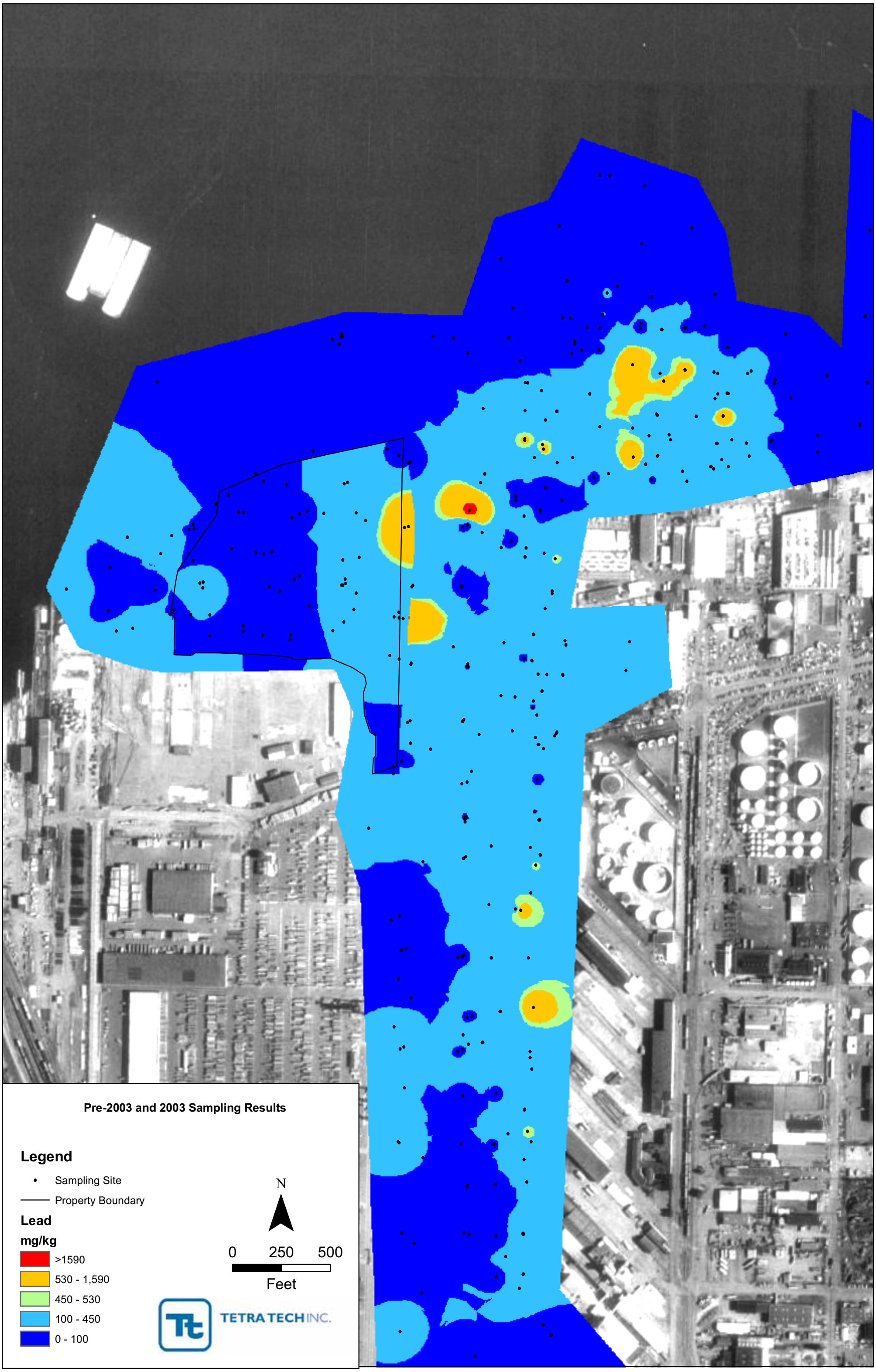

Pre-2003 Sampling Results
Legend
Sampling Site
Property Boundary
Copper
mg/kg
> 1170
390 - 1,170
100 - 390
0 - 100
N
0
250
500
Feet
TETRA TECH INC.

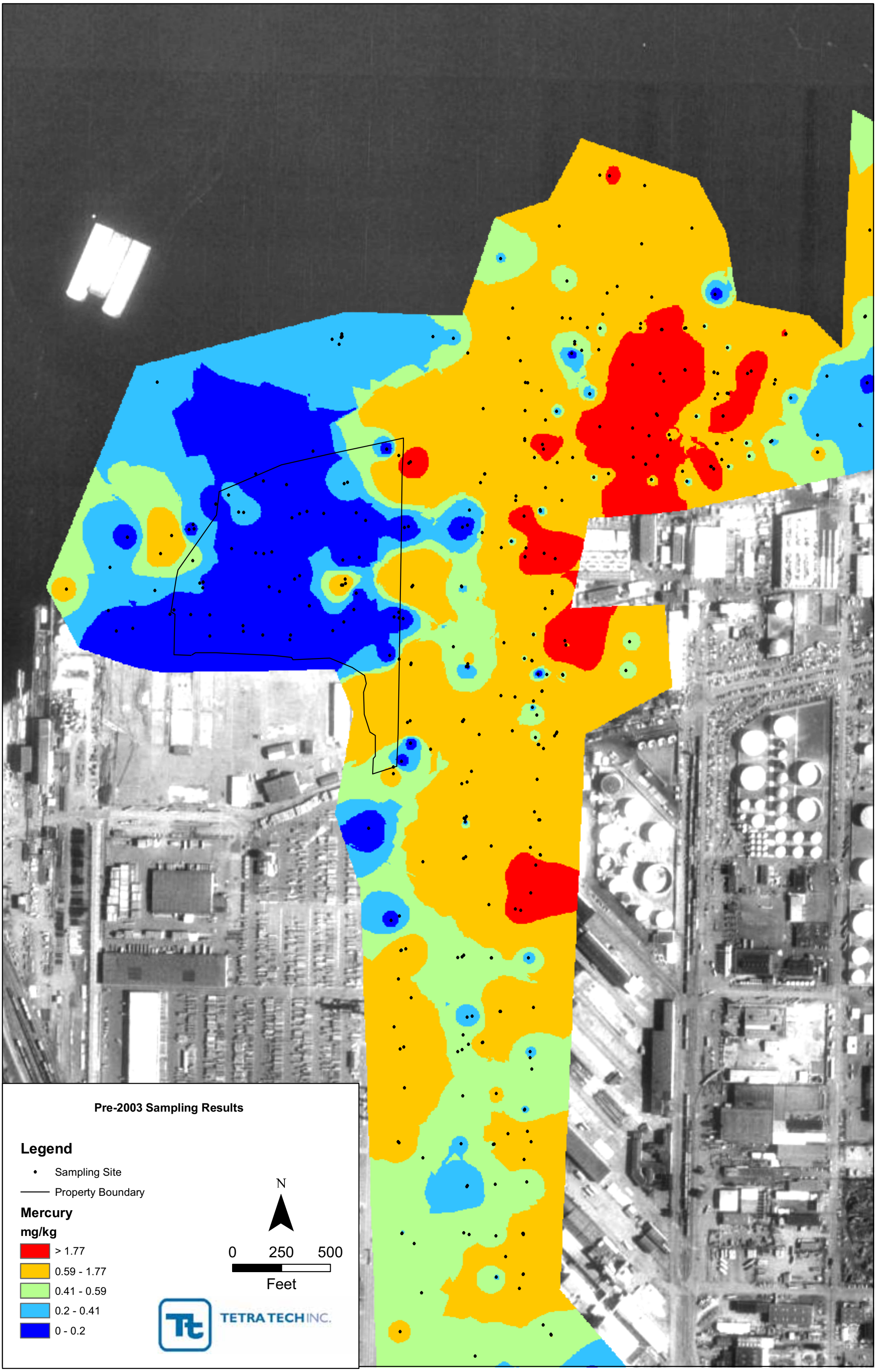

Pre-2003 and 2003 Sampling Results
Legend
Sampling Site
Property Boundary
Copper
mg/kg
> 1170
390 - 1,170
100 - 390
0 - 100
N
0 200 400
Feet
TETRA TECH INC.

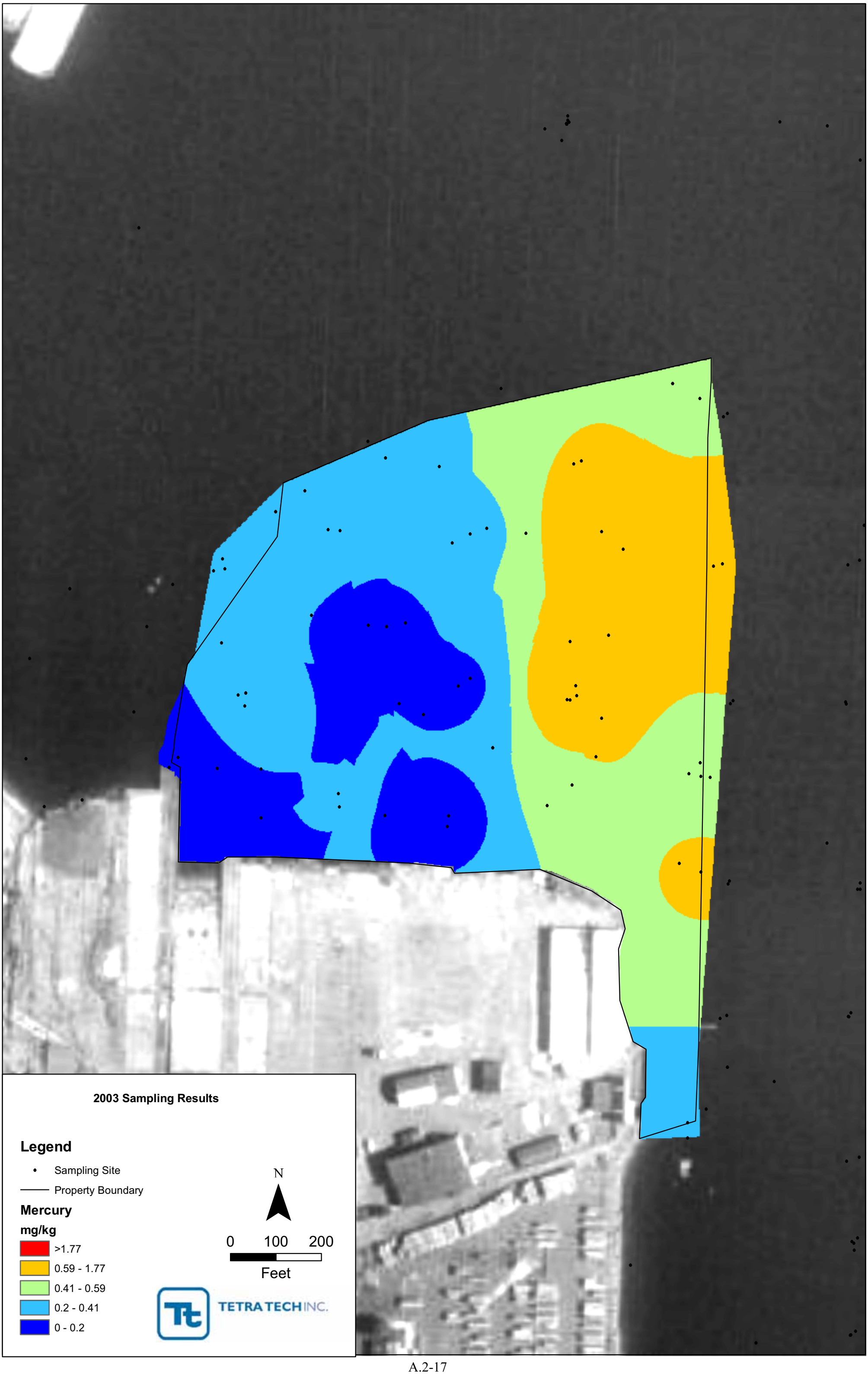

2003 Sampling Results
Legend
Sampling Site
Property Boundary
Copper
mg/kg
> 1170
390 - 1,170
100 - 390
0 - 100
N
0
100
200
Feet
TETRA TECH INC.

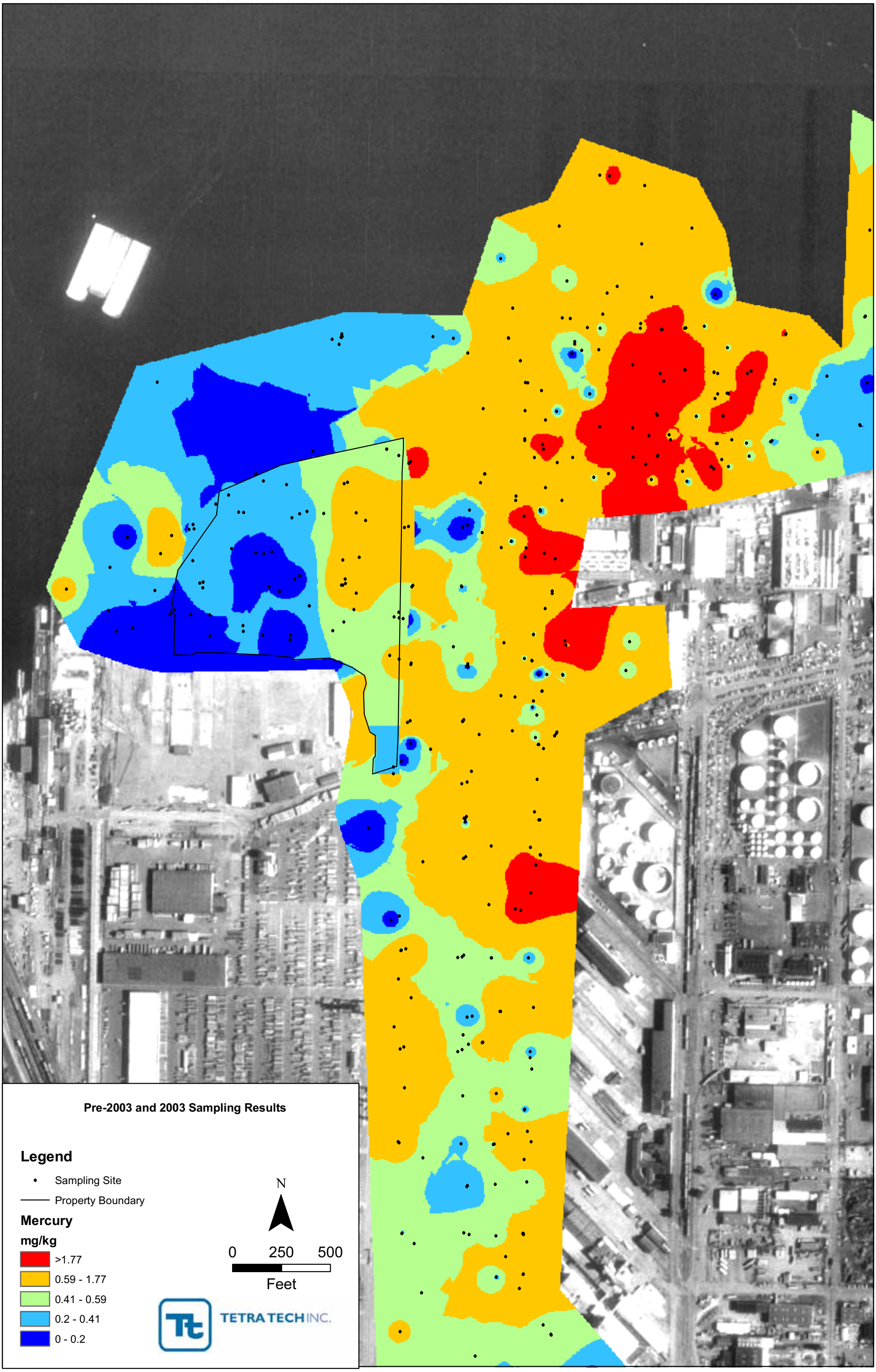

Pre-2003 Sampling Results
Legend
Sampling Site
Property Boundary
Lead
mg/kg
> 1590
530 - 1,590
450 - 530
100 - 450
0 - 100
N
0
250
500
Feet
TETRA TECH INC.

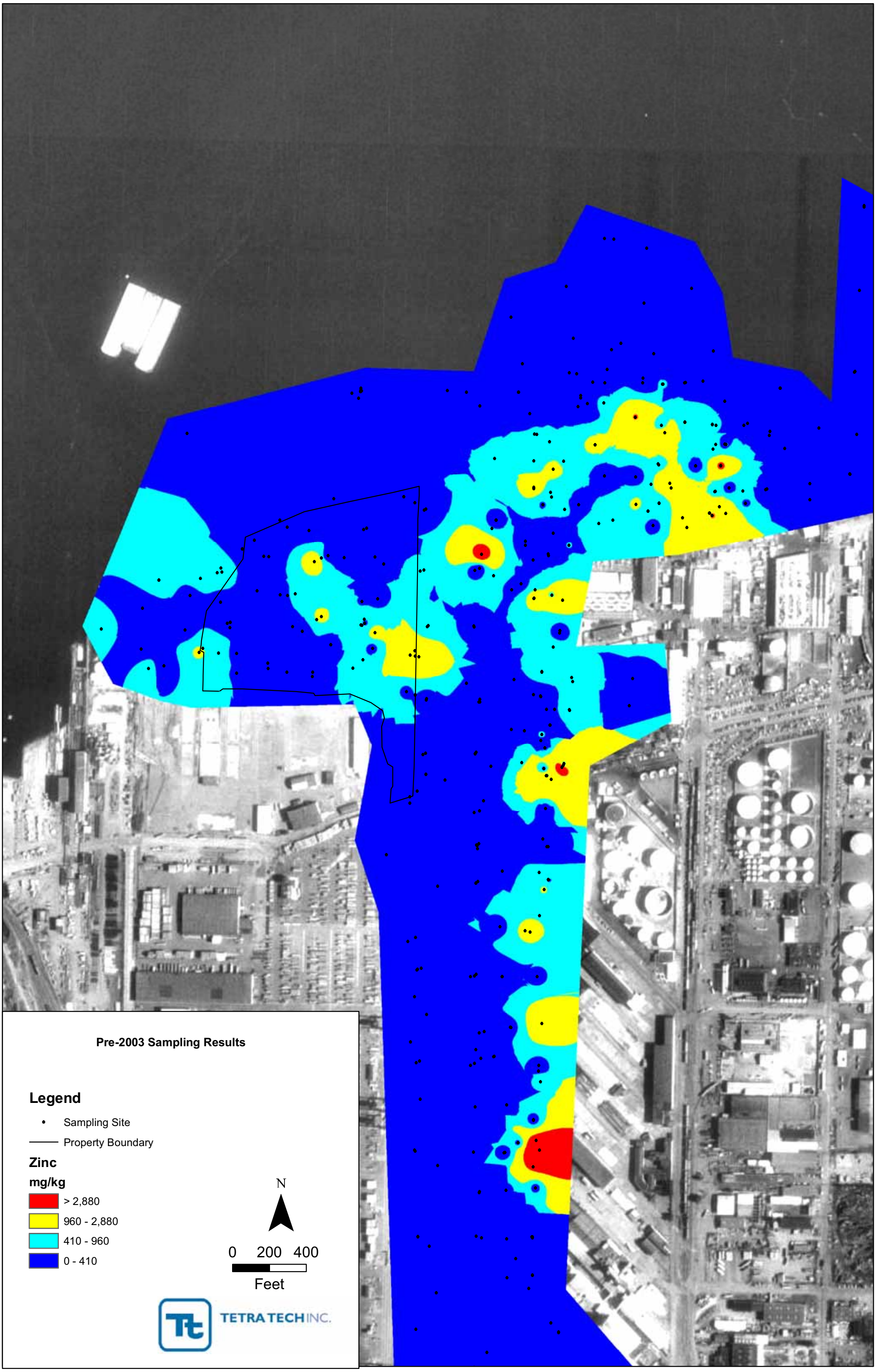

2003 Sampling Results
Legend
Sampling Site
Property Boundary
Lead
mg/kg
>1590
530 - 1,590
450 - 530
100 - 450
0 - 100
N
0
100
200
Feet
TETRA TECH INC.

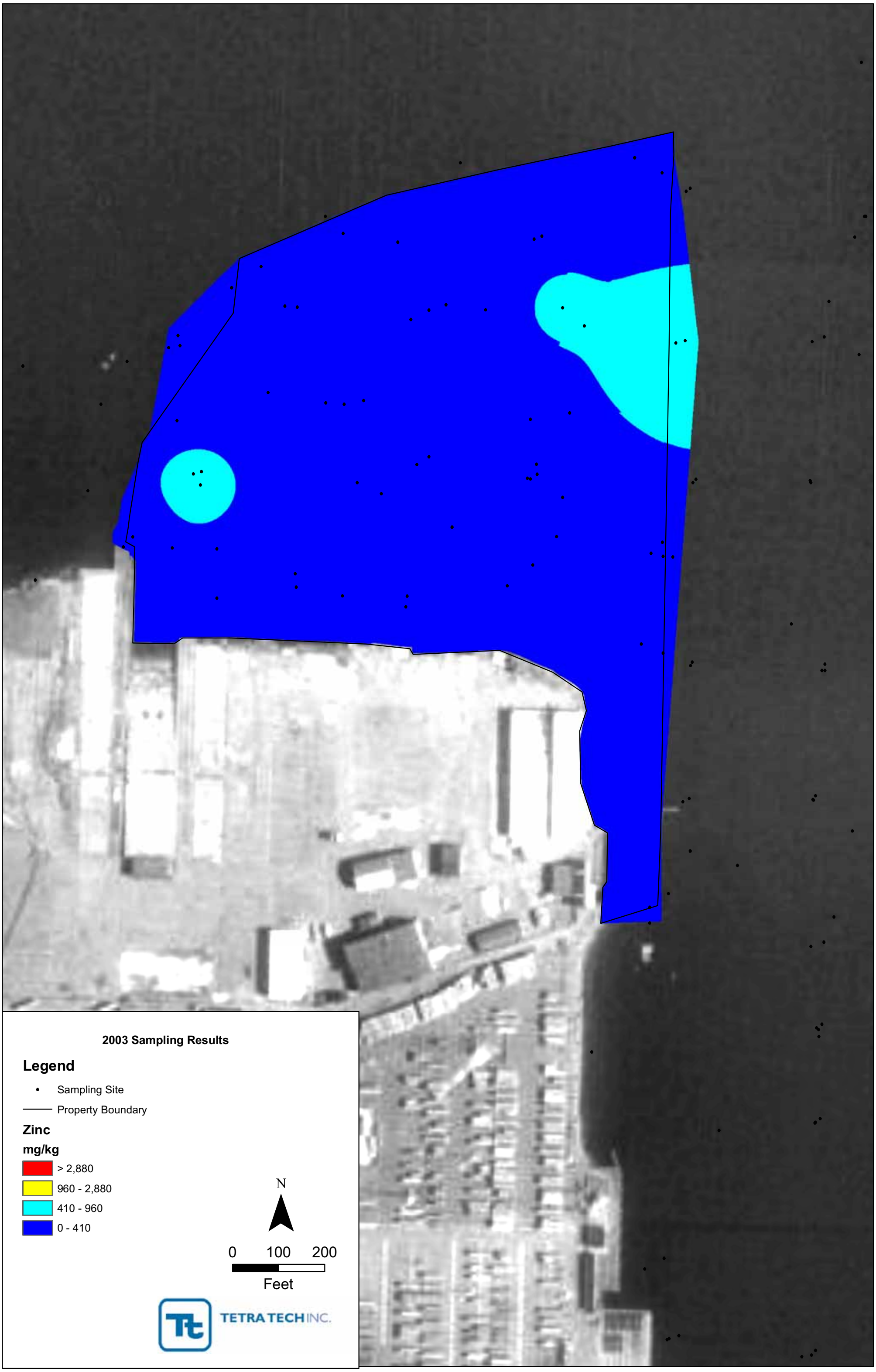

Pre-2003 and 2003 Sampling Results
Legend
Sampling Site
Property Boundary
Lead
mg/kg
>1590
530 - 1,590
450 - 530
100 - 450
0 - 100
N
0
250
500
Feet
TETRA TECH INC.

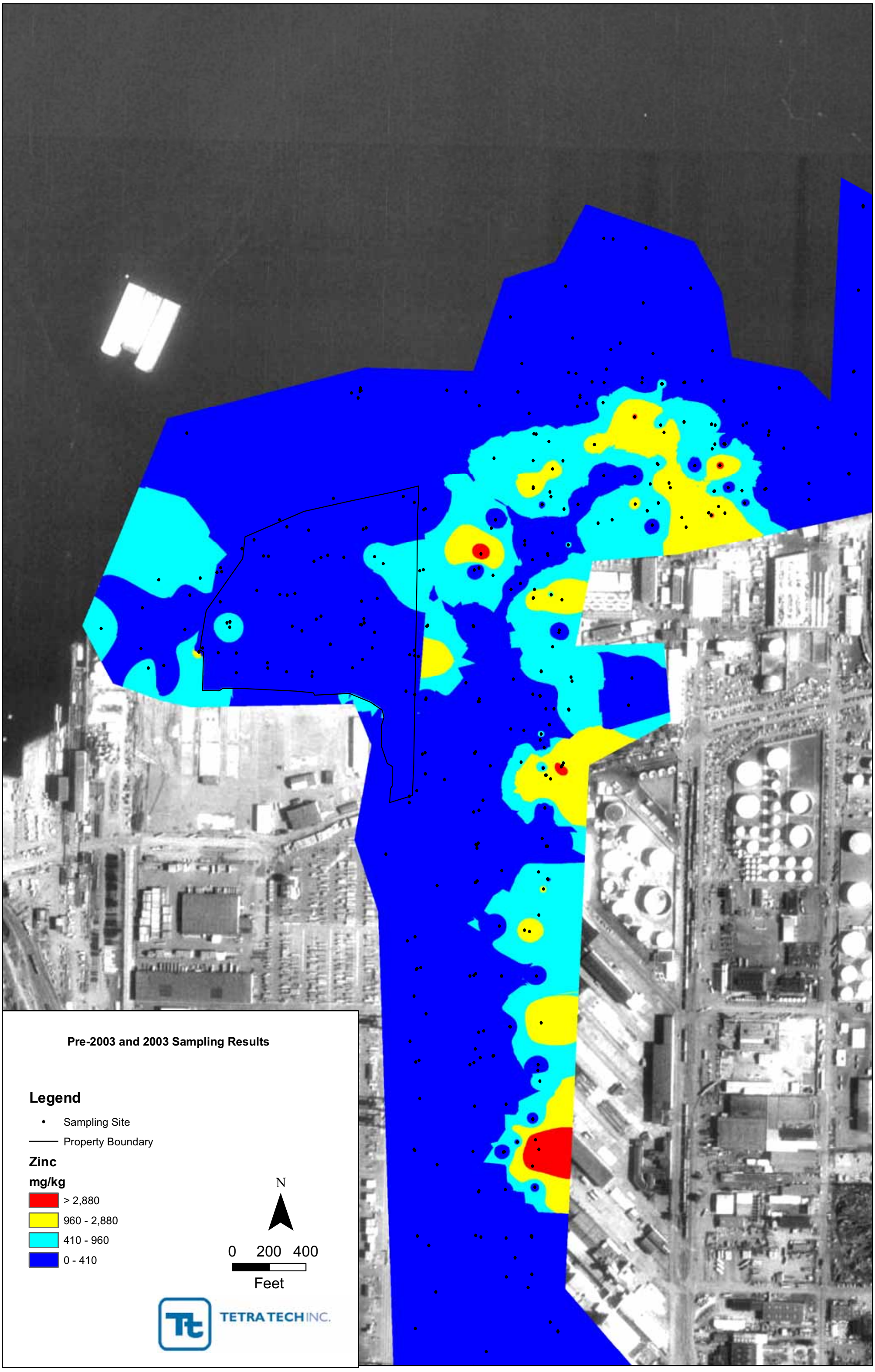

Pre-2003 Sampling Results
Legend
Sampling Site
Property Boundary
Mercury
mg/kg
> 1.77
0.59 - 1.77
0.41 - 0.59
0.2 - 0.41
0 - 0.2
N
0
250
500
Feet
TETRA TECH INC.


2003 Sampling Results
Legend
Sampling Site
Property Boundary
Mercury
mg/kg
>1.77
0.59 - 1.77
0.41 - 0.59
0.2 - 0.41
0 - 0.2
N
0
100
200
Feet
TETRA TECH INC.


Pre-2003 and 2003 Sampling Results
Legend
Sampling Site
Property Boundary
Mercury
mg/kg
>1.77
0.59 - 1.77
0.41 - 0.59
0.2 - 0.41
0 - 0.2
N
0
250
500
Feet
TETRA TECH INC.


Pre-2003 Sampling Results
Legend
Sampling Site
Property Boundary
Zinc
mg/kg
> 2,880
960 - 2,880
410 - 960
0 - 410
N
0 200 400
Feet
TETRA TECH INC.


2003 Sampling Results
Legend
Sampling Site
Property Boundary
Zinc
mg/kg
> 2,880
960 - 2,880
410 - 960
0 - 410
N
0 100 200
Feet
TETRA TECH INC.


Pre-2003 and 2003 Sampling Results
Legend
Sampling Site
Property Boundary
Zinc
mg/kg
> 2,880
960 - 2,880
410 - 960
0 - 410
N
0 200 400
Feet
TETRA TECH INC.

Pre-2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

LPAH

mg/kg-OC

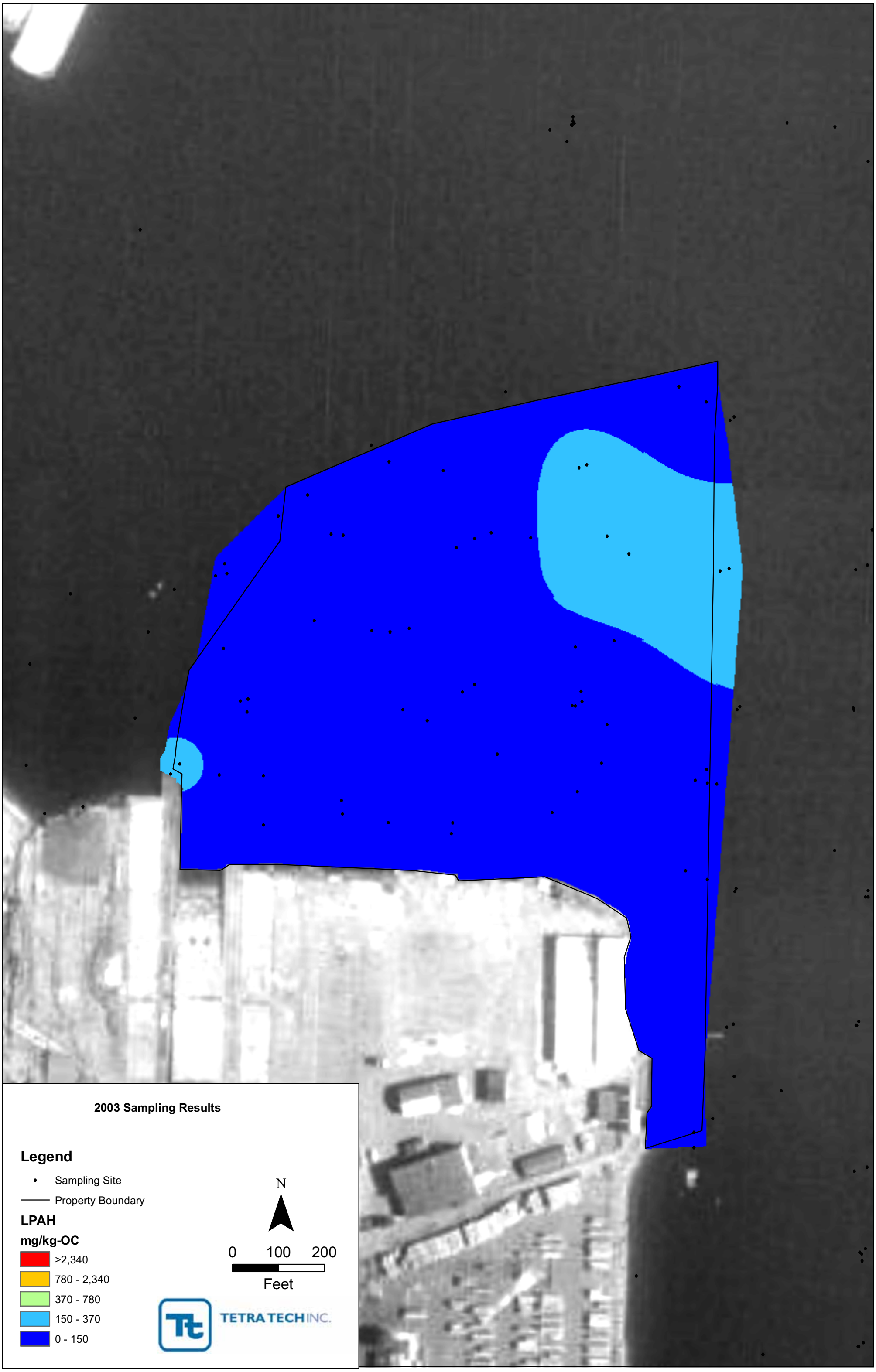
- > 2,340
- 780 - 2,340
- 370- 780
- 150 - 370
- 0 - 150

N

0 250 500

Feet

TETRA TECH INC.


2003 Sampling Results
Legend
Sampling Site
Property Boundary
LPAH
mg/kg-OC
>2,340
780 - 2,340
370 - 780
150 - 370
0 - 150
N
0
100
200
Feet
TETRA TECH INC.

Pre-2003 and 2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

LPAH

mg/kg-OC

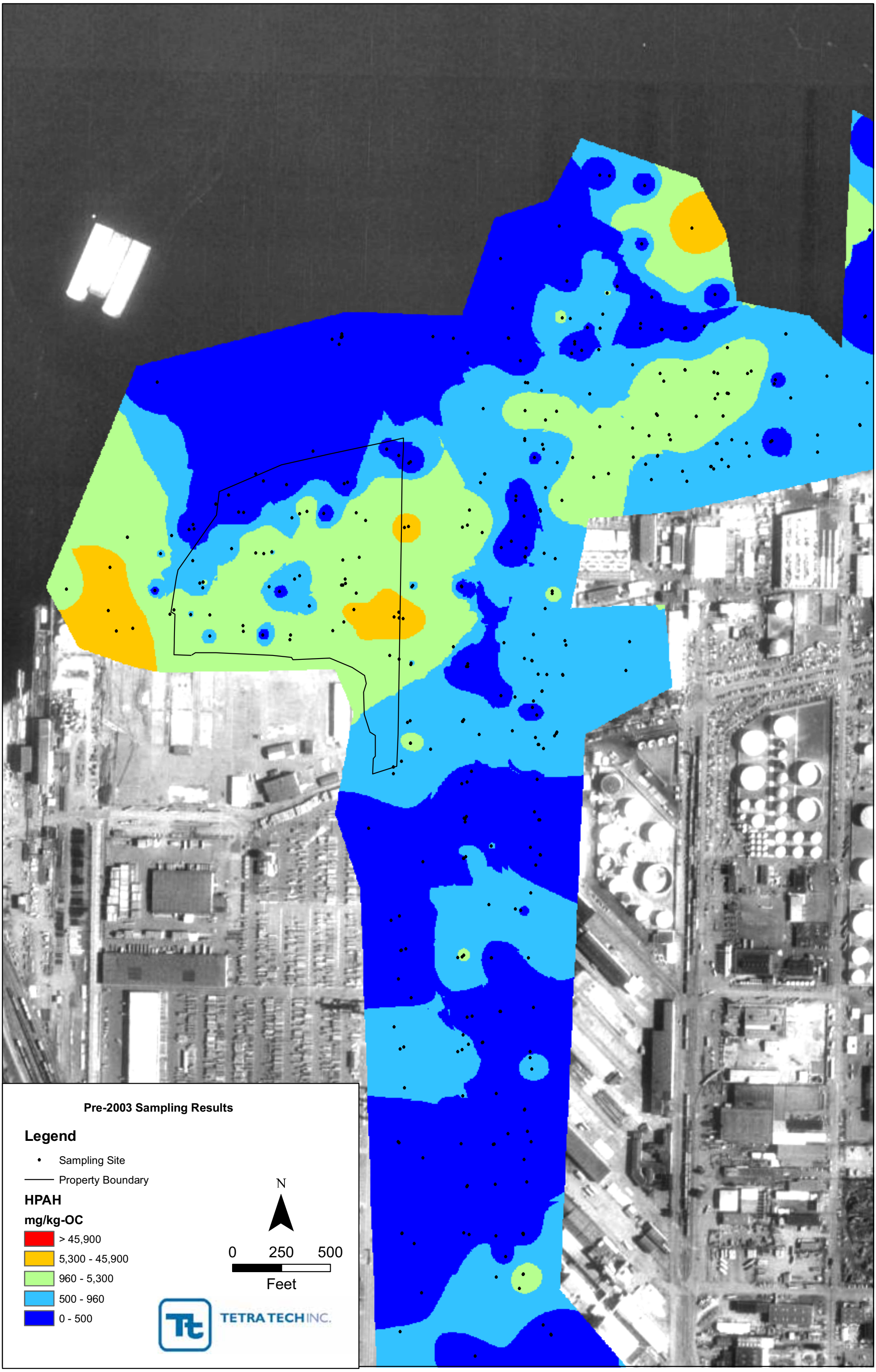
- > 2,340
- 780 - 2,340
- 370- 780
- 150 - 370
- 0 - 150

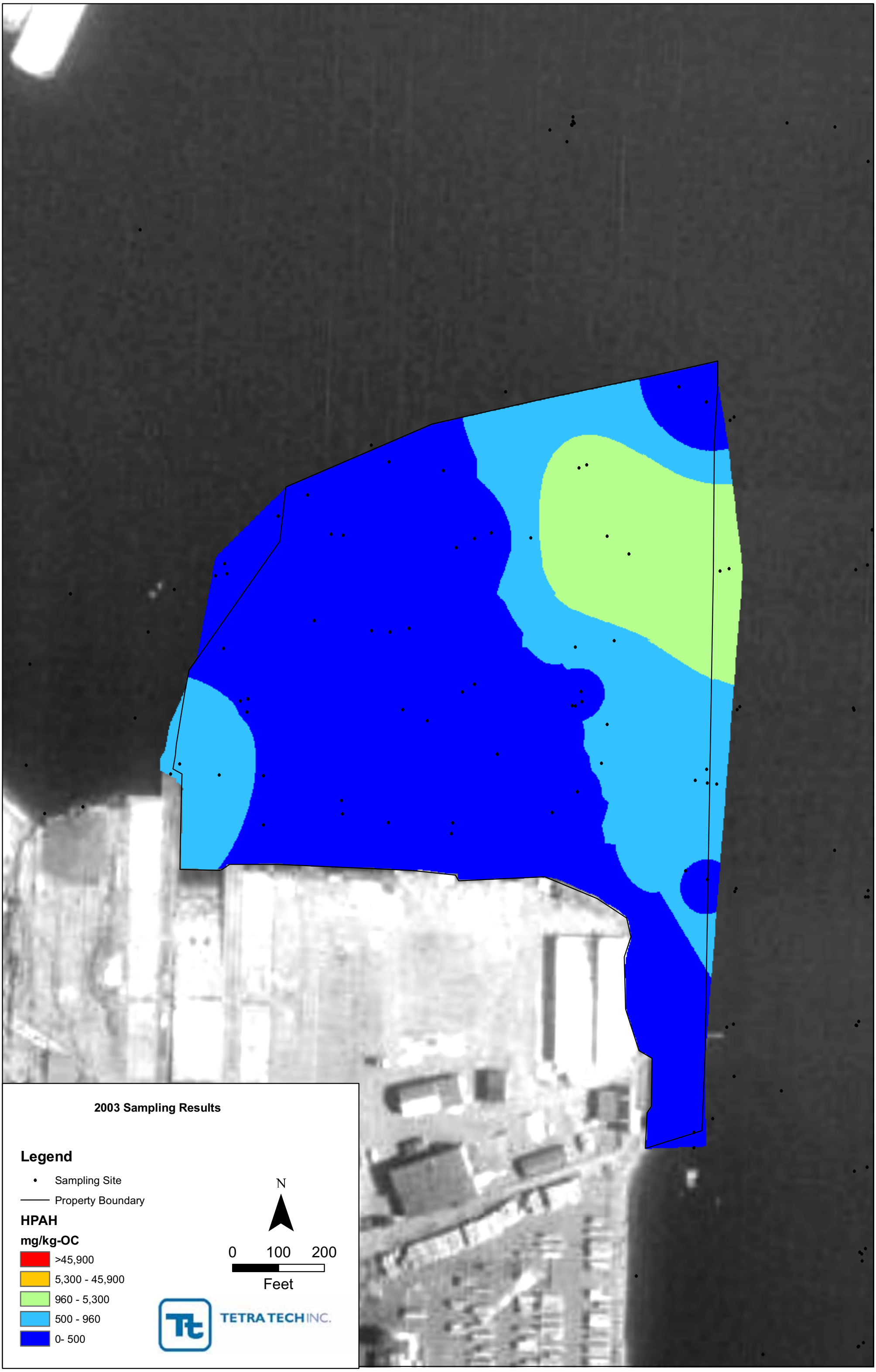
N

0 250 500

Feet

TETRA TECH INC.


Pre-2003 Sampling Results
Legend
Sampling Site
Property Boundary
HPAH
mg/kg-OC
> 45,900
5,300 - 45,900
960 - 5,300
500 - 960
0 - 500
N
0
250
500
Feet
TETRA TECH INC.


2003 Sampling Results
Legend
Sampling Site
Property Boundary
HPAH
mg/kg-OC
>45,900
5,300 - 45,900
960 - 5,300
500 - 960
0- 500
N
0
100
200
Feet
TETRA TECH INC.

Pre-2003 and 2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

HPAH

mg/kg-OC

- > 45,900
- 5,300 - 45,900
- 960 - 5,300
- 500 - 960
- 0 - 500

N

0 250 500

Feet

TETRA TECH INC.

Pre-2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

PCBs

mg/kg-OC

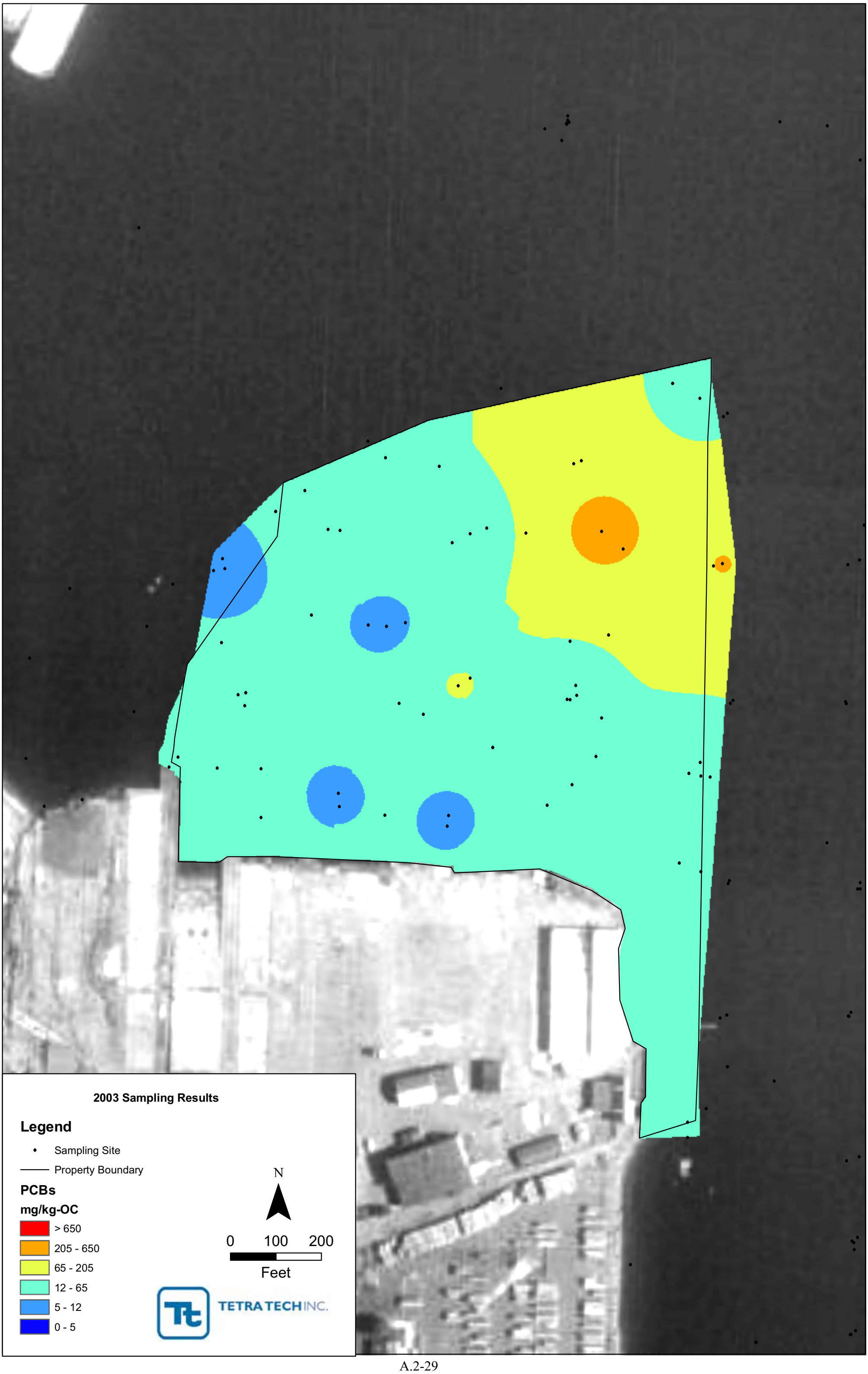
- > 650
- 205 - 650
- 65 - 205
- 12 - 65
- 5 - 12
- 0 - 5

N

0 250 500

Feet

TETRA TECH INC.


2003 Sampling Results
Legend
Sampling Site
Property Boundary
PCBs
mg/kg-OC
> 650
205 - 650
65 - 205
12 - 65
5 - 12
0 - 5
N
0
100
200
Feet
TETRA TECH INC.

Pre-2003 and 2003 Sampling Results

Legend

- Sampling Site
- Property Boundary

PCBs

mg/kg-OC

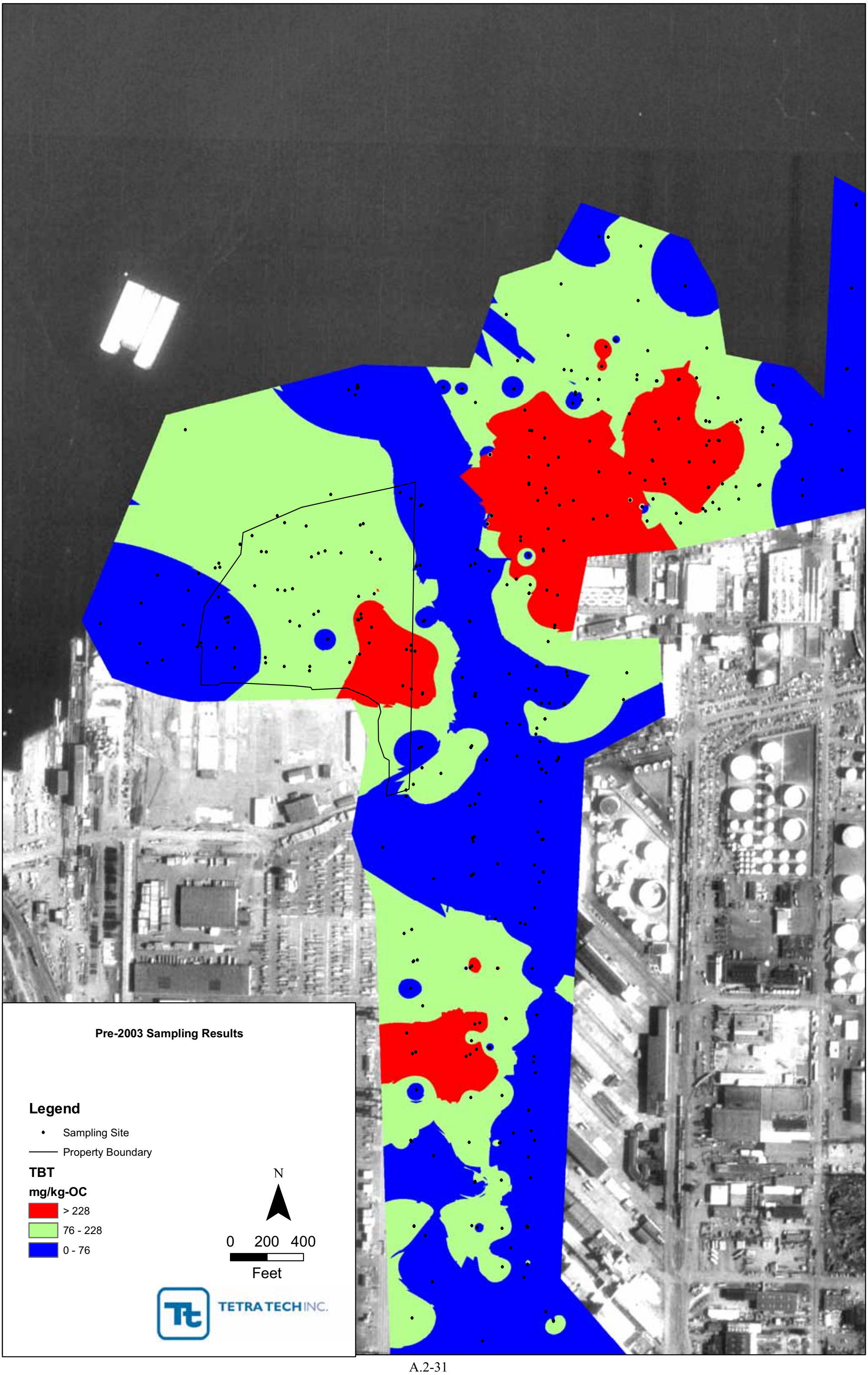
- > 650
- 205 - 650
- 65 - 205
- 12 - 65
- 5 - 12
- 0 - 5

N

0 250 500

Feet

TETRA TECH INC.


Pre-2003 Sampling Results
Legend
Sampling Site
Property Boundary
TBT
mg/kg-OC
> 228
76 - 228
0 - 76
N
0 200 400
Feet
TETRA TECH INC.

2003 Sampling Results

Legend

- Sampling Site

Property Boundary

TBT

mg/kg-OC

> 228

76 - 228

0 - 76

N

0 100 200

Feet

TETRA TECH INC.


Pre-2003 and 2003 Sampling Results
Legend
Sampling Site
Property Boundary
TBT
mg/kg-OC
> 228
76 - 228
0 - 76
N
0 200 400
Feet
TETRA TECH INC.

APPENDIX A.3

DISTILLATION REPORT (ENVIROS 1993)

(UPLAND SEDIMENT AND GEOLOGY DATA)

(on CD)

enviros

Prepared for:

Port of Seattle
Seattle, Washington

Site Location:

Former Lockheed Shipyard
West Seattle, Washington

VOLUME II
Appendix A to Feasibility Study

Distillation Report Summarizing McLaren/ Hart and Enviros Remedial Investigation Work at the Former Lockheed Shipyard (Yard II) in West Seattle, Washington

March 19, 1993 ***900819.16.8***

Enviros, Inc. 5808 Lake Washington Boulevard Northeast, Kirkland (Seattle), Washington 98033 Tel 206 / 827-5525 Fax 206 / 827-3299

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ATTACHMENT A: SOIL, GROUNDWATER AND STORM DRAIN SEDIMENT ANALYTICAL DATA

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I. Introduction

This appendix summarizes existing remedial investigation (RI) data collected by McLaren/ Hart (M/H) on behalf of Lockheed and collected by Enviros on behalf of the Port of Seattle (the Port) since the RI was initiated in 1988. The data base generated during the RI provides the foundation for the feasibility study (FS) work. Section 7 contains references for all M/H and Enviros reports generated to date. The following M/H and Enviros documents provide complete documentation of RI work and present the RI data and procedures in detail:

1. McLaren/ Hart, *Remedial Investigation Report Lockheed Shipbuilding Company Seattle, Yard II Facility,* September 1992, volumes 1 through 12 including data from six previous episodes of M/H sampling (M/H 1988, December 1989, September 1989, January 1990, August 1990, and a groundwater sampling episode in May 1992 not documented previously) as well as two supplementary Enviros reports:

   a. Enviros, Final Report for the Combined Remedial Investigation of Lockheed Shipbuilding Company Seattle Yard II, July 1991;

   b. Enviros, Final Report Former East Inlet Area Drilling and Sampling Project, March 4, 1992a; and

2. Enviros, Final Report: Tidal Monitoring Investigation Report of the Lockheed Property, 2330 SW Florida Street Seattle, Washington, September 17, 1992b.

M/H (1992) incorporates about 95 to 98% of the characterization data and includes data from Enviros (1991 and 1992a) but does not include data presented in Enviros (1992b). It also does not include additional data collected in September 1992, during the treatability evaluation of the FS, when soil samples were collected from 11 areas using a backhoe.

As part of the RI, ChemRisk (a division of M/H) produced a site Human Health risk assessment (RA) titled: *An Evaluation of Potential Human Health and Aquatic Impacts Associated with Current Conditions and Proposed Future Construction Activities at the Lockheed Shipyard II Site,* May 27, 1992, volumes 1 through 8.

The RA used data presented in M/H (September 1992) but does <u>not</u> utilize data from the following:

1. Enviros (1992a and 1992b);

2. Data from an additional round of groundwater sampling conducted by M/H in May 1992; and

3. The additional data collected by Enviros in September 1992, during the treatability evaluation of the FS, when soil samples were collected from eleven areas using a backhoe.

It is the purpose of this appendix to present a complete compilation of characterization data to provide a single working document comprising the data foundation for the FS. This compilation includes presentation of summary statistics (area-weighted averages, upper and lower concentrations, 95% upper confidence levels).

2. Summary of Potential Source Areas

Table 1 contains a summary of 36 potential upland source areas and associated characterization activities (source areas 33 and 34 are not listed and are no longer considered to be potential source areas, and source area 24 was eliminated from statistical analysis because no soil samples were collected from this area). Characterization work was focused around the potential source areas. Table 1 presents locations and descriptions of the potential source areas and chemicals of concern. Figure 1 plots the approximate locations of each source area.

Figure 2 presents a Theissen polygon grid used in ChemRisk (1992) to calculate area weighted averages and 95% upper confidence levels (UCLs) for site contaminants. Using Theissen polygons provides a method of area-weighting data from fields of scattered points in order to obtain a representative estimate of the population mean and 95% UCLs. The calculated weighted averages are considered to be representative of conditions around each of the 31 source areas within each of the 31 polygons. Each of the polygons in Figure 2 are numbered for the source area within them. Organizing data by source area polygons provides a useful means of organizing analytical data. Note that the boundaries of the Theissen polygons, while drawn according to standard procedures, do not necessarily encompass "hot spots"; in fact, it is possible for source area polygons statistics to suggest misleadingly lower contaminant levels if a number of samples had non-detectable concentrations. It is also possible for "hot spots" to straddle the boundaries between two or more source area polygons, which may also result in source area polygon statistics potentially suggesting misleading contaminant concentrations.

Table 1. Potential Source Area Summary

Source Area	Location/Description	Chemicals of Concern
Zone 1		
1	Sheet Metal Shop Bldg. 201	Petroleum hydrocarbons
2	Sheet Metal Shop Bldg. 201	Petroleum hydrocarbons
3	Electrical Shop Bldg. 202	Desiccant and cleaning solvents
4	North of Building 201	Solvents, cutting oils, lubricating oils
5	North of Building 201	Petroleum hydrocarbons, solvents, PNAs, heavy metals
Zone 2		
6	Hose Repair and Storage Building 205	Petroleum hydrocarbons
7	Equipment Storage Bldg. 236	Petroleum hydrocarbons
11	Pipe Cleaning Facility	Acid, solvents, petroleum products, heavy metals
28	Substation S200A	PCBs
31	Diesel Fuel Tank Bldg. 201	Diesel, gasoline, solvent
Zone 3		
8	Pipe Shop Bldg. 207	Acids, solvents, heavy metals, petroleum hydrocarbons
9	Pipe Shop Bldg. 207	Petroleum hydrocarbons, heavy metals
10	Pipe Shop Bldg. 207	Petroleum hydrocarbons, heavy metals
30	Substation S207	PCBs
Zone 4		
12	Automobile Shop Bldg. 208	Petroleum hydrocarbons, solvents
13	Automobile Shop Bldg. 208	Solvents
14	North of Building 208	Solvents, cutting oils, lubricating oils
15	Lube and Oil Change Pit Bldg. 215	Petroleum hydrocarbons
16	Hazardous Waste Storage Area Bldg. 234	Solvents, petroleum hydrocarbons
17	Hazardous Waste Storage Area Bldg. 234	Waste oil
Zone 5		
18	Paint and Sandblast Area Bldg. 224	Solvents, heavy metals
19	Paint Equipment Repair Bldg. 226	Solvents
20	Paint Ecology Area	Heavy metals, solvents
21	Paved Area Between Bldg. 208 and Elliott Bay	Petroleum hydrocarbons, solvents, heavy metals, PNAs
38	Former East Inlet	Petroleum hydrocarbons, volatile organic chemicals, heavy metals

Table 1. Continued.

Source Area	Location/Description	Chemicals of Concern
Zone 6		
22	Paint and Sandblast Facility Bldg. 217	Solvents, heavy metals
23	Paved Area Between Bldgs. 212 and 217	Petroleum hydrocarbons, solvents, heavy metals, PNAs
29	Substation S200	PCBs
32	Gasoline Fuel Tank	Gasoline
Zone 7		
24	Harbor	Heavy metals, petroleum hydrocarbons, solvents, PNAs
25	Air Compressor and Cooling Tower Bldg. 219/231	Petroleum hydrocarbons
26	Soil Piles with Sandblast Grit	Heavy metals
27	Module Assembly Area/Former East Inlet	Solvents, cutting oils, lubricating oils, heavy metals, petroleum hydrocarbons, PNAs
Zone 8		
35	OffSite	Phenols, carbon tetrachloride, creosote, arsenic acid, petroleum hydrocarbons, PNAs, furans, and dioxins
Zone 9		
37	Storm Sewer System	Heavy metals, PNAs, volatile organic compounds, and petroleum hydrocarbons
Zone 10		
36	Along Elliott Bay and West Duwamish Waterway	Heavy metals and petroleum hydrocarbons

3. Soil And Groundwater Contamination Investigations

3.1 McLaren/ Hart Investigations

The purpose of the five main M/H episodes of site characterization since October 1988, and summarized in M/H (September 1992), was to determine the magnitude and extent of contamination in site upland soil, groundwater and storm drain sediments. M/H work presented in the September 1992 report also includes discussions of physical characteristics of the site including hydrogeology, leaching potential investigations, contaminant fate and transport, and summary of risk assessment. Figure 3 shows the locations of all M/H sampling locations. Figure 1 shows the locations of all monitoring wells installed by M/H and by Enviros.

3.1.1 Soils

The M/H soils investigations entailed collecting soil samples from approximately 222 locations around 35 potential source areas on the site using grab sampling, drill rig, and hand augering techniques.

Soil samples were analyzed for the following compounds:

- Priority pollutant metals;
- Cyanide;
- Volatile organic compounds (VOCs);
- Volatile aromatic compounds;
- Halogenated VOCs;
- Phenols;
- Semivolatile organic compounds (SVOCs);
- Polyaromatic hydrocarbon compounds (PAHs);
- Polychlorinated biphenyls (PCBs);
- Dioxins;
- Furans; and
- Total petroleum hydrocarbons (TPH).

The most ubiquitous compounds were the metals and TPH. Detected chemicals measured in soil samples included the following:

- Priority pollutant metals (arsenic, copper, lead, nickel, chromium and zinc were most ubiquitous);
- VOCs;
- SVOCs;
- PAHs;
- PCBs;
- Dioxins;
- Furans; and
- TPH.

Chemicals of concern for soil were identified in the ChemRisk (1992) RA from the above list of detected compounds. The RA is based upon an estimated 90 to 95% complete data set. For unknown reasons, some data were omitted from the RA data set (summarized in Enviros Memos to the Port dated November 6, and November 20, 1992) and some data were not available at the time the RA was produced. As mentioned above, the RA database did not include data from Enviros (March 4 and September 17, 1992), from the

treatability evaluation sampling conducted by Enviros in September 1992, or from an additional round of groundwater sampling conducted by M/H in May 1992. In the RA, chemicals were not considered to be "of concern" if: 1) concentrations were at or near background levels, and/or 2) frequency of detection was below 5%. Analytes eliminated from consideration after evaluation of Criteria 1 and 2 were, on occasion, retained for consideration in the RA if it was known that site operations formerly utilized these compounds. TPH was addressed in the RA by evaluation of its VOC and SVOC/ PAH compounds and not as TPH directly. Following are the 31 chemicals of concern for site soil evaluated in the RA:

- Priority pollutant metals: (antimony, arsenic, cadmium, copper, lead, mercury, nickel, chromium, selenium, silver, zinc);
- VOCs (methylene chloride, tetrachloroethylene [PCE], trichloroethylene [TCE], acetone, toluene, xylenes, trichloroethane [TCA]; and
- SVOC/PAHs (Acenapthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene).

The results of the RA suggest that the following 12 compounds measured in on-site soil present unacceptable risk either to human health (current or future on-site occupational exposure, and current or future exposure from consumption of potentially contaminated fish by individuals who live near the site), or to adjacent surface water ecology, based upon contaminant transport simulations to Elliott Bay and potentially applicable state and federal laws. These compounds were selected based upon RA-calculated cleanup levels and highest concentrations measured during the RI as tabulated in the RA.

- Priority pollutant metals (antimony, arsenic, cadmium, copper, lead, mercury, nickel);
- VOCs (methylene chloride, PCE, TCE); and
- SVOC/ PAHs (benzo(a)pyrene, chrysene).

Soil analytical data for the 31 chemicals of concern (listed above) addressed in the RA are presented below in Section 3.3. Section 3.3 presents data obtained to date for the 31 compounds as well as for TPH for each of the source area polygons in Figure 2.

3.1.2 Groundwater

M/H installed and sampled 32 shallow (generally screened between five and 25-foot depths) monitoring wells as part of the groundwater investigation. The M/H groundwater investigation was completed at the site to assess the following conditions:

- Groundwater quality beneath the potential source areas;
- The direction and gradient of groundwater flow;
- Shallow aquifer transmissive properties by slug and pump testing;
- The tidal effects on the groundwater levels; and
- Likely groundwater quality upgradient of the site.

Approximately 118 groundwater samples collected from the 32 M/H shallow wells, and the 10 Enviros site wells (six deep wells generally screened between 65 and 75-foot depths, and four shallow wells) were analyzed for the following compounds depending upon the drilling location, suspected source area contamination and objectives of the sampling episodes:

- Priority pollutant metals;
- Cyanide;
- TPH;
- VOCs;
- Volatile aromatic compounds;
- Volatile halogenated compounds;
- SVOCs;
- PAHs; and
- Conventional analyses (pH, general minerals, ammonia, nitrate, nitrite, sulfate, sulfide, salinity, total organic carbon, dissolved organic carbon, and dissolved oxygen).

Chemicals detected in site groundwater (at concentrations either above or below potentially applicable regulatory criteria) as identified in M/H (September 1992) are the following:

- Priority pollutant metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc and thallium);
- Cyanide;
- TPH;
- VOCs (acetone, benzene, 1,1 DCA, cis 1,2 DCE, methylene chloride, PCE, toluene, TCE, vinyl chloride, xylenes); and
- SVOC/ PAHs (acenaphthene, acenaphthylene, bis(2-ethylhexyl)phthalate, fluorene, napthalene, and phenanthrene).

The RA did not specifically address risk from exposure to site groundwater contamination because of the following:

- The groundwater is tidally influenced and is brackish and is not considered to be potable;
- The site and surrounding properties are used for industrial purposes and the aquifer is not currently used for domestic, agricultural or industrial purposes;
- Potential exposure to contaminants in the groundwater is restricted to the potential migration of contaminants into Elliott Bay where they may directly impact the local aquatic environment and may indirectly affect human populations via ingestion of local fish; and
- Chemical concentrations representing the incremental contribution from Lockheed activities could not be discerned from off-site sources.

Tidal monitoring work has concluded that mean shallow groundwater gradients are generally in the offshore direction (Enviros, 1992b). This fact, along with the above listed facts, suggest that the exposure point of concern may be where groundwater flows into Elliott Bay.

Risk to exposure to site groundwater was not directly considered in the ChemRisk (1992) RA and cleanup levels for contaminants in site groundwater were not calculated. In the RA, acceptable shallow soil contaminant levels that would be protective of Elliott Bay surface water quality were calculated for selected compounds. Therefore, acceptable shallow soil contaminant levels were back-calculated from appropriate surface water criteria using solute transport relations. This approach allowed determination of proposed cleanup levels for unsaturated soil and soil at the water table, which would cause unacceptable contaminant levels in groundwater (as surface water upon entry to Elliott Bay).

3.2 Enviros Investigations

Enviros characterization work is summarized in Enviros (July 1991; 1992a, and 1992b). Supplementary characterization work has been conducted by Enviros in September 1992 in support of the FS. Figure 1 shows the locations of monitoring wells installed by Enviros and by M/H. Figure 4 shows the locations of all Enviros soil sampling locations. Figure 5 shows the locations of supplemental characterization sampling conducted in support of the FS and the associated treatability evaluation.

Enviros (1991) presents an evaluation of site soil and groundwater conditions based on the information developed during Enviros and M/H work up to July 1991. Data collected by Enviros up to July 1991 is presented along with some M/H data which were particularly relevant to the discussion in the report. Characterization work in Enviros (1991) is generally supplemental to work conducted by M/H and summarizes site conditions as understood at that time, when the bulk of the assessment work had been completed. In addition to presenting and discussing analytical data, this report includes discussions of site hydrogeology and groundwater hydraulics, a statistical evaluation of offshore and upland sediment chemical concentrations and an evaluation of soil and groundwater results in excess of numerical criteria. Data collected during this investigation were incorporated into the M/H (1992) report as well as into the ChemRisk (1992) RA.

Enviros (1992a) summarizes characterization work conducted by Enviros in the area of the former East Inlet in the middle of the site. This work was conducted because there were no lithologic, hydraulic, or chemical data from this area and because there were no suspected contaminant source areas around the location of the former East Inlet. Work entailed the installation of four monitoring wells. One pair (MW38: screened from 65 to 75 feet, and MW38A: screened from 5 to 25 feet) was placed about 75 feet south of the Elliott Bay shoreline, and one pair (MW39: screened from 65 to 75 feet, and MW39A: screened from 5 to 25 feet) was placed approximately midway between the north shoreline and the south property line and directly south of MW38/38A. The two wells in each pair were placed within about 10 feet of each other. Soil samples were analyzed for TPH, VOCs, and total metals. Groundwater samples were analyzed for SVOCs, VOCs, total and dissolved metals, and a suite of conventional analyses. Analytical results indicated that TPH levels in unsaturated soils above 5-foot depths are above MTCA Method A cleanup levels and that concentrations generally decrease to below Method A levels with depth. In groundwater, total lead and arsenic levels were elevated. However, the dissolved metals analyses indicate that these levels were due to suspended particles greater than 0.45 microns in size. Soil and groundwater data collected during this investigation were incorporated into M/H (1992) but not into the ChemRisk (1992) RA.

Enviros (1992b) focused on determining how the daily tidal cycles affect the groundwater flow gradient direction and magnitude at the site and along the eastern edge of the adjacent Pacific Sound Resources (PSR) property. The study area included the site, PSR, and the Alaska Marine Lines site west of PSR. Two phases of data collection were performed. The first phase occurred between January 13-27, 1992, and focused on collecting water level data from 17 on-site and off-site shallow wells (screened from approximately 5 to 25 feet), and five deep wells (screened from approximately 65 to 75 feet). The hydraulic head data from the deep wells was deemed unsuitable for determining the local tidal effects on the deep groundwater because of the paucity and spacing of the wells. Therefore, a second field investigation was performed between June 26 and July 10, 1992, and focused on nine on-site and off-site deep wells. For this second phase of work, three additional deep wells MW42 (off-site), MW43 (off-site), and MW44 (on-site) were drilled to provide a better spatial distribution of deep well monitoring points. During these two investigations, data

loggers were employed to simultaneously collect water level measurements from the shallow and deep monitoring wells every 15 minutes for the duration of the studies. Pressure transducers were connected to the data loggers to measure the water level fluctuations. Actual Elliott Bay tides were simultaneously measured in a stilling well during both investigations. Results of the tidal monitoring studies are presented below in Section 6.3.

In September 1992, Enviros initiated a FS to evaluate cleanup action alternatives for the following media at the site:

- Shallow soil material between the ground surface and the water table;
- Sand blast grit between the ground surface and the water table;
- Slag material between the ground surface and the water table; and
- Storm drain sediments.

Two days were spent using a back hoe to dig 19 test pits to collect 11 grab samples from 11 general locations shown in Figure 5. The reasons for supplemental sampling in the FS are summarized below in Table 2.

Results of additional analytical work will be presented in Section 3.3, below. Data which will not be included in Section 3.3 but will be incorporated into the FS and/ or appendices to the FS will be the following:

- Estimates of vertical gradient of metals concentrations in the grit area, estimates of grit extents and total volume;
- Estimates of total volume of slag and size proportions of slag chunks;
- Results of treatability evaluation simulations;
- Results of additional oil concentration measurements; and
- Results of sampling of the spoils piles from the diesel and gasoline underground storage tank (UST) excavations respectively (TE-7 and TE-10 in Figure 5).

Table 2. Summary of Treatability Evaluation Sampling

Sample No.	Basis for Selecting the Sample Location
TE-1	total metals vertical gradient, total metals in underlying soil, estimate of proportion of grit to other material, estimate of tonnage of grit, treatability experiments, leaching tests for concrete incorporation
TE-2	PAHs, metals and methylene chloride levels; treatability experiments
TE-3	oil, methylene chloride, and PAH levels; treatability experiments
TE-4	additional metals and hydrocarbon characterization of slag, estimate of size proportions, estimate of volume, treatability experiments
TE-5	oil, methylene chloride, metals, and PAH levels; treatability experiments
TE-6	oil, methylene chloride, metals, and PAH levels; treatability experiments
TE-7	additional characterization of diesel UST spoils pile and east wall of the excavation (diesel, stoddard solvent)
TE-8	oil and solvent levels; treatability experiments
TE-9	oil, solvent, and PAH levels; treatability experiments
TE-10	additional characterization of gasoline UST spoils pile (gasoline, lead)
TE-11	total metals vertical gradient, total metals in underlying soil, estimate of proportion of grit to other material, estimate of tonnage of grit

3.3 Summary of Soil and Groundwater Data

Attachment A Tables 2 through 4 (and associated subtables) present the data set for soil, groundwater, and storm drain sediment samples collected since characterization work was commenced by M/H in 1988. The data set presented in Attachment A tables includes data collected by M/H as well as by Enviros to date. Attachment A tables present data for analytes listed above in Section 3.1.

4. Storm Drain Sediment Contamination Investigations

During characterization work in 1989 and in 1990, M/H collected sediment samples from selected catch basins and sediment traps in the site storm drain system. Fifty-five storm drain catch basins and oil-sediment traps were identified at the site. A map of the storm drain system showing sediment sampling locations is shown in Figure 6. Sediment samples were analyzed for the following compounds:

- Priority pollutant metals;
- VOCs;
- SVOCs and PAHs;
- TPH; and
- PCBs.

Because there were detectable levels of contamination in the storm drain system, the catch basins and oil-sediment traps were emptied, steam-cleaned, and inspected for indications of cracking or damage that might provide a pathway for chemical transport to the surrounding soil or groundwater. Inspection revealed 13 out of 55 basins with damage to the walls or floor. Supplementary soil sampling was conducted adjacent to and below the cracked basins using auger drill rig and hand auger procedures. Figure 6 shows the locations of supplementary soil sampling and Attachment A tables present storm drain analytical data.

5. Summary Of McLaren/ Hart QA/QC Data Validation

The M/H Soil and Groundwater QA/QC Summary, Volume 8, Appendix I, of the RI lists and classifies all soil, storm drain, and groundwater data collected at the site as "acceptable" or "unacceptable". The M/H QA/QC summary tabulates the following: sample number, type of analysis, holding times from sampling to extraction and from extraction to analysis, and surrogate test results. The evaluation was based on EPA Functional Guidelines for organics and for inorganics. Data may have been determined unacceptable for one of two reasons:

1. Chemicals detected in samples were also detected in method blanks; or
2. Reporting limits for the target chemicals were five times greater than the maximum detected concentrations for the target chemicals.

Based on the first criteria, M/H classified 2% of metal analysis, 5% of the VOC analyses, and 1% of the TPH results for soils as unacceptable. Twelve percent of SVOC/PAH soil results were classified as unacceptable due to the second criteria.

Data for methylene chloride, benzo-a-anthracene, benzo-a-pyrene, and chrysene were considered questionable. M/H and Enviros analysis of methylene chloride was done by EPA Method 8240. EPA Method 8270 was used to detect benzo-a-anthracene, benzo-a-pyrene, and chrysene. Enviros assesses and summarizes the reasons for M/H's classification of these contaminants as unacceptable below in Table 3. Table 3 lists the type of analysis, affected sample numbers and reasons for classifying the data as unacceptable.

Table 3. "Unacceptable" Soils Data

Analysis	Parameter	Affected Samples	Reason for Unacceptability
EPA 8010	Halogenated Volatile Organics entire suite	HA70-1	y
EPA 8010	Halogenated Volatile Organics entire suite	HA70-8	y
EPA 8010	Halogenated Volatile Organics entire suite	HA72-2	y
EPA 8010	Halogenated Volatile Organics entire suite	SB48-5	x
EPA 8020	Aromatic Volatile Organics	SB48-5	y
EPA 8080	Polychlorinated Biphenyls (PCBs) entire suite	HA2-2	s
EPA 8080	Polychlorinated Biphenyls (PCBs) entire suite	HA80-2.75	y
EPA 8080	Polychlorinated Biphenyls (PCBs) entire suite	HA91-3.5	x
EPA 8080	Polychlorinated Biphenyls (PCBs) entire suite	MW7SB-8	s

Table 3. (continued) "Unacceptable" Soils Data

EPA 8080	Polychlorinated Biphenyls (PCBs) entire suite	SB67-10	x
EPA 8080	Polychlorinated Biphenyls (PCBs) entire suite	SB69-3	x
EPA 8240	Volatile Organics: methylene chloride	HA1-1	Method blank: methylene chloride 5.1 ppm
EPA 8240	Volatile Organics: methylene chloride	HA1-5	Method blank: methylene chloride 5.1 ppm
EPA 8240	Volatile Organics: methylene chloride	HA7-1	Method blank: methylene chloride 5.1 ppm
EPA 8240	Volatile Organics: methylene chloride	HA8-1	Method blank: methylene chloride 5.1 ppm
EPA 8240	Volatile Organics: chloroform and methylene chloride	SB53-1.5	Method Blank: chloroform 1.6 ppb; methylene chloride 5.2 ppb.
EPA 8240	Volatile Organics: chloroform and methylene chloride	SB53-8	Method Blank: chloroform 1.6 ppb; methylene chloride 5.2 ppb.
EPA 8240	Volatile Organics: chloroform and methylene chloride	SB54-1.5	Method Blank: chloroform 1.6 ppb; methylene chloride 5.2 ppb.
EPA 8270	Semi Volatile Organics	HA1-1	x
EPA 8270	Semi Volatile Organics	HA1-5	z
EPA 8270	Semi Volatile Organics	HA91-3	s
EPA 8270	Semi Volatile Organics	HA91-3.5	s
EPA 8270	Semi Volatile Organics	MW10SB-2	y
EPA 8270	Semi Volatile Organics	MW12SB-5	y
EPA 8270	Semi Volatile Organics	SB69-3	s
EPA 8270	Semi Volatile Organics	SB71-9	x
EPA 8310	Polynuclear Aromatic Hydrocarbons: entire suite	MW34SB-10	E-A; method blank: fluoranthene .04 ppm
EPA 8310	Polynuclear Aromatic Hydrocarbons: entire suite	MW34SB-32.5	E-A; Method blank: acenaphthene + fluorene 0.65 ppm: acenaphthylene 0.24 ppm: phenanthrene 0.01 ppm
EPA 8310	Polynuclear Aromatic Hydrocarbons: entire suite	MW34SB-5	E-A

Table 3. (continued) "Unacceptable" Soils Data

EPA 8310	Polynuclear Aromatic Hydrocarbons: entire suite	MW34SB-50	E-A: Method blank: acenaphthene + fluorene 0.65 ppm: acenaphthylene 0.24 ppm: phenanthrene 0.01 ppm
EPA 8310	Polynuclear Aromatic Hydrocarbons: entire suite	MW34SB-73	E-A; method blank: fluoranthene .04 ppm
EPA 8310	Polynuclear Aromatic Hydrocarbons: entire suite	MW35SB-10	E-A; method blank: fluoranthene .04 ppm
EPA 8310	Polynuclear Aromatic Hydrocarbons: entire suite	MW36SB-73	E-A; method blank: fluoranthene .04 ppm
EPA 8310	Polynuclear Aromatic Hydrocarbons: entire suite	MW36SB-8	E-A; method blank: fluoranthene .04 ppm

E-A: Unable to obtain extraction date and so it is assumed that the extraction to sampling time exceeds the maximum allowed time.
s: Surrogate diluted out of range.
x: Surrogate is above approved limit.
y: Surrogate is below approved limit.
z: Duplicate surrogates are above and below approved limit.

During preparation of the QA/QC Summary, M/H did not have access to chain-of-custody documents for several total metals analyses conducted by Enviros. As a result, the extraction dates were unknown and the samples were classified as unacceptable. Enviros has located the chain-of-custody sheets and verified sampling dates and laboratory reporting dates. Sample TP1-3.5 had a holding time of 3 days and thus can be considered as acceptable data. Forty-five soil samples were found not to exceed 36 days from sampling to laboratory reporting date. The precise date of extraction is unknown. The maximum sampling to analysis time for total metal analysis is 30 to 180 days. Since the lowest holding time of 30 days may be slightly surpassed, the samples may be questionable. These samples are listed below:

MW33SB-0.5
MW33SB-25
MW34SB-0
MW34SB-10
MW34SB-32.5
MW34SB-50
MW34SB-70
MW34SBDU-32.5
MW35SB-10
MW35SB-32
MW35SB-52.5
MW35SB-70
MW36SB-0.5
MW36SB-8
MW36SB-28
MW36SB-48
MW36SB-68
MW36SBDU-0.5
MW36SBDU-68

SB26-0.5
SB26-3
SB26-8
SB26-15
SB36-0.5
SB36-0.5
SB40-0.5
SB40DU-0.5
SB41-0.5
SB49-1
SB53-1.5
SB53-8
SB54-1.5

SS01
SS02
SS03
SS03DU
SS05
SS06
SS08
SS011
SS011DU
SS013
SS014

These samples were included in the M/H RA. Enviros has also chosen to include them in the statistical analysis for metal contamination at the site for FS statistical calculations.

The statistical calculations in the RA tables (for VOCs, PCBs, and SVOCs in soils) include most of the "unacceptable" data listed in Table 3. Samples HA91-3, MW10SB-2, and MW12SB-5 were not included and do not appear to be present in Volume 4, Appendix G - Soil Analytical Data Sheets of the RA.

A check of the data utilized for the RI indicates that data deemed unacceptable were not utilized in summary figures, tables, and discussions.

For the FS statistical calculations of the metals within the source area polygons, Enviros chose not to include the questionable data listed in Table 3. Careful review will be done to assess the usability of the questionable data if these data will be helpful for delineation of contamination units.

6. Hydrogeology

6.1 General Lithology

Saturated soils at the site were observed to be, for the most part, sandy (poorly graded to well graded) with varying silt contents. Sand size varied between very fine and coarse grained. In some areas, drilling encountered gravels (including slag material at shallow depths) and construction debris. Drilling work through Enviros (1992b) does not confirm the presence of a laterally continuous silty strata beneath the east part of the site that would act as an aquitard or aquiclude. A number of shallow Enviros borings encountered silty or clayey material on the east portion of the site at a depth of around 17 feet, but the lateral continuity and thickness of this stratum has not been confirmed in three deep wells (MW38, MW39 and MW44) constructed on the east part of the site in 1992, which would indicate the presence of a laterally continuous aquitard or aquiclude. There are no lithologic data indicating the presence of an aquitard or aquiclude for the entire 73 feet drilled in wells MW34, MW35 and MW36. One exception is well MW7, where silty and clayey material was encountered from about 5 feet to the bottom of the boring at 25 feet.

Figure 7 shows the locations of Cross-Sections A-A' and B-B' in Figures 8 and 9. The cross-sections are from M/H (September 1992) and show generalized lithologies encountered during RI work.

The location of the site was occupied by the Duwamish river delta and associated mudflats before the early 1900s. The natural fill of deltaic and floodplain soils (sands, silty sands, sandy silts, silts and clays) at the mouth of the Duwamish River is estimated to be many hundreds of feet deep according to literature cited in M/H (September 1992). Review of historical aerial photographs contained in M/H (September 1992) indicates that the site has been created from fill that was probably obtained from dredging of the West Waterway. The former "East Inlet" was between the present locations of Piers 24 and 25 and led to a log pond beneath what is now Terminal 5. Between 1936 and 1960, fine sediments accumulated on a mudflat beneath what is now the east half of the site. The East Inlet was filled between 1960 and 1969. The "West Inlet" was located along the present west property line and was filled between 1970 and 1977. Drilling in the east part of the site occasionally encountered silts and clays around the 15- to 16-foot depth, which may be the surface of the former mudflat. Shore reinforcement, possibly rip rap, may have been constructed along the former inlets and along the north shoreline. Fine-grained sediment from former inlets and the mudflat and existing and buried shore line reinforcements can affect horizontal and vertical groundwater flow.

6.2 Aquifer Characteristics

Depth to groundwater is typically between 8 and 10 feet below grade and fluctuates with tides (see Section 6.3 below) and likely with seasons. M/H (September 1992) has defined two aquifer systems based upon electroconductivity (EC) values. A shallow fresh water aquifer with EC values of typically less than 2,000 micro-mhos per centimeter overlies a saline aquifer with typical EC values of greater than 10,000 micro-mhos per centimeter. The saltwater "wedge" present beneath the site is typical of coastal aquifers. The depth of the interface between the overlying freshwater lens and the underlying salt water wedge is likely to be a zone varying in depth and thickness according to tides and proximity to the shoreline, but is likely to have a typical thickness at least a few feet thick. For the purposes of aquifer testing, M/H (September 1992) has indicated a saturated thickness of the shallow fresh water aquifer to be between about 22 and 33 feet, depending upon the well and the location at the site, and a total depth of 40 feet.

M/H (September 1992) discusses the results and analysis methods of ten slug tests and three pump tests conducted in July 1990. Water level changes were measured with pressure transducers and all data were recorded by a data logger at pre-set time intervals.

6.2.1 Slug Testing

M/H conducted slug tests in ten wells on the site. Slug testing and data analysis are discussed in the M/H (September 1992). The slug tests allowed the calculation of hydraulic conductivity of material within a few feet of the tested well. Water level changes were measured when the slug was introduced and when the slug was removed. M/H considered the data collected when the slug was removed to be more reliable and therefore only analyzed those data. Using the method of Bouwer and Rice (1976) modified with Bouwer (1989), M/H calculated estimated hydraulic conductivity values in feet/day from slug removal data, which are presented below in Table 4.

If the tested wells are grouped into an eastern area (MW7, MW8, MW11, MW15), a central area (MW3, MW4, MW5) and a western area (MW21, MW25, MW27) average estimated hydraulic conductivities are 8.37, 13.6 and 10.1 feet/day, respectively. The average estimated hydraulic conductivity for the site, calculated using the slug test data, is 10.6 feet/day. Graphed time drawdown data and a more detailed discussion of the data analysis technique are presented in M/H (September 1992).

Table 4. Results of Slug Tests (data from M/H, September 1992)

Well No.	Estimated Hydraulic Conductivity (feet/day)	Average Estimated Hydraulic Conductivity for the Area (feet/day)
MW3	30.2	Central Area
MW4	2.43	
MW5	8.11	13.6
MW7	1.22	Western Area
MW8	8.01	
MW11	16.6	
MW15	14.4	10.1
MW21	0.91	Eastern Area
MW25	20.1	
MW27	4.10	8.37
Site Average		10.6

6.2.2 Pump Testing

Three constant discharge pump tests were conducted by M/H and are discussed in M/H (September 1992). Pump tests allow the calculation of hydraulic conductivities and specific yields of aquifers. Because pump tests can measure aquifer response radially outward from the well ranging from 10 to 100 feet, parameters calculated may be more representative of actual aquifer conditions than parameters calculated from slug tests.

The first pump test was conducted on July 16, 1990, for 3 hours and 58 minutes for well MW3. Wells MW28, MW29, MW30 were used as observation wells. The second pump test was conducted on July 17, 1990, for 4 hours for well MW8. Wells MW9 and MW10

were used as observation wells. The third pump test was conducted on July 18, 1990, for 1 hour and 29 minutes for well MW27. Wells MW25 and MW26 were used as observation wells.

M/H (September 1992) used the Cooper and Jacob (1946) method to estimate values of transmissivity for the aquifer tests. A detailed discussion of the data analysis technique is presented in M/H (September 1992). Table 5 below summarizes important pump test information and presents transmissivities calculated by M/H.

Table 5. Summary of Pump Test Data and Analysis Results

Pumping Well	Tested Well	Minutes of Test Used in Analysis	Calculated Transmissivity (square feet per day)	Estimated Hydraulic Conductivity (feet per day)*	Comments
MW3	MW3	1 to 10	1,541	48.1	
"	MW28	not analyzed	not calculated	not estimated	insufficient draw-down for analysis
"	MW29	1 to 100	2,242	70.1	
"	MW30	"	2,055	64.2	
MW8	MW8	2 to 200	462	14.5	
"	MW9	not analyzed	not calculated	not estimated	"
"	MW10	"	"	"	"
MW27	MW27	1 to 10	46.9	1.38	
"	MW25	not analyzed	not calculated	not estimated	"
"	MW26	"	"	"	"

* Average saturated thickness was calculated to be 32 feet for the shallow fresh water aquifer which is based upon EC values as summarized above and discussed in more detail in M/H (September 1992).

Additional comments on the M/H aquifer testing are presented in Enviros (July 1991).

6.3 Tidal Influence on Groundwater Flow Gradient

The following is a summary of general conclusions obtained during the tidal monitoring study (Enviros, 1992a).

- Monitoring of water level elevations in 16 shallow and 9 deep groundwater wells indicate varying responses of groundwater elevations to changing tides in Elliott Bay and the West Waterway.
- In general, groundwater elevations in the 16 shallow wells changed the most along the north Elliott Bay shore line and the least around the southwest corner of the Lockheed property.
- During the shallow well field investigation, groundwater elevations in shallow wells lagged high tides by between 0 hours (MW33) and 4 hours (MW39A) and lagged low tides by between 1 hour (MW33) and 4 hours (MW39A). Tidal efficiencies for shallow wells ranged between 0.03 (MW31) and 0.59 (MW33).

- During the deep well field investigation, groundwater elevations in deep wells lagged high tides by between 1.45 hours (MW41A) and 3.25 hours (MW43), and lagged the Elliott Bay low tides by 0 hours (MW42) and 5 hours (MW39). Tidal efficiencies for deep wells ranged between 0.03 (MW36) and 0.41 (MW41A).

- Interaction and/or interference between site conditions, groundwater flow, and tidal fluctuations in Elliott Bay and the West Waterway create several notable hydrograph features including:

    - squared waves (MW1, MW4, MW20 and MW37); and
    - little influence of tidal activity in near-shore wells MW26 and MW31.

- Mean Water Level Elevations (MWLEs) calculated for shallow wells for 13:00 on January 21 indicate that net groundwater flow is offshore towards Elliott Bay and the West Waterway. The MWLE map exhibits a north-south "ridge" dominating the west property line of the Lockheed property and an east-west "ridge", or "mound", dominating the north part of the Lockheed property. Net shallow groundwater flow during the test period appears to be towards the north along the west Lockheed property line, towards the north along the Elliott Bay shore line, and towards the east and southeast along the West Waterway shore line. See Figure 11.

- MWLEs calculated for deep wells indicate that the deep groundwater flow is similar to that observed in the shallow groundwater system. A MWLE "ridge" is located along the western property boundary of the Lockheed site and a "mound" is present at the northern end of the "ridge". A second mound is present in the eastern part of the Lockheed site but is controlled by only one data point. Groundwater flows radially from the "mounds" in several directions. The predominant flow off of the western ridge is to the west, north, and east, across the Lockheed/PSR property boundary. The height of the mounds is relatively small in comparison to the daily water level changes caused by the tidal impulses. The mounds represent an increased water level elevation of approximately 0.5 foot above the surrounding "non-mounded" surface compared to the daily tidal changes of approximately 2 feet in these areas. See Figure 12.

- MWLE calculations for two pairs of adjacent wells (MW38/MW38A, MW39/MW39A) indicate a net downward vertical gradient in the center of the Lockheed property. Inferring vertical gradients between shallow groundwater and deeper groundwater at other locations is tenuous because no other immediately adjacent pairs of deep and shallow wells were monitored during this study.

- Maps of shallow well groundwater elevations at a low tide on January 19 and a following high tide on January 20 (16-foot tide swing) indicate dramatic changes in gradient directions and magnitudes with changing tides. A general offshore gradient is evident in shallow groundwater at low tide and an onshore gradient is evident in shallow groundwater at high tide. Similar trends were observed in the maps of the deep groundwater elevations at a high tide on June 30 and a low tide on July 1 (14.6-foot tidal swing).

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FIGURES

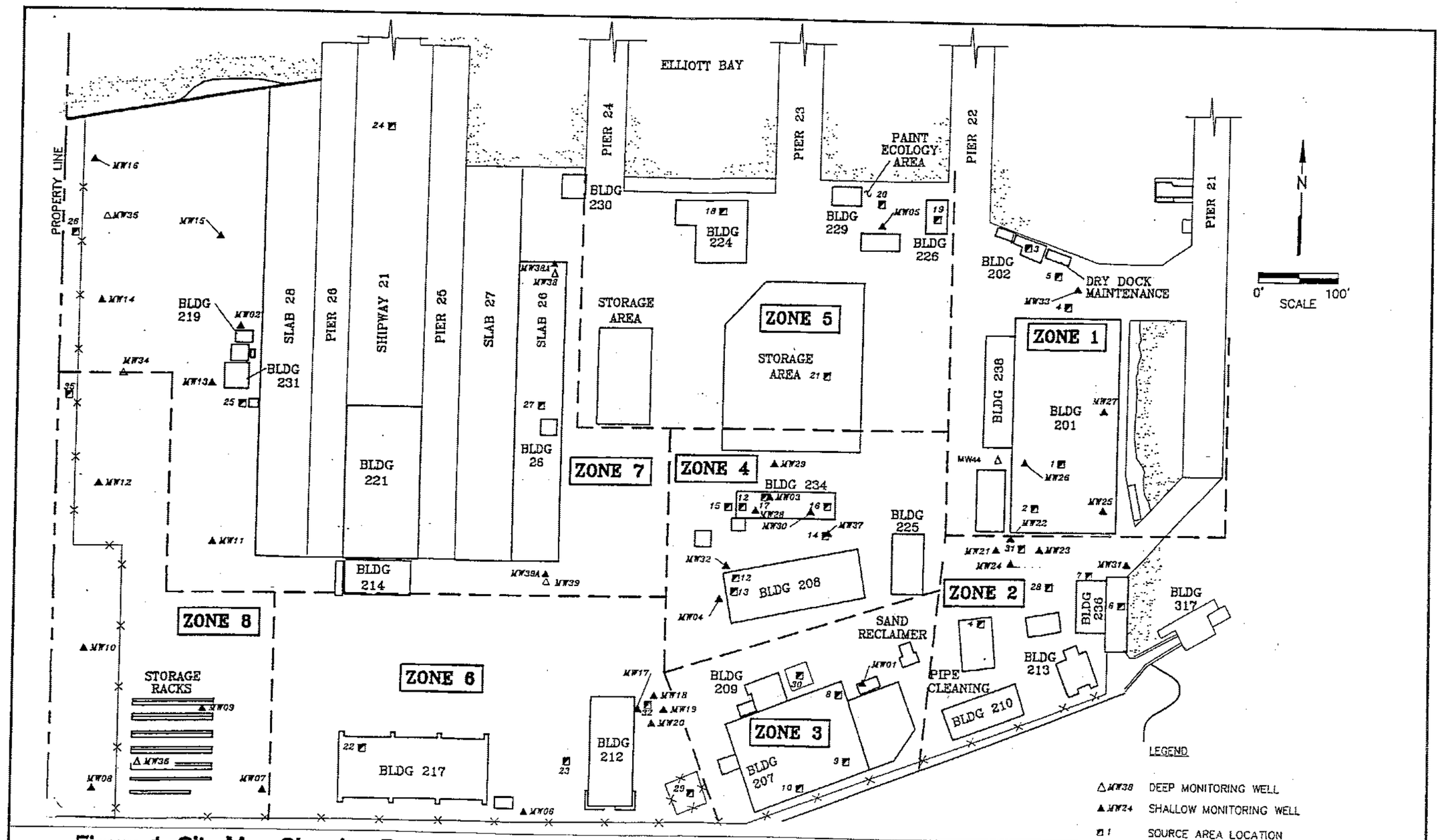

Figure 1. Site Map Showing Potential Source Area Locations and Locations of Deep and Shallow Monitoring Wells (slightly modified from McLaren/ Hart, September 1992).

T-3 Feasibility Study, West Seattle, Washington

Prepared By: T. Cline Date: 11/5/92

Approved By: _____ Date: 3-12-93

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Project #: 900819.16.3

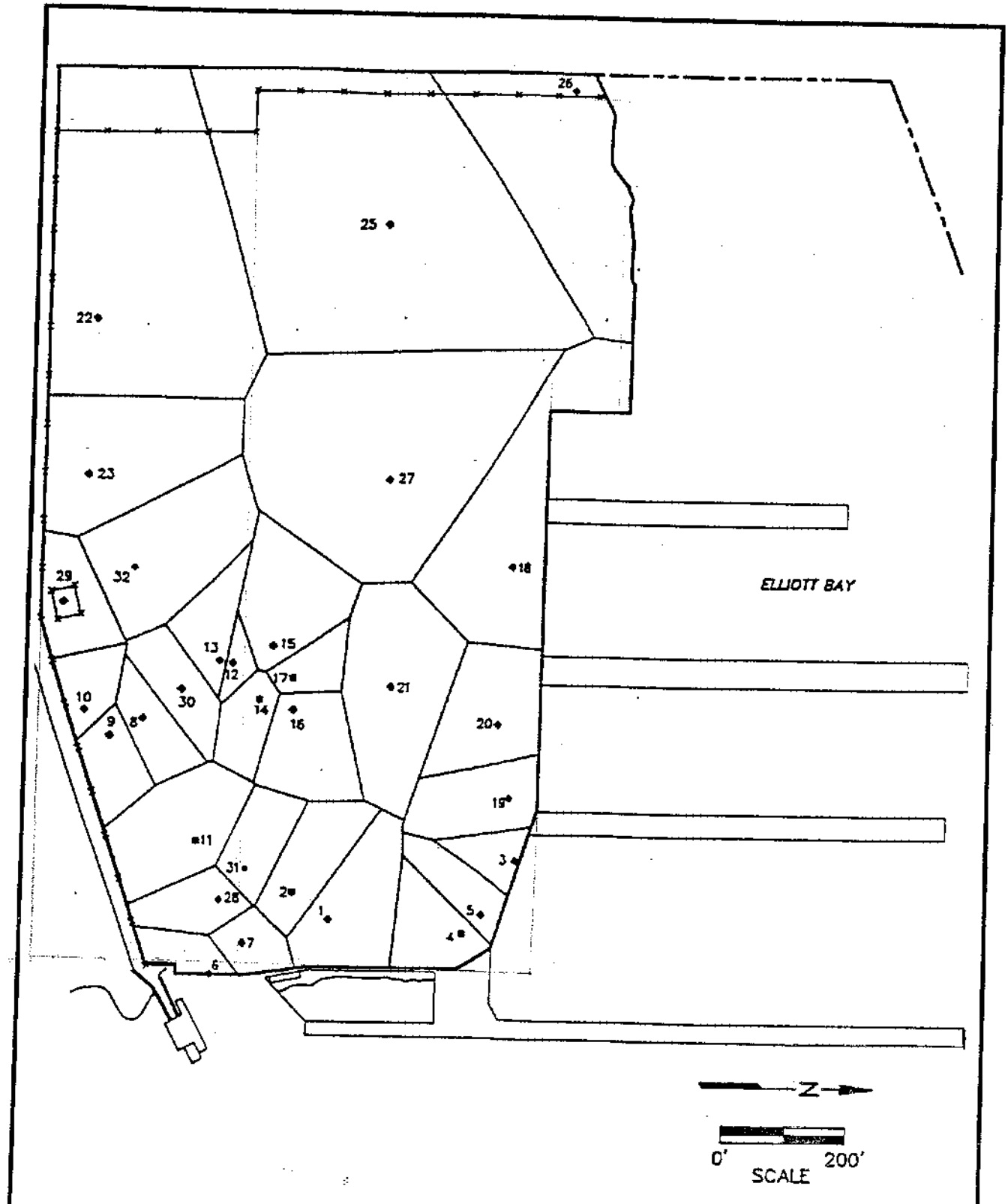

Figure 2. Site Map Showing Theissen Polygons for Impacted On-site Source Areas (unmodified from ChemRisk, 1992)
T-3 Feasibility Study, West Seattle, Washington

enviros
Project #: 900819.16.3

Prepared By: T. Cline Date: 11/5/92

Approved By: TTC Date: 3·12·93

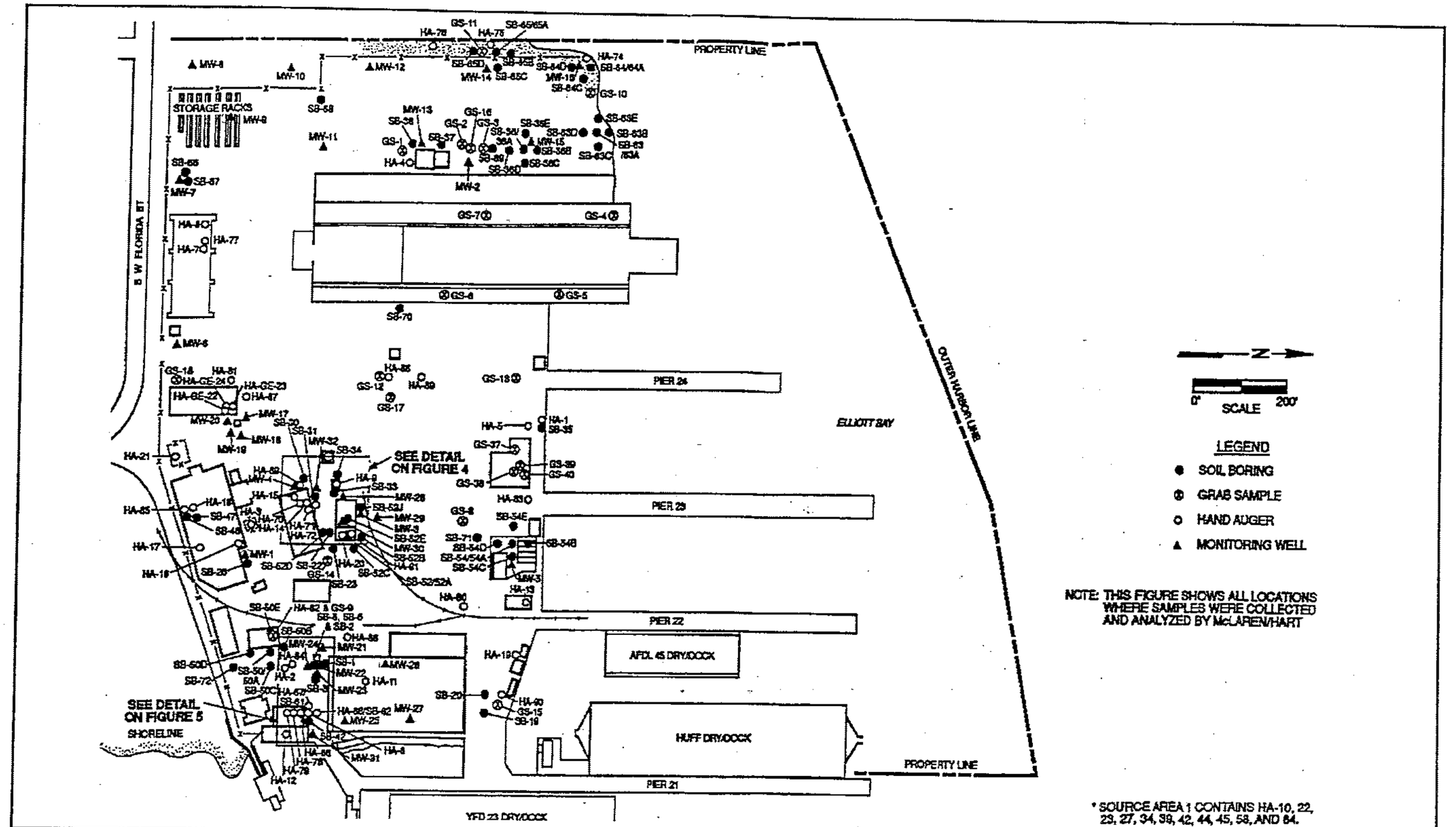

Figure 3. McLaren/Hart Sampling Locations (unmodified from ChemRisk, 1992).

T-3 Feasibility Study, West Seattle, Washington

Prepared By: T. Cline Date: 11/5/92

Approved By: TC Date: 3-12-93

enviros

Project #: 900819.16.3

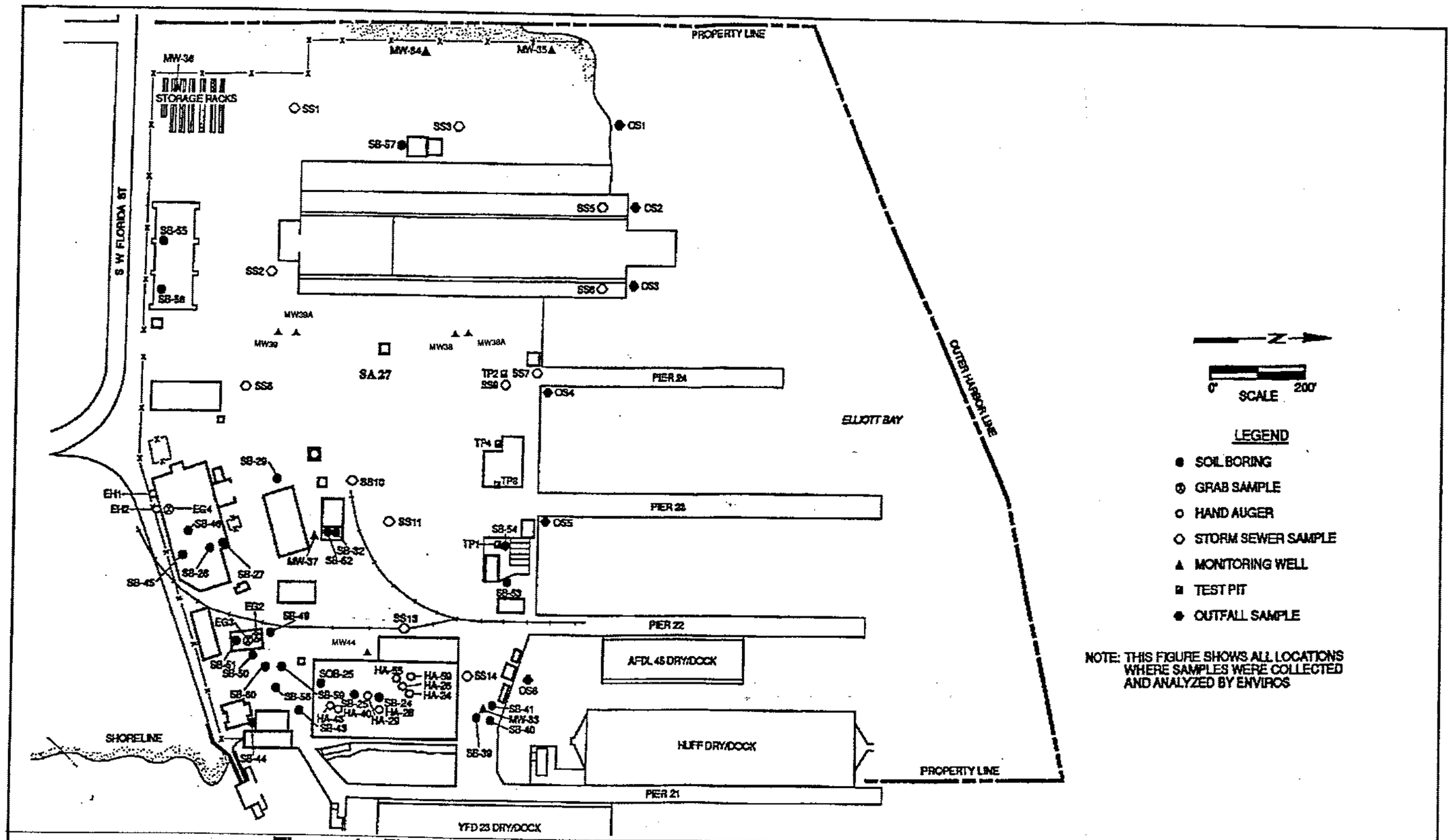

Figure 4. Enviros Sampling Locations (modified from ChemRisk, 1992).

T-3 Feasibility Study, West Seattle, Washington

Prepared By: T. Cline Date: 11/5/92

Approved By: TJC Date: 3.12.93

enviros

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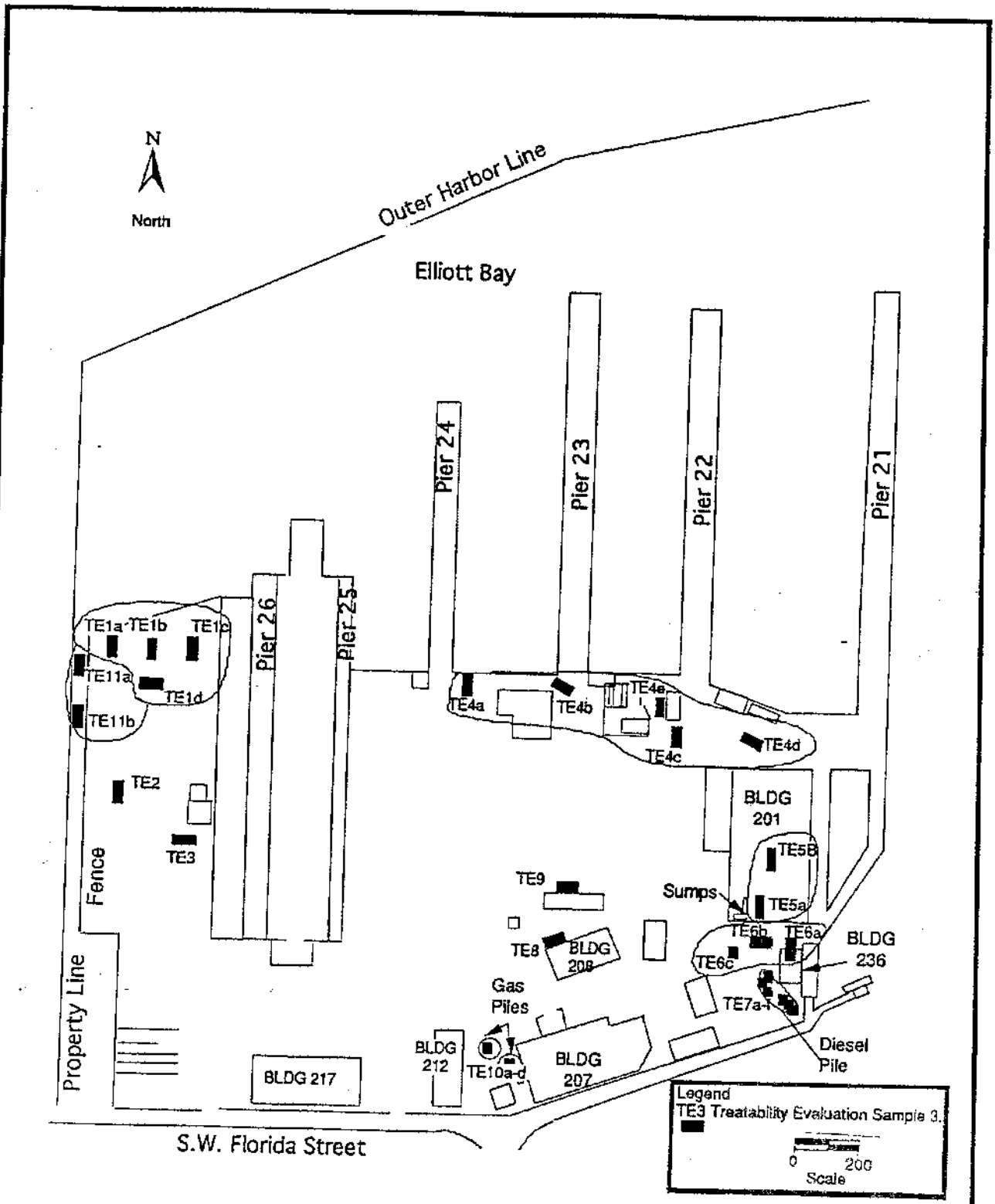

Figure 5. Feasibility Study Treatability Evaluation Sampling Locations.
T-3 Feasibility Study, West Seattle, Washington

enviros
Project #: 900819.16.3

Prepared By: T. Cline Date: 11/5/92

Approved By: TJC Date: 3-12-93

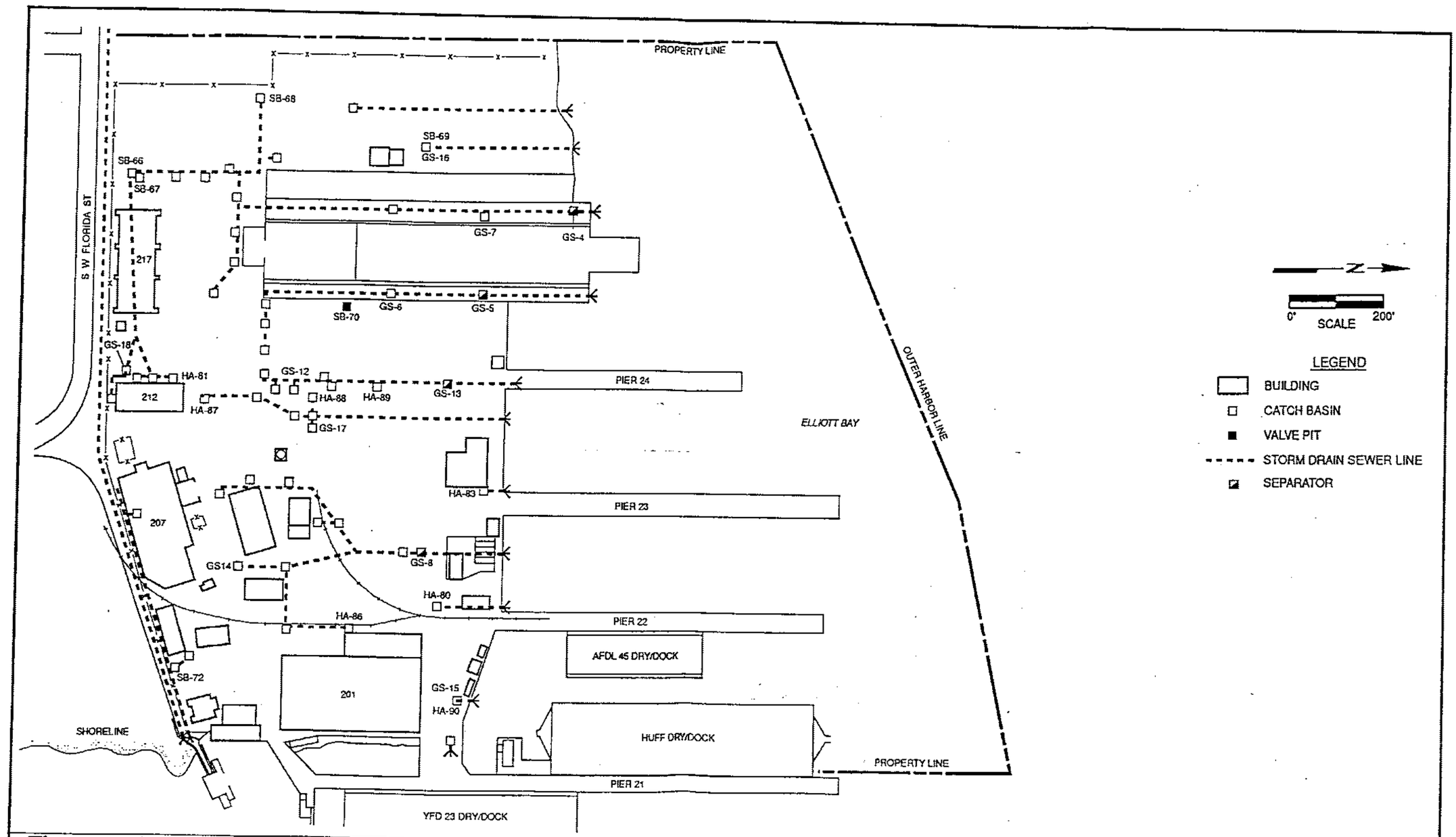

Figure 6. Map of Site Storm Drain System Showing Storm Drain/ Catch Basin Sampling Locations (unmodified from McLaren/Hart, September 1992).

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Prepared By: T. Cline Date: 11/5/92

Approved By: TJC Date: 3.12.93

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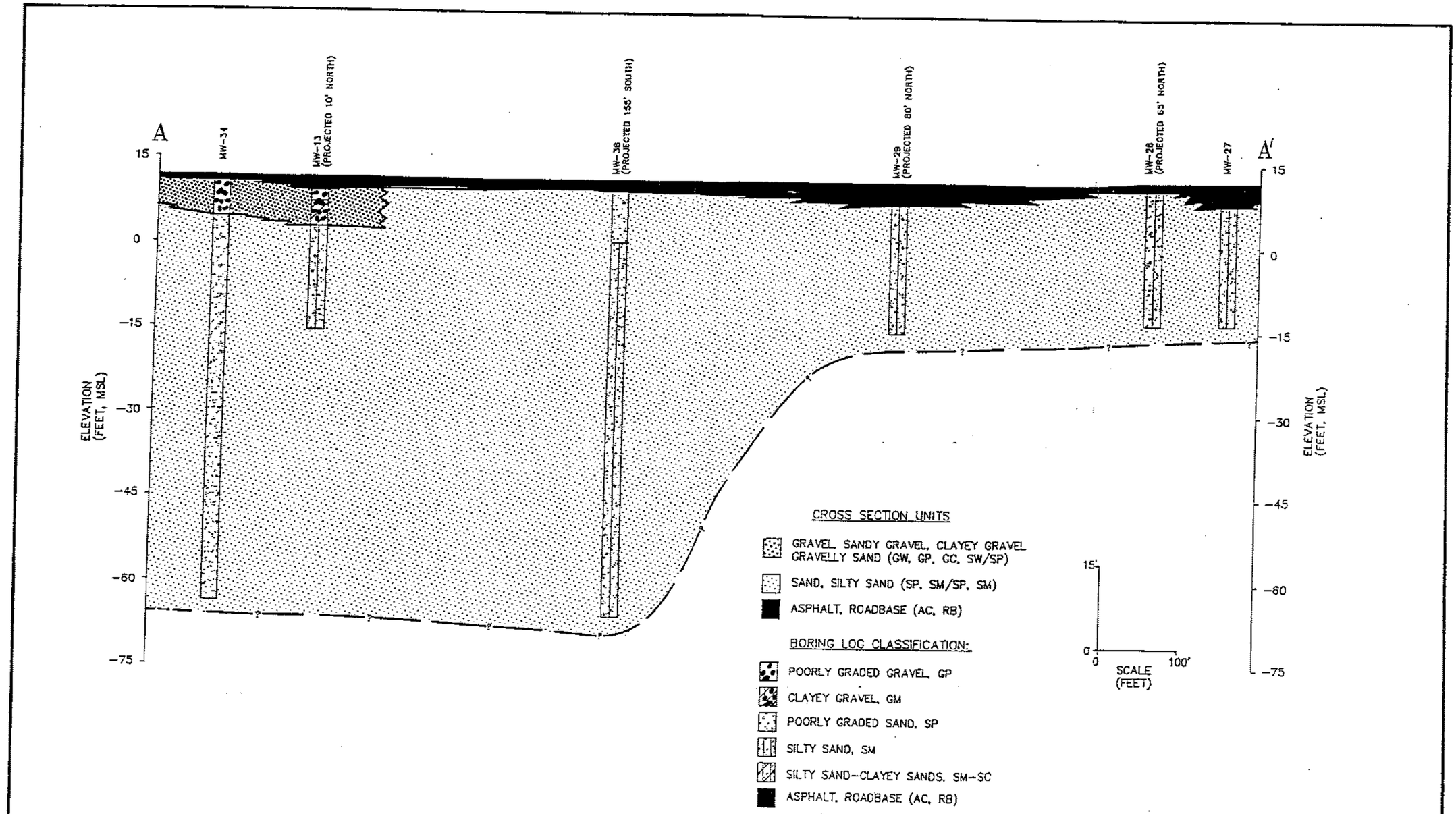

Figure 8. Lithologic Cross-Section A-A' (unmodified from McLaren/Hart, September 1992).

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Prepared By: T. Cline **Date: 11/5/92**

Approved By: TJC **Date:** 3-12-93

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Project #: 900819.16.3

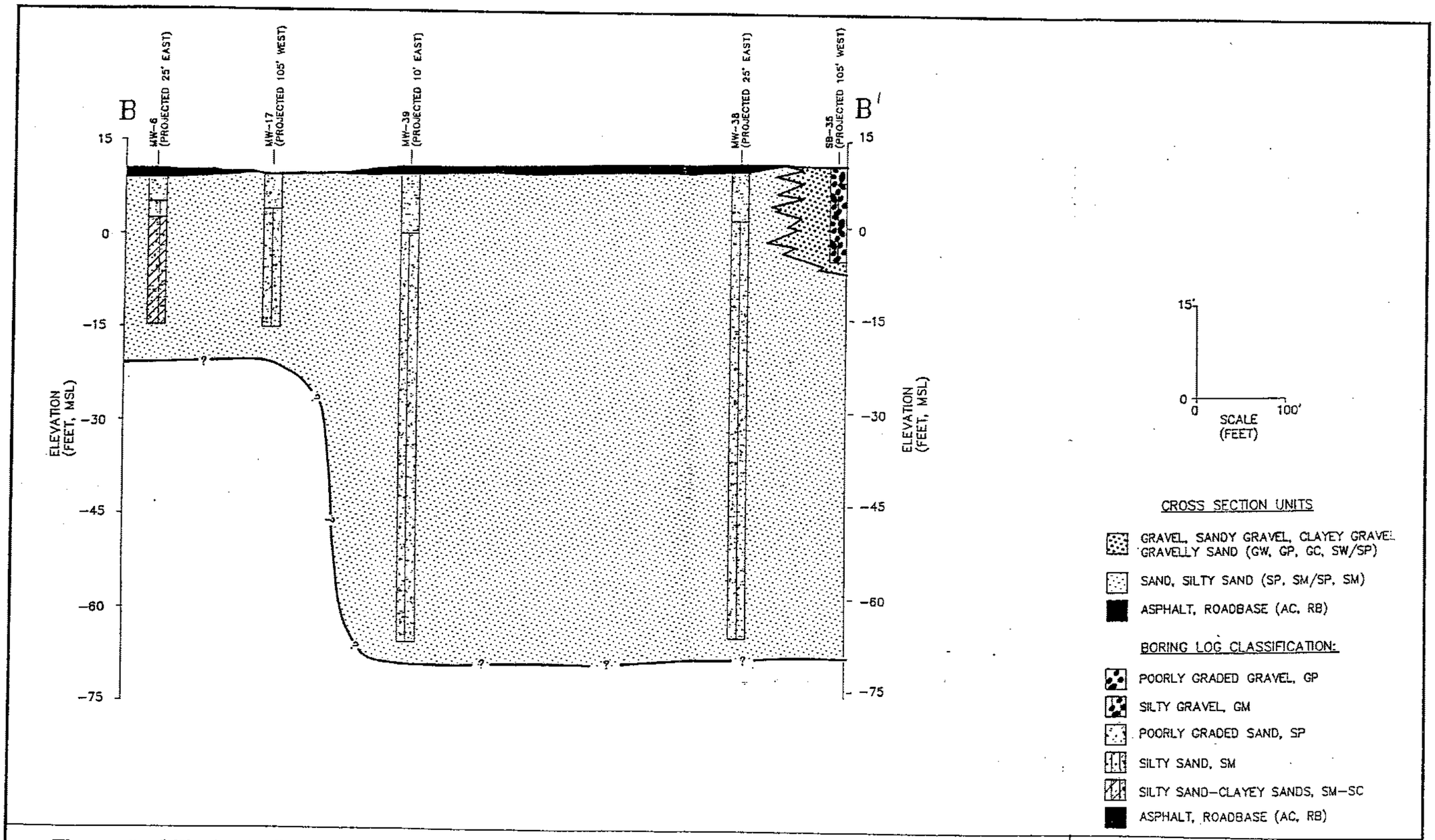

Figure 9. Lithologic Cross-Section B-B' (unmodified from McLaren/Hart, September 1992).

T-3 Feasibility Study, West Seattle, Washington

Prepared By: T. Cline Date: 11/5/92

Approved By: T/C **Date:** 3-12-93

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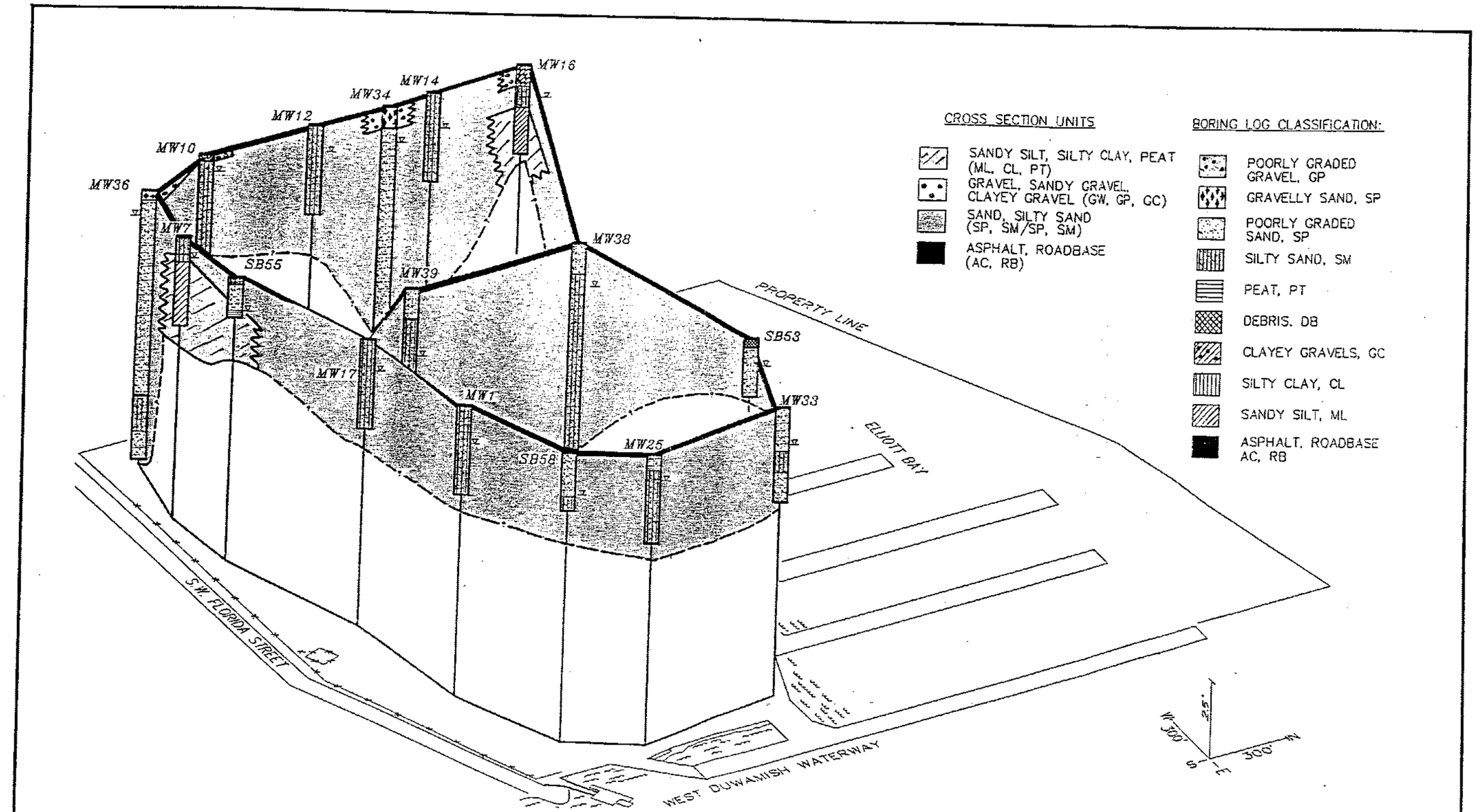

Figure 10. Lithologic Fence Diagram (cross-section units symbols modified from McLaren/Hart, September 1992).

T-3 Feasibility Study, West Seattle, Washington

Prepared By: T. Cline Date: 11/5/92

Approved By: TJC **Date:** 3-12-93

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Project #: 900819.16.3

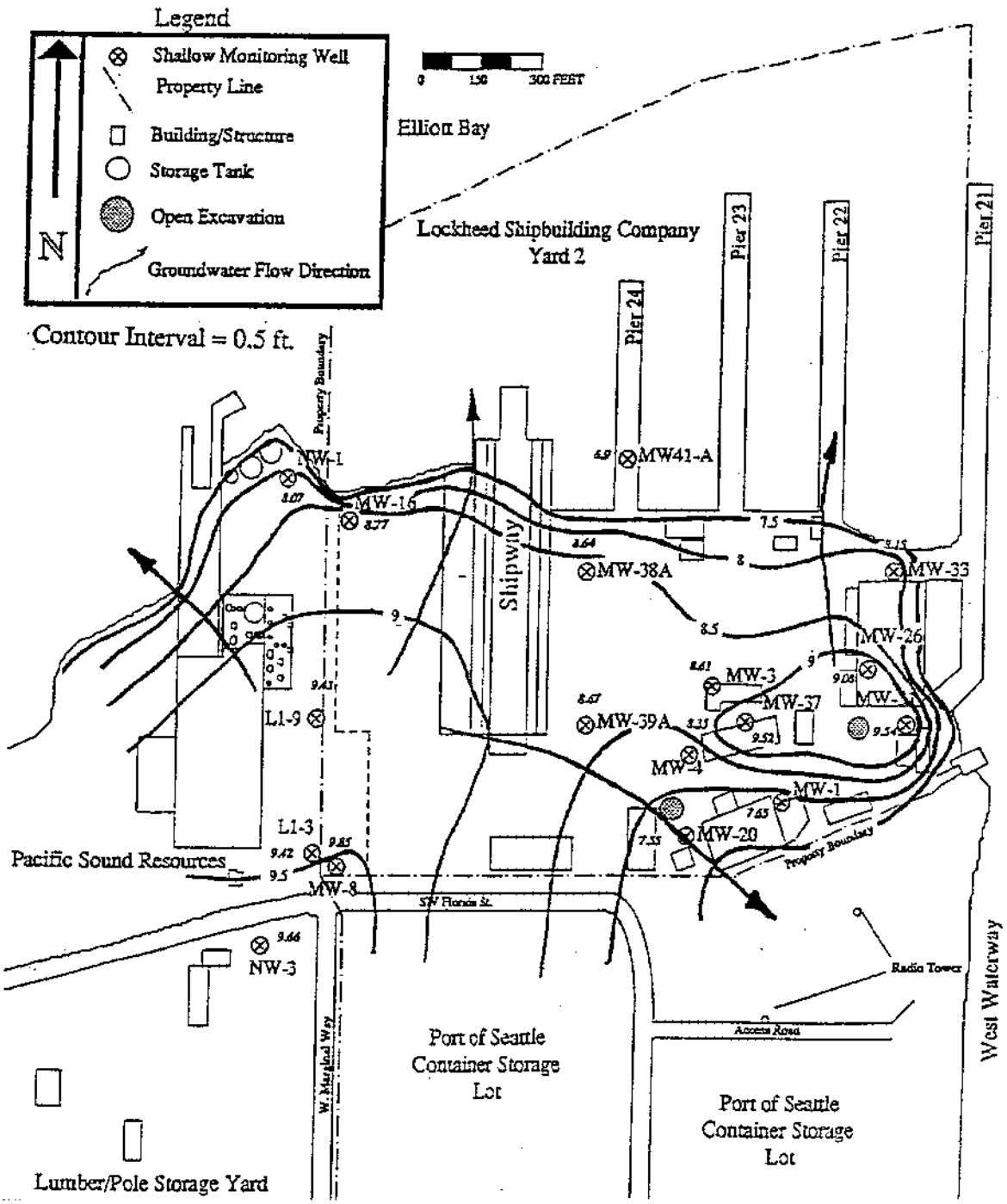

Figure11. Shallow Well Mean Water Level Elevations (calculated from 71 consecutive hourly readings between January 20 and January 22, 1992, from Enviros September 17, 1992).
T-3 Feasibility Study, West Seattle, Washington

enviros
Project #: 900819.16.3

Prepared By: T. Cline Date: 11/5/92

Approved By: TJC Date: 3·12·93

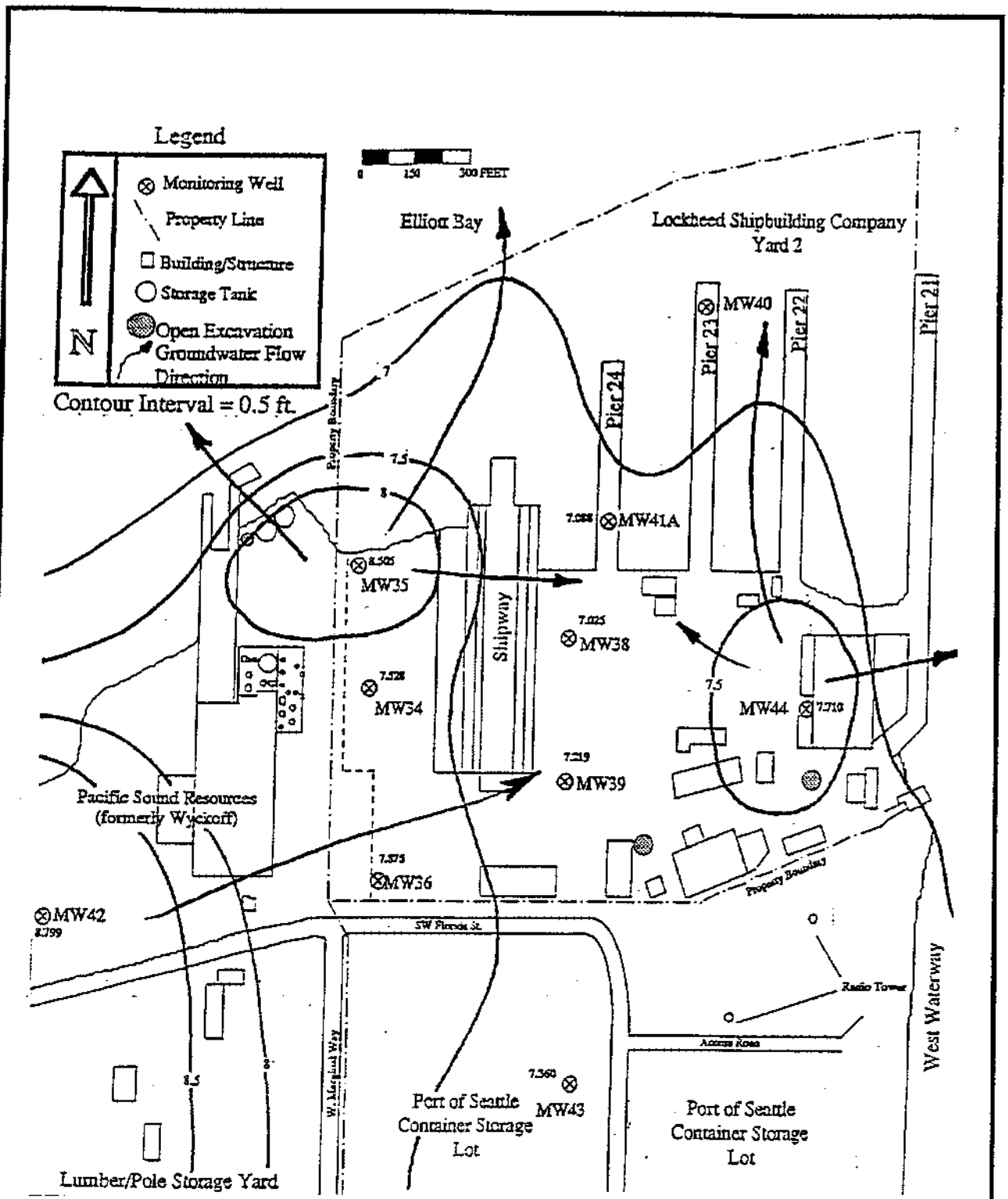

Figure12. Deep Well Mean Water Level Elevations (calculated from 71 consecutive hourly readings between June 26 and June 29, 1992, from Enviros September 17, 1992).
T-3 Feasibility Study, West Seattle, Washington

enviros
Project #: 900819.16.3

Prepared By: T. Cline Date: 11/5/92

Approved By: TJC Date: 3-12-93

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ATTACHMENT A

SOIL, GROUNDWATER AND STORM DRAIN SEDIMENT ANALYTICAL DATA

(for 31 compounds of concern to the risk assessment as identified by ChemRisk, 1992)

Summary of Methods for Statistical Calculations for Soil, and Groundwater Data Tables

The attached tables (Tables 2.1 through 3.4) of soil and groundwater data were grouped according to Thiessen polygons (from ChemRisk, 1992) for impacted on-site source areas as illustrated in Figure 2 (presented in Figures Section). Storm drain sediment data are presented in tables 4.1. through 4.5.

Thiessen polygons provide a method of area-weighting scattered data points that are not sampled randomly, in order to obtain representative estimates of the population means and upper 95% upper confidence limits (UCLs). The method used to obtain 95% UCLs was the same as that used in ChemRisk (1992) and referenced to Davis (1986) and Gilbert (1987). A detailed description can be found on pages 2-10 to 2-15 of the ChemRisk RA.

The site was divided into 31 source areas/polygons (see Section 2: Summary of Potential Source Areas). The analytical data tables summarize the following for each source area and compound of concern:

- Sample mean;
- Area weighted means (based on Thiessen polygons); and
- 95% UCLs.

In addition, the *site wide* weighted mean and 95% UCL was calculated for each compound. The method involved calculating a statistically unbiased estimate of pooled variances for each source area. According to ChemRisk, Gilbert (1987) demonstrates that, if the total population, N, is large then the pooled variance reduces to:

$$s^2(x) = \sum_{h=1}^{L}((W_h{}^2\, s_h{}^2)/n_h)$$

where:

- $s^2(x)$ = pooled variance
- L = number of source areas
- W_h = weighting factor for each source area
- s^2_h = variance of the compound in the source area
- n_h = number of samples in each source area for the compound in question

The "i'th pooled variance", listed for each source area in the summary tables, refers to these individual summation entities. These were summed at the end of the table and resulted in the pooled variance for the compound throughout the site.

Following Gilbert's demonstration, this pooled variance was then used to obtain the 95% UCL for the site:

Key For Interpreting Analytical Tables

Table 2.1. Analytical Results for Soil Metal Concentrations

Unknown depths were assumed to be 0.5 to 15 feet, the zone in which most sampling was conducted.
Concentrations above reporting limits highlighted with boldface, italics, underlined 12 point type;
all others are half the value of the sample reporting limit.
Samples with two depths are composite samples.

* Laboratory ran duplicate analysis on this sample. Concentrations denoted with G are either:

1) the average of the concentrations of the duplicate analyses (if both concentrations were above reporting limits);
2) 1/2 the concentration of the lowest reporting limit (if both sample concentrations were below reporting limits); or
3) the average of 1/2 the reporting limit and the sample concentration if one concentration was below the reporting limit, and the other was above the reporting limit.

** Sample concentrations were less than 5 times the concentration found in the method blank.
Concentrations denoted with G are 1/2 the concentration of the method blank.

t-values: Critical values of t were determined for n-1 degrees of freedom where n-1 was rounded down.

Boxed values signify:
Dotted: Data which were not included in the ChemRisk RA database.
Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

*** 95% UCL can not be calculated when n<2.

\# Unable to locate original laboratory data sheets.

f Two samples were submitted for analysis. Both samples are from a 5 - gallon bucket at 1 to 2 feet.
The sample designated as 1-2 feet is more representative of pure slag.

Dup Laboratory ran duplicate analysis.

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 1													
SB-24 #	7.5				***1.1***		0.2		***10***		***6***		***1.7***
SB-24 #	15				***4.2***		0.2		***8.8***		***8.4***		***2***
MW-44	5				1.3		0.65		8.6		6.1		13
MW-44	15				3.5		0.8		21		16		16
MW-44	50				7.6		0.8		17		19		16
n		0.	0.	0.	5.	0.	5.	0.	5.	0.	5.	0.	5.
Mean					3.5		0.5		13.1		11.1		9.7
Total Mean		0.0		3.5		0.5		13.1		11.1		9.7	
St. Deviation		0.0		2.6		0.3		5.6		6.0		7.3	
Fraction of Total Area		0.025		0.025		0.025		0.025		0.025		0.025	
Area Weighted Mean				0.09		0.01		0.33		0.28		0.24	
i'th Pooled Varianc		0.0000		0.0009		0.0000		0.0039		0.0045		0.0067	
t value				2.132		2.132		2.132		2.132		2.132	
95% UCL				6.1		0.82		18.		17.		17.	
Sources 2- 3: No Data													
Source 4													
SB-39	0.5		***1.18***		***6.3***		0.079		***7.25***		***54***		***20***
SB-40*	0.5		***0.9115*** G		***7.9*** G		0.76 G		***1695*** G		***241*** G		7.5
SB-19**	8	2.5		0.2	G	0.2		***8***		***11***		***8***	
n		1.	2.	1.	2.	1.	2.	1.	2.	1.	2.	1.	2.
Mean		2.5	1.0	0.2	7.1	0.2	0.4	8.0	851.1	11.0	147.5	8.0	13.8
Total Mean		1.5		4.8		0.3		570.1		102.0		11.8	
St. Deviation		0.9		4.1		0.4		974.2		122.3		7.1	
Fraction of Total Area		0.014		0.014		0.014		0.014		0.014		0.014	
Area Weighted Mean		0.02		0.07		0.00		7.98		1.43		0.17	
i'th Pooled Variance		0.0000		0.0011		0.0000		62.0064		0.9769		0.0033	
t value		2.920		2.920		2.920		2.920		2.920		2.920	
95% UCL		3.0		12.		0.96		2200.		310.		24.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	EnviM&H
Sources 5													
MWSB-33	0.5		*0.755*		*6*		*2.19*		*15.9*		*195*		7.5
SB-41	0.5		0.1175		1.15		*0.626*		*450*		*79*		*5.5*
TE4d	2				*50*				*9.4*		*8.3*		*16*
TE4d - slag	2				*19*				*820*		*2900*		*8500*
HA-90	5	2.5		*1.4*		0.2		*4.2*		*12*		*3*	
SB-20**	8	2.5		0.30		0.2		*7*		*12*		*3*	
MWSB-33	25		0.1455		1.45		0.097		*3.79*		*6.8*		0.95
n		2.	3.	2.	5.	2.	3.	2.	5.	2.	5.	2.	5.
Mean		2.5	0.3	0.9	15.5	0.2	1.0	5.6	259.8	12.0	637.8	3.0	1706.0
Total Mean		1.2		11.3		0.7		187.2		459.0		1219.4	
St. Deviation		1.2		18.3		0.9		324.1		1078.6		3210.4	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.01		0.12		0.01		1.97		4.82		12.80	
Ith Pooled Variance		0.0000		0.0053		0.0000		1.6539		18.3220		162.3	
t value		2.132		1.943		2.132		1.943		1.943		1.943	
95% UCL		2.4		25.		1.5		430.		1300.		3600.	
Source 6: No Data													
Source 7													
TE6a (bucket) f	1-2				*40*				*660*		*650*		*52*
TE6a (bucket) f	2				*39*				*120*		*110*		*26*
TE6a	2				*35*				*27*		*33*		*9.7*
TE6a Duplicate	2				*42*				*20*		*30*		*13*
n		0.	0.	0.	4.	0.	0.	0.	4.	0.	4.	0.	4.
Mean				0.0	39.0			0.0	206.8	0.0	205.8	0.0	25.2
Total Mean		0.0		39.0		0.0		206.8		205.8		25.2	
St. Deviation				2.9				305.6		298.5		19.2	
Fraction of Total Area		0.008		0.008		0.008		0.008		0.008		0.008	
Area Weighted Mean		0.00		0.32		0.00		1.70		1.69		0.21	
Ith Pooled Variance		0.0000		0.0001		0.0000		1.5698		1.4975		0.0062	
t value				2.353				2.353		2.353		2.353	
95% UCL		***		42.		***		570.		560.		48.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 8													
SB-26	0.5				*5.8*		*0.83*		*16*		*290*		*120*
HA-16**	1	2.5		*0.7*		0.2		*15*		*14*		*3*	
SB-28	1				*12*		0.05		*14*		*16*		*38*
SB-27	1				*9.7*		*0.14*		*11*		*67*		*17*
SB-26	3				*2.5*		*0.366*		*12*		*120*		*48*
HA-16**	4.5	2.5		*0.6*		0.2		*6*		*50*		*11*	
SB-28	5.5				*9.5*		0.05		*9.3*		*4.3*		*9.8*
SB-27	5.5				*7.1*		0.05		*12*		*59*		*4.2*
SB-26	8				1.4		0.093		*3.3*		*14*		*1.9*
SB-28	10.5				*10*		0.05		*8.5*		*3*		*1.2*
SB-27	10.5				*1.7*		0.05		*6.3*		*3.9*		*1.6*
SB-26	15				1.5		0.102		*9*		*24*		*4.1*
SB-27	15.5				*1.2*		0.05		*7.1*		*2.4*		*0.78*
SB-28	16				*8*		0.05		*10*		*5.4*		*1.6*
n		2.	0.	2.	12.	2.	12.	2.	12.	2.	12.	2.	12.
Mean		2.5		0.7	5.9	0.2	0.2	10.5	9.9	32.0	50.8	7.0	20.7
Total Mean		2.5		5.1		0.2		10.0		48.1		18.7	
St. Deviation		0.0		4.2		0.2		3.6		77.4		32.6	
Fraction of Total Area		0.111		0.111		0.111		0.111		0.111		0.111	
Area Weighted Mean		0.28		0.57		0.02		1.11		5.34		2.08	
Ith Pooled Variance		0.0000		0.0152		0.0000		0.0117		5.2750		0.9341	
t value		6.314		1.771		1.771		1.771		1.771		1.771	
95% UCL		2.5		7.1		0.26		12.		85.		34.	
Source 9: No Data													

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb) M/H	Antimony (Sb) Enviros	Arsenic (As) M/H	Arsenic (As) Enviros	Cadmium (Cd) M/H	Cadmium (Cd) Enviros	Chromium (Cr) M/H	Chromium (Cr) Enviros	Copper (Cu) M/H	Copper (Cu) Enviros	Lead (Pb) M/H	Lead (Pb) Enviros
Source 10													
SB-48	0.5	2.5		3		0.2		6.9		30		39	
HA-85	2.5	2.5		3.1		0.2		5.9		38		26	
SB-48	5	2.5		1.3		0.2		4		22		36	
HA-85	6.5	2.5		1.4		0.2		4.2		15		2	
SB-48	7.5	2.5		1.4		0.2		5.9		19		29	
n		5.	0.	5.	0.	5.	0.	5.	0.	5.	0.	5.	0.
Mean		2.5		2.0		0.2		5.4		24.8		26.2	
Total Mean		2.5		2.0		0.2		5.4		24.8		26.2	
St. Deviation		0.0		0.9		0.0		1.2		9.2		14.6	
Fraction of Total Area		0.009		0.009		0.009		0.009		0.009		0.009	
Area Weighted Mean		0.023		0.018		0.002		0.048		0.223		0.236	
t*th Pooled Variance		0.0000		0.0000		0.0000		0.0000		0.0014		0.0034	
t value		2.132		2.132		2.132		2.132		2.132		2.132	
95% UCL		2.5		2.9		0.2		6.6		34.		40.	
Source 11													
SB-50A	0.5			2.6						57			
SB-50B	0.5			1.2						11			
SB-50C	0.5			1.8						27			
SB-50D	0.5			940						440			
SB-50E	0.5			39						85			
HA-82	1	2.5		1.3		0.2		6.1		25		25	
SB-50A	1			1.3						8.2			
SB-50B	1			1.2						7.4			
SB-50C	1			0.96						5.2			
SB-50D	1			1.1						10			
SB-50E	1			2.5						9.1			
HA-82	5	2.5		0.65		0.2		3.8		8.1		2	
SB-50A	6			2.3						16			
SB-50B	6			2.7						6.2			
SB-50C	6			1.4						6.1			
SB-50D	6			1.1						6.4			
SB-50E	6			0.54						5.2			

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SB-72	11	2.5		*2.8*		0.2		*4.7*		*35*		*3*	
SB-50	0.5 & 5		*2.5*		*13*		*0.14*		*30*		*23*		*47*
SB-51	0.5 & 5		*0.1*		*2.3*		0.05		*11*		*2.7*		*1.4*
SB-49	1 & 5.5				*9.6*		0.087		*9*		*21*		*12*
n		3.	2.	18.	3.	3.	3.	3.	3.	18.	3.	3.	3.
Mean		2.5	1.3	55.8	8.3	0.2	0.1	4.9	16.7	42.7	15.6	10.0	20.1
Total Mean		2.0		49.0		0.1		10.8		38.8		15.1	
St. Deviation		1.1		204.3		0.1		9.8		94.1		18.1	
Fraction of Total Area		0.027		0.027		0.027		0.027		0.027		0.027	
Area Weighted Mean		0.06		1.34		0.00		0.28		1.06		0.41	
i'th Pooled Variance		0.0002		1.4617		0.0000		0.0119		0.3140		0.0405	
t value		2.132		1.725		2.015		2.015		1.725		2.015	
95% UCL		3.0		130.		0.2		19.		74.		30.	
Sources 12 - 13: No Data													
Source 14													
SB-23**	8.5	2.5		0.3		0.2		*6*		*7*		*3*	
SB-22**	9	2.5		0.3		0.2		*5*		*6*		1.5	
n		2.	0.	2.	0.	2.	0.	2.	0.	2.	0.	2.	0.
Mean		2.5		0.3		0.2		5.5		6.5		2.3	
Total Mean		2.5		0.3		0.2		5.5		6.5		2.3	
St. Deviation		0.0		0.0		0.0		0.7		0.7		1.1	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.03		0.00		0.00		0.06		0.07		0.02	
i'th Pooled Variance		0.0000		0.0000		0.0000		0.0000		0.0000		0.0001	
t value		6.314		6.314		6.314		6.314		6.314		6.314	
95% UCL		2.5		0.3		0.2		8.7		9.7		7.0	
Source 15: No Data													

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 16													
SB-32	0.5		*0.07*		*4.6*		*0.15*		*10*		*4.6*		*1.7*
SB-52	0.5		*0.06*		*10*		0.05		*8.9*		*2.7*		*2*
SB-52/32A	0.5			*43*						*140*			
SB-52/32B	0.5			*16*						*70*			
SB52/32C	0.5			*2.1*						*120*			
HA-20	1	*22*		*0.7*		*0.9*		*95*		*220*		*310*	
SB-52/32A	1			*1.6*						*12*			
SB-52/32B	1			*1.7*						*10*			
SB52/32C	1			*1.3*						*15*			
HA-91	3.5	*20*		*3.7*		*0.5*		*38*		*52*		*81*	
SB-52	5		*8.5*		*6.6*		*0.11*		*42*		*41*		*81*
HA-20**	5.5	2.5		*0.6*		0.2		*5*		*25*		*59*	
SB-52/32A	6			*1.1*						*6.6*			
SB-52/32B	6			*1.4*						*7.5*			
SB52/32C	6			*1.3*						*6.7*			
SB-32	7.5		*0.10*		*17*		*0.17*		*10*		*56*		*5.2*
SB52/32D	0.5			*5.7*						*90*			
SB52/32D	1			*1.6*						*8.8*			
SB52/32D	6			*1.4*						*14*			
n		3.	4.	15.	4.	3.	4.	3.	4.	15.	4.	3.	4.
Mean		14.8	2.2	5.5	9.6	0.5	0.1	46.0	17.7	53.2	26.1	150.0	22.5
Total Mean		7.6		6.4		0.3		29.8		47.5		77.1	
St. Deviation		9.6		10.1		0.3		32.4		58.5		108.9	
Fraction of Total Area		0.020		0.020		0.020		0.020		0.020		0.020	
Area Weighted Mean		0.15		0.13		0.01		0.59		0.94		1.52	
Pooled Variance		0.0052		0.0021		0.0000		0.0582		0.0700		0.6569	
t value		1.943		1.734		1.943		1.943		1.734		1.943	
95% UCL		15.		10.		0.52		54.		71.		160.	
Source 17: No Data													

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb) M/H	Antimony (Sb) Enviros	Arsenic (As) M/H	Arsenic (As) Enviros	Cadmium (Cd) M/H	Cadmium (Cd) Enviros	Chromium (Cr) M/H	Chromium (Cr) Enviros	Copper (Cu) M/H	Copper (Cu) Enviros	Lead (Pb) M/H	Lead (Pb) Enviros
Source 18													
HA-1**	1	12		0.2		0.5		16		93		53	
HA-5**	1	8		0.5		0.2		7		13		5	
SB-35	1	34		2.6		3.4		110		660		600	
HA-1	5	2.5		0.3		0.2		10		19		12	
HA-5**	5	11		0.4		0.2		8		13		5	
SB-35	5	13		3		0.4		23		83		67	
SB-35	8	6		1.5		0.2		4		36		5	
SB-35	15	9		2.6		0.2		9		37		7	
n		8.	0.	8.	0.	8.	0.	8.	0.	8.	0.	8.	0.
Mean		11.9		1.4		0.7		23.4		119.3		94.3	
Total Mean		11.9		1.4		0.7		23.4		119.3		94.3	
St. Deviation		9.5		1.2		1.1		35.5		220.6		205.8	
Fraction of Total Area		0.060		0.060		0.060		0.060		0.060		0.060	
Area Weighted Mean		0.71		0.08		0.04		1.40		7.12		5.63	
l'th Pooled Variance		0.0406		0.0006		0.0006		0.5616		21.6861		18.6707	
t value		1.895		1.895		1.895		1.895		1.895		1.695	
95% UCL		18.		2.2		1.4		47.		270.		230.	
Source 19													
TE4c	0.5-1				92				400		69		34
TE4e	1.5-3.5				74				100		430		170
TE4e - slag	2				27				1300		340		62
TE4c	3-5				99				8		10		17
HA-13**	1	12		0.3		0.5		230		110		45	
SB-53	1				0.110		2.14		1198		95.6		8.58
SB-53	1.5				1.05		0.792		4		73		21
HA-80	3	22		2.7		3.8		0.35		820		520	
HA-13	5	2.5		0.3		0.2		7		7		3	
SB-53	8				2.5		0.084		3.7		8		0.65
TE4e	10				56				20		53		29

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	EnviMet
n		3.	0.	3.	8.	3.	3.	3.	8.	3.	8.	3.	8.
Mean		12.2		1.1		1.5		79.1		312.3		189.3	
Total Mean		12.2		32.3		1.3		297.4		183.2		82.8	
St. Deviation		9.8		40.2		1.5		487.4		252.6		152.5	
Fraction of Total Area		0.019		0.019		0.019		0.019		0.019		0.019	
Area Weighted Mean		0.23		0.62		0.02		5.74		3.54		1.60	
Nh Pooled Variance		0.0118		0.0547		0.0001		8.0454		2.1603		0.7877	
t value		2.920		1.812		2.015		1.812		1.812		1.812	
95% UCL		29.		54.		2.4		560.		320.		170.	
Source 20													
SB-54A	0.5			1.1						120			
SB-54B	0.5			1.1						90			
SB-54C	0.5			14						180			
SB-54D	0.5			44						160			
SB-54E	0.5			40						120			
SB-54A	1			1.5						23			
SB-54B	1			21						120			
SB-54C	1			3.1						18			
SB-54D	1			7.1						110			
SB-54E	1			11						250			
SB-54	1.5				37		0.935		275		170		93
HA-83	2	20		3		2		570		260		70	
TE4b	2				290				1700		620		1800
TE4b - slag	2				46				1200		580		2800
TE4b - slag Dup	2				31				990		720		3100
TP1	3.5				0.5		0.250		6.3		5		0.8
TE4b	5				68				50		53		24
SB-54A	6			2.5						12			
SB-54B	6			5.3						11			
SB-54C	6			1						6.7			
SB-54D	6			1.8						8.2			
SB-54E	6			1.3						8			
SB-71	9	2.5		2.5		0.2	0.250	4.1	6.3	15		2	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	EnviM&H
n		2.	0.	17.	6.	2.	3.	2.	7.	17.	6.	2.	6.
Mean		11.3		9.5	78.8	0.9	0.5	287.1	603.9	88.9	358.0	36.0	1303.0
Total Mean		11.3		27.6		0.6		533.5		159.1		986.2	
St. Deviation		12.4		60.3		0.6		627.6		206.9		1358.7	
Fraction of Total Area		0.026		0.026		0.026		0.026		0.026		0.026	
Area Weighted Mean		0.30		0.73		0.02		14.08		4.20		26.04	
Pih Pooled Variance		0.0534		0.1104		0.0001		30.5056		1.2969		160.8	
t value		6.314		1.721		2.353		1.943		1.721		1.943	
95% UCL		66.		49.		1.3		940.		230.		1900.	
Source 21: No Data													
Source 22													
MWSB-36*	0.5		0.120		1.2		0.080		***16***		***15***		***6.4***
HA-7**	1	2.5		***0.3***		0.2		***22***		***26***		***8***	
HA-8**	1	***7***		***0.4***		***0.4***		***28***		***38***		***18***	
HA-77	4.5	***18***		***3.2***		***0.4***		***15***		***25***		***29***	
MWSB-9**	7	***7***		***0.5***		0.2		***7***		***9***		1.5	
MWSB-36	8		0.132		1.3		0.088		***4.1***		***20***		1
MWSB-8**	8	***5***		***0.8***		0.2		***6***		***6***		1.5	
SB-66	11	2.5		***2.9***		0.2		***4.7***		***16***		***3***	
SB-67	11	***270***		***3.9***		***3.1***		***140***		***630***		***1700***	
MWSB-36	28		0.15		1.5		0.1		***5.4***		***7.5***		***1.9***
MWSB-36	48		***0.3***		1.5		0.1		***3.7***		***5.8***		***3***
MWSB-36*	68		0.15 G		1.3 G		0.1 G		***3.45*** G		***7.5*** G		***2.25***
n		7.	5.	7.	5.	7.	5.	7.	5.	7.	5.	7.	5.
Mean		44.6	0.2	1.7	1.4	0.7	0.1	31.8	6.5	107.1	11.2	251.6	2.9
Total Mean		26.1		1.6		0.4		21.3		67.2		148.0	
St. Deviation		77.0		1.2		0.8		38.3		177.5		488.8	
Fraction of Total Area		0.128		0.128		0.128		0.128		0.128		0.128	
Area Weighted Mean		3.33		0.20		0.05		2.72		8.58		18.89	
Pih Pooled Variance		8.0552		0.0018		0.0010		1.9883		42.8288		324.74	
t value		1.796		1.796		1.796		1.796		1.796		1.796	
95% UCL		66.		2.2		0.87		41.		160.		400.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb) M/H	Antimony (Sb) Enviros	Arsenic (As) M/H	Arsenic (As) Enviros	Cadmium (Cd) M/H	Cadmium (Cd) Enviros	Chromium (Cr) M/H	Chromium (Cr) Enviros	Copper (Cu) M/H	Copper (Cu) Enviros	Lead (Pb) M/H	Lead (Pb) Enviros
Source 23													
HA-81	4.5	2.5		*2.1*		0.2		*5.1*		*24*		*7*	
MW-39	5				1.3		0.625		6.25		14		12.5
MW-39	15				1.3		0.625		6.25		9		12.5
MW-39	50				1.3		0.625		6.25		16		12.5
MW-39A	5				1.3		0.625		6.25		20		12.5
MW-39A	15				1.3		0.625		6.25		8		12.5
n		1.	0.	1.	5.	1.	5.	1.	5.	1.	5.	1.	5.
Mean		2.5		2.1	1.3	0.2	0.6	5.1	6.3	24.0	13.4	7.0	12.5
Total Mean		2.5		1.4		0.6		6.1		15.2		11.6	
St. Deviation		0.0		0.3		0.2		0.5		6.2		2.2	
Fraction of Total Area		0.045		0.045		0.045		0.045		0.045		0.045	
Area Weighted Mean		0.11		0.06		0.03		0.27		0.69		0.52	
Ith Pooled Variance		0.0000		0.0000		0.0000		0.0001		0.0132		0.0017	
t value				2.015		2.015		2.015		2.015		2.015	
95% UCL		***		1.7		0.70		6.4		20.		13.	
Source 24: No Data													
Source 25													
MWSB-34*	0		0.1275 G		*7.6* G		0.085 G		*27* G		*25* G		*8.5*
SB-36	0.5		*9.7*		*250*		*3.79*		*100*		*900*		*720*
SB-36A	0.5			*180*						*880*			
SB-36C	0.5			*2.1*						*27*			
SB-36D	0.5			*24*						*180*			
SB-36A	1			*270*						*860*			
SB-36C	1			*2.3*						*18*			
SB-36D	1			*2.5*						*57*			
MWSB-10**	2	2.5		*0.4*		0.2		*7*		*12*		*3*	
SB-69	3	*20*		*3.3*		*1.2*		*34*		*270*		*210*	
MWSB-12	5	2.5		*0.4*		0.2		*6*		*12*		*3*	
MWSB-13**	6	*7*		*0.7*		0.2		*8*		*12*		1.5	
SB-36A	6			*3.1*						*11*			
SB-36C	6			*1.5*						*38*			
SB-36D	6			*1.4*						*5.8*			
SB-68	6.5	2.5		*0.93*		0.2		*4.3*		*13*		*2*	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
MWSB-15	7	2.5		0.4		0.2		6		8		3	
MWSB-11**	8	8		0.5		0.2		11		23		14	
MWSB-34	10		0.1335		1.35		0.089		4.3		5.5		0.9
MWSB-34	32.5		0.1545		1.55		0.103		3.8		6.9		1.530
MWSB-34	50		0.15		1.50		0.1		7.2		15		3
MWSB-34	70		0.162		1.6		0.108		6.5		14		3.2
n		7.	6.	16.	6.	7.	6.	7.	6.	16.	6.	7.	6.
Mean		6.4	1.7	30.8	43.9	0.3	0.7	10.9	24.8	151.7	161.1	33.8	122.9
Total Mean		4.3		34.4		0.5		17.3		154.2		74.9	
St. Deviation		5.7		82.4		1.0		26.5		301.9		202.1	
Fraction of Total Area		0.180		0.180		0.180		0.180		0.180		0.180	
Area Weighted Mean		0.77		6.19		0.09		3.12		27.75		13.47	
Pooled Variance		0.0821		9.9774		0.0026		1.7507		134.0909		101.64	
t value		1.782		1.721		1.782		1.782		1.721		1.782	
95% UCL		7.1		65.		1.0		30.		270.		180.	
Source 26													
MWSB-35	0.5		0.249		7.5		0.083		21		31		24
SB-16/64A	0.5			12						7.8			
SB-16/64C	0.5			95						1500			
SB-16/64D	0.5			2						150			
SB-36B	0.5			150						1000			
SB-36E	0.5			3.2						33			
SB-63A	0.5			51						1200			
SB-63B	0.5			39						1400			
SB-63C	0.5			45						1100			
SB-63D	0.5			49						1200			
SB-63E	0.5			70						1400			
SB-65A	0.5			54						1600			
SB-65B	0.5			33						680			
SB-65C	0.5			15						140			
SB-65D	0.5			91						2200			
TE11a	0-2				93				26		400		210
TE1a	0-2				90				33		1300		430
TE1b	0-2				200				40		1200		460
TE1d	0-2				180				32		2000		430

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
HA-75	1	17		3.5		0.9		31		530		94	
SB-16/64A	1			17						7.4			
SB-16/64C	1			95						620			
SB-16/64D	1			9.2						250			
SB-36B	1			3.2						30			
SB-36E	1			1.6						98			
SB-63A	1			15						190			
SB-63B	1			32						1200			
SB-63C	1			37						890			
SB-63D	1			54						730			
SB-63E	1			0.25						1000			
SB-65A	1			8						120			
SB-65B	1			6.6						130			
SB-65C	1			4.6						67			
SB-65D	1			34						1200			
TE1c	1-2				120				32		1300		320
TE11b	2-4				83				27		400		150
TE1a	2-4				230				26		1400		710
TE1b	2-4				680				64		1900		520
TE1c	2-4				190				48		1200		290
TE1d	2-4				81				38		48		28
TE11a	3-4				220				29		1500		420
SB-63	2.5	14		1.4		1.2		30		980		220	
SB-65A	2.5			3.1						57			
SB-64	3.5	14		2.7		1.6		32		960		790	
HA-75	4	2.5		3.3		0.2		7.4		63		44	
TE11a	4-6				230				47		1200		280
TE1a	4-6				100				45		46		22
TE1b	4-6				94				61		880		230
TE1c	4-6				160				150		780		79
SB-65	5	2.5		3		0.8		18		230		300	
MWSB-14**	6	11		0.1		0.9		49		210		160	
MWSB-16**	6	17		0.3		0.9		130		2600		1000	
SB-16/64A	6			15						850			
SB-16/64C	6			13						190			
SB-16/64D	6			16						610			
SB-36B	6			1.6						5.4			
SB-36E	6			8						150			
SB-63A	6			4.1						900			

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SB-63B	6			*20*						*1200*			
SB-63C	6			*120*						*1200*			
SB-63D	6			*32*						*2000*			
SB-63E	6			*2.5*						*180*			
SB-65B	6			*14*						*38*			
SB-65C	6			*3.6*						*84*			
SB-65D	6			*3*						*10*			
TE1d	6-7.5				*84*				*35*		*73*		*28*
TE11b	6-8				*63*				*46*		*39*		*36*
TE1b	6-8				*100*				*65*		*1400*		*150*
SB-63	7.5	2.5		*2.5*		0.2		*17*		*36*		*4*	
SB-64	7.5	*14*		*2.6*		*1.2*		*76*		*1700*		*530*	
SB-65	8	2.5		*3.2*		0.2		*4.5*		*7.7*		*3*	
TE1c	6-8				*110*				*86*		*360*		*67*
TE1b	8-9				*33*				*54*		*160*		*36*
TE11a	10				*230*				*36*		*110*		*63*
MWSB-35	10		0.1395		1.4		0.093		*4.5*		*24.*		*5.8*
SB-63	10	*7*		*1.3*		*0.5*		*14*		*280*		*47*	
SB-64	10	*11*		*0.82*		*1.4*		*8.7*		*56*		*590*	
SB-65	15	2.5		*2.4*		0.2		*4.8*		*6.6*		*3*	
MWSB-35	32		0.129		1.3		0.086		*6.2*		*9.5*		*2.6*
MWSB-35	52.5		0.153		1.5		0.102		*5.3*		*7.8*		1.0
MWSB-35	70		0.1395		1.4		0.093		*4.4*		*8.0*		0.9
n		13.	5.	55.	26.	13.	5.	13.	26.	55.	26.	13.	26.
Mean		9.0	0.2	23.8	130.2	0.8	0.1	32.5	40.8	641.4	683.7	291.2	192.1
Total Mean		6.6		57.9		0.6		38.0		655.0		225.1	
St. Deviation		6.5		94.9		0.5		31.7		655.7		252.0	
Fraction of Total Area		0.068		0.068		0.068		0.068		0.068		0.068	
Area Weighted Mean		0.44		3.92		0.04		2.58		44.34		15.24	
Pth Pooled Variance		0.0106		0.5093		0.0001		0.1180		24.3302		7.4638	
t value		1.740		1.671		1.740		1.697		1.671		1.697	
95% UCL		9.2		76.		0.81		47.		780.		290.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Sources 27													
HA-88	5.5	2.5		***3***		0.2		***5.0***		***34***		***8***	
HA-89	5.5	2.5		***1.4***		0.2		***3.9***		***15***		***5***	
SB-70	9.5	2.5		***2.5***		0.2		***5.8***		***22***		***10***	
MW-38	5				1.25		0.625		6.25		***7***		12.5
MW-38	15				1.25		0.625		6.25		***13***		12.5
MW-38	50				***3.4***		0.625		6.25		***20***		12.5
MW-38A	5				1.25		0.625		6.25		***10***		12.5
MW-38A	15				7		0.625		19		***41***		12.5
n		3.	0.	3.	5.	3.	5.	3.	5.	3.	5.	3.	5.
Mean		2.5		2.3	2.8	0.2	0.6	4.9	8.8	23.7	18.2	7.7	12.5
Total Mean		2.5		2.6		0.5		7.3		20.3		10.7	
St. Deviation		0.0		2.0		0.2		4.8		11.9		2.8	
Fraction of Total Area		0.113		0.113		0.113		0.113		0.113		0.113	
Area Weighted Mean		0.28		0.30		0.05		0.83		2.28		1.20	
Ith Pooled Variance		0.0000		0.0061		0.0001		0.0362		0.2223		0.0128	
t value		2.920		1.895		1.895		1.895		1.895		1.895	
95% UCL		2.5		3.9		0.61		11.		28.		13.	
SOURCES 28-30: No Data													
SOURCE 31													
HA-86	6	2.5		***3.3***		0.2		***11***		***69***		***17***	
n		1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000
Fraction of Total Area		0.013		0.013		0.013		0.013		0.013		0.013	
Area Weighted Mean		0.0318		0.0419		0.0025		0.1397		0.8763		0.2159	
Ith Pooled Variance		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	
t value													
95% UCL		***		***		***		***		***		***	***

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Antimony (Sb) M/H	Antimony (Sb) Enviros	Arsenic (As) M/H	Arsenic (As) Enviros	Cadmium (Cd) M/H	Cadmium (Cd) Enviros	Chromium (Cr) M/H	Chromium (Cr) Enviros	Copper (Cu) M/H	Copper (Cu) Enviros	Lead (Pb) M/H	Lead (Pb) EnviM&H
SOURCE 32													
HA-87	6	2.5		*1.4*		0.2		*3.1*		*13*		*6*	
n		1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000
Fraction of Total Area		0.039		0.039		0.039		0.039		0.039		0.039	
Area Weighted Mean		0.10		0.05		0.01		0.12		0.51		0.23	
Pth Pooled Variance		0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	
t value													
95% UCL		***		***		***		***		***		***	***
Site Wide Summary:													
N (total analysis)		91		253		125		161		253		160	
Min		0.06		0.10		0.05		0.35		2.40		0.78	
Max		270.00		940.00		3.80		1700.00		2900.00		8500.00	
Total area													
Weighted Means		6.88		14.85		0.41		45.05		115.71		100.73	
Pooled Variance		8.26		12.17		0.00		108.32		253.09		778.33	
t-value		1.671		1.645		1.658		1.658		1.645		1.658	
Site Wide 95% UCL		7.4		15.		0.42		46.		120.		100.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H	Mercury (Hg) Enviros	Nickel (Ni) M/H	Nickel (Ni) Enviros	Selenium (Se) M/H	Selenium (Se) Enviros	Silver (Ag) M/H	Silver (Ag) Enviros	Zinc (Zn) M/H	Zinc (Zn) Enviros
Source 1											
SB-24 #	7.5				***4.8***						***19***
SB-24 #	15				***9.3***						***15***
MW-44	5		0.025		13						***21***
MW-44	15		0.07		16						***63***
MW-44	50		0.11		16						***35***
n		0.	3.	0.	5.	0.	0.	0.	0.	0.	5.
Mean			0.1		11.8						30.6
Total Mean		0.1		11.8						30.6	
St. Deviation		0.0		4.8		0		0		19.6	
Fraction of Total Area		0.025		0.025						0.025	
Area Weighted Mean		0.00		0.30						0.77	
Pooled Variance		0.0000		0.0029		0.0000		0.0000		0.0481	
t value		2.920		2.132		0.000		0.000		2.132	
95% UCL		0.14		16.		***		***		49.	
Sources 2- 3: No Data											
Source 4											
SB-39	0.5		***0.132***		***13***		0.118		0.394		***85.9***
SB-40'	0.5		0.0075		***50*** G		0.2135 G		3.805 G		***178.***
SB-19''	8	0.01		***5***		0.005		0.25		***25.***	
n		1.	2.	1.	2.	1.	2.	1.	2.	1.	2.
Mean		0.0	0.1	5.0	31.5	0.0	0.2	0.3	2.1	25.0	132.0
Total Mean		0.0		22.7		0.1		1.5		96.3	
St. Deviation		0.1		24.0		0.1		2.0		77.0	
Fraction of Total Area		0.014		0.014		0.014		0.014		0.014	
Area Weighted Mean		0.00		0.32		0.00		0.02		1.35	
Pooled Variance		0.0000		0.0377		0.0000		0.0003		0.3876	
t value		2.920		2.920		2.920		2.920		2.920	
95% UCL		0.17		63.		0.29		4.9		230.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Semple Location	Depth	Mercury (Hg) M/H	Mercury (Hg) Enviros	Nickel (Ni) M/H	Nickel (Ni) Enviros	Selenium (Se) M/H	Selenium (Se) Enviros	Silver (Ag) M/H	Silver (Ag) Enviros	Zinc (Zn) M/H	Zinc (Zn) Enviros
Sources 5											
MWSB-33	0.5		*0.091*		*42*		0.113		3.775		*54.4*
SB-41	0.5		0.007		*18*		0.1175		1.175		*32.4*
TE4d	2				*11*						*21*
TE4d - slag	2				*99*						*300*
HA-90	5	*0.08*		*5*		*0.04*		0.25		*17*	
SB-20**	8	0.01		*7*		0.01	G	0.25		*17*	
MWSB-33	25		0.115		*4.8*		0.1455		0.4855		*15.5*
n		2.	3.	2.	5.	2.	3.	2.	3.	2.	5.
Mean		0.0	0.1	6.0	35.0	0.0	0.1	0.3	1.8	17.0	84.7
Total Mean		0.1		26.7		0.1		1.2		65.3	
St. Deviation		0.0		34.5		0.1		1.5		104.4	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.001		0.28		0.001		0.01		0.69	
i'th Pooled Variance		0.0000		0.0187		0.0000		0.0000		0.1717	
t value		2.132		1.943		2.132		2.132		1.943	
95% UCL		0.11		52.		0.14		2.6		140.	
Source 6: No Data											
Source 7											
TE6a (bucket) f	1-2				*240*						*82*
TE6a (bucket) f	2				*58*						*68*
TE6a	2				*11*						*27*
TE6a Duplicate	2				*11*						*24*
n		0.	0.	0.	4.	0.	0.	0.	0.	0.	4.
Mean		0.0		0.0	80.0	0.0		0.0		0.0	50.3
Total Mean		0.0		90.0		0.0		0.0		50.3	
St. Deviation		0.0		108.9		0.0		0.0		29.2	
Fraction of Total Area		0.008		0.008		0.008		0.008		0.008	
Area Weighted Mean		0.000		0.66		0.000		0.00		0.41	
i'th Pooled Variance		0.0000		0.1995		0.0000		0.0000		0.0143	
t value				2.353						2.353	
95% UCL		***		208.		***		***		85.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H	Mercury (Hg) Enviros	Nickel (Ni) M/H	Nickel (Ni) Enviros	Selenium (Se) M/H	Selenium (Se) Enviros	Silver (Ag) M/H	Silver (Ag) Enviros	Zinc (Zn) M/H	Zinc (Zn) Enviros
Source 8											
SB-26	0.5										217
HA-16**	1	0.01		32		0.01	G	0.25		470	
SB-28	1				37						47
SB-27	1				30						56
SB-26	3										117
HA-16**	4.5	0.1		7		0.01	G	0.25		32	
SB-28	5.5				11						16
SB-27	5.5				26						21
SB-26	8										21.7
SB-28	10.5				10						11
SB-27	10.5				8.7						10
SB-26	15										27.1
SB-27	15.5				8.5						9.7
SB-28	16				12						13
n		2.	0.	2.	8.	2.	0.	2.	0.	2.	12.
Mean		0.1		19.5	17.9	0.0		0.3		251.0	47.2
Total Mean		0.1		18.2		0.0		0.3		76.3	
St. Deviation		0.1		11.6		0.0		0.0		126.8	
Fraction of Total Area		0.111		0.111		0.111		0.111		0.111	
Area Weighted Mean		0.01		2.02		0.00		0.03		6.47	
t'th Pooled Variance		0.0000		0.1659		0.0000		0.0000		14.1410	
t value		6.314		1.833		6.314		6.314		1.771	
95% UCL		0.34		25.		0.01		0.25		140.	
Source 9: No Data											

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H	Mercury (Hg) Enviros	Nickel (Ni) M/H	Nickel (Ni) Enviros	Selenium (Se) M/H	Selenium (Se) Enviros	Silver (Ag) M/H	Silver (Ag) Enviros	Zinc (Zn) M/H	Zinc (Zn) Enviros
Source 10											
SB-48	0.5	***0.04***		***12***		***0.13***		0.25		***63***	
HA-85	2.5	***0.08***		***10***		***0.1***		0.25		***56***	
SB-48	5	0.01		***8***		***0.13***		0.25		***24***	
HA-85	6.5	0.01		***6***		***0.1***		0.25		***34***	
SB-48	7.5	0.01		***9***		***0.12***		0.25		***40***	
n		5.	0.	5.	0.	5.	0.	5.	0.	5.	0.
Mean		0.0		9.0		0.1		0.3		43.4	
Total Mean		0.0		9.0		0.1		0.3		43.4	
St. Deviation		0.0		2.2		0.0		0.0		16.0	
Fraction of Total Area		0.009		0.009		0.009		0.009		0.009	
Area Weighted Mean		0.000		0.081		0.001		0.002		0.391	
l'th Pooled Variance		0.0000		0.0001		0.0000		0.0000		0.0041	
t value		2.132		2.132		2.132		2.132		2.132	
95% UCL		0.05		11.		0.13		0.25		59.	
Source 11											
SB-50A	0.5	0.125									
SB-50B	0.5	0.125									
SB-50C	0.5	0.125									
SB-50D	0.5	0.125									
SB-50E	0.5	***0.36***									
HA-82	1	***0.02***		***7***		***0.04***		0.25		***40***	
SB-50A	1	0.125									
SB-50B	1	0.125									
SB-50C	1	0.125									
SB-50D	1	0.125									
SB-50E	1	0.125									
HA-82	5	***0.04***		***5***		***0.04***		0.25		***15***	
SB-50A	6	0.125									
SB-50B	6	0.125									
SB-50C	6	0.125									
SB-50D	6	0.125									
SB-50E	6	0.125									

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg)		Nickel (Ni)		Selenium (Se)		Silver (Ag)		Zinc (Zn)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SB-72	11	0.01		***7***		***0.14***		0.25		***38***	
SB-50	0.5 & 5		***0.72***		***37***		***9.8***		***0.11***		***160***
SB-51	0.5 & 5		***0.58***		***11***		0.05		***0.03***		***15***
SB-49	1 & 5.5										***50***
n		18.	2.	3.	2.	3.	2.	3.	2.	3.	3.
Mean		0.1	0.7	6.3	24.0	0.1	4.9	0.3	0.1	31.0	75.0
Total Mean		0.2		13.4		2.0		0.2		53.0	
St. Deviation		0.2		13.4		4.4		0.1		54.3	
Fraction of Total Area		0.027		0.027		0.027		0.027		0.027	
Area Weighted Mean		0.00		0.37		0.05		0.00		1.45	
i'th Pooled Variance		0.0000		0.0267		0.0028		0.0000		0.3662	
t value		1.729		2.132		2.132		2.132		2.015	
95% UCL		0.24		26.		6.2		0.28		98.	
Sources 12 - 13: No Data											
Source 14											
SB-23**	8.5	0.01		***6.0***		0.005		0.25		***21***	
SB-22**	9	0.01		***5.0***		0.005		0.25		***13***	
n		2.	0.	2.	0.	2.	0.	2.	0.	2.	0.
Mean		0.0		5.5		0.0		0.3		17.0	
Total Mean		0.0		5.5		0.0		0.3		17.0	
St. Deviation		0.0		0.7		0.0		0.0		5.7	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.00		0.06		0.00		0.00		0.18	
i'th Pooled Variance		0.0000		0.0000		0.0000		0.0000		0.0018	
t value		6.314		6.314		6.314		6.314		6.314	
95% UCL		0.01		8.7		0.01		0.25		42.	
Source 15: No Data											

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg)		Nickel (Ni)		Selenium (Se)		Silver (Ag)		Zinc (Zn)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	EnviM&H
Source 16											
SB-32	0.5		*0.59*		*10*		*5.1*		*0.04*		*19*
SB-52	0.5		*0.64*		*6.1*		0.05		*0.05*		*24*
SB-52/32A	0.5	*0.47*									
SB-52/32B	0.5	*0.45*									
SB52/32C	0.5	0.125									
HA-20	1	*0.6*		*86*		*0.1*		*0.6*		*930*	
SB-52/32A	1	0.125									
SB-52/32B	1	0.125									
SB52/32C	1	0.125									
HA-91	3.5	*0.1*		*50*		*0.05*		0.25		*220*	
SB-52	5		*0.97*		*35*		0.05		*0.12*		*200*
HA-20**	5.5	*0.03*		*6*		*0.01*	G	0.25		*34*	
SB-52/32A	6	0.125									
SB-52/32B	6	0.125									
SB52/32C	6	0.125									
SB-32	7.5		*0.59*		*28*		*2.3*		*0.030*		*100*
SB52/32D	0.5	*0.8*									
SB52/32D	1	0.125									
SB52/32D	6	0.125									
n		15.	4.	3.	4.	3.	4.	3.	4.	3.	0.
Mean		0.2	0.7	47.3	19.8	0.1	1.9	0.4	0.1	394.7	85.8
Total Mean		0.3		31.6		1.1		0.2		218.1	
St. Deviation		0.3		29.1		2.0		0.2		324.6	
Fraction of Total Area		0.020		0.020		0.020		0.020		0.020	
Area Weighted Mean		0.01		0.62		0.02		0.00		4.30	
Pth Pooled Variance		0.0000		0.0471		0.0002		0.0000		13.6325	
t value		1.734		1.943		1.943		1.943		2.920	
95% UCL		0.45		53.		2.5		0.34		770.	
Source 17: No Data											

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H	Mercury (Hg) Enviros	Nickel (Ni) M/H	Nickel (Ni) Enviros	Selenium (Se) M/H	Selenium (Se) Enviros	Silver (Ag) M/H	Silver (Ag) Enviros	Zinc (Zn) M/H	Zinc (Zn) Enviros
Source 18											
HA-1**	1	***0.1***		***22***		0.14	G	0.06	G	***350***	
HA-5**	1	0.15	G	***6***		0.01	G	0.25		***19***	
SB-35	1	***0.47***		***120***		***0.21***		***1.4***		***3800***	
HA-1	5	***0.02***		***6***		0.005		0.25		***48***	
HA-5**	5	0.01		***6***		0.01	G	0.25		***21***	
SB-35	5	***0.05***		***34***		***0.04***		0.25		***370***	
SB-35	8	0.01		***4***		***0.02***		0.25		***39***	
SB-35	15	0.01		***9***		***0.02***		0.25		***35***	
n		8.	0.	8.	0.	8.	0.	8.	0.	8.	0.
Mean		0.1		25.9		0.1		0.4		585.3	
Total Mean		0.1		25.9		0.1		0.4		585.3	
St. Dovlation		0.2		39.4		0.1		0.4		1307.4	
Fraction of Total Area		0.060		0.060		0.060		0.060		0.060	
Area Weighted Mean		0.01		1.54		0.00		0.02		34.94	
I'th Pooled Variance		0.0000		0.6930		0.0000		0.0001		761.5131	
t value		1.895		1.895		1.895		1.895		1.895	
95% UCL		0.21		52.		0.11		0.65		1500.	
Source 19											
TE4c	0.5-1				***30***						***250***
TE4e	1.5-3.5				***100***						***630***
TE4e - slag	2				***130***						***160***
TE4c	3-5				***11***						***42***
HA-13**	1	0.01		***260***		0.14	G	***0.6***		***350***	
SB-53	1				***9.7***						***41.4***
SB-53	1.5		***0.185***		***14***						***320***
HA-80	3	0.01		***70***		***0.09***		***1.6***		***1500***	
HA-13	5	0.01		***6***		0.005		0.25		***26***	
SB-53	8		***0.122***		***5.9***						***15***
TE4e	10				***13***						***81***

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg)		Nickel (Ni)		Selenium (Se)		Silver (Ag)		Zinc (Zn)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	EnviM4t
n		3.	2.	3.	8.	3.	0.	3.	0.	3.	8.
Mean		0.0		112.0		0.1		0.8		625.3	192.4
Total Mean		0.1		59.1		0.1		0.8		310.5	
St. Deviation		0.1		79.1		0.1		0.7		437.1	
Fraction of Total Area		0.019		0.019		0.019		0.019		0.019	
Area Weighted Mean		0.00		1.14		0.00		0.02		5.99	
l'th Pooled Variance		0.0000		0.2119		0.0000		0.0001		6.4691	
t value		2.132		1.812		2.920		2.920		1.812	
95% UCL		0.15		100.		0.19		2.0		550.	
Source 20											
SB-54A	0.5	0.125									
SB-54B	0.5	0.125									
SB-54C	0.5	***0.65***									
SB-54D	0.5	***0.28***									
SB-54E	0.5	0.125									
SB-54A	1	0.125									
SB-54B	1	***0.37***									
SB-54C	1	0.125									
SB-54D	1	0.125									
SB-54E	1	***0.78***									
SB-54	1.5		***0.289***		***17***						***467***
HA-83	2	***0***		***60***		***0.16***		***1***		***420***	
TE4b	2				***110***						***1000***
TE4b - slag	2				***120***						***3100***
TE4b - slag Dup	2				***190***						***2600***
TP1	3.5				***4.1***						***12.5***
TE4b	5				***11***						***82***
SB-54A	6	0.125									
SB-54B	6	0.125									
SB-54C	6	0.125									
SB-54D	6	0.125									
SB-54E	6	0.125									
SB-71	9	0.01		***6***		***0.12***		0.25		***19***	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H	Mercury (Hg) Enviros	Nickel (Ni) M/H	Nickel (Ni) Enviros	Selenium (Se) M/H	Selenium (Se) Enviros	Silver (Ag) M/H	Silver (Ag) Enviros	Zinc (Zn) M/H	Zinc (Zn) Enviros
n		17.	1.	2.	6.	2.	0.	2.	0.	2.	6.
Mean		0.2	0.3	33.0	75.4	0.1		0.8		219.5	1210.3
Total Mean		0.2		64.8		0.1		0.8		962.6	
St. Deviation		0.2		68.8		0.0		0.7		1216.5	
Fraction of Total Area		0.026		0.026		0.026		0.026		0.026	
Area Weighted Mean		0.01		1.71		0.00		0.02		25.41	
i'th Pooled Variance		0.0000		0.4121		0.0000		0.0002		128.9316	
t value		1.740		1.943		6.314		6.314		1.943	
95% UCL		0.29		110.		0.27		4.1		1800.	
Source 21: No Data											
Source 22											
MWSB-36*	0.5		***0.0325***		***27***		0.12		0.4		***28.6***
HA-7**	1	0.01		***36***		0.14 G		0.25		***37***	
HA-8**	1	***0.02***		***42***		0.14 G		0.25		***75***	
HA-77	4.5	***0.06***		***30***		***0.12***		***2***		***52***	
MWSB-9**	7	0.01		***6***		0.14 G		0.25		***17***	
MWSB-36	8		0.0075		***6.2***		***0.8***		0.5		***26.6***
MWSB-8**	8	0.01		***6***		0.14 G		0.25		***24***	
SB-66	11	***0.08***		***6***		***0.07***		0.25		***20***	
SB-67	11	***0.08***		***160***		***1***		***1.8***		***4300***	
MWSB-36	28		***0.024***		***7.8***		0.15		0.35		***19.2***
MWSB-36	48		0.013		***5***		0.15		0.5		***14.2***
MWSB-36*	68		0.0125 G		***5.55*** G		0.15 G		0.272 G		***15.5*** G
n		7.	5.	7.	5.	7.	5.	7.	5.	7.	5.
Mean		0.0	0.0	40.9	10.3	0.3	0.3	0.7	0.4	646.4	20.8
Total Mean		0.0		28.1		0.3		0.6		385.8	
St. Deviation		0.0		43.8		0.3		0.6		1232.8	
Fraction of Total Area		0.128		0.128		0.128		0.128		0.128	
Area Weighted Mean		0.00		3.59		0.03		0.08		49.26	
i'th Pooled Variance		0.0000		2.6014		0.0001		0.0005		2065.	
t value		1.796		1.796		1.796		1.796		1.796	
95% UCL		0.04		51.		0.42		0.91		1000.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H		Mercury (Hg) Enviros		Nickel (Ni) M/H		Nickel (Ni) Enviros		Selenium (Se) M/H		Selenium (Se) Enviros		Silver (Ag) M/H		Silver (Ag) Enviros		Zinc (Zn) M/H		Zinc (Zn) Enviros	
Source 23																					
HA-81	4.5	***0.06***				***60***				***0.05***				0.25				***49***			
MW-39	5			0.05				6.25												40	
MW-39	15			0.05				6.25												30	
MW-39	50			0.05				6.25												32	
MW-39A	5			0.05				6.25												47	
MW-39A	15			0.05				6.25												33	
n		1.		5.		1.		5.		1.		0.		1.		0.		1.		5.	
Mean		0.1		0.1		60.0		6.3		0.1		0.0		0.3		0.0		49.0		36.4	
Total Mean		0.1				15.2				0.1				0.3				36.5			
St. Deviation		0.0				21.9				0.0				0.0				0.0			
Fraction of Total Area		0.045				0.045				0.045				0.045				0.045			
Area Weighted Mean		0.00				0.69				0.00				0.01				1.74			
Ith Pooled Variance		0.0000				0.1647				0.0000				0.0000				0.0000			
t value		2.015				2.015												2.015			
95% UCL		0.06				33.				***				***				39.			
Source 24: No Data																					
Source 25																					
MWSB-34*	0			0.0095	G			***41***	G			***0.255***	G			0.425	G			***62.3***	G
SB-36	0.5			***0.055***				***60***				0.1185				3.95				***2160***	
SB-36A	0.5	0.125																			
SB-36C	0.5	0.125																			
SB-36D	0.5	0.125																			
SB-36A	1	0.125																			
SB-36C	1	0.125																			
SB-36D	1	0.125																			
MWSB-10**	2	0.01				***7***				0.14		G		0.25				***34***			
SB-69	3	***0.06***				***34***				***0.1***				***0.7***				***830***			
MWSB-12	5	0.01				***7***				0.005				0.25				***34***			
MWSB-13**	6	0.008			G	***7***				0.014		G		0.25				***26***			
SB-36A	6	0.125																			
SB-36C	6	0.125																			
SB-36D	6	0.125																			
SB-68	6.5	***0.04***				***6***				***0.03***				0.25				***22***			

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg)		Nickel (Ni)		Selenium (Se)		Silver (Ag)		Zinc (Zn)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
MWSB-15	7	0.01		*6*		0.005		0.25		*20*	
MWSB-11**	8	0.008		*15*		0.014	G	0.25		*54*	
MWSB-34	10		*0.021*		*4.4*		0.1335		0.4455		*14.9*
MWSB-34	32.5		0.009		*5.65*		0.1545		0.515		*15.4*
MWSB-34	50		0.0105		*9*		0.150		0.5		*23.6*
MWSB-34	70		0.013		*8.6*		0.162		0.504		*20.8*
n		16.	6.	7.	6.	7.	6.	7.	6.	7.	6.
Mean		0.1	0.0	11.7	21.4	0.0	0.2	0.3	1.1	145.7	382.8
Total Mean		0.1		16.2		0.1		0.7		255.2	
St. Deviation		0.1		17.5		0.1		1.0		613.8	
Fraction of Total Area		0.180		0.180		0.180		0.180		0.180	
Area Weighted Mean		0.01		2.92		0.02		0.12		45.90	
l'lh Pooled Variance		0.0000		0.7622		0.0000		0.0025		937.7830	
t value		1.721		1.782		1.782		1.782		1.782	
95% UCL		0.08		25.		0.14		1.2		560.	
Source 26											
MWSB-35	0.5		*0.078*		*33*		0.1245		0.415		*62.0*
SB-16/64A	0.5	*0.48*									
SB-16/64C	0.5	*0.48*									
SB-16/64D	0.5	*0.33*									
SB-36B	0.5	0.125									
SB-36E	0.5	0.125									
SB-63A	0.5	*0.78*									
SB-63B	0.5	*0.33*									
SB-63C	0.5	*0.43*									
SB-63D	0.5	*0.49*									
SB-63E	0.5	*0.63*									
SB-65A	0.5	*0.64*									
SB-65B	0.5	*0.64*									
SB-65C	0.5	0.125									
SB-65D	0.5	*1.6*									
TE11a	0-2			*77*						*380*	
TE1a	0-2			*120*						*1600*	
TE1b	0-2			*120*						*1100*	
TE1d	0-2			*110*						*1200*	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H		Mercury (Hg) Enviros		Nickel (Ni) M/H		Nickel (Ni) Enviros		Selenium (Se) M/H		Selenium (Se) Enviros		Silver (Ag) M/H		Silver (Ag) Enviros		Zinc (Zn) M/H		Zinc (Zn) Enviros	
HA-75	1	*0.22*				*40*				*0.08*				*1.9*				*430*			
SB-16/64A	1	0.125																			
SB-16/64C	1	0.125																			
SB-16/64D	1	0.125																			
SB-36B	1	0.125																			
SB-36E	1	0.125																			
SB-63A	1	0.125																			
SB-63B	1	0.125																			
SB-63C	1	*0.31*																			
SB-63D	1	*0.39*																			
SB-63E	1	*0.32*																			
SB-65A	1	*0.39*																			
SB-65B	1	0.125																			
SB-65C	1	0.125																			
SB-65D	1	*0.82*																			
TE1c	1-2							*120*												*1100*	
TE11b	2-4							*59*												*160*	
TE1a	2-4							*110*												*2600*	
TE1b	2-4							*130*												*2900*	
TE1c	2-4							*140*												*700*	
TE1d	2-4							*52*												*140*	
TE11a	3-4							*110*												*1900*	
SB-63	2.5	*0.26*				*43*				*0.13*				*1.5*				*550*			
SB-65A	2.5	*0.31*																			
SB-64	3.5	0.01				*40*				*0.13*				*1.4*				*2600*			
HA-75	4	*0.11*				1				*0.06*				*0.5*				*48*			
TE11a	4-6							*1600*												*1000*	
TE1a	4-6							*63*												*87*	
TE1b	4-6							*150*												*670*	
TE1c	4-6							*420*												*790*	
SB-65	5	*0.89*				*43*				*0.07*				0.25				*220*			
MWSB-14**	6	0.060			G	*480*				0.14			G	*0.6*			G	*220*			
MWSB-16**	6	0.06			G	*100*				0.14			G	*1.0*			G	*660*			
SB-16/64A	6	*1.7*																			
SB-16/64C	6	0.125																			
SB-16/64D	6	0.125																			
SB-36B	6	0.125																			
SB-36E	6	0.125																			
SB-63A	6	*1.4*																			

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg)		Nickel (Ni)		Selenium (Se)		Silver (Ag)		Zinc (Zn)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SB-63B	6	*0.28*									
SB-63C	6	0.125									
SB-63D	6	*2.3*									
SB-63E	6	0.125									
SB-65B	6	0.125									
SB-65C	6	0.125									
SB-65D	6	0.125									
TE1d	6-7.5				*42*						*110*
TE11b	6-8				*53*						*73*
TE1b	6-8				*180*						*1500*
SB-63	7.5	*0.02*		*34*		*0.04*		0.25		*50*	
SB-64	7.5	*0.06*		*210*		*0.11*		*1.7*		*570*	
SB-65	8	0.01		*7*		*0.05*		0.25		*37*	
TE1c	6-8				*110*						*260*
TE1b	8-9				*41*						*140*
TE11a	10				*110*						*120*
MWSB-35	10		0.0105		*7.4*		0.1395		0.465		*31*
SB-63	10	*0.06*		*30*		*0.08*		*0.8*		*230*	
SB-64	10	*0.04*		*22*		*0.05*		*0.7*		*92*	
SB-65	15	0.01		*6*		*0.04*		0.25		*22*	
MWSB-35	32		*0.023*		*6.9*		0.129		0.43		*20.5*
MWSB-35	52.5		0.0095		*6.1*		0.153		0.501		*19*
MWSB-35	70		0.011		*6.4*		0.1395		0.46		*17*
n		55.	5.	13.	26.	13.	5.	13.	5.	13.	26.
Mean		0.4	0.0	81.2	153.0	0.1	0.1	0.9	0.5	440.7	718.4
Total Mean		0.3		129.0		0.1		0.7		625.9	
St. Deviation		0.4		261.6		0.0		0.5		781.9	
Fraction of Total Area		0.068		0.068		0.068		0.068		0.068	
Area Weighted Mean		0.02		8.74		0.01		0.05		42.37	
Pth Pooled Variance		0.0000		8.0398		0.0000		0.0001		71.8467	
t value		1.671		1.697		1.740		1.740		1.697	
95% UCL		0.42		200.		0.12		0.96		840.	

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H	Mercury (Hg) Enviros	Nickel (Ni) M/H	Nickel (Ni) Enviros	Selenium (Se) M/H	Selenium (Se) Enviros	Silver (Ag) M/H	Silver (Ag) Enviros	Zinc (Zn) M/H	Zinc (Zn) Enviros
Sources 27											
HA-86	5.5	***0.06***		***8***		***0.13***		0.25		***43***	
HA-89	5.5	0.01		***5***		***0.10***		0.25		***21***	
SB-70	9.5	***0.06***		***9***		***0.05***		0.25		***56***	
MW-38	5		0.05		6.25						23
MW-38	15		0.05		6.25						31
MW-38	50		0.05		6.25						34
MW-38A	5		0.05		6.25						20
MW-38A	15		0.3		18						68
n		3.	5.	3.	5.	3.	0.	3.	0.	3.	5.
Mean		0.0	0.1	7.3	8.6	0.1		0.3		40.0	35.2
Total Mean		0.1		8.1		0.1		0.3		37.0	
St. Deviation		0.1		4.2		0.0		0.0		17.5	
Fraction of Total Area		0.113		0.113		0.113		0.113		0.113	
Area Weighted Mean		0.01		0.91		0.01		0.03		4.16	
t*Th Pooled Variance		0.0000		0.0276		0.0000		0.0000		0.4846	
t value		1.895		1.895		2.920		2.920		1.895	
95% UCL		0.14		11.		0.16		0.25		49.	
SOURCES 28-30: No Data											
SOURCE 31											
HA-86	6	***0.34***		***10***		***0.11***		0.25		***72***	
n		1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000
Fraction of Total Area		0.013		0.013		0.013		0.013		0.013	
Area Weighted Mean		0.0043		0.1270		0.0014		0.0032		0.9144	
t*Th Pooled Variance		0.0000		0.0000		0.0000		0.0000		0.0000	
t value											
95% UCL		***		***		***		***		***	***

Table 2.1. Analytical Results for Soil Metal Concentrations (mg/kg)

Sample Location	Depth	Mercury (Hg) M/H	Mercury (Hg) Enviros	Nickel (Ni) M/H	Nickel (Ni) Enviros	Selenium (Se) M/H	Selenium (Se) Enviros	Silver (Ag) M/H	Silver (Ag) Enviros	Zinc (Zn) M/H	Zinc (Zn) Enviros
SOURCE 32											
HA-87	6	***0.02***		***4***		***0.09***		0.25		***19***	
n		1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000
Fraction of Total Area		0.039		0.039		0.039		0.039		0.039	
Area Weighted Mean		0.00		0.16		0.00		0.01		0.74	
ith Pooled Variance		0.0000		0.0000		0.0000		0.0000		0.0000	
t value											
95% UCL		***		***		***		***		***	***
Site Wide Summary:											
N (total analysis)		200		155		91		91		156	
Min		0.01		1.00		0.01		0.03		9.70	
Max		2.30		1600.00		9.80		3.95		4300.00	
Total area											
Weighted Means		0.09		26.22		0.17		0.43		229.44	
Pooled Variance		0.00		13.41		0.00		0.00		4001.09	
t-value		1.645		1.658		1.671		1.671		1.658	
Site Wide 95% UCL		0.09		27.		0.18		0.44		240.	

Key For Interpreting Analytical Tables

Table 2.2. Analytical Results for Soil VOCs

All units are ppm.

Unknown depths are assumed to be 0.5 to 15 feet, the zone in which most sampling was conducted.

Concentrations above reporting limits highlighted with boldface, italic, underlined 12 point type; all others are half the value of the sample reporting limit.

Half the value of the method detection limit was applied to ND samples for which the sample detection limit could not be determined

G Reporting Limit for the chemical in this sample was > 5 times the highest report concentration for this chemical in other samples; The concentration below reporting limits, and therefore was eliminated, in accordance with USEPA (1989).

** Split sample: McLaren/Hart and Enviros results were averaged.

*** 95% UCL can not be calculated when n<2.

t-values: Critical values of t were determined for n-1 degrees of freedom where n-1 was rounded down.

Boxed values signify:

Dotted: Data which were not included in the ChemRisk RA database.

Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

Unable to locate original laboratory data sheets.

B Methylene chloride was detected in the method blank and not used in this table.

C Result is 4.50 ppm greater than five times the method blank. The method blank registered at 0.24 ppm.

Samples HA70-1, HA70-2, HA72-2, and SB48-5 were classified as 'unacceptable' data and are not included in this table.

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone		Methylene Chloride		Tetrachloroethylene (PERC / PCE)		Toluene		Trichloroethane TCA		Trichloroethylene TCE		Xylenes	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 1															
SB-25	0.5				0.0005		0.0005				0.0005		0.0005		
SB-25	1.5				0.0005		0.0005				0.0005		0.0005		
SB-25	6.5				0.0005		0.0005				0.0005		0.0005		
SB-24	7.5				***0.003***		0.0005				0.0005		0.0005		
SB-24	15				0.0005		0.0005				0.0005		0.0005		
MW-44	5				0.1250		1.5000				0.2500		0.1250		
MW-44	15				0.1250		0.0250				0.2500		0.1250		
MW-44	50				0.1250		0.0250				0.2500		0.1250		
n		0.	0.	0.	8.	0.	8.	0.	0.	0.	8.	0.	8.	0.	0.
Mean				0.0		0.2				0.1		0.0			
St. Deviation		0.0		0.1		0.0		0.0		0.1		0.1		0.0	
Fraction of Total Area		0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value				1.895		1.895				1.895		1.895			
95% UCL		***		0.091		0.194		***		0.181		0.090			
Ith Pooled Variance		0		3.2E-07		0		0		1.3E-06		3.2E-07		0	
Source 2															
SOB-25	0.5				0.0005		0.0005				0.0005		0.0005		
SOB-25	7.5				0.0005		0.0005				0.0005		0.0005		
SOB-25	15				***0.001***		0.0005				0.0005		0.0005		
n		0.	0.	0.	3.	0.	3.	0.	0.	0.	3.	0.	3.	0.	0.
Mean				0.0		0.0				0.0		0.0		0.0	
St. Deviation				0.0		0.0				0.0		0.0		0.0	
Fraction of Total Area		0.017		0.017		0.017		0.017		0.017		0.017		0.017	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value				2.920		2.920				2.920		2.920			
95% UCL		***		0.001		0.001		***		0.001		0.001		***	
Ith Pooled Variance		0		0		0		0		0		0		0	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone		Methylene Chloride		Tetrachloroethylene (PERC / PCE)		Toluene		Trichloroethane TCA		Trichloroethylene TCE		Xylenes	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 3															
HA-19	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-19	5	*		1.25		0.5		0.25		0.50		0.25		0.25	
n		0.	0.	2.	0.	2.	0.	2.	0.	2.	0.	2.	0.	2.	0.
Mean		0.0		1.3		0.5		0.3		0.5		0.3		0.3	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.008		0.008		0.008		0.008		0.008		0.008		0.008	
Area Weighted Mean		0.00		0.01		0.00		0.00		0.00		0.00		0.00	
t value				6.314		6.314		6.314		6.314		6.314		6.314	
95% UCL		***		1.250		0.500		0.250		0.500		0.250		0.250	
ith Pooled Variance		0		0		0		0		0		0		0	
Source 4															
SB-39	0.5				0.0005		0.0005				0.005		0.0005		
SB-40	0.5				0.0005		0.0005				0.005		0.0005		
SB-39	7.5				0.0005		0.0005				0.005		0.0005		
SB-40	7.5				0.0005		0.0005				0.005		0.0005		
SB-19	8	*		1.25		0.5		0.25		0.50		0.50		0.25	
n		0.	0.	1.	4.	1.	4.	1.	0.	1.	4.	1.	4.	1.	0.
Mean		0.0		0.3		0.1		0.3		0.1		0.1		0.3	
St. Deviation		0.0		0.6		0.2		0.0		0.2		0.2		0.0	
Fraction of Total Area		0.014		0.014		0.025		0.025		0.025		0.025		0.025	
Area Weighted Mean		0.00		0.00		0.00		0.01		0.00		0.00		0.01	
t value				2.132		2.132				2.132		2.132			
95% UCL		***		0.783		0.313		***		0.315		0.313		***	
ith Pooled Variance		0		1.2E-05		6.2E-06		0		6.1E-06		6.2E-06		0	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
Source 5															
MWSB-33	0.5				0.0005		0.0005		0.0005		0.005		0.0005		0.0010
SB-41	0.5				0.0005		0.0005				0.005		0.0005		
MWSB-33	7.5				0.0005		0.0005		0.0005		0.005		0.0005		0.001
SB-41	7.5				0.0005		*0.001*				0.005		0.0005		
SB-20	8	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-41	13						*0.001*								
n		0.	0.	1.	4.	1.	5.	1.	2.	1.	4.	1.	4.	1.	2.
Mean		0.0		0.3		0.1		0.1		0.1		0.1		0.1	
St. Deviation		0.0		0.6		0.2		0.1		0.2		0.1		0.1	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value				2.132		2.015		2.920		2.132		2.132		2.920	
95% UCL		***		0.783		0.252		0.327		0.315		0.157		0.326	
Pth Pooled Variance		0		6.9E-06		7.6E-07		7.6E-07		1.1E-06		2.7E-07		7.6E-07	
Source 6 : No Data															
Source 7															
TE6b	8				B		0.027				0.027		0.027		
n		0.	0.	0.	0.	0.	1.	0.	0.	0.	1.	0.	1.	0.	0.
Mean		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.008		0.008		0.008		0.008		0.008		0.008		0.008	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value															
95% UCL		***		***		***		***		***		***		***	***
Pth Pooled Variance		0		0		0		0		0		0		0	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
Source 8															
HA-16	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-1	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-26	1			0.25		0.01		***0.31***		0.02		0.01		0.03	
SB-28	1			0.25		0.01		0.01		0.02		0.01		0.03	
SB-26	2			0.25		0.01		***0.36***		0.02		0.01		0.03	
SB-27	2			*		1.0		1.00		2.0		1		3.00	*
MWSB-1	3.2	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-16	4	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-26	4			0.25		0.01		***0.31***		0.50		0.01		0.03	
TE8	4				B		0.028				0.028		0.028		
HA-16**#	4.5			***0.128***	G	***0.007***	G	0.01		0.01		0.01		0.01	
SB-28	5			0.25		0.01		0.01		0.02		0.01		0.03	
SB-27	6			*		1.0		1.00		2.0		1.0		3.00	*
SB-28	7.5			0.25		0.01		0.01		0.02		0.01		0.03	
SB-27	8			0.25		0.01		1.00		0.02		0.01		0.03	
MWSB-1	8	*		1.25		0.5		0.25		0.25		0.25		0.25	
SB-26	9			0.25		0.01		0.01		0.02		0.01		0.03	
SB-27	10.5									***0.01***					
SB-26	15				0.0005		0.0005				0.005		0.0005		
SB-27 #	15.5									***0.01***					
SB-28 #	15.5			0.25		0.01		0.01		0.01		0.01		0.01	
n		0.	0.	15.	1.	17.	2.	17.	0.	19.	2.	17.	2.	17.	0.
Mean		0.0		0.5		0.2		0.3		0.3		0.2		0.4	
St. Deviation		0.0		0.5		0.3		0.4		0.6		0.3		1.0	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.00		0.01		0.00		0.00		0.00		0.00		0.00	
t value				1.746		1.734		1.746		1.725		1.734		1.746	
95% UCL		***		0.757		0.380		0.460		0.554		0.301		0.852	
Pth Pooled Variance		0		1.9E-06		7.5E-07		8.8E-07		2.0E-06		6.1E-07		6.7E-06	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone		Methylene Chloride		Tetrachloroethylene (PERC / PCE)		Toluene		Trichloroethane TCA		Trichloroethylene TCE		Xylenes	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 9															
SB-45	8.5				0.0005		0.0005				0.0005		0.005		
n		0.	0.	0.	1.	0.	1.	0.	0.	0.	1.	0.	1.	0.	0.
Mean		0.0		0.0005		0.0005		0.0000		0.0005		0.0050		0.0000	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
i'th Pooled Variance		0		0		0		0		0		0		0	
Source 10															
SB-47	0.5			2.50		0.10		0.10		0.20		0.10		0.30	
SB-48	0.5			*		1		1		2.00		1		3	*
HA-17	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-18	1	*		1.25		0.50		0.25		0.50		0.25		0.25	
HA-85	2.5			2.5		0.1		0.1		0.2		0.1		0.3	
HA-18	5	*		1.25		0.50		0.25		0.50		0.25		0.25	
SB-47	5			0.25		0.01		0.01		0.02		0.01		0.03	
HA-85	6.5			0.25		0.01		0.01		0.02		0.01		0.03	
SB-47	7.5			0.25		0.01		0.01		0.02		0.01		0.03	
SB-48	7.5			*		1		1		2		1		3	*
n		0.	0.	8.	0.	10.	0.	10.	0.	10.	0.	10.	0.	10.	0.
Mean		0.0		1.2		0.4		0.3		0.8		0.3		0.7	
St. Deviation		0.0		0.9		0.4		0.4		0.8		0.4		1.2	
Fraction of Total Area		0.009		0.009		0.009		0.009		0.009		0.009		0.009	
Area Weighted Mean		0.00		0.01		0.00		0.00		0.01		0.00		0.01	
t value				1.895		1.812		1.812		1.812		1.812		1.812	
95% UCL		***		1.813		0.597		0.517		1.035		0.517		1.428	
i'th Pooled Variance		0		8.8E-06		1.2E-06		1.2E-06		4.8E-06		1.2E-06		1.2E-05	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
Source 11															
HA-82	1			0.25		0.01		0.01		0.02		0.01		0.03	
HA-82	5			0.25		0.01		0.01		0.02		0.01		0.03	
n		0.	0.	2.	0.	2.	0.	2.	0.	2.	0.	2.	0.	2.	0.
Mean		0.0		0.3		0.0		0.0		0.0		0.0		0.0	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.027		0.027		0.027		0.027		0.027		0.027		0.027	
Area Weighted Mean		0.00		0.01		0.00		0.00		0.00		0.00		0.00	
t value				6.314		6.314		6.314		6.314		6.314		6.314	
95% UCL		***		0.250		0.010		0.010		0.020		0.010		0.030	
l'th Pooled Variance		0		0		0		0		0		0		0	
Source 12															
HA-14	1	*		1.25		0.5		0.25		0.50		0.25		***1.9***	
SB-30	1			0.25		0.01		***0.46***		0.02		0.01		0.03	
SB-31	1			0.25		0.01		***0.03***		0.02		0.01		0.03	
HA-71	2			0.25		0.01		***0.16***		0.02		0.01		0.03	
HA-14	2.2	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-14	5	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-70	5			0.25		0.01		0.01		0.02		0.01		0.03	
HA-71	5			0.25		0.01		***0.12***		0.02		0.01		0.03	
HA-72	5			0.25		0.01		***0.10***		0.02		0.01		0.03	
MWSB-32	5.0							0.01						0.03	
SB-30	5			0.25		0.01		0.01		0.02		0.01		0.03	
SB-31	5			0.25		0.01		***0.05***		0.02		0.01		0.03	
HA-71	7.5			0.25		0.01		0.01		0.02		0.01		0.03	
HA-72	7.5			0.25		0.01		0.01		0.02		0.01		0.03	
MWSB-32	8							0.01						0.03	
SB-30	8			0.25		0.01		***0.03***		0.02		0.01		0.03	
SB-31	8			0.25		0.01		0.01		0.02		0.01		0.03	
MWSB-32	15				0.0005		0.0005				0.0005		0.0005		

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
n		0.	0.	15.	1.	15.	1.	17.	0.	15.	1.	15.	1.	17.	0.
Mean		0.0		0.4		0.1		0.1		0.1		0.1		0.2	
St. Deviation		0.0		0.4		0.2		0.1		0.2		0.1		0.5	
Fraction of Total Area		0.004		0.004		0.004		0.004		0.004		0.004		0.004	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value				1.734		1.734		1.729		1.734		1.734		1.729	
95% UCL		***		0.602		0.187		0.159		0.193		0.096		0.356	
Ith Pooled Variance		0		1.6E-07		3.5E-08		1.4E-08		3.4E-08		8.5E-09		1.7E-07	
Source 13															
MWSB-4	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-29	1				0.0005		0.0005		0.0005		0.005		0.0005		0.0010
HA-15	1.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-69	2			0.25		0.01		0.01		0.02		0.01		0.03	
HA-15	5	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-4	5	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-69	5			0.25		0.01		***0.02***		0.02		0.01		0.03	
SB-29	5.5				0.0005		0.0005		0.0005		0.005		0.0005		0.0010
MWSB-4	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-69	7.5			0.25		0.01		0.01		0.02		0.01		0.03	
SB-29	8				0.0005		0.0005		0.0005		0.005		0.0005		0.0010
SB-29	15				0.0005		0.0005				0.005		0.0005		
n		0.	0.	8.	4.	8.	4.	8.	3.	8.	4.	8.	4.	8.	3.
Mean		0.0		0.6		0.2		0.1		0.2		0.1		0.1	
St. Deviation		0.0		0.6		0.3		0.1		0.3		0.1		0.1	
Fraction of Total Area		0.012		0.012		0.012		0.012		0.012		0.012		0.012	
Area Weighted Mean		0.00		0.01		0.00		0.00		0.00		0.00		0.00	
t value		0.000		1.796		1.796		1.812		1.796		1.796		1.812	
95% UCL		***		0.893		0.343		0.187		0.345		0.172		0.189	
Ith Pooled Variance		0		4.3E-06		7.9E-07		2.1E-07		7.7E-07		2.0E-07		2.0E-07	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
Source 14															
MWSB-37	8.5		*		0.0005		0.0005		0.0025		0.0005		0.0005		0.0025
SB-23	8.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-22	9	*		1.25		0.5		0.25		0.50		0.25		0.25	
n		0.	0.	2.	1.	2.	1.	2.	1.	2.	1.	2.	1.	2.	1.
Mean		0.0		0.8		0.3		0.2		0.3		0.2		0.2	
St. Deviation		0.0		0.7		0.3		0.1		0.3		0.1		0.1	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.00		0.01		0.00		0.00		0.00		0.00		0.00	
t value				2.920		2.920		2.920		2.920		2.920		2.920	
95% UCL		***		2.050		0.820		0.408		0.820		0.410		0.408	
Pooled Variance		0		2.0E-05		3.2E-06		7.8E-07		3.2E-06		7.9E-07		7.8E-07	
Source 15															
MWSB-28	1				0.25 #		0.01 #	0.1			0.01 #		0.01 #	0.3	
MWSB-28	5				0.25 #		0.01 #	***0.06***			0.01 #		0.01 #	0.03	
MWSB-28	8							0.01						0.03	
MWSB-28	10				***0.002***		0.0005				0.0005		0.0005		
n		0.	0.	0.	3.	0.	3.	3.	0.	0.	3.	0.	3.	3.	0.
Mean		0.0		0.2		0.0		0.1		0.0		0.0		0.1	
St. Deviation		0.0		0.1		0.0		0.0		0.0		0.0		0.2	
Fraction of Total Area		0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value		0.000		2.920		2.920		2.920		2.920		2.920		2.920	
95% UCL		***		0.409		0.016		0.133		0.016		0.016		0.383	
Pooled Variance		0		4.3E-06		6.4E-09		4.3E-07		6.4E-09		6.4E-09		5.1E-06	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
Source 16															
SB-32	0.5		*		0.05		0.05		0.05		0.10		0.05		0.05
SB-52	0.5		*		0.05		0.05		0.05		0.05		0.05		0.05
HA-20	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-52	5		0.25		0.05		0.05		0.05		0.10		0.05		0.05
HA-20	5.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
n		0.	1.	2.	3.	2.	3.	2.	3.	2.	3.	2.	3.	2.	3.
Mean		0.0		0.5		0.2		0.1		0.3		0.1		0.1	
St. Deviation		0.0		0.7		0.2		0.1		0.2		0.1		0.1	
Fraction of Total Area		0.020		0.020		0.020		0.020		0.020		0.020		0.020	
Area Weighted Mean		0.00		0.01		0.00		0.00		0.00		0.00		0.00	
t value				2.132		2.132		2.132		2.132		2.132		2.132	
95% UCL		***		1.157		0.465		0.234		0.468		0.234		0.234	
Pth Pooled Variance		0		0		0		0		0		0		0	
Source 17															
MWSB-30	1							***0.04***							
MWSB-30	5							0.01						0.03	
MWSB-3	6	*		1.25		0.5		0.25		0.50		0.25		0.03	
MWSB-30	7.5				***0.002***		0.0005				***0.001***		0.0005	0.25	
MWSB-29	8				***0.003***		0.0005				0.0005		0.0005		
TE9	10				- B				0.033		0.033		0.033		-
MWSB-30	15				***0.003***		0.0005				0.0005		0.0005		
MWSB-29	20				***0.001***		0.0005				0.0005		0.0005		
MWSB-30	8-8.5							***0.02***						***0.02***	
n		0.	0.	1.	4.	1.	4.	4.	1.	1.	5.	1.	5.	4.	0.
Mean		0.0		0.3		0.1		0.1		0.1		0.0		0.1	
St. Deviation		0.0		0.6		0.2		0.1		0.2		0.1		0.1	
Fraction of Total Area		0.008		0.008		0.008		0.008		0.008		0.008		0.008	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value				2.015		2.132		2.132		2.015		2.015		2.353	
95% UCL		***		0.755		0.313		0.167		0.255		0.130		0.214	
Pth Pooled Variance		0		3.6E-06		5.8E-07		1.2E-07		3.9E-07		9.6E-08		1.8E-07	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
Source 18															
HA-1	1				B	0.1		0.1		0.2		0.1		0.1	B
HA-5	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-1	5				B	0.1		0.1		0.2		0.1		0.1	B
HA-5	5	*		1.25		0.5		0.25		0.50		0.25		0.25	
n		0.	0.	4.	0.	4.	0.	4.	0.	4.	0.	4.	0.	4.	0.
Mean		0.0		1.3		0.3		0.2		0.4		0.2		0.2	
St. Deviation		0.0		0.0		0.2		0.1		0.2		0.1		0.1	
Fraction of Total Area		0.060		0.060		0.060		0.060		0.060		0.060		0.060	
Area Weighted Mean		0.00		0.07		0.02		0.01		0.02		0.01		0.01	
t value				2.353		2.353		2.353		2.353		2.353		2.353	
95% UCL		***		1.250		0.572		0.277		0.554		0.277		0.277	
ith Pooled Variance		0		0		4.8E-05		6.7E-06		2.7E-05		6.7E-06		6.7E-06	
Source 19															
HA-13	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-13	5	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-53	1.5		***0.092***		B		0.002		0.002		0.004		0.002		0.002
SB-53	8		***0.099***		B		0.003		0.003		0.006		0.003		0.003
TE4e	10			***5,700***	C		0.035				0.035		0.035		
n		0.	2.	2.	1.	2.	3.	2.	2.	2.	3.	2.	3.	2.	2.
Mean		0.1		2.7		0.2		0.1		0.2		0.1		0.1	
St. Deviation		0.0		2.6		0.3		0.1		0.3		0.1		0.1	
Fraction of Total Area		0.019		0.019		0.019		0.019		0.019		0.019		0.019	
Area Weighted Mean		0.00		0.05		0.00		0.00		0.00		0.00		0.00	
t value		6.314		2.132		2.132		2.353		2.132		2.132		2.353	
95% UCL		0.118		5.896		0.462		0.294		0.463		0.232		0.294	
ith Pooled Variance		4.6E-09		8.2E-04		5.3E-06		1.9E-06		5.3E-06		1.3E-06		1.9E-06	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone		Methylene Chloride		Tetrachloroethylene (PERC / PCE)		Toluene		Trichloroethane TCA		Trichloroethylene TCE		Xylenes	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 20															
SB-54	1.5		*0.098*		B		0.002		0.002		0.005		0.002		*1.2*
MWSB-5	3	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-5	6	*		1.25		0.5		0.25		0.50		0.25		0.25	
TP-1	6				*0.001*		*0.001*				0.0005		0.0005		
n		0.	1.	2.	1.	2.	2.	2.	1.	2.	2.	2.	2.	2.	1.
Mean		0.1		0.8		0.3		0.2		0.3		0.1		0.6	
St. Deviation		0.0		0.7		0.3		0.1		0.3		0.1		0.5	
Fraction of Total Area		0.026		0.026		0.026		0.026		0.026		0.026		0.026	
Area Weighted Mean		0.00		0.02		0.01		0.00		0.01		0.00		0.01	
t value				2.353		2.353		2.920		2.353		2.353		2.920	
95% UCL		***		1.813		0.589		0.409		0.589		0.295		1.491	
Pth Pooled Variance		0		1.2E-04		1.4E-05		4.8E-06		1.4E-05		3.6E-06		7.0E-05	
Source 21: No Data															
Source 22															
HA-7	1				B	0.1		0.1		0.2		0.1		0.1	
HA-8	1				B	0.1		0.1		0.2		0.1		0.1	
HA-77	4.5	0.0125		0.0025		0.0025		0.0025		0.0050		0.0025		0.0025	
MWSB-7	8	*		*3.6*		0.5		0.25		0.50		0.25		0.25	
n		1.	0.	2.	0.	4.	0.	4.	0.	4.	0.	4.	0.	4.	0.
Mean		0.0		1.8		0.2		0.1		0.2		0.1		0.1	
St. Deviation		0.0		2.5		0.2		0.1		0.2		0.1		0.1	
Fraction of Total Area		0.128		0.128		0.128		0.128		0.128		0.128		0.128	
Area Weighted Mean		0.00		0.23		0.02		0.01		0.03		0.01		0.01	
t value				2.353		2.353		2.353		2.353		2.353		2.353	
95% UCL		***		6.034		0.436		0.233		0.467		0.233		0.233	
Pth Pooled Variance		0		5.3E-02		2.0E-04		4.3E-05		1.7E-04		4.3E-05		4.3E-05	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
Source 23															
MWSB-6	7			1.25		0.5		0.25		0.50		0.25		0.25	
MWSB38	5				0.025		0.025				0.05		0.025		
MWSB38	15				0.025		0.025				0.05		0.025		
MWSB38	50				0.025		0.025				0.05		0.025		
MWSB38A	5				0.025		0.025				0.05		0.025		
MWSB38A	15				0.025		0.025				0.05		0.025		
n		0.	0.	1.	5.	1.	5.	1.	0.	1.	5.	1.	5.	1.	0.
Mean		0.0		0.2		0.1		0.3		0.1		0.1		0.3	
St. Deviation		0.0		0.5		0.2		0.0		0.2		0.1		0.0	
Fraction of Total Area		0.045		0.045		0.045		0.045		0.045		0.045		0.045	
Area Weighted Mean		0.00		0.01		0.00		0.01		0.01		0.00		0.01	
t value				2.015		2.015				2.015		2.132		2.920	
95% UCL		***		0.641		0.264		***		0.276		0.142		***	
Pooled Variance		0		8.6E-05		1.3E-05		0		1.2E-05		2.9E-06		0	
Sources 24-25: No Data															
Source 26															
TE11a	3				B		0.0265				0.0265		0.0265		
TE11b	3				B		0.0265				0.0265		0.0265		B
TE1b	8.5		0.0015		B		0.0005		0.0005		0.0005		0.0005		0.0005
TE1d	9		B		B		0.0005		0.0005		0.0005		0.0005		0.0005
n		0.	1.	0.	0.	0.	4.	0.	2.	0.	4.	0.	4.	0.	2.
Mean		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.068		0.068		0.068		0.068		0.068		0.068		0.068	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value		6.314				2.353		6.314		2.353		2.353		6.314	
95% UCL		***		***		0.031		0.001		0.031		0.031		0.001	***
Pooled Variance		0		0		2.6E-07		0		2.6E-07		2.6E-07		0	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone		Methylene Chloride		Tetrachloroethylene (PERC / PCE)		Toluene		Trichloroethane TCA		Trichloroethylene TCE		Xylenes	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 27															
MWSB39	5				0.025		0.025				0.05		0.025		
MWSB39	15				0.025		0.025				0.05		0.025		
MWSB39	50				0.025		0.025				0.05		0.025		
MWSB39A	5				0.025		0.025				0.05		0.025		
MWSB39A	15				0.025		0.025				0.05		0.025		
n		0.	0.	0.	5.	0.	5.	0.	0.	0.	5.	0.	5.	0.	0.
Mean		0.0		0.0		0.0		0.0		0.1		0.0		0.0	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.113		0.113		0.113		0.113		0.113		0.113		0.113	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.01		0.00		0.00	
t value				2.132		2.132				2.132		2.132			
95% UCL		***		0.025		0.025				0.050		0.025			
Ith Pooled Variance		0		0		0		0		0		0		0	
Sources 28-30: No Data															
Source 31															
MWSB-21	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-22	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-24	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-02	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-03	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-06	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-08	1	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-23	1.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-01	1.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-21	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-22	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-24	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-02	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-03	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-06	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-08	7	*		1.25		0.5		0.25		0.50		0.25		0.25	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone M/H	Acetone Enviros	Methylene Chloride M/H	Methylene Chloride Enviros	Tetrachloroethylene (PERC / PCE) M/H	Tetrachloroethylene (PERC / PCE) Enviros	Toluene M/H	Toluene Enviros	Trichloroethane TCA M/H	Trichloroethane TCA Enviros	Trichloroethylene TCE M/H	Trichloroethylene TCE Enviros	Xylenes M/H	Xylenes Enviros
MWSB-23	7.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
SB-01	7.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
n		0.	0.	18.	0.	18.	0.	18.	0.	18.	0.	18.	0.	18.	0.
Mean		0.0		1.3		0.5		0.3		0.5		0.3		0.3	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.013		0.013		0.013		0.013		0.013		0.013		0.013	
Area Weighted Mean		0.00		0.02		0.01		0.00		0.01		0.00		0.00	
t value		***		1.740		1.740		1.740		1.740		1.740		1.740	
95% UCL				1.250		0.500		0.250		0.500		0.250		0.250	
ith Pooled Variance		0		0		0		0		0		0		0	
Source 32															
HA-22GE	3.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-23GE	4	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-24GE	4	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-22GE	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-23GE	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-24GE	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-20	7	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-17	7.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
MWSB-18	7.5	*		1.25		0.5		0.25		0.50		0.25		0.25	
HA-22GE	9	*		1.25		0.5		0.25		0.50		0.25		0.25	
n		0.	0.	10.	0.	10.	0.	10.	0.	10.	0.	10.	0.	10.	0.
Mean		0.0		1.3		0.5		0.3		0.5		0.3		0.3	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.039		0.039		0.039		0.039		0.039		0.039		0.039	
Area Weighted Mean		0.00		0.05		0.02		0.01		0.02		0.01		0.01	
t value		***		1.833		1.833		1.833		1.833		1.833		1.833	
95% UCL				1.250		0.500		0.250		0.500		0.250		0.250	
ith Pooled Variance		0		0		0		0		0		0		0	

Table 2.2. Analytical Results for Soil VOCs (concentrations in mg/kg)

Sample Location	Depth (ft)	Acetone		Methylene Chloride		Tetrachloroethylene (PERC / PCE)		Toluene		Trichloroethane TCA		Trichloroethylene TCE		Xylenes	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Site Wide Summary :															
N (total analysis)		6		145		160		125		162		160		124	
Min		0.0015		0.0005		0.0005		0.0005		0.0005		0.0005		0.0005	
Max		0.2500		5.7000		1.5000		1.0000		2.0000		1.0000		3.0000	
Pooled Variance		0.0000		0.0539		0.0003		0.0001		0.0003		0.0001		0.0001	
Total area															
Weighted Means		0.01		0.53		0.11		0.08		0.13		0.07		0.10	
t-value		2.353		1.645		1.645		1.645		1.645		1.645		1.645	
Site wide 95% UCL		0.01		0.56		0.12		0.08		0.13		0.07		0.10	

Key For Interpreting Analytical Tables

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polynuclear Aromatic Hydrocarbons (PNAs)

Unknown depths are assumed to be 0.5 to 15 feet, the zone in which most sampling was conducted.
Concentrations above reporting limits highlighted with boldface, italic, underlined 12 point type; all others are half the value of the sample reporting limit.
Where acenaphthene and fluorene were analyzed together, the concentration of each was assumed to be one-half the total.
0.04 ppm fluoranthene was detected in Enviros method blank; 0.12 ppm in MW-36 at 8' was eliminated from database, per USEPA (1989).

* The reporting limit was > 5 times the maximum sample concentration detected for this compound; NDs were eliminated in accordance with USEPA (1989).
** Split sample: McLaren/Hart and Enviros results were averaged.
*** 95% UCL cannot be calculated when n<2.
e Estimated value: less than the reporting limit and not included in this table.
B Analyte was detected in method blanks and not used in this table
D The value reported in the laboratory sheets derives from analysis of a diluted sample or sample extract and is not included in this table
Unable to locate original laboratory data sheets.

Boxed values signify:
Dotted: Data which were not included in the ChemRisk RA database.
Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

Samples HA1-1, HA1-5, HA91-3.5, SB69-3, SB71-9 were classified as 'unacceptable' data because surrogates were above or below approved limits. They were not used in this table.
Samples MWSB34-5, 10, 32.5, 50, 73, MWSB35-10,73, and MWSB36-8,73 were classified as 'unacceptable' data because the extraction to analysis time is not known. They were not used in this table.

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	acenaphthene		anthracene		benzo(a)anthracene		benzo(b) fluoranthene		benzo(k) fluoranthene		benzo(a)pyrene		bis(2-ethyl-hexyl) phthalate	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Sources 1 - 4: NO DATA															
Source 5															
HA-90	5	0.165		0.165		0.165		0.165		*		0.165		0.165	
n		1.	0.	1.	0.	1.	0.	1.	0.	0.	0.	1.	0.	1.	0.
Mean		0.165		0.165		0.165		0.165		0.000		0.165		0.165	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.002		0.002		0.002		0.002		0.000		0.002		0.002	
t value															
95% UCL		***		***		***		***		***		***		***	
Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Sources 6 - 10: NO DATA															
Source 11															
HA-82 #	1	0.005		0.005		0.005		0.005		0.005		0.005		0.005	
HA-82 #	5	0.005		0.005		0.005		0.005		0.005		0.005		0.005	
SB-72	11	0.165		*		0.165		*		*		0.165		0.165	
n		3.	0.	2.	0.	3.	0.	2.	0.	2.	0.	3.	0.	3.	0.
Mean		0.058		0.005		0.058		0.005		0.005		0.058		0.058	
St. Deviation		0.092		0.000		0.092		0.000		0.000		0.092		0.092	
Fraction of Total Area		0.027		0.027		0.027		0.027		0.027		0.027		0.027	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value		2.920		6.314		2.920		6.314		6.314		2.920		2.920	
95% UCL		0.214		0.005		0.214		0.005		0.005		0.214		0.214	
Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00		0.00	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	acenaphthene		anthracene		benzo(a)anthracene		benzo(b) fluoranthene		benzo(k) fluoranthene		benzo(a)pyrene		bis(2-ethyl-hexyl) phthalate	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Sources 12 - 18: NO DATA															
Source 19															
HA-80	3	1.65		1.65		1.65		*		*		*			
TE4e	1.5-3.5		0.017		0.017		e		0.043		0.043		0.0165		
n		1.	1.	1.	1.	1.	0.	0.	1.	0.	1.	0.	1.	0.	0.
Mean		0.8		0.8		1.7		0.0		0.0		0.0		0.0	
St. Deviation		1.2		1.2		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.019		0.019		0.019		0.019		0.019		0.019		0.019	
Area Weighted Mean		0.02		0.02		0.03		0.00		0.00		0.00		0.00	
t value		6.314		6.314		6.314									
95% UCL		5.990		5.990		***		***		***		***		***	
Pooled Variance		0.00025		0.00025		0.00		0.00		0.00		0.00		0.00	
Source 20															
HA-83	2	0.165		0.165		0.165		0.165		*					
MWSB-5	3	0.165		0.165		0.165		0.165		*		0.165		0.165	
MWSB-5	6	0.165		0.165		0.165		0.165		*		0.165		0.165	
n		3.	0.	3.	0.	3.	0.	3.	0.	0.	0.	3.	0.	3.	0.
Mean		0.2		0.2		0.2		0.2		0.0		0.2		0.2	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.026		0.026		0.026		0.026		0.026		0.026		0.026	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value		2.920		2.920		2.920		2.920				2.920		2.920	
95% UCL		0.165		0.165		0.165		0.165		***		0.165		0.165	
Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00		0.00	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	acenaphthene		anthracene		benzo(a)anthracene		benzo(b) fluoranthene		benzo(k) fluoranthene		benzo(a)pyrene		bis(2-ethyl-hexyl) phthalate	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 21: NO DATA															
Source 22															
SB-66	11	0.165		0.165		0.165		0.165		*		0.165		0.165	
SB-67	11	0.165		0.165		0.165		0.165		*		0.165		0.165	
n		2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00	2.00	0.00	2.00	0.00
Mean		0.17		0.17		0.17		0.17		0.00		0.17		0.17	
St. Deviation		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Fraction of Total Area		0.128		0.128		0.128		0.128		0.128		0.128		0.128	
Area Weighted Mean		0.02		0.02		0.02		0.02		0.00		0.02		0.02	
t value		6.314		6.314		6.314		6.314				6.314		6.314	
95% UCL		0.165		0.165		0.165		0.166		***		0.165		0.165	
l'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Source 23															
HA-81	4.5	0.165		0.165		0.165		0.165		*		0.165		***0.38***	
n		1.	0.	1.	0.	1.	0.	1.	0.	0.	0.	1.	0.	1.	0.
Mean		0.2		0.2		0.2		0.2		0.0		0.2		0.4	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.045		0.045		0.045		0.045		0.045		0.045		0.045	
Area Weighted Mean		0.01		0.01		0.01		0.01		0.00		0.01		0.02	
t value		***		***		***		***		***		***		***	
95% UCL															
l'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Source 24: NO DATA															

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	acenaphthene		anthracene		benzo(a)anthracene		benzo(b) fluoranthene		benzo(k) fluoranthene		benzo(a)pyrene		bis(2-ethyl-hexyl) phthalate	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 25															
SB-36*	0.5		*		*		*		*		*		*		*
SB-37*	0.5		*		*		*		*		*		*		*
SB-38*	0.5		*		*		*		*		*		*		*
SB-57	0.5		*		*		5.		*		*		*		*
TE3	0-3.5		0.038		0.038		0.038				0.038		0.038		0.038
TE2	2-4		0.0185		0.0185		0.0185		0.0185		0.0185		0.0185		
TE3	2-3.5		0.019		0.019		0.019						0.019		0.019
TE2	4-6		***5.4***		***3***		***0.74***		***0.91*** e		***0.91*** e		***0.42***		
SB-36	5		0.005		0.005		0.005		0.005		0.005		0.005		
SB-68	6.5	0.165		0.165		0.165		0.165		*		0.165		0.165	
n		1.	5.	1.	5.	1.	6.	1.	3.	0.	4.	1.	5.	1.	2.
Mean		0.941		0.541		0.855		0.275		0.243		0.111		0.074	
St. Deviation		2.185		1.206		1.847		0.430		0.445		0.162		0.079	
Fraction of Total Area		0.180		0.180		0.180		0.180		0.180		0.180		0.180	
Area Weighted Mean		0.17		0.10		0.15		0.05		0.04		0.02		0.01	
t value		2.015		2.015		1.943		2.353		2.353		2.015		2.920	
95% UCL		2.739		1.533		2.211		0.780		0.766		0.245		0.208	
l'th Pooled Variance		0.026		0.00785		0.016		0.00149		0.0016		0.00014		0.000068	
Source 26															
TE11b	2-4						***0.11***		***0.25***		***0.25***		***0.12***		
TE11a	4-6		***0.092*** e		***0.12*** e		***0.44***		***0.77***		***0.77***		***0.41***		
n		0.	1.	0.	1.	0.	2.	0.	2.	0.	2.	0.	2.	0.	0.
Mean		0.092		0.120		0.275		0.510		0.510		0.265		0.000	
St. Deviation		0.000		0.000		0.233		0.368		0.368		0.205		0.000	
Fraction of Total Area		0.068		0.068		0.068		0.068		0.068		0.068		0.068	
Area Weighted Mean		0.01		0.01		0.02		0.03		0.03		0.02		0.00	
t value		2.353		2.353		2.353		2.353		2.353		2.353			
95% UCL		***		***		0.663		1.122		1.122		0.606		***	
l'th Pooled Variance		0.00		0.00		0.0001		0.0003		0.0003		0.0001		0.00	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	acenaphthene		anthracene		benzo(a)anthracene		benzo(b) fluoranthene		benzo(k) fluoranthene		benzo(a)pyrene		bis(2-ethyl-hexyl) phthalate	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 27															
HA-89	5.5	0.165		0.165		0.165		0.165		*		0.165		0.165	
HA-89	5.5	0.165		0.165		0.165		0.165		*		0.165		0.165	
SB-70	9.5	0.165		0.165		0.165		0.165		*		0.165		0.165	
n		3.	0.	3.	0.	3.	0.	3.	0.	0.	0.	3.	0.	3.	0.
Mean		0.165		0.165		0.165		0.165		0.000		0.165		0.165	
St. Deviation		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
Fraction of Total Area		0.113		0.113		0.113		0.113		0.113		0.113		0.113	
Area Weighted Mean		0.02		0.02		0.02		0.02		0.00		0.02		0.02	
t value		2.920		2.920		2.920		2.920				2.920		2.920	
95% UCL		0.165		0.165		0.165		0.165		***		0.165		0.165	
Pth Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Sources 28 - 30: NO DATA															
Source 31															
HA-86	6	0.165		0.165		0.165		0.165		*		0.165		0.165	
n		1.	0.	1.	0.	1.	0.	1.	0.	0.	0.	1.	0.	1.	0.
Mean		0.2		0.2		0.2		0.2		0.0		0.2		0.2	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.013		0.013		0.013		0.013		0.013		0.013		0.013	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
t value															
95% UCL		***		***		***		***		***		***		***	
Pth Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00		0.00	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	acenaphthene		anthracene		benzo(a)anthracene		benzo(b) fluoranthene		benzo(k) fluoranthene		benzo(a)pyrene		bis(2-ethyl-hexyl) phthalate	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 32															
HA-87	6	0.165		0.165		0.165		0.165		*		0.165		0.165	
n		1.	0.	1.	0.	1.	0.	1.	0.	0.	0.	1.	0.	1.	0.
Mean		0.2		0.2		0.2		0.2		0.0		0.2		0.2	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.039		0.039		0.039		0.039		0.039		0.039		0.039	
Area Weighted Mean		0.01		0.01		0.01		0.01		0.00		0.01		0.01	
t value		***		***		***		***		***		***		***	
95% UCL															
Pth Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Site Wide Summary :															
N (total analysis)		17		16		17		15		2		16		16	
Min		0.005		0.005		0.005		0.005		0.005		0.005		0.005	
Max		5.40		3.00		5.00		0.91		0.91		0.42		0.38	
Total area															
Weighted Means		0.25		0.18		0.27		0.15		0.08		0.10		0.09	
Pooled Variance		0.03		0.01		0.02		0.00		0.00		0.00		0.00	
t-value		1.697		1.697		1.697		1.697		1.697		1.697		1.697	
Site Wide 95% UCL		0.32		0.22		0.32		0.17		0.13		0.11		0.09	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	chrysene M/H	chrysene Enviros	fluoranthene M/H	fluoranthene Enviros	fluorene M/H	fluorene Enviros	Indeno(1,2,3-c,d) pyrene M/H	Indeno(1,2,3-c,d) pyrene Enviros	phenanthrene M/H	phenanthrene Enviros	pyrene M/H	pyrene Enviros
Sources 1 - 4: NO DATA													
Source 5													
HA-90	5	0.165		0.165		0.165		0.165		0.165		0.165	
n		1.	0.	1.	0.	1.	0.	1.	0.	1.	0.	1.	0.
Mean		0.165		0.165		0.165		0.165		0.165		0.165	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.011		0.011		0.011		0.011		0.011		0.011	
Area Weighted Mean		0.002		0.002		0.002		0.002		0.002		0.002	
t value													
95% UCL		***		***		***		***		***		***	
l'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	
Sources 6 - 10: NO DATA													
Source 11													
HA-82 #	1	0.005		0.005		0.005		0.005		0.005		0.005	
HA-82 #	5	0.005		0.005		0.005		0.005		0.005		0.005	
SB-72	11	0.165		0.165		0.165		0.165		0.165		0.165	
n		3.	0.	3.	0.	3.	0.	3.	0.	3.	0.	3.	0.
Mean		0.058		0.058		0.058		0.058		0.058		0.058	
St. Deviation		0.092		0.092		0.092		0.092		0.092		0.092	
Fraction of Total Area		0.027		0.027		0.027		0.027		0.027		0.027	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00	
t value		2.920		2.920		2.920		2.920		2.920		2.920	
95% UCL		0.214		0.214		0.214		0.214		0.214		0.214	
l'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	chrysene		fluoranthene		fluorene		indeno(1,2,3-c,d) pyrene		phenanthrene		pyrene	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Sources 12 - 18: NO DATA													
Source 19													
HA-80	3	1.65		1.65		1.65		*		*		1.65	
TE4a	1.5-3.5		0.065 e				0.0165 e		e		e		e
n		1.	1.	1.	0.	1.	1.	0.	0.	0.	0.	1.	0.
Mean		0.9		1.7		0.8		0.0		0.0		1.7	
St. Deviation		1.1		0.0		1.2		0.0		0.0		0.0	
Fraction of Total Area		0.019		0.019		0.019		0.019		0.019		0.019	
Area Weighted Mean		0.02		0.03		0.02		0.00		0.00		0.03	
t value		6.314		6.314		6.314						6.314	
95% UCL		5.861		***		5.990		***		***		***	
Pth Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	
Source 20													
HA-83	2	0.165		0.165		0.165		0.165		0.165		0.165	
MWSB-5	3	0.165		0.165		0.165		0.165		0.165		0.165	
MWSB-5	6	0.165		0.165		0.165		0.165		0.165		0.165	
n		3.	0.	3.	0.	3.	0.	3.	0.	3.	0.	3.	0.
Mean		0.2		0.2		0.2		0.2		0.2		0.2	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.026		0.026		0.026		0.026		0.026		0.026	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00	
t value		2.920		2.920		2.920		2.920		2.920		2.920	
95% UCL		0.165		0.165		0.165		0.165		0.165		0.165	
Pth Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	chrysene		fluoranthene		fluorene		Indeno(1,2,3-c,d) pyrene		phenanthrene		pyrene	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 21: NO DATA													
Source 22													
SB-66	11	0.165		0.165		0.165		0.165		0.165		0.165	
SB-67	11	0.165		0.165		0.165		0.165		0.165		0.165	
n		2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00	2.00	0.00
Mean		0.17		0.17		0.17		0.17		0.17		0.17	
St. Deviation		0.00		0.00		0.00		0.00		0.00		0.00	
Fraction of Total Area		0.128		0.128		0.128		0.128		0.128		0.128	
Area Weighted Mean		0.02		0.02		0.02		0.02		0.02		0.02	
t value		6.314		6.314		6.314		6.314		6.314		6.314	
95% UCL		0.165		0.165		0.165		0.165		0.165		0.165	
l'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	
Source 23													
HA-81	4.5	0.165		0.165		0.165		0.165		0.165		0.165	
n		1.	0.	1.	0.	1.	0.	1.	0.	1.	0.	1.	0.
Mean		0.2		0.2		0.2		0.2		0.2		0.2	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.045		0.045		0.045		0.045		0.045		0.045	
Area Weighted Mean		0.01		0.01		0.01		0.01		0.01		0.01	
t value		***		***		***		***		***		***	
95% UCL													
l'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	
Source 24: NO DATA													

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	chrysene		fluoranthene		fluorene		Indeno(1,2,3-c,d) pyrene		phenanthrene		pyrene	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 25													
SB-36*	0.5		•		•		•		•		•		•
SB-37*	0.5		•		•		•		•		•		•
SB-38*	0.5		•		•		•		•		•		•
SB-57	0.5		•		•		•		•		•		•
TE3	0-3.5		0.038		e		0.038		0.038		0.038		e
TE2	2-4		0.0185		e		0.0185		0.0185		0.0185		e
TE3	2-3.5		0.019		***0.048***		0.019		0.019		***0.092***		***0.043***
TE2	4-6		***0.64***		***5***		***5***		***0.16***		D		***2.1***
SB-36	5		0.005		0.005		0.005		0.005		0.005		0.005
SB-68	6.5	0.165		0.165		0.165		0.165		0.165		0.165	
n		1.	5.	1.	3.	1.	5.	1.	5.	1.	4.	1.	3.
Mean		0.148		1.305		0.874		0.068		0.064		0.828	
St. Deviation		0.248		2.465		2.022		0.074		0.066		1.516	
Fraction of Total Area		0.180		0.180		0.180		0.180		0.180		0.180	
Area Weighted Mean		0.03		0.23		0.16		0.01		0.01		0.15	
t value		2.015		2.353		2.015		2.015		2.132		2.353	
95% UCL		0.352		4.204		2.538		0.129		0.126		2.612	
Pth Pooled Variance		0.000333		0.049		0.022		0.00003		0.000028		0.019	
Source 26													
TE11b	2-4		***0.11***		***0.18***		e		***0.09***		***0.17***		***0.18***
TE11a	4-6		***0.46***		***0.95***		***0.082***		***0.69***				
n		0.	2.	0.	2.	0.	1.	0.	2.	0.	1.	0.	1.
Mean		0.285		0.565		0.082		0.385		0.170		0.180	
St. Deviation		0.247		0.544		0.000		0.431		0.000		0.000	
Fraction of Total Area		0.068		0.068		0.068		0.068		0.068		0.068	
Area Weighted Mean		0.02		0.04		0.01		0.03		0.01		0.01	
t value		2.353		2.353		2.353		2.353		2.920		2.920	
95% UCL		0.697		1.471		***		1.103		***		***	
Pth Pooled Variance		0.0001		0.0007		0.00		0.0004		0.00		0.00	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	chrysene		fluoranthene		fluorene		Indeno(1,2,3-c,d) pyrene		phenanthrene		pyrene	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 27													
HA-88	5.5	0.165		0.165		0.165		0.165		0.165		0.165	
HA-89	5.5	0.165		0.165		0.165		0.165		0.165		0.165	
SB-70	9.5	0.165		0.165		0.165		0.165		0.165		0.165	
n		3.	0.	3.	0.	3.	0.	3.	0.	3.	0.	3.	0.
Mean		0.165		0.165		0.165		0.165		0.165		0.165	
St. Deviation		0.000		0.000		0.000		0.000		0.000		0.000	
Fraction of Total Area		0.113		0.113		0.113		0.113		0.113		0.113	
Area Weighted Mean		0.02		0.02		0.02		0.02		0.02		0.02	
t value		2.920		2.920		2.920		2.920		2.920		2.920	
95% UCL		0.165		0.165		0.165		0.165		0.165		0.165	
i'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	
Sources 28 - 30: NO DAT													
Source 31													
HA-86	6	0.165		0.165		0.165		0.165		0.165		0.165	
n		1.	0.	1.	0.	1.	0.	1.	0.	1.	0.	1.	0.
Mean		0.2		0.2		0.2		0.2		0.2		0.2	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.013		0.013		0.013		0.013		0.013		0.013	
Area Weighted Mean		0.00		0.00		0.00		0.00		0.00		0.00	
t value		***		***		***		***		***		***	
95% UCL													
i'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	

Table 2.3. Analytical Results for Soil Semi Volatile Organics (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (Concentrations in mg/kg)

Sample	Depth (ft)	chrysene		fluoranthene		fluorene		Indeno(1,2,3-c,d) pyrene		phenanthrene		pyrene	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
Source 32													
HA-87	6	0.165		0.165		0.165		0.165		0.165		0.165	
n		1.	0.	1.	0.	1.	0.	1.	0.	1.	0.	1.	0.
Mean		0.2		0.2		0.2		0.2		0.2		0.2	
St. Deviation		0.0		0.0		0.0		0.0		0.0		0.0	
Fraction of Total Area		0.039		0.039		0.039		0.039		0.039		0.039	
Area Weighted Mean		0.01		0.01		0.01		0.01		0.01		0.01	
t value													
95% UCL		***		***		***		***		***		***	
l'th Pooled Variance		0.00		0.00		0.00		0.00		0.00		0.00	
Site Wide Summary :													
N (total analysis)		17		17		17		16		16		17	
Min		0.005		0.005		0.005		0.005		0.005		0.005	
Max		1.65		5.00		5.00		0.69		0.17		3.10	
Total area													
Weighted Means		0.13		0.37		0.24		0.10		0.09		0.26	
Pooled Variance		0.00		0.05		0.02		0.00		0.00		0.02	
t-value		1.697		1.697		1.697		1.697		1.697		1.697	
Site Wide 95% UCL		0.13		0.46		0.30		0.11		0.09		0.31	

Key For Interpreting Analytical Tables

Table 2.4 Analytical Results for Soil Total Petroleum Hydrocarbons (TPH)

All units are ppm.

Concentrations above reporting limits highlighted with boldface, italics, underlined 12 point type; all others are half the value of the sample reporting limit.

*** 95% UCL can not be calculated when n<2.

t-values: Critical values of t were determined for *n*-1 degrees of freedom where *n*-1 was rounded down.

Boxed values signify:

Dotted: Data which were not included in the ChemRisk RA database.

Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
Source 1:										
HA10	1					*11000*	500	*11000*		
HA10	5					*11000*	500	*11000*		
HA22	1	*5300*								
HA22	5	5								
HA22	6	*910*								
HA22	8	2.5								
HA23	1									
HA23	5	*44*								
HA23	8	*60*								
HA24	6	*96*								
HA27	1	*700*								
HA27	5	*45*								
HA27	8	*50*								
HA28	6	*27*								
HA29	2	*670*								
HA34	1	*300*								
HA34	5	*24*								
HA34	8	2.5								
HA39	1	*1400*								
HA39	5	*1100*								
HA39	8	*1000*								
HA40	8	*50*								
HA42	1	*10000*								
HA42	1	*8300*								
HA42	5	*700*								
HA42	5	*1200*								
HA42	8	*26*								
HA42	8	*250*								
HA43	8	*860*								
HA45	2	*2000*								
HA45	5	2.5								
HA45	8	2.5								
HA55	5	5								
HA55	8	5								
HA57	5	5								
HA57	8	5								
HA58	1	*6*								
HA58	5	*6*								
HA58	8	*6*								
HA58	8	5								
HA64	1.5	*8*								
HA64	5	2.5								
HA64	8	*7*								
MW26SB	0.5	*480*								
MW26SB	1	2.5								
MW26SB	5	2.5								
MW26SB	5	*62*								
MW26SB	7.5	*28*								
MW26SB	8	2.5								
MW26SB	25	*44*								
MW27SB	1	*280*								
MW27SB	5	2.5								
MW27SB	5	5								
MW27SB	7.5	*34*								
MW27SB	8	2.5								
MW27SB	25	*300*								
MW27SBDU	5	5								
SB24	0.5	*15000*								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
SB24	5	***420***								
SB24	7.5	***43***								
SB24	15	***55***								
SB24DU	0.5	***13000***								
TE5b	3-6	***3,000***								
TE5b	6	***35***								
TE5b	10	5								
n		62.	0.	0.	0.	2.	2.	2.	0.	0.
Mean		1096.7	0.0	0.0	0.0	11000.0	500.0	11000.0	0.0	0.0
St. Deviation		2971.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Area Weighted Mean		27.42	0.00	0.00	0.00	275.00	12.50	275.00	0.00	0.00
t value		1.671				6.314	6.314	6.314		
95% UCL		1727.408	***	***	***	11000.0	500.000	11000.000	***	***
ith Pooled Variance		89.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 2										
HA11	1					5	5	5		
HA11	5					***500***	500	500		
MW25SB	0.5	5								
MW25SB	1	***8***								
MW25SB	5	2.5								
MW25SB	7.5	5								
MW25SB	8	2.5								
MW25SB	25	***170***								
MW25SBDU	7.5	5								
S0B25	15						0.5	12.5		
SB25	0.5	***41000***					0.5	12.5		
SB25	1.5	***230***					0.5	12.5		
SB25	6.5	***440***					0.5	12.5		
SB25	15	***42***								
SOB25	0.5						0.5	12.5		
SOB25	7.5						0.5	12.5		
TE5a	0.5	***40***								
TE5a	1	5								
TE5a	9.5	5								
n		14.	0.	0.	0.	2.	8.	8.	0.	0.
Mean		3810.0	0.0	0.0	0.0	252.5	63.5	72.5	0.0	0.0
St. Deviation		12335.3	0.0	0.0	0.0	350.0	176.4	172.8	0.0	0.0
Fraction of Total Area		0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Area Weighted Mean		64.77	0.00	0.00	0.00	4.29	1.08	1.23	0.00	0.00
t value		1.771				6.314	1.895	1.895		
95% UCL		9648.548	***	***	***	1815.215	181.671	188.244	***	***
ith Pooled Variance		3141.	0	0	0	18.	1.1	1.1	0	0
Source 3: No Data										

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
Source 4										
EG04		0.5								
MW33SB	0.5	***220***								
MW33SB	3	***170***								
MW33SB	7.5	***120***								
MW33SB	13	***100***								
MW33SB	25	***220***								
MW34SB	0	***210***								
MW34SB	5	***26000***								
MW34SB	10	***150***								
MW34SB	20	***150***								
MW34SB	32.5	***100***								
MW34SB	40	***160***								
MW34SB	50	***130***								
MW34SB	60	***110***								
MW34SB	70	***120***								
MW34SB	73	***220***								
SB19	8				2.5	5	5	5		
SB20	8				2.5	5	5	5		
SB39	0.5	***9600***								
SB39	3	***710***								
SB39	7.5	***120***								
SB39	13	***150***								
SB40	0.5	***170***								
SB40	3	***150***								
SB40	7.5	***190***								
SB40	13	***92***								
SB41	0.5	***240***								
SB41	3	***170***								
SB41	7.5	***150***								
SB41	13	***77***								
n		28.	0.	0.	2.	2.	2.	2.	0.	0.
Mean		1428.6	0.0	0.0	2.5	5.0	5.0	5.0	0.0	0.0
St. Deviation		5135.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Area Weighted Mean		20.00	0.00	0.00	0.04	0.07	0.07	0.07	0.00	0.00
t value		1.703			6.314	6.314	6.314	6.314		
95% UCL		3081.412	---	---	2.500	5.000	5.000	5.000	---	---
ith Pooled Variance		185.	0	0	0	0	0	0	0	0

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
Source 5										
HA90	5	2.5								
HA91	3.5	***11000***								
SS14		***52000***								
n		3.	0.	0.	0.	0.	0.	0.	0.	0.
Mean		21000.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Deviation		27403.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0105	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105	0.0105
Area Weighted Mean		220.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t value		2.920								
95% UCL		67199.242	***	***	***	***	***	***	***	***
Pth Pooled Variance		27597.	0	0	0	0	0	0	0	0
Source 6										
HA12	1					5	5	5		
HA12	5					5	5	5		
n		0.	0.	0.	0.	2.	2.	2.	0.	0.
Mean		0.0	0.0	0.0	0.0	5.0	5.0	5.0	0.0	0.0
St. Deviation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
Area Weighted Mean		0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.00	0.00
t value						6.314	6.314	6.314		
95% UCL		***	***	***	***	5.000	5.000	5.000	***	***
Pth Pooled Variance		0	0	0	0	0	0	0	0	0
Source 7										
HA06	1					***30***	***30***	5		
HA06	5					500	500	500		
HA66	1.5	***140***								
HA66	1.6	***410***								
HA66	5	2.5								
HA66	5	5								
HA66	7.5	***10000***								
HA66	8	***4900***								
HA67	2	2.5								
HA67	5	***33***								
HA68	1	2.5								
HA68	5	2.5								
HA78	1	***70***								
HA78	5	***700***								
HA79	2	***180***								
HA79	5	***6***								
HA79	8	2.5								
MW31SB	0.5	***670***					0.5	12.5		
MW31SB	1	2.5								
MW31SB	5	***20000***								
MW31SB	5	***20***								
MW31SB	7.5	***36***					0.5	12.5		
MW31SB	8	2.5								
MW31SB	15	***32***								
MW31SB	25	***100***								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
MW31SBDU	0.5						0.5	12.5		
SB42	0.5	***530***								
SB42	1	***6***								
SB42	5.5	***27***								
SB42	6	***120***								
SB42	10.5	***67***								
SB42	11	2.5								
SB42	15.5	***39***								
SB43	1	***160***								
SB43	6	***840***								
SB43	9	***970***					0.5	12.5		
SB43	15.5	***47***					0.5	12.5		
SB44	1	***1700***								
SB44	6	***50***								
SB44	10.5	***71***								
SB44	15.5	***31***								
SB61	8	***10***								
TE6a	1-2	***50***								
TE6a	5	5								
TE6a	8	5								
TE6b	4-6	***380***								
TE6b	6-8	5								
TE6b	8.5	***120***								
SB62	7.5	2.5								
n		46.	0.	0.	0.	2	7.	7.	0.	0.
Mean		925.2	0.0	0.0	0.0	265.0	76.1	81.1	0.0	0.0
St. Deviation		3302.7	0.0	0.0	0.0	332.3	187.3	184.8	0.0	0.0
Fraction of Total Area		0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082
Area Weighted Mean		7.59	0.00	0.00	0.00	2.17	0.62	0.66	0.00	0.00
t value		1.684				6.314	1.943	1.943		
95% UCL		1745.197	***	***	***	1748.790	213.591	216.750	***	***
i'th Pooled Variance		16.	0	0	0	3.7	0.34	0.33	0	0
Source 8										
HA16	1				2.5					
HA16	4				2.5					
MW01SB	8				2.5					
MW01SB	1					5	5	5		
MW01SB	3.2					***140***	***140***	5		
SB26	0.5						0.5	12.5		
SB26	1	***250***								
SB26	4	5								
SB26	2	***340***								
SB26	8						0.5	12.5		
SB26	9	2.5								
SB26	15						0.5	12.5		
SB27	2	***110***					0.5	12.5		
SB27	6	***23***					0.5	12.5		
SB27	8	***6***								
SB27	8.5						0.5	12.5		
SB27	15.5						0.5	12.5		
SB27DU	8.5						0.5	12.5		
SB28	1	***6***					0.5	12.5		
SB28	5.5						0.5	12.5		
SB28	5	***140***								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
SB28	6						0.5	12.5		
SB28	7.5	***6***								
SB28	15.5						0.5	12.5		
n		10.	0.	0.	3.	2.	13.	13.	0.	0.
Mean		88.9	0.0	0.0	2.5	72.5	11.6	11.3	0.0	0.0
St. Deviation		120.9	0.0	0.0	0.0	95.5	38.6	2.8	0.0	0.0
Fraction of Total Area		0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Area Weighted Mean		0.99	0.00	0.00	0.03	0.80	0.13	0.13	0.00	0.00
t value		1.833			2.920	6.314	1.782	1.782		
95% UCL		158.922	***	***	2.500	498.695	30.658	12.738	***	***
i'th Pooled Variance		0.18	0	0	0	0.56	0.014	0.000075	0	0
Source 9										
HA17	1					5	5	5		
SB45	1.5	***16000***								
SB45	6	***140***								
SB45	8						0.5	12.5		
SB45	11	***20***								
SB45	15.5	***680***								
n		4.	0.	0.	0.	1.	2.	2.	0.	0.
Mean		4210.0	0.0	0.0	0.0	5.0	2.8	8.8	0.0	0.0
St. Deviation		7865.2	0.0	0.0	0.0	0.0	3.2	5.3	0.0	0.0
Fraction of Total Area		0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Area Weighted Mean		46.31	0.00	0.00	0.00	0.06	0.03	0.10	0.00	0.00
t value		2.353					6.314	6.314		
95% UCL		13463.455	***	***	***	***	16.957	32.428	***	***
i'th Pooled Variance		1871.	0	0	0	0	0.00061	0.0017	0	0
Source 10										
EHA01	1	***62***								
EHA01	6	5								
EHA02	1	***190***								
EHA02	5	***490***								
HA18	1					***30***	5	***30***		
HA18	5					5	5	5		
HA85	2.5	***80***								
HA85	6.5	***6***								
HA85	6.5	5								
SB46	0.5	***470***								
SB46	5	5								
SB47	0.5	***600***								
SB47	0.5	***1000***					0.5	12.5		
SB47	5	***7***								
SB47	5	5								
SB47	7.5	***9***								
SB48	0.5	***29***								
SB48	0.5	***230***								
SB48	5	***6000***								
SB48	5	***3000***								
SB48	7.5	***15000***								
SB48	7.5	***12000***								
SB48	15	***3200***								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
SB48	16	***120***								
n		22.	0.	0.	0.	2.	3.	3.	0.	0.
Mean		1932.4	0.0	0.0	0.0	17.5	3.5	15.8	0.0	0.0
St. Deviation		4047.5	0.0	0.0	0.0	17.7	2.6	12.8	0.0	0.0
Fraction of Total Area		0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
Area Weighted Mean		17.39	0.00	0.00	0.00	0.16	0.03	0.14	0.00	0.00
t value		1.721				6.314	2.920	2.920		
95% UCL		3417.503	***	***	***	96.425	7.880	37.461	***	***
Pth Pooled Variance		60.	0	0	0	0.013	0.00018	0.0044	0	0
Source 11										
EG02		***30000***								
EG03		***75***								
HA82	1	***29***								
HA82	1	***270***								
HA82	5	2.5								
HA82	5	***39***								
SB49	1.5	***340***								
SB49	6	***77***								
SB49	8	***800***					0.5	12.5		
SB49	15	***62***								
SB50	0.5	5								
SB50	5	***620***								
SB50	7.5	5								
SB50	15	5								
SB51	0.5	5								
SB51	5	5								
SB51	10	5								
SB51	15	5								
n		18.	0.	0.	0.	0.	1.	1.	0.	1.
Mean		1797.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Deviation		7042.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0273	0.0273	0.0273	0.0273	0.0273	0.0273	0.0273	0.0273	0.0273
Area Weighted Mean		49.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t value		1.740								
95% UCL		4685.387	***	***	***	***	***	***	***	***
Pth Pooled Variance		2053.	0	0	0	0	0	0	0	0
Source 12										
HA69	2	***10***								
HA69	5	***55***								
HA69	7.5	***6***								
HA70	1	***38***								
HA70	5	***28***								
HA70	8	5								
HA71	2	2.5								
HA71	5	***12***								
HA71	7.5	2.5								
HA72	1						0.5	12.5		
HA72	1	***20***								
HA72	2	***80***								
HA72	5	***200***								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
HA72	5	***110***								
HA72	7.5	2.5								
HA72	8	5								
HA72DU	5	***110***								
MW32SB	5	2.5								
MW32SB	5	***740***								
MW32SB	7.5	***48***								
MW32SB	8	***2.5***								
MW32SB	15	***28***								
SB30	1	***22***					0.5	12.5		
SB30	5	2.5								
SB30	5.5						0.5	12.5		
SB30	8	2.5					0.5	12.5		
SB30	16	***11***					0.5	12.5		
SB30DU	16						0.5	12.5		
SB31	1	***310***					0.5	12.5		
SB31	5	2.5								
SB31	6						0.5	12.5		
SB31	8	2.5					0.5	12.5		
SB31	15.5	20					0.5	12.5		
SB31DU	15.5						0.5	12.5		
TE8	7	5								
n		29.	0.	0.	0.	0.	11.	11.	0.	0.
Mean		64.8	0.0	0.0	0.0	0.0	0.5	12.5	0.0	0.0
St. Deviation		146.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038
Area Weighted Mean		0.25	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
t value		1.699					1.833	1.833		
95% UCL		111.125	---	---	---	---	0.500	12.500	---	---
ith Pooled Variance		0.011	0	0	0	0	0	0	0	0
Source 13										
HA15	1.5					5	5	5		
HA15	5					5	5	5		
SB29	1	***52***					0.5	12.5		
SB29	5.5	***43***					0.5	12.5		
SB29	8						0.5	12.5		
SB29	15.5	***300***					0.5	12.5		
n		3.	0.	0.	0.	2.	6.	6.	0.	0.
Mean		131.7	0.0	0.0	0.0	5.0	2.0	10.0	0.0	0.0
St. Deviation		145.9	0.0	0.0	0.0	0.0	2.3	3.9	0.0	0.0
Fraction of Total Area		0.0121	0.0121	0.0121	0.0121	0.0121	0.0121	0.0121	0.0121	0.0121
Area Weighted Mean		1.59	0.00	0.00	0.00	0.06	0.02	0.12	0.00	0.00
t value		2.920				6.314	2.015	2.015		
95% UCL		377.550	---	---	---	5.000	3.912	13.186	---	---
ith Pooled Variance		1.0	0	0	0	0	0.00013	0.00037	0	0

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
Source 14										
MW37SB	1.5	***550***								
MW37SB	5.5	***72***								
MW37SB	8.5	***48***								
MW37SB	16	***47***								
MW37SB	21	***55***								
SB22	9				2.5	5	5	5		
SB23	8.5				2.5	5	5	5		
n		5.	0.	0.	2.	2.	2.	2.	0.	0.
Mean		154.4	0.0	0.0	2.5	5.0	5.0	5.0	0.0	0.0
St. Deviation		221.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0107	0.0107	0.0107	0.0107	0.0107	0.0107	0.0107	0.0107	0.0107
Area Weighted Mean		1.65	0.00	0.00	0.03	0.05	0.05	0.05	0.00	0.00
t value		2.132			6.314	6.314	6.314	6.314		
95% UCL		365.471	---	---	2.500	5.000	5.000	5.000	---	---
ith Pooled Variance		1.1	0	0	0	0	0	0	0	0
Source 15										
HA09	1					***50***	5	***50***		
HA09	5					5	5	5		
HA14	1					***1400***	50	***1400***		
HA14	2.2					***70***	5	***70***		
HA14	5					***290***	25	***290***		
SB33	7.5	***400***								
SB33	10	***1400***					0.5	12.5		
SB33	10	***95***								
SB34	7.5	***33***								
SB34	10	2.5								
SB34	10	***190***								
n		6.	0.	0.	0.	5.	6.	6.	0.	0.
Mean		353.4	0.0	0.0	0.0	363.0	15.1	304.6	0.0	0.0
St. Deviation		532.3	0.0	0.0	0.0	590.1	19.2	546.8	0.0	0.0
Fraction of Total Area		0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Area Weighted Mean		8.91	0.00	0.00	0.00	9.15	0.38	7.68	0.00	0.00
t value		2.015				2.132	2.015	2.015		
95% UCL		791.310	---	---	---	925.598	30.843	754.408	---	---
ith Pooled Variance		30.	0	0	0	44.	0.039	32.	0	0

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
Source 16										
MW30SB	1	***46***								
MW30SB	1	***180***								
MW30SB	5	***12***								
MW30SB	5	***92***								
MW30SB	7.5	***53***								
MW30SB	8	2.5								
MW30SB	15	***28***								
MW30SB	25	***39***								
SB32	0.5	5								
SB32	5	5								
SB32	7.5	5								
SB52	0.5	5								
SB52	5	***17***								
n		13.	0.	0.	0.	0.	0.	0.	0.	0.
Mean		37.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Deviation		50.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197
Area Weighted Mean		0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t value		1.782								
95% UCL		62.449	***	***	***	***	***	***	***	***
ith Pooled Variance		0.075	0	0	0	0	0	0	0	0
Source 17										
MW03SB	6				***130***					
MW28SB	0.5	***1000***								
MW28SB	1	***12***								
MW28SB	5	2.5								
MW28SB	5	***24***								
MW28SB	8	2.5								
MW28SB	10	***110***								
MW28SB	15	***39***								
MW29SB	8	***44***								
MW29SB	15	***230***								
MW29SB	20	***230***								
MW29SB	25	***230***								
TE9	10	5								
n		12.	0.	0.	1.	0.	0.	0.	0.	0.
Mean		160.8	0.0	0.0	130.0	0.0	0.0	0.0	0.0	0.0
St. Deviation		280.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076
Area Weighted Mean		1.22	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
t value		1.796								
95% UCL		306.132	***	***	***	***	***	***	***	***
ith Pooled Variance		0.38	0	0	0	0	0	0	0	0

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
Source 18										
SB35	1	***60***								
SB35	1	***84***								
SB35	5	5								
SB35	5	5								
SB35	8	2.5								
SB35	15	***30***								
SB35	15	***410***								
SHIP 21	Grab #	***250***								
n		8.	0.	0.	0.	0.	0.	0.	0.	0.
Mean		105.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Deviation		147.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0597	0.0597	0.0597	0.0597	0.0597	0.0597	0.0597	0.0597	0.0597
Area Weighted Mean		6.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t value		1.895								
95% UCL		204.748	***	***	***	***	***	***	***	***
ith Pooled Variance		9.7	0	0	0	0	0	0	0	0
Source 19										
TE4c	3-5	***60***								
n		1.								
Mean		60.0								
St. Deviation		0.0								
Fraction of Total Area		0.0193								
Area Weighted Mean		1.16								
t value										
95% UCL		***								
ith Pooled Variance		0								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
Source 20										
SB53	6	***140***								
SB54	2	***4600***								
SB54B	0					***770***	25	25		***770***
SB54B	1					***250***	25	25		***250***
SB54B	6					***3300***	500	***3300***		***500***
SB54G	0					***810***	***80***	25		***730***
SB54G	1					***660***	50	50		***520***
TE4b	2	***210***								
TE4b	5	5								
TP01	4	***1200***					0.5	***410***		
TP01	6	***240***								
n		6.00	0.	0.	0.	5.	6.	6.	0.	5.
Mean		1065.8	0.0	0.0	0.0	1158.0	113.4	639.2	0.0	0.0
St. Deviation		1783.55	0.0	0.0	0.0	1217.81	191.30	1312.35	0.0	0.0
Fraction of Total Area		0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264
Area Weighted Mean		28.14	0.00	0.00	0.00	30.57	2.99	16.87	0.00	0.00
t value		2.015				2.132	2.015	2.015		
95% UCL		2533.0	***	***	***	2319.1	270.8	1718.7	***	***
ith Pooled Variance		370.	0	0	0	207.	4.3	200.	0	0
Source 21										
HA80	2.9	***800***								
HA83	1.5	***310***								
HA86	6	***8***								
SB71	9	***9***								
SS10		***7200***								
SS11		***70000***								
SS13		***10000***								
n		7.	0.	0.	0.	0.	0.	0.	0.	0.
Mean		12618.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Deviation		25619.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0432	0.0432	0.0432	0.0432	0.0432	0.0432	0.0432	0.0432	0.0432
Area Weighted Mean		545.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t value		1.943								
95% UCL		31432.482	***	***	***	***	***	***	***	***
ith Pooled Variance		174985.	0	0	0	0	0	0	0	0

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
Source 22										
HA77	4.5	***300***								
MW36SB	0.5	***120***								
MW36SB	3	***160***								
MW36SB	8	***56***								
MW36SB	18	***29***								
MW36SB	28	5								
MW36SB	38	***17***								
MW36SB	48	***20***								
MW36SB	58	***23***								
MW36SB	68	***23***								
MW36SB	73	***25***								
MW36SBDU	0.5	***190***								
SB55	1	5								
SB55	5	***600***								
SB55	10	***450***								
SB56	1	5								
SB56	5	***92***								
SB56	10	5								
n		18.	0.	0.	0.	0.	0.	0.	0.	0.
Mean		118.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Deviation		170.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.1277	0.1277	0.1277	0.1277	0.1277	0.1277	0.1277	0.1277	0.1277
Area Weighted Mean		15.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t value		1.740								
95% UCL		187.872	***	***	***	***	***	***	***	***
ith Pooled Variance		26.	0	0	0	0	0	0	0	0
Source 23										
GS18						5	5	5		
HAGE24	4					5	5	5		
HAGE24	7					5	5	5		
HA81	4.5	***90***								
MW39ASB	0	***3600***								
MW39ASB	5	***960***								
MW39ASB	10	***97***								
MW39ASB	15	***62***								
MW39ASB	25	***110***								
MW39SB	0	***2400***								
MW39SB	5	***120***								
MW39SB	10	***87***								
MW39SB	15	***84***								
MW39SB	25	***780***								
MW39SB	50	***64***								
MW39SB	75	***12.5***								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
n		13.	0.	0.	0.	3.	3.	3.	0.	0.
Mean		651.3	0.0	0.0	0.0	5.0	5.0	5.0	0.0	0.0
St. Deviation		290.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453
Area Weighted Mean		29.50	0.00	0.00	0.00	0.23	0.23	0.23	0.00	0.00
t value		1.782				2.920	2.920	2.920		
95% UCL		794.891	***	***	***	5.000	5.000	5.000	***	***
ith Pooled Variance		13.	0	0	0	0	0	0	0	0
Source 24: No Data										
Source 25										
GS01	0					50	50	100		
GS02	0					50	50	100		
GS03	0					50	50	100		
GS16						***1700***	50	***1700***		
GS17						***630***	25	***630***		
HA04	1					5	5	5		
HA04	5					5	5	5		
HA87	6	***8***								
HA88	5.5	***60***								
HA89	5.5	***8***								
MW02SB	1.5					5	5	5		
MW02SB	5				2.5					
MW35SB	0.5	***190***								
MW35SB	5	***1000***								
MW35SB	10	***19***								
MW35SB	20	***34***								
MW35SB	32	5								
MW35SB	40	5								
MW35SB	52.5	***30***								
MW35SB	60	***23***								
MW35SB	70	***24***								
SB36	0.5	***13000***								
SB36	1	***9000***								
SB36	5	2.5								
SB36	5	5								
SB36	7.5	5								
SB36	8	2.5								
SB36	15	5								
SB38	0.5	***5600***								
SB38	1	***5200***								
SB38	5	2.5								
SB38	5	5								
SB38	7.5	5								
SB38	8	***90***								
SB38	15	5								
SB57	0.5	***7400***								
SB57	5	***62***								
SB57	7.5	***74***								
SB57	15	***5***								
SB57DU	7.5	***22***								
SB59	8						0.5	12.5		
SB59	16	***31***								
SB63	7.5	***39***								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
SS02		***1700***								
SS03		***7700***								
SS03DU		***8000***								
SS07		***4300***								
SS08		***4500***								
SS09		***6500***								
TE2	2-4	***60***								
TE2	4-6	***2200***								
TE2	4.5	***1400***								
TE3	0-3.5	***1100***								
TE3	2-3.5	***290***								
n		44.	0.	0.	1.	8.	9.	9.	0.	0.
Mean		1811.7	0.0	0.0	2.5	311.9	26.7	295.3	0.0	0.0
St. Deviation		3180.9	0.0	0.0	0.0	599.6	23.1	562.6	0.0	0.0
Fraction of Total Area		0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799
Area Weighted Mean		325.93	0.00	0.00	0.45	56.11	4.81	53.12	0.00	0.00
t value		1.684				1.895	1.860	1.860		
95% UCL		2619.270	***	***	***	713.574	41.052	644.109	***	***
ith Pooled Variance		7442.	0	0	0	1454.	1.9	1138.	0	0
Source 26										
TE11a	0-2	***500***								
TE11a	3-4	***76***								
TE11a	4-6	***680***								
TE11a	9.5	***14***								
TE11b	2-4	***560***								
TE11b	6-8	***70***								
n		6.								
Mean		316.7								
St. Deviation		295.0								
Fraction of Total Area		0.0677								
Area Weighted Mean		21.44								
t value		2.015								
95% UCL		559.362								
ith Pooled Variance		66.								
Source 27:										
MW38ASB	0	***510***								
MW38ASB	5	***92***								
MW38ASB	10	***12.5***								
MW38ASB	15	***84***								
MW38ASB	25	***63***								
MW38SB	0	***250***								
MW38SB	5	***12.5***								
MW38SB	10	***47***								
MW38SB	15	***140***								
MW38SB	25	***240***								
MW38SB	30	***12.5***								
MW38SB	75	***12.5***								
MW38SBDU	10	***66***								

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
n		13.								
Mean		118.6								
St. Deviation		142.5								
Fraction of Total Area		0.1125								
Area Weighted Mean		13.34								
t value		1.782								
95% UCL		189.030								
i'th Pooled Variance		20.								
Source 28										
SB58	0.5	5								
SB58	5	5								
SB58DU	5	5								
SB59	1	***31***								
SB59	6	***32***								
SB59	8	***71***								
SB59	11	***23***								
SB60	1	***130***								
SB60	5.5	***31***								
SB60	8	***19***								
SB60	16	***26***								
TP04	7	5								
n		12.	0.	0.	0.	0.	0.	0.	0.	0.
Mean		31.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St. Deviation		36.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fraction of Total Area		0.0115	0.0115	0.0115	0.0115	0.0115	0.0115	0.0115	0.0115	0.0115
Area Weighted Mean		0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t value		1.796								
95% UCL		50.629	***	***	***	***	***	***	***	***
i'th Pooled Variance		0.014	0	0	0	0	0	0	0	0
Sources 29-30: No Data										
Source 31										
GS30						5	5	5		
GS31						5	5	5		
GS32						5	5	5		
GS33						***5000***	***3000***	***2000***		
GS34		***2800***								
GS35						***760***	***220***	***340***		
GS42	8	***21***								
GS43	8	2.5								
GS45	8									
GS46	8	***6***								
GS47	8	2.5								
GS48	8									
MW21SB	1				***8***	5	5	5		
MW21SB	7				***36***	5	5	5		
MW22SB	1				***9***	5	5	5		
MW22SB	7				2.5	5	5	5		
MW23SB	1.5				2.5	5	5	5		

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
MW23SB	7.5				***400***	***900***	50	***900***		
MW24SB	1				***7***	***160***	10	***160***		
MW24SB	7				2.5	5	5	5		
SB01	1.5				***8***	5	5	5		
SB01	7.5				***7***	5	5	5		
SB02	1				2.5	5	5	5		
SB02	7				***350***	***100***	***100***	5		
SB03	1				***80***	***90***	5	***90***		
SB03	7				***110***	***30***	5	***30***		
SB06	1				***13***	5	5	5		
SB06	7				***1200***	5	5	5		
SB08	1				***120***	5	5	5		
SB08	7				***6***	5	5	5		
n		5.	0.	0.	18.	23.	23.	23.	0.	0.
Mean		566.4	0.0	0.0	131.3	309.6	150.9	156.7	0.0	0.0
St. Deviation		1248.5	0.0	0.0	291.7	1049.4	623.0	447.0	0.0	0.0
Fraction of Total Area		0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127
Area Weighted Mean		7.19	0.00	0.00	1.67	3.93	1.92	1.99	0.00	0.00
t value		2.132			1.740	1.717	1.717	1.717		
95% UCL		1756.931	***	***	250.976	685.280	373.904	316.770	***	***
ith Pooled Variance		50.	0	0	0.76	7.7	2.7	1.4	0	0
Source 32										
GS26						5	5	5		
GS27						5	5	5		
GS28						5	5	5		
GS29						5	5	5		
GS36						***30***	***30***	5		
HAGE22	3.5					5	5	5		
HAGE22	7					***10***	5	***10***		
HAGE22	9					***40***	10	***40***		
HAGE23	4					5	5	5		
HAGE23	7					***20***	5	20		
MW17SB	7.5					***30***	5	***30***		
MW18SB	7.5					5	5	5		
MW20SB	7					5	5	5		
GS25						5	5	5		
MW41SBDU	50	***59***								
MW41SBDU	75	***33***								
SB24	0.5	***15000***					0.5	12.5		
SB24	5	***420***					0.5	12.5		
SB24	7.5	***43***					0.5	12.5		
SB24	15	***55***					0.5	12.5		
SB24DU	0.5	***13000***					0.5	12.5		
SB26	0.5									
SB36B	0					***43***	5	5		***43***
SB36B	1					***250***	10	10		***250***
SB36B	6					5	5	5		5
SB36D	0					***750***	100	100		***430***
SB36D	1					***430***	100	100		***430***
SB36D	6					5	5	5		5
SB36E	0					***200***	10	10		***200***
SB36E	1					***770***	100	100		***770***
SB36E	6					***1100***	100	100		***1100***
SB36H	0					***780***	25	25		***780***

Table 2.4. Analytical Results for Soil Total Petroleum Hydrocarbons (TPH) (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 Gasoline	418.1 Diesel	418.1 O&G Oil & Grease	8015M TPH	8015M Gasoline	8015M Diesel	8015M Oil & Grease	8015M Motor Oil
SB36H	1					***97***	10	10		***97***
SB36H	6					***820***	25	25		***820***
SB36I	0					***380***	25	25		***380***
SB36I	1					***44***	5	5		***44***
SB36I	6					***120***	5	5		***120***
SB37	0.5	***230***								
SB37	1	***11000***								
SB37	5	***6000***								
SB37	5	***22000***								
SB37	7.5	***3500***								
SB37	8	***11000***								
SB37	15	***33***								
SB37DU	15	***35***								
SB50	3						0.5	12.5		
SB50E	3					***850***	20	***330***		***520***
SB50H	0					***660***	25	25		***660***
SB50H	1					5	5	5		5
SB50H	6					***35***	5	5		***35***
SB50I	0					***310***	25	25		***310***
SB50I	1					***34***	5	5		***34***
SB50I	6					5	5	5		5
SB66	11	***8***								
SB67	10.5	2.5								
SB68	6.5	2.5								
SB69	3	***12000***								
SB70	9.5	***300***								
SB72	11	***2.5***								
SOB25	0.5	***140***								
SOB25	7.5	***2600***								
SOB25	15	***180***								
SS01		***3800***								
SS05		***1900***								
n		26.	0.	0.	0.	35.	42.	42.	0.	22.
Mean		3974.8	0.0	0.0	0.0	218.6	17.2	27.5	0.0	320.1
St. Deviation		6088.3	0.0	0.0	0.0	322.8	28.3	55.2	0.0	329.3
Fraction of Total Area		0.0391	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391
Area Weighted Mean		155.41	0.00	0.00	0.00	8.55	0.67	1.08	0.00	12.52
t value		1.708				1.697	1.684	1.684		1.721
95% UCL		6014.119	***	***	***	309.852	24.576	41.846	***	440.980
i'th Pooled Variance		2180.	0	0	0	4.4	0.029	0.11	0	7.5
Site Wide Summary:										
N (total analysis)		434	0	0	27	99	148	148	0	28
Min		0.500	0.000	0.000	2.500	5.000	0.500	5.000	0.000	5.000
Max		70000.0	0.00	0.000	1200.0	11000.0	3000.0	11000.0	0.00	1100.0
Total area										
Weighted Means		1617	0.00	0.00	3	391	26	359	0.00	13
Pooled Variance		2.2E+05	0.0	0.0	7.6E-01	1.7E+03	1.0E+01	1.4E+03	0.0	7.5
t-value		1.645			1.706	1.671	1.645	1.645		1.703
Site Wide 95% UCL		1654.43	***	***	3.48	398.23	26.01	363.56	***	13.40

Key for Interpreting Analytical Tables

Table 2.5. Analytical Results for Soil Toxic Characteristic Leaching Procedure (TCLP)

Concentrations above reporting limits highlighted with boldface, italics, underlined 12 point type; all others are half the value of the sample reporting limit.

Samples with two depths are composite samples.

t-values: Critical values of t were determined for n-1 degrees of freedom wher n-1 was rounded down.

*** 95% UCL can not be calculated when n<2.

Unable to locate original laboratory data sheets.

Table 2.5. Analytical Results for Soil Toxic Characteristic Leaching Procedure (TCLP, mg/L)

Sample Location	Depth (ft)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Zinc (Zn)
Sources 1-18: NO DATA									
Source 19									
SB54-A	0.5	0.25	0.05			0.0005			
SB54-B	0.5	0.25	0.98			0.0005			
SB54-C	0.5	0.25	0.16			0.0005			
SB54-D	0.5	0.25	0.05			0.0005			
SB54-E	0.5	0.25	0.05			0.0005			
SB54-A	1	0.25	0.05			0.0005			
SB54-B	1	0.25	0.15			0.0005			
SB54-C	1	0.25	0.05			0.0005			
SB54-D	1	0.25	0.05			0.0005			
SB54-E	1	0.25	0.05			0.0005			
SB53	1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
TE4d&TE4e	2	0.025		0.05				0.15	0.01
SB54-A	6	0.25	0.05			0.0005			
SB54-B	6	0.25	0.05			0.0005			
SB54-C	6	0.25	0.05			0.0005			
SB54-D	6	0.25	0.05			0.0005			
SB54-E	6	0.25	0.05			0.0005			
n		17.	16.	2.	1.	16.	1.	2.	1.
Mean		0.225	0.121	0.050	0.050	0.004	0.050	0.100	0.010
St. Deviation		0.071	0.232	0.000		0.012		0.071	
Fraction of Total Area		0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Area Weighted Mean		0.004	0.002	0.001	0.001	0.000	0.001	0.002	0.000
t value		1.746	1.746	6.314		1.753	6.314	6.314	
95% UCL		0.255	0.222	0.050	***	0.009		0.416	***
i'th Pooled Variance		1.10E-07	1.25E-06	0.00E+00	0	3.57E-09	0	9.31E-07	0

Table 2.5. Analytical Results for Soil Toxic Characteristic Leaching Procedure (TCLP, mg/L)

Sample Location	Depth (ft)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Zinc (Zn)
Source 20									
TE4b	2	0.025	0.05	0.05	0.05	0.1		0.15	***0.21***
n		1.	1.	1.	1.	1.	0.	1.	1.
Mean		0.025	0.050	0.050				0.150	0.210
St. Deviation									
Fraction of Total Area		0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264
Area Weighted Mean		0.00066	0.00132	0.00132	0.00		0	0.00396	0.005544
t value									
95% UCL		***	***	***			***	***	***
i'th Pooled Variance		0	0	0	0	0	0	0	0
Sources 21-24: NO DATA									
Source 25									
SB-36A	0.5	0.25			***0.28***		0.0005		
SB-36C	0.5	0.25			0.05		0.0005		
SB-36D	0.5	0.25			***0.3***		0.0005		
SB-36A	1	0.25			***0.16***		0.0005		
SB-36C	1	0.25			0.05		0.0005		
SB-36D	1	0.25			***0.21***		0.0005		
SB-36A	6	0.25			0.05		0.0005		
SB-36C	6	0.25			0.05		0.0005		
SB-36D	6	0.25			0.05		0.0005		

Table 2.5. Analytical Results for Soil Toxic Characteristic Leaching Procedure (TCLP, mg/L)

Sample Location	Depth (ft)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Zinc (Zn)
n		9.	0.	0.	9.	0.	9.	0.	0.
Mean		0.250			0.133		0.001		
St. Deviation		0.000			0.106		0.000		
Fraction of Total Area		0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180
Area Weighted Mean		0.04			0.02		9.00E-05		
t value		1.860			1.860		1.860		
95% UCL		0.250			0.199		0.001		
i'th Pooled Variance		0.00E+00	0	0	4.07E-05	0	0	0	0
Source 26									
SB-36B	0.5	0.25			***0.53***		0.0005		
SB-36E	0.5	0.25			0.05		0.0005		
SB-63A	0.5	0.25			***1.1***		0.0005		
SB-63B	0.5	0.25			***3.7***		0.0005		
SB-63C	0.5	0.25			***3.4***		0.0005		
SB-63D	0.5	0.25			***3.2***		0.0005		
SB-63E	0.5	0.25			***4.9***		0.0005		
SB-65A	0.5	0.25			***6.4***		0.0005		
SB-65B	0.5	0.25			0.05		0.0005		
SB-65C	0.5	0.25			***0.19***		0.0005		
SB-65D	0.5	0.25			***14***		0.0005		
SB-16/64A	0.5	0.25			***0.13***		0.0005		
SB-16/64C	0.5	0.25			***2.6***		0.0005		
SB-16/64D	0.5	0.25			0.05		0.0005		
SB-36B	1	0.25			0.05		0.0005		
SB-36E	1	0.25			0.05		0.0005		

ANALYTICAL RESULTS FOR GROUNDWATER

Table 3.1. Analytical Results for Groundwater Total Metals Analysis (concentrations in µg/l)

Sample Label	Year Collected	By:	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Cyanide (Cn)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Zinc (Zn)
Source 1													
MW-26	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
MW-27	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			2	2	2	0	2	2	2	2	2	2	2
Mean			5.00	5.00	10.00	0.00	1.50	0.25	10.00	2.50	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Area Weighted Mean			0.13	0.13	0.25	0.00	0.04	0.01	0.25	0.06	0.13	0.13	0.25
i'th Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 2													
MW-25	92	M/H	5	5	10	5	1.5	0.25	10	2.5	5	5	10
n			1	1	1	1	1	1	1	1	1	1	1
Mean			5.00	5.00	10.00	5.00	1.50	0.25	10.00	2.50	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Area Weighted Mean			0.09	0.09	0.17	0.09	0.03	0.00	0.17	0.04	0.09	0.09	0.17
i'th Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 3: No Data													
Source 4													
MW-33	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			1	1	1	0	1	1	1	1	1	1	1
Mean			5.00	5.00	10.00	0.00	1.50	0.25	10.00	2.50	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Area Weighted Mean			0.07	0.07	0.14	0.00	0.02	0.00	0.14	0.04	0.07	0.07	0.14
i'th Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sources 5-6: No Data													

Table 3.1. Analytical Results for Groundwater Total Metals Analysis (concentrations in µg/l)

Sample Label	Year Collected	By:	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Cyanide (Cn)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Zinc (Zn)
Source 7													
MW-31	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	29
n			1	1	1	0	1	1	1	1	1	1	1
Mean			5.00	5.00	10.00	0.00	1.50	0.25	10.00	2.50	5.00	5.00	29.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082
Area Weighted Mean			0.04	0.04	0.08	0.00	0.01	0.00	0.08	0.02	0.04	0.04	0.24
i'th Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 8													
MW-1	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			1	1	1	0	1	1	1	1	1	1	1
Mean			5.00	5.00	10.00	0.00	1.50	0.25	10.00	2.50	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111
Area Weighted Mean			0.06	0.06	0.11	0.00	0.02	0.00	0.11	0.03	0.06	0.06	0.11
i'th Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sources 9-11: No Data													
Source 12													
MW-32	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			1	1	1	0	1	1	1	1	1	1	1
Mean			5.00	5.00	10.00	0.00	1.50	0.25	10.00	2.50	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038
Area Weighted Mean			0.02	0.02	0.04	0.00	0.01	0.00	0.04	0.01	0.02	0.02	0.04
i'th Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 13: No Data													

Table 3.1. Analytical Results for Groundwater Total Metals Analysis (concentrations in µg/l)

Sample Label	Year Collected	By:	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Cyanide (Cn)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Zinc (Zn)
Source 14													
MW-37	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			1	1	1	0	1	1	1	1	1	1	1
Mean			5.00	5.00	10.00	0.00	1.50	0.25	10.00	2.50	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Area Weighted Mean			0.09	0.09	0.17	0.00	0.03	0.00	0.17	0.04	0.09	0.09	0.17
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 15: No Data													
Source 16													
MW-30	92	M/H	5	5	10		1.5	0.25	10	6	5	5	10
n			1	1	1	0	1	1	1	1	1	1	1
Mean			5.00	5.00	10.00	0.00	1.50	0.25	10.00	6.00	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197
Area Weighted Mean			0.10	0.10	0.20	0.00	0.03	0.00	0.20	0.12	0.10	0.10	0.20
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 17													
MW-29	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
MW-3	92	M/H	5	5	10	5	1.5	0.25	23	2.5	5	5	10
n			2	2	2	1	2	2	2	2	2	2	2
Mean			5.00	5.00	10.00	5.00	1.50	0.25	16.50	2.50	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	9.19	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076
Area Weighted Mean			0.04	0.04	0.08	0.04	0.01	0.00	0.13	0.02	0.04	0.04	0.08
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sources 18-19: No Data													

Table 3.1. Analytical Results for Groundwater Total Metals Analysis (concentrations in µg/l)

Sample Label	Year Collected	By:	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Cyanide (Cn)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Zinc (Zn)
Source 20													
MW-5	92	M/H	5	5	10	5	1.5	0.25	***23***	2.5	5	5	10
MW-5DU	92	M/H	5	5	10	5	1.5	0.25	10	***5***	5	5	10
n			2	2	2	2	2	2	2	2	2	2	2
Mean			5.00	5.00	10.00	5.00	1.50	0.25	16.50	3.75	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	9.19	1.77	0.00	0.00	0.00
Fraction of Total Area			0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264
Area Weighted Mean			0.13	0.13	0.26	0.13	0.04	0.01	0.44	0.10	0.13	0.13	0.26
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.029	0.0011	0.0	0.0	0.0
Source 21: No Data													
Source 22													
MW-10	89	M/H	***100***	5.0	45.	5.	25.	1.0	100	0.5	25.	500	40.
MW-7	89	M/H	2.5	***10.***	45.		25.	1.0	100	0.5	25.	500	40.
MW-8	89	M/H	***30.***	5.0	45.	5.	25.	1.0	100	0.5	25.	500	40.
MW-9	89	M/H	2.5	***10.***	45.		25.	1.0	100	0.5	25.	500	40.
MW-10	90	M/H	***250***	5.0	45.	5.	50.	1.0	100	0.5	25.0	500	40.
MW-36	90	Enviros	5.0	2.5	***177***		***31.***	***0.6***	20.	2.5	5.0	***80.***	***264***
MW-7	90	M/H	***8.0***	5.0	45.	5.	50.	1.0	100	0.5	25.0	500	40.
MW-8	90	M/H	***27.***	5.0	45.	5.	50.	1.0	100	***1.0***	25.0	500	40.
MW-9	90	M/H	***5.0***	5.0	45.	5.	50.	1.0	100	0.5	25.0	500	40.
MW-10	92	M/H	***55***	5	10		1.5	0.25	10	2.5	5	5	***20***
MW-7	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
MW-8	92	M/H	***12***	5	10	5	***7***	0.25	10	2.5	5	5	***36***
MW-9	92	M/H	***15***	5	10		1.5	0.25	10	2.5	5	5	10
n			13	13	13	7	13	13	13	13	13	13	13
Mean			39.77	5.58	44.38	5.00	26.35	0.74	66.15	1.31	17.31	315.38	50.77
St Deviation			68.99	2.08	43.13	0.00	19.35	0.36	44.64	0.99	10.13	243.83	65.12
Fraction of Total Area			0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Area Weighted Mean			5.08	0.71	5.67	0.64	3.36	0.09	8.45	0.17	2.21	40.27	6.48
ith Pooled Variance			6.0	0.0054	2.3	0.0	0.47	0.00016	2.5	0.0012	0.13	75.	5.3
Source 23													
MW-6	89	M/H	2.5	***10.***	45.		25.	1.0	100	0.5	25.	500	40.
MW-6	90	M/H	***14.***	5.0	45.	5.	50.	1.0	100	***1.0***	25.0	500	40.
MW-6	92	M/H	5	5	10		1.5	0.25	10	***5***	5	5	10
n			3	3	3	1	3	3	3	3	3	3	3
Mean			7.17	6.67	33.33	5.00	25.50	0.75	70.00	2.17	18.33	335.00	30.00
St Deviation			6.05	2.89	20.21	0.00	24.25	0.43	51.96	2.47	11.55	285.79	17.32
Fraction of Total Area			0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453
Area Weighted Mean			0.32	0.30	1.51	0.23	1.16	0.03	3.17	0.10	0.83	15.18	1.36
ith Pooled Variance			0.025	0.0057	0.28	0.0	0.40	0.00013	1.8	0.0042	0.091	56.	0.21

Table 3.1. Analytical Results for Groundwater Total Metals Analysis (concentrations in µg/l)

Sample Label	Year Collected	By:	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Cyanide (Cn)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Zinc (Zn)
Source 24: No Data													
Source 25													
MW-11	89	M/H	***40***	5.0	45.	5.	25.	1.0	100	0.5	25.	500	40.
MW-12	89	M/H	***10***	5.0	45.	5.	25.	1.0	100	0.5	25.	500	40.
MW-13	89	M/H	***6***	5.0	45.	5.	50.	1.0	100	0.5	25.	500	40.
MW-15	89	M/H	***200***	5.0	45.	5.	50.	1.0	100	0.5	25.	500	***200***
MW-11	90	M/H	***30***	5.0	45.		50.	***31.***	100	***1***	25.	500	***210***
MW-12	90	M/H	***10***	5.0	45.	5.	50.	1.0	100	***1***	25.	500	40.
MW-13	90	M/H	***5***	5.0	45.		50.	1.0	100	0.5	25.	500	40.
MW-15	90	M/H	***110***	5.0	45.		50.	1.0	100	0.5	25.	500	40.
MW-34-1	90	Enviros	5.0	2.5	***114***		***75***	***0.7***	20.	2.5	5.0	***130***	***174***
MW-34-2	90	Enviros	5.0	2.5	12.5		***242***	***0.5***	20.	2.5	***17.***	***70.***	***294***
MW-11	92	M/H	***10***	5	10		1.5	0.25	10	2.5	5	5	***57***
MW-12	92	M/H	5	5	10	5	1.5	0.25	***20***	2.5	5	5	10
MW-13	92	M/H	5	5	10		1.5	0.25	10	***6***	5	5	10
MW-14	92	M/H	***13***	5	10		1.5	0.25	10	2.5	5	5	10
MW-15	92	M/H	***34***	5	10		1.5	0.25	10	2.5	5	5	10
MW-2	92	M/H	5	5	10	5	1.5	0.25	10	2.5	5	5	10
MW-34	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			17	17	17	7	17	17	17	17	17	17	17
Mean			29.29	4.71	32.74	5.00	39.85	2.41	54.12	1.82	15.12	249.12	72.65
St Deviation			51.14	0.83	27.20	0.00	57.80	7.38	44.73	1.44	10.01	245.84	88.23
Fraction of Total Area			0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799
Area Weighted Mean			5.27	0.85	5.89	0.90	7.17	0.43	9.74	0.33	2.72	44.82	13.07
ith Pooled Variance			5.0	0.0013	1.4	0.0	6.4	0.10	3.8	0.0039	0.19	115.	15.
Source 26													
MW-14	89	M/H	2.5	***30.***	45.	5.	50.	1.0	100	0.5	25.	500	40.
MW-16	89	M/H	2.5	***10.***	45.	5.	***200***	1.0	100	0.5	25.	500	40.
MW-14	90	M/H	***24.***	***20.***	45.	5.	50.	1.0	100	***1***	25.0	500	40.
MW-16	90	M/H	2.5	***60.***	45.	5.	***200***	1.0	***200***	0.5	25.0	500	***160***
MW-35	90	Enviros	5.0	2.5	***64.***		***69.***	***0.7***	20.	2.5	***120***	***110***	***542***
MW-16	92	M/H	5	5	10	5	1.5	0.25	10	2.5	5	5	10
MW-16DU	92	M/H	5	5	10	5	1.5	0.25	10	2.5	5	5	10
MW-35	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			8	8	8	6	8	8	8	8	8	8	8
Mean			6.44	17.19	34.25	5.00	71.69	0.68	68.75	1.56	29.38	265.63	106.50
St Deviation			7.20	19.70	21.08	0.00	83.37	0.37	68.54	1.02	37.93	252.90	182.73
Fraction of Total Area			0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677
Area Weighted Mean			0.44	1.16	2.32	0.34	4.85	0.05	4.65	0.11	1.99	17.98	7.21
ith Pooled Variance			0.030	0.22	0.25	0.0	4.0	0.00008	2.7	0.00059	0.82	37.	19.

Table 3.1. Analytical Results for Groundwater Total Metals Analysis (concentrations in µg/l)

Sample Label	Year Collected	By:	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Cyanide (Cn)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Zinc (Zn)
Source 27													
MW-38	92	Enviros	***1***	5	***10***	***69***	***28***	0.05	50				***240***
MW-38	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
MW-38A	92	Enviros	***9***	1	***61***	5	***37***	***0.2***	***30***				***92***
MW-38A	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	***150***
MW-39	92	Enviros	***2***	5	***10***	5	2.5	0.05	50				***40***
MW-39A	92	Enviros	***9***	1	***68***	***299***	***50***	***0.2***	***20***				***121***
MW-39	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
MW-39A	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			8	8	8	4	8	8	8	4	4	4	8
Mean			5.13	4.00	23.63	94.50	15.44	0.19	23.75	2.50	5.00	5.00	84.13
St Deviation			2.85	1.85	25.30	139.63	19.86	0.09	17.68	0.00	0.00	0.00	83.23
Fraction of Total Area			0.1125	0.1125	0.1125	0.1125	0.1125	0.1125	0.1125	0.1125	0.1125	0.1125	0.1125
Area Weighted Mean			0.58	0.45	2.66	10.63	1.74	0.02	2.67	0.28	0.56	0.56	9.46
ith Pooled Variance			0.013	0.0054	1.0	62.	0.62	0.0	0.49	0.0	0.0	0.0	11.
Sources 28-30: No Data													
Source 31													
MW-21	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
MW-24	92	M/H	5	5	10		1.5	0.25	10	2.5	5	5	10
n			2	2	2	0	2	2	2	2	2	2	2
Mean			5.00	5.00	10.00	0.00	1.50	0.25	10.00	2.50	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127
Area Weighted Mean			0.06	0.06	0.13	0.00	0.02	0.00	0.13	0.03	0.06	0.06	0.13
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 32													
MW-18	89	M/H				5							
MW-17	92	M/H	5	5	10		1.5	0.25	10	***6***	5	5	10
MW-18	92	M/H	5	5	10		1.5	0.25	10	***5***	5	5	10
MW-19	92	M/H	5	5	10		1.5	0.25	10	***7***	5	5	10
MW-20	92	M/H	5	5	10	5	1.5	0.25	10	2.5	5	5	10
MW-17	89	M/H				5							
n			4	4	4	3	4	4	4	4	4	4	4
Mean			5.00	5.00	10.00	5.00	1.50	0.25	10.00	5.13	5.00	5.00	10.00
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.93	0.00	0.00	0.00
Fraction of Total Area			0.0391	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391	0.0391
Area Weighted Mean			0.20	0.20	0.39	0.20	0.06	0.01	0.39	0.20	0.20	0.20	0.39
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0014	0.0	0.0	0.0

Table 3.1. Analytical Results for Groundwater Total Metals Analysis (concentrations in µg/l)

Sample Label	Year Collected	By:	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Cyanide (Cn)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Zinc (Zn)
Site Wide Summary:													
Min			1.00	1.00	10.00	5.00	1.50	0.05	10.00	0.50	5.00	5.00	10.00
Max			250.0	60.0	177.0	299.0	242.0	31.0	200.0	7.0	120.0	500.0	542.0
N (total analysis)			68	68	68	32	68	68	68	64	64	64	68
Total area													
Weighted Means			12.69	4.48	20.06	13.18	18.58	0.68	30.92	1.69	9.32	119.82	39.76
Pooled Variance			11.02	0.24	5.29	61.69	11.84	0.10	11.37	0.01	1.24	282.14	50.43
t-value			1.671	1.671	1.671	1.701	1.671	1.671	1.671	1.671	1.671	1.671	1.671
Site Wide 95% UCL			13.37	4.58	20.53	15.55	19.28	0.74	31.60	1.71	9.55	123.33	41.20

Note: All units are ppb.
Concentrations above reporting limits are highlighted with boldface, italic, underlined 12 point type; all others are half the value of the sample reporting limit.
Boxed values signify:
Dotted: Data which were not included in the ChemRisk RA database.
Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

Table 3.2. Analytical Results for Groundwater Volatile Organic Compounds (VOCs) (concentrations in µg/l)

Sample Location	Year Collected	By:	Acetone	1,1-Dichloro ethane	1,2-dichloro ethene	Methylene Chloride	Toluene	Tetrachoro ethylene	Trichloro ethylene	Xylenes
Source 1										
MW-25	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-27	92	M/H		0.25	*0.55*	10	0.25	0.25	*0.86*	0.75
n			0	2	2	2	2	2	2	2
Mean			0.00	0.25	0.53	10.00	0.25	0.25	0.56	0.75
St Deviation			0.00	0.00	0.04	0.00	0.00	0.00	0.43	0.00
Fraction of Total Area			0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Area Weighted Mean			0.00	0.01	0.01	0.25	0.01	0.01	0.01	0.02
i'th Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.000058	0.0
Source 2										
MW-25	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			0	1	1	1	1	1	1	1
Mean			0.00	0.25	0.50	10.00	0.25	0.25	0.25	0.75
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Area Weighted Mean			0.00	0.00	0.01	0.17	0.00	0.00	0.00	0.01
i'th Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 3: No Data										
Source 4										
MW-33	90	Enviros		0.5	0.5	0.5		0.5	0.5	
MW-33	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			0	2	2	2	1	2	2	1
Mean			0.00	0.38	0.50	5.25	0.25	0.38	0.38	0.75
St Deviation			0.00	0.18	0.00	6.72	0.00	0.18	0.18	0.00
Fraction of Total Area			0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Area Weighted Mean			0.00	0.01	0.01	0.07	0.00	0.01	0.01	0.01
i'th Pooled Variance			0.0	0.0	0.0	0.0044	0.0	0.0	0.0	0.0
Sources 5-6: No Data										

Table 3.2. Analytical Results for Groundwater Volatile Organic Compounds (VOCs) (concentrations in µg/l)

Sample Location	Year Collected	By:	Acetone	1,1-Dichloro ethane	1,2-dichloro ethene	Methylene Chloride	Toluene	Tetrachloro ethylene	Trichloro ethylene	Xylenes
Source 7										
MW-31	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-31	92	M/H		0.25	0.5	10	0.25	*2*	*0.7*	0.75
n			0	2	2	2	2	2	2	2
Mean			0.00	0.25	0.50	10.00	0.25	1.13	0.48	0.75
St Deviation			0.00	0.00	0.00	0.00	0.00	1.24	0.32	0.00
Fraction of Total Area			0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082
Area Weighted Mean			0.00	0.00	0.00	0.08	0.00	0.01	0.00	0.01
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.000051	0.0	0.0
Source 8										
MW-1	89	M/H					0.25			0.75
MW-1	92	M/H		0.25	*2.9*	10	0.25	0.25	*0.58*	0.75
n			0	1	1	1	2	1	1	2
Mean			0.00	0.25	2.90	10.00	0.25	0.25	0.58	0.75
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111
Area Weighted Mean			0.00	0.00	0.03	0.11	0.00	0.00	0.01	0.01
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sources 9-11: No Data										
Source 12										
MW-28	90	M/H		*6.7*	*3.9*	10	0.25	*0.6*	0.25	0.75
MW-32	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-32	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			0	3	3	3	3	3	3	3
Mean			0.00	2.40	1.63	10.00	0.25	0.37	0.25	0.75
St Deviation			0.00	3.72	1.96	0.00	0.00	0.20	0.00	0.00
Fraction of Total Area			0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038
Area Weighted Mean			0.00	0.01	0.01	0.04	0.00	0.00	0.00	0.00
ith Pooled Variance			0.0	0.000067	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.2. Analytical Results for Groundwater Volatile Organic Compounds (VOCs) (concentrations in µg/l)

Sample Location	Year Collected	By:	Acetone	1,1-Dichloro ethane	1,2-dichloro ethene	Methylene Chloride	Toluene	Tetrachloro ethylene	Trichloro ethylene	Xylenes
Source 13										
MW-4	89	M/H					0.25			0.75
n			0	0	0	0	1	0	0	1
Mean			0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.75
St Deviation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0121	0.0121	0.0121	0.0121	0.0121	0.0121	0.0121	0.0121
Area Weighted Mean			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Source 14										
MW-37	90	Enviros	50	2.5	2.5	2.5	2.5	2.5	2.5	2.5
MW-37	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			1	2	2	2	2	2	2	2
Mean			50.00	1.38	1.50	6.25	1.38	1.38	1.38	1.63
St Deviation			0.00	1.59	1.41	5.30	1.59	1.59	1.59	1.24
Fraction of Total Area			0.0107	0.0107	0.0107	0.0107	0.0107	0.0107	0.0107	0.0107
Area Weighted Mean			0.54	0.01	0.02	0.07	0.01	0.01	0.01	0.02
ith Pooled Variance			0.0	0.00014	0.00011	0.0016	0.00014	0.00014	0.00014	0.000088
Source 15: No Data										
Source 16										
MW-30	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-30	90	Enviros								0.75
MW-30DU	90	M/H					0.25	0.25	0.25	0.75
MW-30	92	M/H		0.5	0.5	10	0.25	0.25	0.25	0.75
n			0	2	2	2	3	3	3	4
Mean			0.00	0.38	0.50	10.00	0.25	0.25	0.25	0.75
St Deviation			0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197
Area Weighted Mean			0.00	0.01	0.01	0.20	0.00	0.00	0.00	0.01
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.2. Analytical Results for Groundwater Volatile Organic Compounds (VOCs) (concentrations in µg/l)

Sample Location	Year Collected	By:	Acetone	1,1-Dichloro ethane	1,2-dichloro ethene	Methylene Chloride	Toluene	Tetrachloro ethylene	Trichloro ethylene	Xylenes
Source 17										
MW-3	89	M/H	12.5	0.5	***9***	***13***	0.25	***4.2***	***2.7***	0.75
MW-29	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-29	92	M/H		0.25	***0.94***	10	0.25	0.25	0.25	0.75
MW-3	92	M/H		0.25	***0.88***	10	0.25	0.25	0.25	0.75
n			1	4	4	4	4	4	4	4
Mean			0.00	0.31	2.83	10.75	0.25	1.24	0.86	0.75
St Deviation			0.00	0.13	4.12	1.50	0.00	1.98	1.23	0.00
Fraction of Total Area			0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076
Area Weighted Mean			0.00	0.00	0.02	0.08	0.00	0.01	0.01	0.01
i'th Pooled Variance			0.0	0.0	0.00024	0.0	0.0	0.000056	0.0	0.0
Sources 18-19: No Data										
Source 20										
MW-5	89	M/H		0.5	0.5	0.5	0.5	0.5	0.5	0.5
MW-5	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-5DU	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			0	3	3	3	3	3	3	3
Mean			0.00	0.33	0.50	6.83	0.33	0.33	0.33	0.67
St Deviation			0.00	0.14	0.00	5.48	0.14	0.14	0.14	0.14
Fraction of Total Area			0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264	0.0264
Area Weighted Mean			0.00	0.01	0.01	0.18	0.01	0.01	0.01	0.02
i'th Pooled Variance			0.0	0.0	0.0	0.0070	0.0	0.0	0.0	0.0
Source 21: No Data										

Table 3.2. Analytical Results for Groundwater Volatile Organic Compounds (VOCs) (concentrations in µg/l)

Sample Location	Year Collected	By:	Acetone	1,1-Dichloro ethane	1,2-dichloro ethene	Methylene Chloride	Toluene	Tetrachoro ethylene	Trichloro ethylene	Xylenes
Source 22										
MW-10	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-11	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-7	89	M/H	***950***	25	25	125	25	50	25	25
MW-8	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-9	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-10	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-11	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-11	90	Enviros								0.75
MW-11DU	90	M/H					0.25			0.75
MW-7	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-8	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-9	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-10	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-11	92	M/H		0.25		10	0.25	0.25	0.25	0.75
MW-7	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-8	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-9	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			5	15	14	15	16	15	15	17
Mean			200.00	2.50	2.82	18.33	2.36	4.83	2.50	2.59
St Deviation			419.26	6.31	6.45	29.53	6.12	12.68	6.31	5.82
Fraction of Total Area			0.1277	0.1277	0.1277	0.1277	0.1277	0.1277	0.1277	0.1277
Area Weighted Mean			25.54	0.32	0.36	2.34	0.30	0.62	0.32	0.33
ith Pooled Variance			0.0	0.043	0.048	0.95	0.038	0.17	0.043	0.033
Source 23										
MW-6	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-6	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-6DU	90	M/H		0.25	0.5	10		0.25	0.25	
MW-39	92	Enviros	2.5	0.5	0.5	*1*	0.5	0.5	0.5	1
MW-39	92	M/H		0.25	0.5	10	*1.4*	0.25	0.25	0.75
MW-39A	92	Enviros	2.5	0.5	1	1	0.5	0.5	0.5	1
MW-39A	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-6	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			3	8	8	8	7	8	8	7
Mean			0.00	0.59	0.81	8.06	0.81	0.91	0.59	1.07
St Deviation			0.00	0.78	0.70	4.44	0.85	1.66	0.78	0.64
Fraction of Total Area			0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453	0.0453
Area Weighted Mean			0.00	0.03	0.04	0.37	0.04	0.04	0.03	0.05
ith Pooled Variance			0.0	0.00016	0.00013	0.0051	0.00021	0.00071	0.00016	0.00012
Source 24: No Data										

Table 3.2. Analytical Results for Groundwater Volatile Organic Compounds (VOCs) (concentrations in µg/l)

Sample Location	Year Collected	By:	Acetone	1,1-Dichloro ethane	1,2-dichloro ethene	Methylene Chloride	Toluene	Tetrachoro ethylene	Trichloro ethylene	Xylenes
Source 25										
MW-12	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-13	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-14	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-15	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-2	89	M/H					0.25			0.75
MW-12	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-13	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-14	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-15	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-12	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-13	92	M/H		0.25		10	0.25	0.25	0.25	0.75
MW-14	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-15	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-2	92	M/H		0.25		10	0.25	0.25	0.25	0.75
MW-34	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			4	14	12	14	15	14	14	15
Mean			12.50	0.89	1.17	10.71	0.85	1.61	0.89	1.22
St Deviation			0.00	1.05	0.98	1.17	1.03	2.23	1.05	0.80
Fraction of Total Area			0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799	0.1799
Area Weighted Mean			2.25	0.16	0.21	1.93	0.15	0.29	0.16	0.22
ith Pooled Variance			0.0	0.0026	0.0026	0.0032	0.0023	0.011	0.0026	0.0014
Source 26										
MW-16	89	M/H	12.5	2.5	2.5	12.5	2.5	5.0	2.5	2.5
MW-16	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-16	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-16DU	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-35	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			1	5	5	5	5	5	5	5
Mean			12.50	0.70	0.90	10.50	0.70	1.20	0.70	1.10
St Deviation			0.00	1.01	0.89	1.12	1.01	2.12	1.01	0.78
Fraction of Total Area			0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677	0.0677
Area Weighted Mean			0.85	0.05	0.06	0.71	0.05	0.08	0.05	0.07
ith Pooled Variance			0.0	0.00093	0.00073	0.0011	0.00093	0.0041	0.00093	0.00056

Table 3.2. Analytical Results for Groundwater Volatile Organic Compounds (VOCs) (concentrations in µg/l)

Sample Location	Year Collected	By:	Acetone	1,1-Dichloro ethane	1,2-dichloro ethene	Methylene Chloride	Toluene	Tetrachoro ethylene	Trichloro ethylene	Xylenes
Source 27										
MW-38	92	Enviros	2.5	0.5	0.5	*1.5*	*0.6*	0.5	0.5	1
MW-38	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-38A	92	Enviros	2.5	0.5	1	1	0.5	0.5	0.5	1
MW-38A	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			2	4	4	4	4	4	4	4
Mean			0.00	0.38	0.63	5.63	0.40	0.38	0.38	0.88
St Deviation			0.00	0.14	0.25	5.06	0.18	0.14	0.14	0.14
Fraction of Total Area			0.1125	0.1125	0.1125	0.1125	0.1125	0.1125	0.1125	0.1125
Area Weighted Mean			0.00	0.04	0.07	0.63	0.05	0.04	0.04	0.10
Ith Pooled Variance			0.0	0.000066	0.00020	0.081	0.00010	0.000066	0.000066	0.000066
Sources 28-30: No Data										
Source 31										
MW-21	89	M/H	12.5	2.5	2.5	12.5	2.5	5	2.5	2.5
MW-22	89	M/H	12.5	2.5	2.5	12.5	2.5	5	2.5	2.5
MW-23	89	M/H	12.5	2.5	2.5	12.5	2.5	5	2.5	2.5
MW-24	89	M/H	12.5	2.5	2.5	12.5	2.5	5	2.5	2.5
MW-21	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-24	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			4	6	6	6	6	6	6	6
Mean			0.00	1.75	1.83	11.67	1.75	3.42	1.75	1.92
St Deviation			0.00	1.16	1.03	1.29	1.16	2.45	1.16	0.90
Fraction of Total Area			0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127	0.0127
Area Weighted Mean			0.00	0.02	0.02	0.15	0.02	0.04	0.02	0.02
Ith Pooled Variance			0.0	0.0	0.0	0.0	0.0	0.00016	0.0	0.0

Table 3.2. Analytical Results for Groundwater Volatile Organic Compounds (VOCs) (concentrations in µg/l)

Sample Location	Year Collected	By:	Acetone	1,1-Dichloro ethane	1,2-dichloro ethene	Methylene Chloride	Toluene	Tetrachoro ethylene	Trichloro ethylene	Xylenes
Source 32										
MW-17	89	M/H					0.25			0.75
MW-18	89	M/H					***2.9***			***20.4***
MW-19	89	M/H					0.25			0.75
MW-20	89	M/H					0.25			0.75
MW-17	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-17	90	Enviros								
MW-18	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-19	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-19	90	Enviros								
MW-20	90	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-20	90	Enviros								
MW-17	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-18	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-19	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
MW-20	92	M/H		0.25	0.5	10	0.25	0.25	0.25	0.75
n			0	8	8	8	12	8	8	15
Mean			0.00	0.25	0.50	10.00	0.47	0.25	0.25	2.06
St Deviation			0.00	0.00	0.00	0.00	0.76	0.00	0.00	5.07
Fraction of Total Area			0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Area Weighted Mean			0.00	0.01	0.02	0.39	0.02	0.01	0.01	0.08
ith Pooled Variance			0.0	0.0	0.0	0.0	0.000075	0.0	0.0	0.0026
Site Wide Summary:										
N (total analysis)			21	82	79	82	89	83	83	94
Min			2.500	0.250	0.500	0.500	0.250	0.250	0.250	0.500
Max			950.00	25.00	25.00	125.00	25.00	50.00	25.00	25.00
Total area										
Weighted Means			29.17	0.69	0.91	7.77	0.68	1.19	0.70	1.00
Pooled Variance			0.00	0.05	0.05	1.05	0.04	0.19	0.05	0.04
t-value			1.725	1.671	1.671	1.671	1.671	1.671	1.671	1.671
Site Wide 95% UCL			29.17	0.73	0.96	7.96	0.71	1.27	0.74	1.03

Note: All units are ppb.

Concentrations above reporting limits are highlighted with boldface, italic, underlined 12 point type; all others are half the value of the sample reporting limit.

t-values: Critical values of t were determined for *n*-1 degrees of freedom where *n*-1 was rounded down.

Boxed values signify:

Dotted: Data which were not included in the ChemRisk RA database.

Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

Table 3.3. Analytical Results for Groundwater Semi Volatile Organic Compounds (SVOCs) (concentrations in µg/l)

Sample Label	Year Collected	By:	Acenapthalene	Benzoic Acid	Bis(2-ethylhexyl) phthalate	Flourene	Napthalene phthalate
Source 1: No Data							
Source 2							
MW-25	92	M/H	*0.28*	25	5	0.05	0.05
n			1	1	1	1	1
Mean			0.28	25.00	0.00	0.05	0.05
St Deviation			0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.017	0.017	0.017	0.017	0.017
Area Weighted Mean			0.00	0.43	0.00	0.00	0.00
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0
Source 3: No Data							
Source 4							
MW-33	92	M/H	0.1	25	5	0.05	0.05
n			1	1	1	1	1
Mean			0.10	25.00	0.00	0.05	0.05
St Deviation			0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.014	0.014	0.014	0.014	0.014
Area Weighted Mean			0.00	0.35	0.00	0.00	0.00
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0
Sources 5-7: No Data							
Source 8							
MW-1	92	M/H	0.1	25	5	0.05	*0.62*
n			1	1	1	1	1
Mean			0.10	25.00	0.00	0.05	0.62
St Deviation			0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0111	0.0111	0.0111	0.0111	0.0111
Area Weighted Mean			0.00	0.28	0.00	0.00	0.01
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0
Sources 9-11: No Data							

Table 3.3. Analytical Results for Groundwater Semi Volatile Organic Compounds (SVOCs) (concentrations in µg/l)

Sample Label	Year Collected	By:	Acenapthalene	Benzoic Acid	Bis(2-ethylhexyl) phthalate	Flourene	Napthalene phthalate
Source 12							
MW-32	92	M/H	0.1	25	5	0.05	0.05
n			1	1	1	1	1
Mean			0.10	25.00	0.00	0.05	0.05
St Deviation			0.00	0.00	0.00	0.00	0.00
Fraction of Total Area			0.0038	0.0038	0.0038	0.0038	0.0038
Area Weighted Mean			0.00	0.10	0.00	0.00	0.00
ith Pooled Variance			0.0	0.0	0.0	0.0	0.0
Sources 13-19: No Data							
Source 20							
MW-5	89	M/H	5.0	25.0	5.0	5.0	5.0
MW-5	92	M/H	0.1	25.0	5.0	0.05	0.05
MW-5DU	92	M/H	0.1	25.0	5.0	0.05	0.05
n			3	3	3	3	3
Mean			1.73	25.00	5.00	1.70	1.70
St Deviation			2.83	0.00	0.00	2.86	2.86
Fraction of Total Area			0.0264	0.0264	0.0264	0.0264	0.0264
Area Weighted Mean			0.05	0.66	0.13	0.04	0.04
ith Pooled Variance			0.0019	0.0	0.0	0.0019	0.0019
Source 21: No Date							
Source 22							
MW-11	89	M/H	5.0	25	5.0	5.0	5.0
MW-11DU	89	M/H		25	5.0		
MW-8	89	M/H	5.0	25	5.0	5.0	5.0
MW-9	89	M/H	5.	25	***14.***	5.	5.
MW-10	90	M/H	5.0		5.0	5.0	5.0
MW-11	90	M/H	5.0		5.0	5.0	5.0
MW-7	90	M/H	5.0		5.0	5.0	5.0
MW-8	90	M/H	5.0		5.0	5.0	5.0
MW-9	90	M/H	5.0		5.0	5.0	5.0
MW-11	92	M/H	0.1	25	5.0	0.05	0.05
MW-7	92	M/H	***0.29***	25	5.0	0.05	0.05
MW-8	92	M/H	0.1	25	5.0	0.05	0.05
n			11	7	12	11	11
Mean			3.68	25.00	5.75	3.65	3.65
St Deviation			2.26	0.00	2.60	2.31	2.31
Fraction of Total Area			0.1277	0.1277	0.1277	0.1277	0.1277
Area Weighted Mean			0.47	3.19	0.73	0.47	0.47
ith Pooled Variance			0.0076	0.0	0.0092	0.0079	0.0079

Table 3.3. Analytical Results for Groundwater Semi Volatile Organic Compounds (SVOCs) (concentrations in µg/l)

Sample Label	Year Collected	By:	Acenapthalene	Benzoic Acid	Bis(2-ethylhexyl) phthalate	Flourene	Napthalene phthalate
Source 23							
MW-6	90	M/H	5.0		5.0	5.0	5.0
MW-39	92	Enviros	0.5	5	***3.8***	0.5	0.5
MW-39A	92	Enviros	0.5	5	***0.5***	0.5	0.5
MW-6	92	M/H	0.1	25	5	0.05	0.05
n			4	3	4	4	4
Mean			1.53	11.67	3.58	1.51	1.51
St Deviation			2.32	11.55	2.13	2.33	2.33
Fraction of Total Area			0.0453	0.0453	0.0453	0.0453	0.0453
Area Weighted Mean			0.07	0.53	0.16	0.07	0.07
ith Pooled Variance			0.0028	0.091	0.0	0.0028	0.0028
Source 24: No Data							
Source 25							
MW-12	89	M/H	5.0	25	5.0	5.0	5.0
MW-13	89	M/H	5.0	25	5.0	5.0	5.0
MW-14	89	M/H	5.0	25	***18.0***	5.0	5.0
MW-15	89	M/H	5.0	25	5.0	5.0	5.0
MW-12	90	M/H	5.0		5.0	5.0	5.0
MW-13	90	M/H	5.0		***22.0***	5.0	5.0
MW-14	90	M/H	5.0		5.0	5.0	5.0
MW-15	90	M/H	5.0		5.0	5.0	5.0
MW-12	92	M/H	***4.6***	25	5	0.05	***1.1***
MW-15	92	M/H	0.1	25	5	0.05	***0.96***
n			10	6	10	10	10
Mean			4.47	25.00	8.00	4.01	4.21
St Deviation			1.54	0.00	6.39	2.09	1.67
Fraction of Total Area			0.1799	0.1799	0.1799	0.1799	0.1799
Area Weighted Mean			0.80	4.50	1.44	0.72	0.76
ith Pooled Variance			0.0077	0.0	0.0	0.014	0.0091
Source 26							
MW-16	89	M/H	5.0	25	5.0	5.0	5.0
MW-16	90	M/H	5.0		5.0	5.0	5.0
MW-16	92	M/H	0.1	25	5	0.05	0.05
MW-16DU	92	M/H	0.1	25	5	0.05	0.05
n			4	3	4	4	4
Mean			2.55	25.00	5.00	2.53	2.53
St Deviation			2.83	0.00	0.00	2.86	2.86
Fraction of Total Area			0.0677	0.0677	0.0677	0.0677	0.0677
Area Weighted Mean			0.17	1.69	0.34	0.17	0.17
ith Pooled Variance			0.0092	0.0	0.0	0.0094	0.0094

Table 3.3. Analytical Results for Groundwater Semi Volatile Organic Compounds (SVOCs) (concentrations in µg/l)

Sample Label	Year Collected	By:	Acenapthalene	Benzoic Acid	Bis(2-ethylhexyl) phthalate	Flourene	Naphthalene phthalate
Source 27							
MW-38	92	Enviros	0.5	*1.1*	*6.1*	0.5	0.5
MW-38A	92	Enviros	0.5	5	0.5	*1.1*	0.5
MW-38A	92	M/H	0.1	25	5	*1.5*	*8*
n			3	3	3	3	3
Mean			0.37	10.37	3.87	1.03	3.00
St Deviation			0.23	12.82	2.97	0.50	4.33
Fraction of Total Area			0.1125	0.1125	0.1125	0.1125	0.1125
Area Weighted Mean			0.04	1.17	0.44	0.12	0.34
ith Pooled Variance			0.00023	0.69	0.0	0.0011	0.079
Sources 28-32: No Data							
Site Wide Summary:							
N (total analysis)			39	29	40	39	39
Min			0.10	1.10	0.50	0.05	0.05
Max			0.10	1.10	0.50	0.05	0.05
Total area Weighted Means			1.61	12.88	3.24	1.59	1.85
Pooled Variance			0.03	0.78	0.01	0.04	0.11
t-value			1.697	1.701	1.697	1.697	1.697
Site Wide 95% UCL			1.66	13.16	3.27	1.64	1.94

Note: All units are ppb.
Concentrations above reporting limits are highlighted with boldface, italic, underlined 12 point type; all others are half the value of the sample reporting limit.
t-values: Critical values of t were determined for n-1 degrees of freedom where n-1 was rounded down.
Boxed values signify:
Dotted: Data which were not included in the ChemRisk RA database.
Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

Table 3.4. Analytical Results for Groundwater
Total Petroleum Hydrocarbons (TPH)
(concentrations in µg/l)

Sample Location	Year Collected	By:	TPH
Source 1			
MW-26	90	M/H	250
MW-26	90	Enviros	500
MW-27	90	M/H	250
MW-27	90	Enviros	500
MW-26	92	M/H	250
MW-27	92	M/H	250
n			6
Mean			333.33
St Deviation			129.10
Fraction of Total Area			0.025
Area Weighted Mean			8.33
ith Pooled Variance			1.7
Source 2			
MW-25	90	M/H	250
MW-25	90	Enviros	500
MW-25	92	M/H	250
n			3
Mean			333.33
St Deviation			144.34
Fraction of Total Area			0.017
Area Weighted Mean			5.67
ith Pooled Variance			2.0
Source 3: No Data			
Source 4			
EG-4	90	Enviros	500
MW-33	90	Enviros	500
MW-33	92	M/H	250
n			3
Mean			416.67
St Deviation			144.34
Fraction of Total Area			0.014
Area Weighted Mean			5.83
ith Pooled Variance			1.4
Sources 5-6: No Data			

Table 3.4. Analytical Results for Groundwater
Total Petroleum Hydrocarbons (TPH)
(concentrations in µg/l)

Sample Location	Year Collected	By:	TPH
Source 7			
MW-31	90	M/H	250
MW-31	90	Enviros	500
MW-31	92	M/H	250
n			3
Mean			333.33
St Deviation			144.34
Fraction of Total Area			0.0082
Area Weighted Mean			2.73
i'th Pooled Variance			0.47
Source 8			
MW-1	89	M/H	250
MW-1	92	M/H	250
n			2
Mean			250.00
St Deviation			0.00
Fraction of Total Area			0.0111
Area Weighted Mean			2.78
i'th Pooled Variance			0.0
Sources 9-10: No Data			
Source 11			
EG-3	90	Enviros	***75000***
n			1
Mean			75000.00
St Deviation			0.00
Fraction of Total Area			0.0273
Area Weighted Mean			2047.50
i'th Pooled Variance			0.0

Table 3.4. Analytical Results for Groundwater
Total Petroleum Hydrocarbons (TPH)
(concentrations in µg/l)

Sample Location	Year Collected	By:	TPH
Source 12			
MW-28	90	Enviros	500
MW-32	90	M/H	250
MW-32	90	Enviros	500
MW-32	92	M/H	250
n			4
Mean			375.00
St Deviation			144.34
Fraction of Total Area			0.0038
Area Weighted Mean			1.43
ñh Pooled Variance			0.075
Source 13			
MW-4	89	M/H	250
n			1
Mean			250.00
St Deviation			0.00
Fraction of Total Area			0.0121
Area Weighted Mean			3.03
ñh Pooled Variance			0.0
Source 14			
MW-37	90	Enviros	500
MW-37	92	M/H	250
n			2
Mean			375.00
St Deviation			176.78
Fraction of Total Area			0.0107
Area Weighted Mean			4.01
ñh Pooled Variance			1.8
Source 15: No Data			

Table 3.4. Analytical Results for Groundwater Total Petroleum Hydrocarbons (TPH) (concentrations in µg/l)

Sample Location	Year Collected	By:	TPH
Source 16			
MW-30	90	Enviros	500
MW-30	92	M/H	250
n			2
Mean			375.00
St Deviation			176.78
Fraction of Total Area			0.0197
Area Weighted Mean			7.39
ith Pooled Variance			6.1
Source 17			
MW-29	90	Enviros	500
MW-29	92	M/H	250
MW-3	89	M/H	250
MW-3	92	M/H	250
n			4
Mean			312.50
St Deviation			125.00
Fraction of Total Area			0.0076
Area Weighted Mean			2.38
ith Pooled Variance			0.23
Sources 18-19: No Data			
Source 20			
MW-5	92	M/H	250
MW-5DU	92	M/H	250
n			2
Mean			250.00
St Deviation			0.00
Fraction of Total Area			0.0264
Area Weighted Mean			6.60
ith Pooled Variance			0.0
Source 21: No Data			

Table 3.4. Analytical Results for Groundwater
Total Petroleum Hydrocarbons (TPH)
(concentrations in µg/l)

Sample Location	Year Collected	By:	TPH
Source 22			
MW-10	89	M/H	250
MW-10	90	Enviros	500
MW-10	92	M/H	250
MW-10DU	89	M/H	250
MW-36	90	Enviros	500
MW-7	90	Enviros	500
MW-7	92	M/H	250
MW-8	89	M/H	250
MW-8	90	Enviros	500
MW-8	92	M/H	250
MW-9	89	M/H	250
MW-9	90	Enviros	500
MW-9	92	M/H	250
n			13
Mean			346.15
St Deviation			126.59
Fraction of Total Area			0.1277
Area Weighted Mean			44.20
ith Pooled Variance			20.
Source 23			
MW-6	90	Enviros	500
MW-6	92	M/H	250
MW-39	92	M/H	250
MW-39A	92	M/H	250
n			4
Mean			312.50
St Deviation			125.00
Fraction of Total Area			0.0453
Area Weighted Mean			14.16
ith Pooled Variance			8.0
Source 24: No Data			

Table 3.4. Analytical Results for Groundwater Total Petroleum Hydrocarbons (TPH) (concentrations in µg/l)

Sample Location	Year Collected	By:	TPH
Source 25			
MW-11	89	M/H	250
MW-11	90	Enviros	1000
MW-11	92	M/H	250
MW-12	89	M/H	250
MW-12	90	Enviros	500
MW-12	92	M/H	250
MW-13	89	M/H	250
MW-13	90	Enviros	500
MW-13	92	M/H	250
MW-14	92	M/H	250
MW-14	89	M/H	250
MW-14	90	Enviros	500
MW-15	89	M/H	250
MW-15	90	Enviros	500
MW-15	92	M/H	250
MW-2	89	M/H	250
MW-2	92	M/H	250
MW-34-1	90	Enviros	500
MW-34-2	90	Enviros	500
n			19
Mean			368.42
St Deviation			193.08
Fraction of Total Area			0.1799
Area Weighted Mean			66.28
ith Pooled Variance			64.
Source 26			
MW-16	89	M/H	250
MW-16	90	Enviros	500
MW-16	92	M/H	250
MW-16DU	92	M/H	250
MW-35	90	Enviros	8000
MW-35	92	M/H	250
n			6
Mean			1583.33
St Deviation			3145.10
Fraction of Total Area			0.0677
Area Weighted Mean			107.19
ith Pooled Variance			7556.

Table 3.4. Analytical Results for Groundwater Total Petroleum Hydrocarbons (TPH) (concentrations in µg/l)

Sample Location	Year Collected	By:	TPH
Source 27			
MW-38	92	M/H	250
MW-38A	92	M/H	250
n			2
Mean			250.00
St Deviation			0.00
Fraction of Total Area			0.1125
Area Weighted Mean			28.13
ith Pooled Variance			0.0
Sources 28-30: No Data			
Source 31			
MW-21	89	M/H	250
MW-21	92	M/H	250
MW-22	89	M/H	250
MW-23	89	M/H	250
MW-24	89	M/H	250
MW-24	92	M/H	250
n			6
Mean			250.00
St Deviation			0.00
Fraction of Total Area			0.0127
Area Weighted Mean			3.18
ith Pooled Variance			0.0

Table 3.4. Analytical Results for Groundwater
Total Petroleum Hydrocarbons (TPH)
(concentrations in µg/l)

Sample Location	Year Collected	By:	TPH
Source 32			
MW-17	89	M/H	250
MW-17	90	M/H	250
MW-17	90	Enviros	500
MW-17DU	90	M/H	250
MW-17	92	M/H	250
MW-18	89	M/H	250
MW-18	90	M/H	250
MW-18	90	Enviros	500
MW-18	92	M/H	250
MW-19	89	M/H	250
MW-19	90	M/H	250
MW-19	90	Enviros	500
MW-19	92	M/H	250
MW-20	89	M/H	250
MW-20	90	M/H	250
MW-20	90	Enviros	500
MW-20	92	M/H	250
n			16
Mean			312.50
St Deviation			111.80
Fraction of Total Area			0.0391
Area Weighted Mean			12.22
ith Pooled Variance			1.2
Site Wide Summary:			
N (total analysis)			99
Min			250.0
Max			75000.0
Total area			
Weighted Means			2373.02
Pooled Variance			7662.60
t-value			1.671
95% UCL			3659.89

Note:
All units are ppb.
Concentrations above reporting limits are highlighted
with boldface, *italic*, underlined 12 point type;
all others are half the value of the sample reporting limit.
Boxed values signify:
Dotted: Data which were not included in the
ChemRisk RA database.
Solid: Modified from RA database to correspond
with lab reports presented with the M/H RL

ANALYTICAL RESULTS FOR STORM DRAIN SEDIMENTS

Table 4.1. Analytical Results for Storm Drain Sediment Metals (concentrations in mg/kg)

Sample Location	Depth	Antimony (Sb)		Arsenic (As)		Beryllium (Be)		Cadmium (Cd)		Chromium (Cr)		Copper (Cu)		Lead (Pb)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SS-14	0		3.92		87.		1.650		11.6		350.		1100.		2800
SS-11	0		5.3		185.		1.205		8.82	–	230.		1600.		1200
SS-13	0		5.21		75.		0.590		5.70		290.		980.		1300
GS-4 #	0			0.25				5.5		400.		610.		160.	
GS-5 #	0			5.5				2.0		110.		690.		310.	
SS-1	0		0.582		31.		1.020		1.94		71.		850.		170.
SS-5	0		0.468		9.3		0.410		0.117		16.		52.		20.
SS-6	0		0.981		51.		0.382		0.98		130.		260.		130.
SS-3	0		10.3		93.		0.700		16.2		180.		560.		1000
GS-17	0	2.5		0.4		0.250		5.0		66.		870.		360.	
SS-2	0		0.940		60.		1.020		2.90		150.		1340.		540.
SS-8	0		0.714		42.		1.250		2.74		100.		780.		420.
SS-10	0		9.72		100		5.000		7.44		860		1020		1860
GS-9	0	20		0.3		0.25		10		120		860		970	
GS-10	0	6		0.1		0.6		17		29		1000		2000	
GS-11	0	7		0.4		0.6		1		40		1600		310	
GS-16	0	2.5		0.5		0.25		5		68		360		590	
GS-37	0	6		0.3		0.25		7.3		340		1700		620	
GS-38	0	6		0.32		0.25		5.3		660		720		600	
GS-39	0	7		0.49		0.25		1.9		570		530		21	
GS-40	0	6		0.48		0.25		4.2		250		820		330	

Table 4.1. Analytical Results for Storm Drain Sediment Metals (concentrations in mg/kg)

Sample Location	Depth	Mercury (Hg)		Nickel (Ni)		Selenium (Se)		Silver (Ag)		Thallium (Tl)		Zinc (Zn)	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SS-14	0		***0.329***		***72.***		***1.57***		2.355		***2.83***		***4320.***
SS-11	0		***0.066***		***120.***		***0.432***		2.575		***3.62***		***4445.***
SS-13	0		***0.434***		***99.***		***0.672***		0.84		***3.53***		***3780.***
GS-4 #	0	***0.01***		***820.***								***3100.***	
GS-5 #	0	***0.01***		***110.***								***16000.***	
SS-1	0		***0.068***		***41.***		0.455		1.455		***2.13***		***1820.***
SS-5	0		***0.041***		***15.***		0.1755		0.585		***1.05***		***235.***
SS-6	0		***0.034***		***84.***		0.1635		0.545		***1.85***		***1200.***
SS-3	0		***0.254***		***120.***		0.3045		1.015		***3.04***		***8380.***
GS-17	0	***0.05***		***42.***		***0.04***		***1.0***		5.		***1500.***	
SS-2	0		***0.053***		***56.***		0.1455		1.455		***2.44***		***2800.***
SS-8	0		***0.032***		***49.***		0.1755		1.755		***2.46***		***1700.***
SS-10	0		0.489		***570***		***0.429***		7.15		***3.72***		***12100***
GS-9	0	***0.4***		***90***		***0.02***		***3***		5.25		***3700***	
GS-10	0	0.01		***33***		***0.01***		***2***		***16***		***550***	
GS-11	0	0.01		***30***		0.005		***2***		***16***		***630***	
GS-16	0	***0.1***		***50***		***0.04***		***0.9***		5		***2400***	
GS-37	0	***0.1***		***410***		***0.14***		***1.8***		5		***7600***	
GS-38	0	***0.03***		***740***		***0.25***		***1.4***		5		***2000***	
GS-39	0	0.01		***810***		***0.17***		***1.1***		***10***		***1000***	
GS-40	0	***0.03***		***400***		***0.16***		***1.4***		***10***		***3500***	

Notes:

All units are ppm.

Concentrations above reporting limits are highlighted with boldface, italics, underlined 12 point type; all others are half the value of the sample reporting limit.

Unable to locate original laboratory data sheets.

Boxed values signify:

Dotted: Data which were not included in the ChemRisk RA database.

Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

Table 4.2. Analytical Results for Storm Drain Sediment Volatile Organic Compounds (VOCs) (concentrations in mg/kg)

Sample Location	Depth	Ethylbenzene		Toluene		Xylenes		1,2-dichlorobenzene		1,3-dichlorobenzene		1,4-dichlorobenzene	
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SS-14	0								0.600		0.600		0.600
GS-9	0	0.25		***0.9***		0.25							
SS-11	0								0.8		0.8		0.8
SS-13	0								***5.3***		***0.63***		***1.1***
SS-5	0								0.045		0.045		0.045
SS-6	0								0.05		0.05		0.05
SS-3	0								0.75		0.75		0.75
SS-7	0								0.12		0.12		0.12
GS-30	0	0.01		0.01		0.01		0.010		0.010		0.010	
GS-31	0	0.01		0.01		0.01		0.010		0.010		0.010	
GS-32	0	0.01		0.01		0.01		0.010		0.010		0.010	
GS-33	0	***1.4***		0.5		***9.0***							
GS-35	0	0.2		0.2		***1.1***		0.200		0.200		0.200	
GS-25	0	0.25		0.25		0.25							
GS-26	0	0.01		0.01		0.03		0.010		0.010		0.010	
GS-27	0	0.01		0.01		0.03		0.010		0.010		0.010	
GS-28	0	0.01		0.01		0.03		0.010		0.010		0.010	
GS-29	0	0.01		0.01		0.03		0.010		0.010		0.010	
GS-36	0	0.1		***0.6***		***4.4***		0.010		0.010		0.010	

Notes:

All units are ppm.

Concentrations above reporting limits are emphasized with boldface, italics, underlining and 12 point type; all others are half the value of the sample reporting limit.

Xylenes are total xylenes. For sample GS-35 two halved nondetects and one detect were summed.

Boxed values signify:

Dotted: Data which were not included in the ChemRisk RA database.

Solid: Modified from RA database to correspond with lab reports presented with the M/H RI.

Table 4.3. Analytical Results for Storm Drain Sediment Semi Volatile Organic Compounds (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (concentrations in mg/kg)

Sample Location	Depth	acenaphthene		anthracene		benzo(a) anthracene		benzo(b) fluoranthene		benzo(g,h,i) perylene		benzo(k) fluoranthene		benzo(a) pyrene	benzo
		M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SS-14	0		***2.6***		***4.6***		***4.8***		***3.1***		1.2		***3.2***		***2.4***
SS-11	0		0.8		***1.7***		***2.4***		0.8		1.6		0.8		0.8
SS-13	0		0.25		***1.0***		***1.4***		***1.7***		0.5		***1.1***		***0.91***
SS-5	0		0.045		0.045		0.045		0.045		0.09		0.045		0.045
SS-6	0		0.050		***0.23***		***0.2***		***0.29***		0.1		***0.21***		***0.19***
SS-3	0		0.75		***3.9***		***7.1***		***10.***		***5.8***		***8.5***		***7.5***
SS-7	0		***1.4***		***1.4***		***2.***		***1.8***		0.245		***1.***		***0.8***

Table 4.3. Analytical Results for Storm Drain Sediment Semi Volatile Organic Compounds (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (concentrations in mg/kg)

Sample Location	benzyl butyl phthalate		bis(2-ethyl-hexyl) phthalate		chrysene		di-n-octyl phthalate		di-n-butyl phthalate		dibenzofuran		fluoranthene		benzo fluorene	
	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SS-14		*1.8*		*24.*		*6.6*		*1.2*		*6.5*		*2.4*		*22.*		*5.2*
SS-11		0.8		*79.*		*6.1*		*5.*		*1.7*		0.8		*12.*		*1.8*
SS-13		0.25		*22.*		*2.7*		*0.83*		*1.4*		0.25		*6.4*		*0.96*
SS-5		0.045		*0.68*		0.045		0.045		0.045		0.045		0.045		0.045
SS-6		0.050		*7.8*		*0.38*		*0.1*		0.050		0.050		*0.89*		*0.12*
SS-3		0.75		*4.8*		*11.*		0.75		0.75		0.75		*21.*		*1.8*
SS-7		*0.5*		*16.*		*3.4*		*1.9*		*0.92*		*1.*		*11.*		*2.0*

Table 4.3. Analytical Results for Storm Drain Sediment Semi Volatile Organic Compounds (SVOCs) and Polyaromatic Hydrocarbons (PAHs) (concentrations in mg/kg)

Sample Location	Indeno(1,2,3-cd) pyrene		4-methyl phenol		2-methyl naphthalene		phenanthrene		phenol		pyrene	
	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros	M/H	Enviros
SS-14		1.2		***10.***		***1.9***		***24.***		0.6		***15.***
SS-11		1.6		0.8		***1.7***		***7.9***		0.8		***18.***
SS-13		0.5		***1.4***		***0.91***		***5.***		0.25		***4.7***
SS-5		0.09		0.045		0.045		0.045		0.045		0.045
SS-6		0.1		0.050		0.050		***0.61***		0.050		***0.56***
SS-3		***6.5***		0.75		0.75		***12.***		0.75		***17.***
SS-7		0.245		***1.1***		***0.51***		***7.6***		***0.44***		***7.5***

NOTE: All units are ppm.

Concentrations above reporting limits are highlighted with boldface, italics, underlined 12 point type; all others are half the value of the sample reporting limit.

Half the value of the method detection limit was applied to ND samples for which the sample detection limit could not be determined.

Where acenaphthene and fluorene were analyzed together, the conc. of each was assumed to be one-half the total.

0.04 ppm fluoranthene detected in Enviros method blank; 0.12 ppm in MW-36 at 8' was eliminated from database, per USEPA (1989).

Table 4.4. Analytical Results for Storm Drain Total Petroleum Hydrocarbons (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 O&G Oil Grease	8015M TPH	8015M Oil & Grease	8015M Diesel
Sources 1-4: No Data						
Source 5						
HA90	5	2.5				
GS15			*20000*			
SS14		*52000*	-			
Sources 6-10: No Data						
Source 11						
SB72	11	2.5				
Sources 12-14: No Data						
Source 15						
GS14			*12000*			
Sources 16-20: No Data						
Source 21						
HA83	2.5	*310*				
HA80	3.5	*800**				
HA86	6	*8*				
SS10		*7200*				
SS11		*70000*				
SS13		*10000*				
SB71	4.5	*9*				
Source 22						
SB67	10.5	2.5				
SB66	11	*8*				
Source 23						
HA81	4.5	*90*				5
GS18				5		
Source 24: No Data						
Source 25						
SB69	3	*12000*				*1700*
SB68	6.5	2.5				
SS1		*3800*				
SS3		*7700*				
GS16				*1700*		
GS7			*700*			
Source 26						
GS4			*600*			
GS5			*1100*			
SS5		*1900*	-			

Table 4.4. Analytical Results for Storm Drain Total Petroleum Hydrocarbons (concentrations in mg/kg)

Sample Location	Depth (ft)	418.1 TPH	418.1 O&G Oil Grease	8015M TPH	8015M Oil & Grease	8015M Diesel
Source 27						
HA88	6	***60***				
HA89	6	***8***				
SB70	10	***300***				***630***
SS2		***1700***				
GS12			***3000***			
GS13			***3000***			
GS17				***630***		
GS6			***110***			
GS8			***32000***			
SS7			***4300***			
SS8			***4500***			
SS9			***6500***			
Sources 28-31: No Data						
Source 32						
HA87	6	*8*				

Note: All units are ppm.
Concentrations above reporting limits are emphasized with boldface, italics, underlining and 12 point type; all others are half the value of the sample reporting limit.

Table 4.5. Analytical Results for Storm Drain Polychlorinated Biphenyls (PCBs) (concentrations in mg/kg)

Sample Location	Depth (ft)	PCB
SS-1	0	***1.9***
SS-2	0	***1***
SS-3	0	***2***
SS-5	0	0.5
SS-8	0	***1***
SS-9	0	***1.5***
SS-10	0	***8.6***
SS-11	0	***13***
SS-13	0	0.5
SS-14	0	***6.8***
HA-80	3.5	***0.6****
SB-67`	10.5	***0.3***
HA-81``	4.5	0.03
HA-83``	2.5	0.03
HA-86``	6	0.03
HA-87``	6.5	0.03
HA-88``	6	0.03
HA-89``	6	0.03
HA-90``	5.5	0.03
SB-68``	7	0.03
SB-70``	10	0.03
SB-71``	4.5	0.03

Note: Concentrations above reporting limits are emphasized with boldface, italics, underlining and 12 point type; all others are half the value of the sample reporting limit.

* Sampled at 275 ft.

` Detected on aroclor 1254.

`` All 7 aroclor types were undected. The PCB concentration is one half the average of the 7 reporting limits.

APPENDIX A.4

HYDROLOGIC CHARACTERIZATION REPORT (ASPECT 2005)

(on CD)

SOUTHWEST HARBOR PROJECT PHASE I GROUNDWATER CONFIRMATION MONITORING PROGRAM

Hydrologic Characterization Report

Prepared for: Port of Seattle

Project No. 990106-004-20 • March 3, 2005 Agency Review Draft

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1 Introduction

This Hydrologic Characterization Report summarizes the findings of the Southwest Harbor Project (SWHP) Phase I Groundwater Confirmation Monitoring Program (GWCMP). The Phase I GWCMP specifically addresses characterization of the post-redevelopment groundwater flow system, and forms the basis for development of a site-wide water quality monitoring program to evaluate the effectiveness of remedial actions completed in conjunction with site redevelopment. A clear understanding of the groundwater flow regime is necessary to develop an effective water quality monitoring program. A key component of this Phase I study was evaluation of the effect of the Longfellow Creek Overflow Line (LFOL) on groundwater flow in the Fill Aquifer. Under pre-redevelopment conditions, significant groundwater discharge occurred through the former equalization basins located along the LFOL. During redevelopment, the open equalization basins were replaced with buried pipe (i.e., "tight-lined"), resulting in altered groundwater discharge conditions.

The Phase I GWCMP was completed in accordance with the *Draft Monitoring Plan – Phase I Ground Water Confirmation Monitoring Program (Monitoring Plan)* (Associated Earth Sciences, Inc., 2000). The *Monitoring Plan* was developed in accordance with the consent decrees signed with Ecology for those remediation areas (RA's) that were redeveloped as part of the SWHP, and in accordance with the March 1999 *Ground Water Conceptual Letter* (Port of Seattle, 1999). Additional Phase I work elements were identified in the *Monitoring Network Construction Report* (Aspect Consulting, 2002a). This report identified data gaps in the Fill Aquifer and LFOL flow monitoring network, which were subsequently addressed in the summer 2003.

This Hydrologic Characterization Report documents current groundwater flow conditions at the SWHP, reflecting the changes resulting from the site redevelopment. Post-redevelopment groundwater and LFOL flow conditions are compared to pre-redevelopment conditions and to the assumptions utilized during formulation of the Cleanup Action Plans for the SWHP.

The post-redevelopment groundwater flow conditions documented in the Hydrologic Characterization Report form the basis for recommendations for the Phase II GWCMP Water Quality Monitoring Program. These recommendations identify selected Fill Aquifer monitoring wells to evaluate present-day Fill Aquifer groundwater quality and potential impacts associated with groundwater discharge to surface water quality in the West Waterway and Elliott Bay.

1.1 Hydrologic Characterization Report Summary

A brief description of the Hydrologic Characterization Report contents is as follows:

- Section 2: SITE HISTORY AND DESCRIPTION; contains a description of the site and a summary of site history and present site conditions.
- Section 3: SITE HYDROLOGIC SETTING; contains a description of the site hydrologic setting, a summary of hydrologic conditions prior to site redevelopment, and details on assumptions regarding the effects of redevelopment on post-redevelopment groundwater flow and quality.
- Section 4: PHASE I MONITORING PROGRAM OBJECTIVES; presents a summary of assumptions and primary objective of the Phase I GWCMP.
- Section 5: SUMMARY OF PREVIOUS PHASE I REPORT SUBMITTALS; identifies previously submitted Phase I GWCMP reports, and provides a summary of key content and findings.
- Section 6: HYDROLOGIC DATA COLLECTION; presents detailed documentation of data collection activities and methods for the Phase I GWCMP.
- Section 7: HYDROLOGIC DATA ANALYSES; summarizes key findings of each element of the Phase I GWCMP and synthesizes current post redevelopment hydrologic conditions.
- Section 8: COMPARISON OF PRE- AND POST-REDEVELOPMENT HYDROLOGIC CONDITIONS, provides a detailed comparison of present hydrologic conditions to pre-redevelopment conditions.
- Section 9: SUMMARY OF FINDINGS; presents major Phase I GWCMP findings and conclusions, and resolution of key project objectives
- Section 10: RECOMMENDED PHASE II WATER QUALITY MONITORING PROGRAM, proposes selected Fill Aquifer monitoring wells for evaluation of water quality at key locations inland from discharge points along the West Waterway and Elliot Bay, as well as at upgradient locations. Also identifies a preliminary groundwater analytical program and sampling schedule, and presents potential methodologies for evaluation of groundwater compliance with surface water standards.
- Section 11: REFERENCES; lists references used in this report.

2 Site History and Description

The Port of Seattle SWHP is located along the base of the West Seattle highland at the confluence of the West Waterway of the Duwamish River (West Waterway) and Elliott Bay. The site location is shown on Figure 2.1. The facility includes approximately 185 acres of land exclusive of the original Terminal 5 area located immediately adjacent to the West Waterway. Most of the facility overlies former tideflats that have been filled and used for various industrial purposes including railroad yarding, wood treatment, steel scrap yarding, and municipal and wood waste landfilling. The SWHP is designated for port industrial usage in both City of Seattle and Port of Seattle land use plans.

The study area addressed in the Phase I GWCMP encompasses most of the SWHP site which was divided into five Remediation Areas (RA's) for evaluation during the redevelopment project. These remediation areas include the Spokane Street Properties (RA-1), former Salmon Bay Steel Property (RA-2), former West Seattle Landfill and Purdy Scrap/Former Seattle Steel Inc. property (RA-3), and the former Lockheed Yard 2 (RA-5). The site location and general outline of the RA's is shown on Figure 2.2. The configuration of the present monitoring well network and the boundaries of the RA's, and details of the location and construction of the LFOL, are shown on Figure 2.2.

The Port and Ecology negotiated Cleanup Action Plans for the SWHP that addressed specific remediation plans and goals for remediation areas RA-1, RA-2, RA-3 and RA-5 within the present-day Terminal 5 facility. Remediation area RA-4 is being addressed under the Superfund process by the U.S. Environmental Protection Agency (EPA). The individual remediation areas are depicted on Figure 2.2 and described below.

RA-1: RA-1 was occupied by the Buckley Railroad and various Spokane Street facilities. The Buckley Yard served as a rail car staging area beginning in the 1920s. From the mid 1970s to the mid 1990s, the size of the yard increased dramatically. The Spokane Street facilities included the following manufacturing and service businesses: aluminum foundry, chemical distribution warehouse, automotive repairs, fuel oil distribution and retail foods stores. The soil contamination associated with the Spokane Street facilities was remediated by excavation and landfilling between 1994 and 1998. The feasibility study completed for the Buckley Yard (URS, 1995a) concluded that capping of the soil contamination would be adequately protective of marine surface water quality in Elliot Bay. Asphalt and concrete caps were subsequently placed over the soil contamination in the Buckley Yard, except in the northern potion of the area east of RA-3, where 24 inches of ballast cover was placed under the railroad tracks. Presently, RA-1 is occupied by Burlington Northern (BN) rail spurs, the main access road into the American Presidents Line (APL) facility, and office buildings. Contaminants of concern (COCs) for groundwater in RA-1 include hydrocarbons (diesel), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), carcinogenic polycyclic aromatic hydrocarbons (CPAHs), metals, and bis(2-ethyl hexyl) phthalate (URS, 1995a,b).

RA-2: RA-2 was historically referred to as the Salmon Bay Steel north area. The area was used to support steel mill operations from the early 1900s until the 1970s, and

included two large warehouses, a scale, and railroad spurs. Beginning in the late 1800s, the tideflats on the property were gradually filled with dredge sediments, slag, and steel mill debris. This fill material is predominantly slag, and reaches depths of 25 feet in places. Between 1996 and 1998, a cleanup measure was implemented that involved covering a quarter of the site with a gravel ballast cap and the remainder of the site with an impermeable asphalt pavement cap. Prior to this effort, the contaminated soil from areas where the gravel ballast cover was to be placed was moved to areas where asphaltic cover would be emplaced. Presently, the western portion of RA-2 is occupied by the BN Rail Yard, and the eastern portion is occupied by the main APL facility entrance gate and the south end of the APL On-Dock Intermodal Train Yard. COCs for groundwater in RA-2 include hydrocarbons (diesel), PCBs, arsenic, and bis(2-ethyl hexyl) phthalate (Black and Veatch, 1995).

RA-3: The former Seattle Steel Incorporated (SSI) property, RA-3, was the location of both the West Seattle Landfill and a scrap metal processing company. The West Seattle Landfill occupied 30 acres (approximately three-quarters of this remediation area) and was in operation from 1939 to 1966. The former landfill was almost entirely covered with slag, construction debris, steel mill debris, and an un-engineered soil cover. In the spring of 1995, near-surface refuse from the eastern portion of the landfill was relocated to a consolidation landfill area on the western portion of the site. An interim cover consisting of processed solid landfill material was placed over the property. Since this time, an engineered cover consisting of clean fill and a low-permeability geomembrane has been placed over the former landfill, and an asphalt cover has been placed over the former SSI property south of the landfill. The Port operates a landfill gas collection and treatment system in the former landfill area. Presently, the south portion of the paved consolidated area of RA-3 is leased to a tanker truck company for vehicle parking. The Port continues to seek additional tenants for productive use of the area while preserving the integrity of the remedial structures. COCs for groundwater in RA-3 include hydrocarbons (diesel), PCBs, and arsenic (Woodward Clyde, 1995).

RA-5: RA-5 was originally a tideflat zone that has since been filled with dredge sediment, slag and construction debris. The western portion of the remediation area, filled prior to 1936, was the site of Nettleton Lumber until the late 1960s. The eastern portion of the site was filled in the late 1950s, becoming the location of Lockheed Shipyard #2, which operated from 1956 to 1987 as a ship maintenance and refitting outfit. Air photos indicate that by 1969, the Lockheed Shipyard #2 occupied all of remediation area RA-5. In 1994, the area used for shipbuilding operations underwent excavation and treatment of contaminated soils. As part of the cleanup effort, the former storm drain system was decommissioned. Contaminated sediments within the former storm drain system were removed and disposed off-site. In addition, an asphaltic concrete cap has been placed over the entire site. Presently, RA-5 is used by APL for parking and interim container storage. COCs for groundwater in RA-5 include metals (arsenic, lead, antimony, chromium, copper, nickel) and hydrocarbons (Enviros, 1993, 1994).

RA-4: RA-4, referred to as the Pacific Sound Resources site, is being addressed separately under the Superfund process by EPA. However, the portion of RA-4 south of the former Florida Street alignment is being considered under the Ground Water Confirmation Monitoring Program in order to evaluate groundwater flow from RA-4 into

the adjacent remediation areas. The portion of RA-4 north of Florida Street was occupied by a wood treating plant until 1994, when remediation activity began. The portion south of Florida Street was used primarily for log and treated wood storage. The cleanup effort involved removal of contaminated soils process waste and wood waste, and the placement of a low-permeability asphaltic concrete cap over the entire site. Waste was disposed or recycled off-site and the excavated areas were backfilled. Where appropriate, a geotextile identifier layer was installed between clean import fill and underlying contaminated soils. Prior to filling and capping on the site, a groundwater containment slurry wall was constructed along the northern perimeter of the property to a maximum depth of 50 feet below the pre-redevelopment ground surface to limit migration of contaminants into Puget Sound. An adjacent LNAPL recovery trench was also installed parallel to the slurry wall on its landward side to a depth of approximately 15 feet below top of the slurry wall. RA-4 is presently occupied by the northern end of the APL Intermodal Train Yard, the BN Storage Track Yard and the Jack Block Public Shoreline Access and Park and a public access area. Potential COCs for groundwater in the southern portion of RA-4 include hydrocarbons (diesel), metals and PCBs that may potentially migrate beneath RA-4 from upgradient sources on RA-1 and RA-3.

Access to the Terminal 5 facility and the adjacent vicinity is controlled by several different entities including the Port, APL, and BN. Access to the main facility and the original Terminal 5 area is through the main APL gate off Spokane Street. Access to the southwest portion of the site, including the Nucor Steel property south of the main BN rail yards, is via an access road located off Spokane Street west of the main APL gate. Access to the west part of the site, including most of RA-3, is from a gate located on Harbor Avenue west of the West Seattle Freeway. Access to the northwest portion of the site is through the Florida Street gate or through a public shoreline access road located on Harbor Avenue north of Florida Street.

3 Site Hydrogeologic Setting

The local groundwater regime beneath the SWIIP includes a Fill Aquifer and a deeper Estuarine Aquifer. The Fill Aquifer consists of groundwater occurring in various fill materials between depths of 20 and 40 feet below ground surface (bgs). A sandy silt to silty fine sand tideflat deposit, typically 1 to 10 feet in thickness, occurs between the Fill and Estuarine Aquifer zones over most of the site with the exception of the easternmost portion near the West Waterway, and in isolated areas near the former axis of Longfellow Creek along the eastern edge of RA-3. Where present, this low-permeability unit results in locally confined conditions in the Estuarine Aquifer zone. The Estuarine Aquifer is underlain by a lower permeability unit that occurs at a depth of approximately 40 feet along the western boundary of the site near Harbor Avenue, and appears to dip to the east.

The Fill Aquifer/Estuarine Aquifer system is bounded to the north by Elliott Bay and to the east by the West Waterway. The aquifers thin to the south and west and terminate to the west against the West Seattle bluff, encountering deposits of the low-permeability Lawton Clay unit.

3.1 Summary of Pre-Redevelopment Hydrologic Conditions

Prior to site remediation and redevelopment of the SWIIP, the primary recharge to the Fill and Estuarine Aquifers was through direct infiltration of incident precipitation, with limited lateral groundwater inflow from the West Seattle bluffs to the west and the Longfellow Creek/Delridge basin to the south. Under pre-remediation conditions, recharge from on-site infiltration was estimated to be approximately 3.5 times higher than recharge through lateral groundwater flow from off-site (Port of Seattle, 1999). Downward vertical gradients existed between the Fill and Estuarine Aquifers under pre-redevelopment conditions, indicating that on-site infiltration was a significant recharge source to the aquifer systems.

Pre-remediation groundwater studies, primarily the site wide tidal study by Woodward Clyde (1994), indicate that historical groundwater flow direction in the Fill Aquifer was toward the LFOL equalization basins within much of RA-2 and RA-3 and the southern portion of RA-4, and the western portion of the original Terminal 5 area. Selected groundwater elevation contour maps from this study are included in this report. Much of the historic Fill Aquifer groundwater discharge from these areas occurred through the LFOL via the former equalization basins, with lesser discharge through documented pre-redevelopment leaks in the LFOL.

3.2 Original Model of Post-Redevelopment Hydrologic Conditions

Closure of the equalization basins and completion of a continuous LFOL conveyance tightline across the SWHP, and subsequent repair of leaks identified in the existing LFOL, was expected to significantly affect the post redevelopment groundwater flow regime, especially in the Fill Aquifer. The groundwater flow direction within the Fill Aquifer under post remediation conditions was expected to be primarily to the east or northeast, with lateral groundwater flow onto the site from the highlands (to the south and west),with limited hydraulic effect along the now tightlined LFOL, and eventual diffuse discharge to the surface waters of the West Waterway and Elliott Bay. Additionally, closure of the equalization basins and repair of the LFOL was expected to greatly reduce the upland extent of tidal influence in the Fill Aquifer. The slurry wall installed along the northern perimeter of RA-4 likely also contributes to reduced propagation of tidal influence in the Fill Aquifer.

The pre-remediation flow direction in the Estuarine Aquifer was to the north-northeast, with discharge to Elliott Bay and the West Waterway. Post redevelopment Estuarine Aquifer flow was expected to be relatively unaffected by site development, with the exception of possible reduction in horizontal groundwater gradient, and a possible southwestward (upland) shift in the position of the salt water interface along Elliott Bay and the West Waterway.

4 Phase I Monitoring Program Objectives

4.1 Groundwater Flow Regime Evaluation Objectives

The primary goal of the Phase I GWCMP was assess changes in groundwater flow conditions resulting from the SWHP remediation and redevelopment activities, including documenting post remediation flow directions, recharge areas, and discharge zones, and evaluating the hydraulic effect of the LFOL and tidal influences on the groundwater flow regime in the Fill and Estuarine Aquifers. Documenting the post-redevelopment flow regime will allow subsequent identification of appropriate groundwater quality monitoring points for compliance monitoring with surface water quality standards.

The *Monitoring Plan* identified six specific objectives for the Phase I GWCMP. The following sections detail these specific project objectives and work completed to satisfy these objectives. Additionally, summaries of the status and general findings of each objective are provided in Table 4.1.

4.1.1 Objective 1 – Implement Monitoring Network

Objective 1 addressed implementation of the monitoring network to define the SWHP post redevelopment groundwater flow regime and provide the basis for identifying the Phase II water quality monitoring network. The majority of the monitoring network was completed in late 2001, and included retrofitting existing wells and installation of new Fill and Estuarine Aquifer wells. Complete details of the monitoring network construction and operation are provided in the *Monitoring Network Construction Report* (Aspect Consulting, 2002a).

The *Monitoring Program Southwest Harbor Project Monitoring Network Adequacy Technical Memorandum* (Aspect Consulting, 2003) identified data gaps in the Fill Aquifer in the Original Terminal 5 Area, and three additional Fill Aquifer wells (CMP-18, 19 and 20) were installed in this in the summer 2003. Construction of these wells followed procedures in the *Agency Review Draft Monitoring Plan* (AESI, 2000). Monitoring well construction logs for these wells are included in Appendix A. All other monitoring well construction logs can be found in the *Monitoring Network Construction Report* (Aspect Consulting, 2002a).

The current monitoring well network includes 25 Fill Aquifer and five Estuarine Aquifer monitoring wells. The Phase I hydrologic characterization study included collection of water level and water quality data from the network over a 2-year period to assess seasonal hydrologic variations and define the site-wide groundwater flow regime.

4.1.2 Objective 2 – Document Reduced Recharge to Fill and Estuarine Aquifers

A majority of the SWHP area has been capped with low-permeability asphalt and landfill geomembrane covers. These low-permeability covers, in combination with the site-wide

surface drainage collection system constructed during site redevelopment, are expected to result in the reduction of on-site infiltration and corresponding reduction in recharge to the Fill Aquifer system. Objective 2 addressed characterization of the anticipated reduction in recharge through collection of water level data over a 2-year period to document anticipated site-wide declines in water levels relative to pre-redevelopment conditions.

4.1.3 Objective 3 – Confirm Reduction in Downward Vertical Gradient

This objective focused on documenting anticipated post redevelopment reductions in downward vertical gradients, and corresponding reduction in exchange of groundwater between the Fill and Estuarine Aquifers. Reductions in downward vertical gradients were anticipated to result from reduced precipitation recharge to the Fill Aquifer. The approach to this objective was to utilize water level data over a 2-year period from paired Fill and Estuarine Aquifer wells to document post redevelopment vertical gradients between the Fill and Estuarine Aquifers across the site.

4.1.4 Objective 4 – Document Reduced Discharge to Elliott Bay and West Waterway

Objective 4 addressed documenting anticipated post redevelopment reductions in discharge from the Fill and Estuarine Aquifers to Elliott Bay and the West Waterway. The approach to this objective focused on collecting 2 years of water level data to document post redevelopment groundwater levels and gradients across the site. In addition, the completed tidal study facilitated assessment of the role of the tightlined LFOL as a preferential pathway for groundwater discharge.

4.1.5 Objective 5 – Document Post Redevelopment Effect of LFOL on Groundwater Regime

The results of the Woodward Clyde tidal study conducted in 1994 (prior to the site redevelopment and closure of the equalization basins) clearly demonstrate that at that time the LFOL acted as a point of discharge for the Fill Aquifer. The tidally-induced hydraulic head changes that occurred in the equalization basins along the LFOL alignment had a significant effect on the shallow groundwater regime. Closing of the LFOL equalization basins and repair of the leaks within the LFOL was expected to result in a marked reduction of tidal influence around the former equalization basins and to reduce the extent of upland tidal influence within the Fill Aquifer. Objective 5 of the Phase I GWCMP addressed evaluation of the degree to which tightlining of the LFOL equalization basins has reduced the hydraulic effect of the LFOL on the Fill Aquifer flow system. This objective was accomplished through a focused tidal study (*Tidal Monitoring Study Report*, Aspect Consulting, 2002b), and through long-term, automated monitoring of water levels and water quality parameters in key Fill aquifer wells located along the LFOL.

4.1.6 Objective 6 – Document Reduction in Leachate Production from RA-3

Objective 6 focused on verifying the anticipated post redevelopment reduction in leachate generation from the former West Seattle Landfill (RA-3). Reduced leachate generation was expected due to a combination of reduced precipitation infiltration through the solid waste, and lowered water levels in the Fill Aquifer resulting in less potentially saturated solid waste. This objective was addressed through collection of 2 years of automated water level and water quality parameter data from key Fill and Estuarine Aquifer wells adjacent to RA-3, and comparison of these data to pre-redevelopment conditions.

5 Summary of Previous Phase I Report Submittals

5.1.1 Monitoring Plan

The *Agency Review Draft Monitoring Plan* (AESI, 2000) describes the proposed components for the hydrologic flow regime characterization phase (Phase I) of the GWCMP. This document was developed in accordance with the consent decrees for the individual remediation areas that were redeveloped as part of the SWIP, and followed the general scope defined in the *Ground Water Conceptual Letter* (Port of Seattle, 1999). The *Agency Review Draft Monitoring Plan* (AESI, 2000) presented specific work scope element and procedures to develop a site-wide monitoring network adequate to characterize post-redevelopment groundwater flow conditions at the SWIP and to achieve the specific Objectives 1 through 6 identified in the Monitoring Plan (see Section 4 of this report).

5.1.2 Addendum #1 to Monitoring Plan

Addendum #1 to Monitoring Plan (AESI, 2001) was prepared to address comments raised by Ecology at a June 5, 2001 meeting to discuss the *Agency Review Draft Monitoring Plan* (AESI, 2000). Ecology's comments were subsequently documented in a letter to the Port dated July 5, 2001. This letter also confirmed Ecology's approval of the *Monitoring Plan*, as amended by the *Addendum #1 to Monitoring Plan* (AESI, 2001). *Addendum #1 to Monitoring Plan* (AESI, 2001) specifically addressed retrofitting, abandonment, and replacement of selected monitoring wells that were damaged during the Nisqually Earthquake. This document also stipulated a change in the planned location of CMP-11 to outside the EPA-regulated RA-4 remediation area, and added a requirement to complete, after 1 year of monitoring, a technical memorandum (the subsequent *Monitoring Program Southwest Harbor Project Monitoring Network Adequacy Technical Memorandum*, Aspect Consulting, 2003) documenting the adequacy of the monitoring network. *Addendum #1 to Monitoring Plan* (AESI, 2001), together with the *Agency Review Draft Monitoring Plan* (AESI, 2000), encompass the final Ecology-approved scope for the SWIP Phase I GWCMP.

5.1.3 Monitoring Network Construction Report

The *Monitoring Network Construction Report* (Aspect Consulting, 2002a) detailed the construction of the Phase I monitoring well and surface water monitoring station network. All relevant monitoring well completion data, including survey information, were presented in tabular form, and geologic and well completion logs for new, existing, and retrofitted monitoring were included. The report also included abandonment records for wells that were deemed unsuitable for use in the program, and detailed well development records for new and existing wells. The *Monitoring Network Construction Report* (Aspect Consulting, 2002a) documented the construction of surface water monitoring stations in the LFOL, and provided detailed documentation of the installation and calibration of the In-Situ Troll dataloggers installed in the site monitoring wells and surface water monitoring stations. This document also detailed any deviations from the

approved scope or procedures, and documented investigation-derived waste management, waste profiling, and waste treatment/disposal procedures.

5.1.4 Tidal Monitoring Study Report

This *Tidal Monitoring Study Report* (Aspect Consulting, 2002b) documents the tidal monitoring study completed as part of the Phase I GWCMP. The objectives of the documented tidal monitoring study were to evaluate potential changes in groundwater flow conditions resulting from the SWHP redevelopment activities, with specific focus on the potential effect on Fill Aquifer flow from tightlining of the LFOL. The *Tidal Monitoring Study Report* (Aspect Consulting, 2002b) documents all data collection activities associated with the tidal monitoring study and provides a detailed evaluation of the tidal monitoring data. The report presented pre-redevelopment and post-redevelopment Fill and Estuarine Aquifer groundwater elevation contour maps for different tidal stages, and provided conclusions regarding post-redevelopment changes in the Fill and Estuarine Aquifer groundwater flow regime in the vicinity of the LFOL.

5.1.5 Monitoring Network Adequacy Technical Memorandum

The *Monitoring Program Southwest Harbor Project Monitoring Network Adequacy Technical Memorandum*, (Aspect Consulting, 2003) was prepared after evaluation of one year of water level monitoring data from the Phase I GWCMP monitoring network. The memorandum summarized the results of the first year of monitoring, and presented an assessment of the adequacy of the monitoring network for effectively characterizing the post redevelopment shallow hydrologic system at SWHP. The memorandum also evaluated the status of the *Agency Review Draft Monitoring Plan* (AESI, 2000) objectives after the first year of monitoring, and identified two apparent data gaps. These data gaps were:

1. Lack of adequate downgradient Fill Aquifer monitoring well coverage in the Original Terminal 5 Area, and,

2. Inadequacy of Fill Aquifer water data alone to characterize potential Fill Aquifer/LFOL interactions in the LFOL.

Recommendations were provided to address these data gaps. These recommendation included installation of three additional Fill Aquifer monitoring wells in the Original Terminal 5 Area, and completion of a focused water quality and discharge study in the LFOL to further evaluate potential Fill Aquifer/LFOL interactions. The new monitoring wells (CMP-18, 19, 20) were installed in the April 2003, and the focused water quality study was completed in the summer and fall of 2004.

5.1.6 Periodic Project Status Reports

A total of 11 periodic *Project Status Reports* were completed and submitted to Ecology between December 2001 and February 2004. These reports presented updates on work completed over the reporting period, problems encountered and resolutions, work and submittals scheduled for the subsequent reporting period, and updated project schedules. Submission of periodic status reports was discontinued in early 2004 at the conclusion of the 2-year monitoring period.

6 Hydrologic Data Collection

The following sections document hydrologic data collection and analysis activities completed during the Phase I GWCMP. Where these activities have been addressed in previous project reports, the reader is directed to those by reference.

6.1 Automated Downhole Groundwater Level and Water Quality Data Collection

6.1.1 Instrumentation Setup

Automated In-Situ Troll® datalogging probes were installed in selected site monitoring wells early December 2001 to record groundwater levels. Additional Fill Aquifer monitoring wells CMP-18, 19 and 20 were instrumented with mini Troll probes in December 2001. The Troll 4000 (T-4000) and mini-Troll probes measured water level (pressure head) and temperature. The Troll MP-8000s (T-8000s) also measured pH and conductivity. A summary of the Phase I monitoring instrumentation is provided in Table 6.1. Complete monitoring equipment setup procedures are documented in the *Monitoring Network Construction Report* (Aspect Consulting, 2002a), and in the periodic *Project Status Reports*. Individual daily field reports are provided in Appendix B.

6.1.2 Water Level Data Calculation

Collection of water level elevations was a primary element of the Phase I GWCMP. The In-Situ probes measured the height of the water column (pressure head) above the probe, and an accurate probe elevation is required for conversion of the probe's pressure head reading to water level elevation. Initially, the elevation of each probe was determined by taking concurrent measurements of static water level (in feet below the top of the casing with a known elevation) and the recorded pressure. The equation used for determining the elevation of the probe is:

$$Elev_{probe} = Elev_{TOC} - SWL_{TOC} - H_{probe}$$

where: Elevprobe is the elevation of the probe (ft MLLW);

ElevTOC is the elevation of the top of the casing (ft MLLW);

SWLTOC is the measured depth to water below the top of the casing (ft); and

Hprobe is the salinity-corrected freshwater equivalent head due to water above the probe (ft) recorded by the datalogger.

Difficulty was encountered in re-establishing a constant probe elevation between download events, particularly for the probes with water quality sensors which required removal from the well to calibrate. To eliminate transducer elevation discrepancies caused by cable stretch and hanger slippage in June, 2002, all wells with In-Situ probes were equipped with spacers constructed of 1½-inch-diameter polyvinyl chloride (PVC)

casings. The spacers were installed in the base of each well using stainless-steel recovery cables. The cone-shaped base of the In-Situ probes "seated" on the top of the spacers, thereby ensuring that the sensors elevations were fixed for the remainder of the study.

6.1.3 Pressure Sensor Calibration

During the December 2002 download event, all Troll probe pressure sensors were field checked for accuracy using a three-point pressure check. The pressure checks were completed with a field-portable pressure chamber and manufacturer-calibrated reference transducer. The manufacturer's published pressure accuracy for the pressure sensors ranges from 0.015 pounds per square inch (psi) for a 15 psi sensor, to 0.03 psi for a 30 psi sensor (± 0.1 percent of full scale). Based on the project-specific data quality needs for the pressure measurements, we established an acceptable pressure accuracy of 0.08 psi for all sensors. All but three probes (CMP-3, CMP-7, and MW-308N) passed the field check. The three probes with pressure sensors out of the acceptable range were removed from the wells and returned to the manufacturer for re-calibration. These probes were reinstalled after calibration.

6.1.4 Water Quality Data Collection and Sensor Calibration

Collection of water quality data (pH and conductivity) was an additional element of the Phase I GWCMP. The T-8000 pH and conductivity sensors required periodic calibration to maintain accuracy. Water quality sensors (pH and conductivity) were initially calibrated prior to installation in December 2001. During each download event, water quality sensors were field checked using known solutions. pH sensor calibrations were made when measurement error was greater than ½ pH unit. pH sensors were typically tested using a solution of 7.0, so sensors that measured less than 6.5 or greater than 7.5 were calibrated. Conductivity sensor calibrations were made when measurement error was greater than 10 percent of the known solution. For example, a conductivity sensor might be tested using a solution of 1440 microSiemens (µS). Conductivity sensors measuring less than 1296 µS or greater than 1584 µS were calibrated. Water quality sensor calibrations were documented in the periodic *Project Status Reports*. Individual daily field reports are provided in Appendix B.

The pH sensors in the Troll 8000 probes had a manufacturer-published functional life of 1 year, and the pH sensors in probes CMP-2, CMP-3, CMP-4, CMP-11, CMP-13, and MW-308N failed in the second year of the monitoring program. As over a full year of valid pH data had been collected, the failed pH sensors were not replaced during the remaining Phase I Hydrologic. Conductivity sensors remained in good working order over the course of the project.

6.2 Groundwater Sample Collection And Analysis

Groundwater samples for chloride analysis were collected from all site wells in December 2001, and from selected wells thereafter. The chloride data allowed for salinity corrections for the water level data from the Estuarine Aquifer wells, and provided a check for salinities calculated from conductivity measurements in the Fill Aquifer wells. Wells initially selected for chloride analyses were those exhibiting

significantly elevated conductivity measurements during well development completed in late 2001. Initial samples were collected on December 12 and 17, 2001.

Water samples for chloride analyses were collected through 1/16-inch-diameter dedicated polyethylene tubing installed in the wells to a depth approximately equal to the transducer elevation. A peristaltic pump was used to purge the tubing and samples were collected in 500-milliliter polyethylene containers, placed on ice and shipped to North Creek Analytical in Bothell under industry-standard chain-of-custody. All water samples were analyzed for chloride content by EPA Method 300.0. The laboratory results are provided in Appendix C. Sampling events are also documented in the individual field reports included in Appendix B.

6.2.1 Salinity Corrections to Water Level Data

The salinity data were used to allow correction of water level data for density differences, and to provide additional information regarding post-redevelopment changes in the Fill Aquifer groundwater flow system. Consistent with findings from the Woodward Clyde (1994) tidal study, groundwater salinity (thus density) was not found to alter the Fill Aquifer groundwater level data significantly. Salinity correction factors were greater than 0.98 in all Fill Aquifer wells, resulting in water level elevation corrections of generally less than 0.01 feet, with no Fill Aquifer well correction exceeding 0.11 feet. For the Estuarine Aquifer wells, salinity corrections resulted in water level differences in excess of 1 foot in well MW-44. All water elevation data recorded from these wells were corrected for salinity in accordance with the following procedures (ASTM, 1995; Woodward Clyde, 1994).

Salinity (on the Practical Salinity Scale (PSS) ($S_{0\text{-}40}$)), was calculated from conductivity, temperature, and pressure as follows:

$$S_{0\text{-}40} = S_{2\text{-}42} - \frac{A_0}{1+1.5(400R_t)+(400R_t)^2} - \frac{B_0}{1+(100R_t)^{1/2}+(100R_t)^{3/2}}\left[\frac{t-15}{1+0.0162(t-15)}\right]$$

$$S_{2\text{-}42} = a_0 + a_1R_t^{1/2} + a_2R_t + a_3R_t^{3/2} + a_4R_t^2 + a_5R_t^{5/2} + \Delta S$$

$$\Delta S = \left[\frac{t-15}{1+0.162(t-15)}\right]\left(b_0 + b_1R_t^{1/2} + b_2R_t + b_3R_t^{3/2} + b_4R_t^2 + b_5R_t^{5/2}\right)$$

where R_t is given by

$$R_t = \frac{R}{R_p r_t}$$

$$R_p = \left[1 + \frac{p(e_1 + e_2p + e_3p^2)}{1 + d_1t + d_2t^2 + (d_3 - d_4t)R}\right]$$

$$r_t = \left[c_0 + c_1t + c_2t^2 + c_3t^3 + c_4t^4\right]$$

$$R = \frac{k}{k_{standard}}$$

where A_0, B_0, a_n, b_n, c_n, d_n, and e_n are coefficients,

t is temperature (°C),
p is in situ pressure (bars),
k is the in situ conductivity (µS/cm),
$k_{standard}$ is standard conductivity at $S = 35$ PSS, $t = 15$°C, $p = 0$ above one standard atmosphere. For our purposes, we use $k_{standard} = 42{,}914$ µS/cm.

Calculate the density, ρ (kg/m^3), of the sample from salinity and temperature:

$$\rho = \rho_0 + AS + BS^{3/2} + CS^2$$

$$\rho_0 = f_0 + f_1 t + f_2 t^2 + f_3 t^3 + f_4 t^4 + f_5 t$$
$$A = g_0 + g_1 t + g_2 t^2 + g_3 t^3 + g_4 t^4$$
$$B = h_0 + h_1 t + h_2 t^2$$
$$C = i_0$$

where f_n, g_n, h_n, i_0 are coefficients,
ρ_0 is the density of fresh water at the same temperature (kg/m3),
S is salinity (PSS), and
t is temperature (°C)

Compute the elevation/salinity correction factor, CF, for each well:

$$CF = \frac{\rho_0}{\rho}$$

Calculate the salinity corrected water level elevations, W_{elev} (ft MLLW):

$$W_{elev} - \left(CF \times p \times 2.307 \frac{\text{ft}}{\text{psi}} \right) + TD_{elev}$$

where p is the pressure due to water above the transducer and
TD_{elev} is the elevation of transducer sensor.

For wells with chloride analyses only (Estuarine Aquifer), salinity is calculated from chloride as follows:

$S = (35/19) \times |Cl|$

where S is salinity (PSS), and
[Cl] is chloride concentration in parts per thousand (ppt)

6.3 LFOL Water Quality and Discharge Study

As discussed in Section 5.1.5, the automated water level and water quality data alone were not adequate to resolve the degree of potential communication between the Fill Aquifer and the LFOL. A focused, phased water quality and discharge study of the LFOL was recommended in the *Monitoring Program Southwest Harbor Project Monitoring Network Adequacy Technical Memorandum*, (Aspect Consulting, 2003), and was completed in the summer 2004. The first phase of this study employed installation of In-Situ Troll 8000 probes at three manhole locations along the length of the LFOL to evaluate variations in both water levels and major water quality parameters within the LFOL. The second phase included sampling and analyses of discharge samples from three manhole locations, and monitoring of flow rates and discharge volumes at these locations. Details of each phase of the LFOL water quality and discharge study are provided below.

6.3.1 Continuous LFOL Water Level and Water Quality Data Collection

Figure 6.1 shows the location of the water quality and flow monitoring stations in the LFOL at manholes MH-1, MH-4 and MH-7. The monitoring stations were installed in accordance with Section 5.2 of the *Monitoring Plan*, and consisted of 2-inch-diameter slotted PVC pipe affixed to the manhole ladders using fasteners. The pipes were installed vertically in each manhole with the lower end set in the manhole sump. Each location was equipped with an In-Situ Troll 8000 probe equipped to monitor water level, temperature, conductivity, dissolved oxygen, and pH installed with the sensors positioned marginally above the invert level of the LFOL pipe. The probes were set up to collect measurements every 10 minutes and were installed on June 3, 2004. Data was collected through July 6, 2004, when the probes were downloaded and removed.

After completion of the automated water level monitoring, the recorded water level and water quality data were uploaded to the project database and plotted for evaluation. Plots of these data are presented in Figures D-1 through D-3 in Appendix D.

6.3.2 LFOL Water Quality Sampling and Flow Rate Measurements

Based on evaluation of the water level and water quality data collected from the LFOL in June 2004, the water quality sampling phase was scheduled for strong tidal cycles in late July 2004, when LFOL sampling locations were most fully flushed of tidal water and samples would be most representative of non-tidal "baseflow". In the absence of surface water inflow, this "baseflow" should include Nucor Steel non-contact cooling water (discharged under NPDES permit to the LFOL at a point south of Spokane Street), plus any potential groundwater leakage (inflow). The calculated allowable time windows for sampling at the individual LFOL manhole locations are shown in Table 6.2.

Water quality sampling was completed between July 28 and 30, 2004, within the allowable time windows at each LFOL sampling station. Water samples were collected directly from the discharge flow into laboratory-prepared one liter glass bottles, and then decanting the water into appropriate, laboratory-supplied containers. Samples were hand-

delivered or couriered to and delivered to North Creek Analytical in Bothell, Washington for analyses. Each sample was analyzed for the following parameters: Metals (Ca, Fe, Mg, K, Na), Ferric Iron, Alkalinity, Chloride, Ammonia, Nitrate/Nitrite, pH, Sulfate, Conductance, TDS, TSS, and Turbidity. Laboratory results are presented in Table 6.3, and laboratory data reports are provided in Appendix E.

At the completion of the water quality sampling, flow velocity/discharge monitoring was conducted at each monitoring location (MH-1, MH-4 and MH-7). Initially, flow measurements were planned to be collected using a Swoffer Model 3000 current velocity meter. However, due to limited flow depths, this method was not practicable, and flow velocity measurements were collected by measuring channel profiles and flow velocities. Channel bed profiles were constructed from measurements of water depth at 0.2-foot intervals across the apparent channel width. Channel surface velocity was measured by timing the transit time of a float along a 10-foot reach of the channel. The average of five measurements was used to estimate channel velocity at the surface.

Channel flow was calculated using the average channel depth, the channel width, and an average channel velocity is 60 percent of channel velocity at the surface. Results of the flow calculations are provided in Table 6.4. Calculated average flows measured at each station in the LFOL ranged from 99 gallons per minute (gpm) to 107 gpm.

6.3.3 *LFOL Inspection*

During collection of flow data and discharge samples in late July 2004, limited sections of the LFOL were also inspected by Aspect Consulting personnel. Portions of the LFOL inspected included the 25-foot sections north (upstream) from Manholes MH-1, MH-2 and MH-4, the 150-foot section north (downstream) of Manhole MH-8, and the 160-foot section south (upstream) of Manhole MH-7. Some minor leakage was noted around the pipe joints at the manhole locations, but no significant leaks were visible or audible during inspection of these sections. An outfall approximately 24 inches in diameter discharging into the LFOL was observed at the location of Manhole MH-8, with discharge from this outfall estimated at 15 to 20 gpm. Complete LFOL inspection reports are provided in the daily field reports located in Appendix B.

6.4 Tidal, Barometric Pressure, and Precipitation Data Collection

Verified tidal data were obtained for NOAA Station Number 9447130 (SEATTLE, PUGET SOUND, WA) at the NOAA web site: "co-ops.nos.noaa.gov". The station is located at Pier 52 (the Colman Ferry Dock). The hourly data were reported on Pacific Standard Time and in feet relative to the mean-lower-low-water (MLLW) datum. Tidal data were stored in a spreadsheet where daily average, minimum, and maximum tides were calculated, as well as monthly average tides.

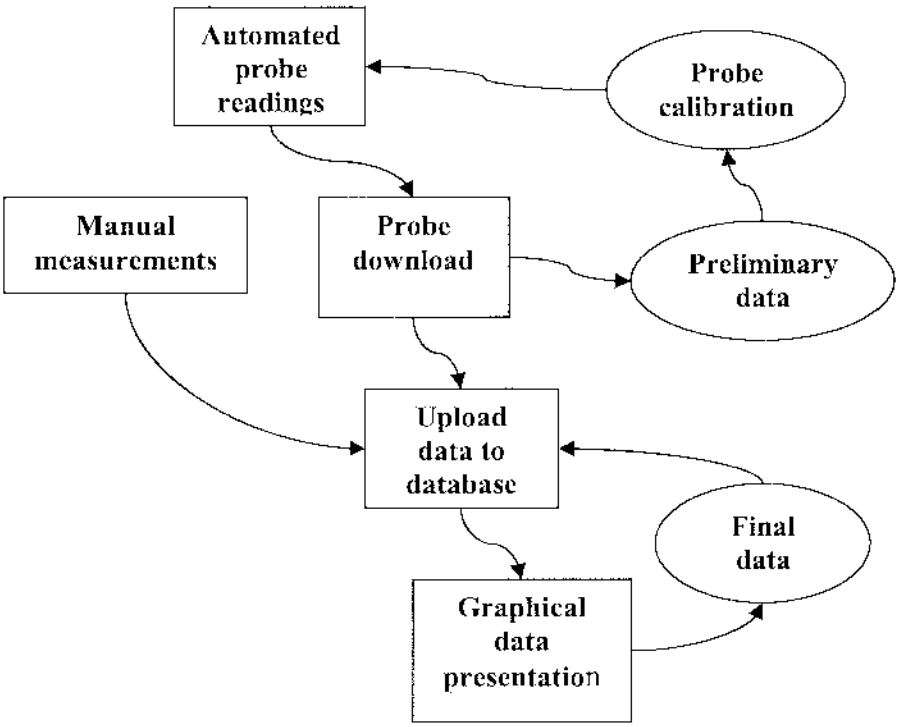
Barometric pressure data were also obtained for station 9447130 SEATTLE, PUGET SOUND, WA at the NOAA web site: "co-ops.nos.noaa.gov". The hourly data were reported in millibars using Pacific Standard Time. Barometric pressure data were stored in a spreadsheet where data were converted from millibars to feet of water head and daily averages were calculated.

Daily precipitation data was from a tipping bucket located on the northeast side of Seatac International Airport monitored by Taylor Associates, Inc. Precipitation data was stored in the project database, and exported to a spreadsheet for reporting.

6.5 Data Management

All manual and probe data collected during Phase I of the GWCMP are stored in a database developed by Aspect Consulting specifically for this project. Over 300 manual water level and water quality measurements were made at up to 32 locations. Nearly ½ million probe readings were made at up to 28 instrumented locations with up to five sensors installed on each probe. The database also is programmed to calculate the salinity correction for wells with conductivity or chloride data.

The flow of project data from collection through interpretation and eventual delivery to the Port is illustrated in the diagram below:



Data originated with either automated probe readings or manual measurements. Manual measurements of depth to water and salinity were recorded on field sheets. Probes were downloaded to a field laptop with preliminary data quality assurance/quality control (QA/QC). Preliminary data QA/QC included verifying that sensor readings were within

the normal range and that transducer-calculated water levels corresponded with manual measurements. If necessary, sensors on the probes would be field tested and field calibrated. After a site visit, data from field sheets would be entered into the database, and probe data would be uploaded to the database. The data were then exported to a spreadsheet for graphical analysis including final data QA/QC. Final QA/QC included comparisons of manual water level measurements over time and with nearby locations.

7 Hydrologic Data Analyses

7.1 Groundwater Levels and Water Quality Parameters

7.1.1 Summary of Fill Aquifer Groundwater Levels and Water Quality Parameter Data

7.1.1.1 Water Level

Daily average water level data for all Fill Aquifer wells are provided in Figure 7.1. This figure also includes averaged tidal stage data for Elliot Bay, and precipitation data from Seatac Airport. Individual plots of automated and manual water level, and water quality parameter data, for each monitored Fill Aquifer well are provided in Appendix F.

Review of Figure 7.1 and Figures F-1 through F-16 indicates that over the 2-year study period, Fill Aquifer water levels at the Site varied seasonally by as much as 6 feet. In general, Fill Aquifer wells inland from the shoreline exhibited from 1 to 4 feet of seasonal variation in water levels over the monitoring period, with the highest variations in inland wells occurring adjacent to the western upland at CMP-5, and in the area along the lower portion of the LFOL in the vicinity of the former lower equalization basins near Florida Street. Seasonal variations in Fill Aquifer water levels beneath the central paved portion of the site ranged from 1 to 3 feet, with the smallest variations occurring beneath central portion of the site from RA-3 through the Original Terminal 5 Area to the portion of RA-1 along Marginal Way SW. Site-wide seasonal variations were largest (6 feet) in strongly tidally influenced, nearshore Fill Aquifer wells CMP-16 and MW-5 located along the northern, seaward edge of RA-5. Overall, Fill Aquifer water levels appear to have stabilized after site redevelopment, with comparable seasonal elevations in both 2002 and 2003.

7.1.1.2 Temperature

Groundwater temperatures variations in Fill Aquifer wells (see Figure 7.3 and Figures F-1 through F-16) followed an offset, bimodal seasonal pattern with lowest temperatures occurring in late spring, after the winter recharge, and generally a few weeks after the seasonal high water levels. Highest groundwater Fill Aquifer groundwater temperatures generally occurred late October or early November, just above the onset of the winter recharge. Many Fill Aquifer wells display a net increase in average groundwater temperature between 2002 and 2003. This increase in groundwater temperature may result from continued equilibration of the aquifer to post-redevelopment reduction in recharge.

7.1.1.3 Salinity

Salinity levels in the Fill Aquifer vary widely across the site, with highest levels typically found in wells immediately adjacent to the shoreline. Well CMP-16, located along the northern edge of RA-5, exhibited elevated laboratory-reported salinity levels. Elevated salinity levels were also recorded in wells CMP-11, CMP-12 and CMP-13, located along

the lower portion of the LFOL near the former "lower" equalization basins. Fill Aquifer wells in the central portion of the site generally exhibited salinity levels less than 1 part per thousand (ppt).

Fill Aquifer groundwater salinity trends were not as consistent as temperature trends, but the wells can be grouped into three subsets that exhibited well- and/or area-specific behavior. Salinity levels in wells CMP-3, CMP-6 and MW-307A were generally constant throughout the monitoring period, suggesting stabilized conditions in the central portion of the site extending southward from the north end of RA-3 and along the eastern edge of RA-3 through RA-1. Conversely, salinity levels in nearshore wells MW-26R and MW-308N show increasing trends throughout the 2-year monitoring period. These increasing trends are suggestive of landward movement of salt water intrusion into the Fill Aquifer between early 2002 and late 2003. Wells CMP-8, CMP-11, CMP-12 and CMP-13 all exhibited significant variations in salinities. CMP-8, located in the central portion of the site within the Original Terminal 5 Area shows pronounced cyclical variations in salinity, with the higher salinity values occurring in the latter 6 months of each year, and roughly corresponding to lower groundwater elevations and elevated temperatures. Conversely, wells CMP-11, CMP-12 and CMP-13, located along the lower portion of the LFOL near the former "lower" equalization basins, show generally elevated salinities during the winter months.

The cause of the salinity variations in well CMP-8 is unknown. Salinity variations in wells CMP-11, CMP-12 and CMP-13 appear related to upward movement of deeper, seawater-enriched groundwater from the Estuarine Aquifer during periods of higher averaged tides. Inspection of the LFOL in the area of the "lower" Estuarine Basins did not indicate the presence of leaks that could result in movement of seawater from the LFOL into the aquifer in this area. Upward movement of saline groundwater from the Estuarine Aquifer in this area is also suggested by the presence of observed upward vertical gradients between the Fill and Estuarine Aquifers in the MW-307 and MW-308 wells pairs in the winter months (see Section 7.3).. The *Tidal Monitoring Study Report* (Aspect Consulting, 2002b) also confirmed the potential occurrence of Fill/Estuarine Aquifer interactions in the area of the former "lower" equalization basins.

7.1.1.4 pH

Automated measurements of pH in the Fill Aquifer (see Figure 7.4 and Figures F-1 through F-16) ranged from greater than 10.7 in well CMP-3 located on the downgradient edge of RA-2, to as low as 4.3 in well CMP-4 located east and downgradient of RA-3. Elevated pH levels in RA-2 are likely indicative of groundwater contact with calcium-rich slag materials. pH levels in excess of 9 in well CMP-2, located on the upgradient side of RA-2, also suggest that groundwater is interacting with slag in areas upgradient of RA-2. Historic aerial photographs indicate extensive slag is present beneath RA-2 and in the upgradient area southwest of RA-2. There is no discernable post redevelopment trend in groundwater pH levels in wells CMP-2 and CMP-3.

Low pH levels in well CMP-4 located immediately east of RA-3, likely result from interaction of Fill Aquifer groundwater with refuse as it migrates to eastward beneath RA-3. pH trends in this well (see Figure F-3)indicate a cyclical decrease in pH during the winter and early spring, when water levels beneath RA-3 are highest. This suggests a

direct correlation between the saturated thickness of the refuse, and corresponding lowered pH levels in the Fill Aquifer east of RA-3. The overall pH trend in well CMP-4 over the monitoring period was upward, with pH levels in excess of 7.6 recorded in the early summer of 2003. This overall trend suggests a general post redevelopment decrease in the impact of RA-3 refuse on downgradient Fill Aquifer water quality.

Outside of RA-2 and area along the eastern margin of RA-3, Fill Aquifer groundwater pH levels are generally near neutral, ranging between 6 and 8 over the monitoring period. A weak seasonal trend is noted in well CMP-13, with decreasing pH levels in the winter months possibly related to increased water levels beneath RA-3. Weak seasonal trend is also noted in well CMP-14, where elevated pH levels roughly correlate with the mid-winter months. The cause of the periodic increased pH in well CMP-14 is unknown.

7.1.2 *Summary of Estuarine Aquifer Groundwater Levels and Salinity*

Daily averaged water level data for all Estuarine Aquifer wells are provided in Figure 7.5. This figure also includes averaged tidal stage data for Elliot Bay, and precipitation data from Seatac Airport. Individual plots of automated and manual water level, and water quality parameter data, for each monitored Estuarine Aquifer well are provided in Appendix F.

Review of Figure 7.3 and Figures F-17 through F-21 indicates that over the 2-year study period, Estuarine Aquifer water levels at the Site varied seasonally by as much as 7 feet. In general, the more inland Estuarine Aquifer wells (CMP-7, MW-36, MW-307BR, and MW-308S) exhibited from 2.5 to 3 feet of seasonal variation in water levels over the monitoring period. In these wells, changes related to seasonal precipitation dominate, with second-order tidal fluctuations superimposed on the dominant seasonal trends. Well MW-44, located in the northeastern corner of RA-5, is dominated by strong tidal water level fluctuations of as much as 4 feet. Overall, Estuarine Aquifer water levels exhibited comparable seasonal elevations in both 2002 and 2003.

7.1.2.1 Temperature

Groundwater temperatures in all Estuarine Aquifer (see Figure 7.6) wells generally exhibited no significant short term or long term trends during the monitoring period. A very slight increasing trend of around 0.25 degrees Celsius is evident in wells CMP-7, MW-307BR, and MW-308S.

7.1.2.2 Salinity

Field-measured and laboratory-reported salinity levels in the Estuarine Aquifer vary widely across the site. The highest salinities were recorded in wells MW-36 and MW-308S, with levels typically exceeding 10 ppt. Conversely, salinity levels in the other Estuarine Aquifer wells were generally less than 2 ppt.

Due to the lack of downhole conductivity measurements, adequate data is not available to evaluate Estuarine Aquifer groundwater salinity trends in any detail. The limited available data suggest that the most significant variations in salinity levels occurred in Well MW-36, which is located approximately 800 feet inland from the shoreline. The cause of the apparent salinity variations in this well are unknown.

7.2 Groundwater Elevations

The water level elevation data for both the Fill and Estuarine Aquifers were corrected for salinity as described in Section 6.2.1 of this report and calculated relative to MLLW datum. The salinity-corrected water level elevation data were then used to calculate 72-hour mean groundwater elevations using the method of Serfes (1991). This method corrects for the major lunar and solar frequencies that produce the tides, and provides a mean groundwater elevation for the 72-hour time period. Eight sets of mean groundwater elevation data (4 for each aquifer) were developed, using data from four seasonal high and low groundwater elevation stages within the monitoring period. These mean (tidally averaged) potentiometric groundwater elevation data sets were then used to construct the hand-contoured groundwater elevation maps. From these contour maps, mean groundwater flow directions and hydraulic gradients were determined, which represent the seasonal net groundwater flow conditions over the course of multiple tidal cycles. In developing the groundwater elevation contour maps for the Fill Aquifer, selected manual water level measurements from non-instrumented wells were used to supplement the automated water level data. Only manual measurements from wells at distances roughly 500 feet or greater from the West Waterway or Elliot Bay were used, since they have negligible tidal response.

7.2.1 Fill Aquifer

The average groundwater elevation contour maps for the Fill Aquifer are presented on Figures 7.7 through 1.10. To facilitate comparison of pre- and post-redevelopment groundwater flow conditions, a map representing pre-redevelopment (1994) average Fill Aquifer groundwater flow conditions is presented sequentially in Figure 7.11. The Fill Aquifer groundwater flow conditions for the monitoring period, and comparison to pre-redevelopment conditions (1994), are described below.

7.2.1.1 Flow Direction

Examination of Figures 7.7 through 7.10 indicates that Fill Aquifer groundwater flows east-northeast off the West Seattle uplands, beneath RA-3, then diverges radially to the north and east, and discharges along the West Waterway and Elliot Bay. In the southern portion of the site beneath RA-1 and RA-2, Fill Aquifer groundwater flows northward onto the site from beneath the Nucor Steel facility, then verges to the northeast beneath RA-1 and discharges to the West Waterway. Primary recharge zones for the Fill Aquifer appear to be the West Seattle uplands west of RA-3, and the Delridge/Longfellow creek basin south of RA-1 and RA-2. A subtle groundwater ridge or high is evident in the vicinity of well CMP-10 on all the Fill Aquifer contour maps. This high extended northeastward beneath RA-5 in December 2001, and again in December 2003.

Fill Aquifer flow was not characterized beneath the northern, EPA-regulated portion of RA-4 during this study. The slurry wall installed along the seaward portion of this area was designed to minimize tidal influence landward of the wall and significantly reduce discharge of groundwater through the Fill Aquifer, thereby creating a stagnation zone which would divert groundwater to the northeast and northwest, to discharge points adjacent to RA-4 along Elliott Bay. The *Upland Groundwater Remedy 2003 Annual Monitoring Report* (RETEC, 2004) for RA-4 concluded that Fill Aquifer groundwater

with the RA-4 slurry wall was stagnant, and that there was essentially no Fill Aquifer flow around the ends of the walls.

7.2.1.2 Horizontal Flow Gradient

Calculated groundwater gradients in the Fill Aquifer during the monitoring period were as high as 0.01 feet per foot in the winter beneath RA-3, and as high as 0.005 feet per foot beneath the southern portion of RA-1. These relatively high gradients suggest that recharge via infiltrating precipitation is occurring in uplands bordering these areas. Gradients were generally much lower beneath the main portion of the site, with calculated values of less than 0.001 feet per foot beneath the southern part of the Original Terminal 5 Area in December 2003 ((Figure 7.10). These low groundwater gradients indicate that once Fill Aquifer groundwater enters the site and moves beneath the Original Terminal 5 Area and RA-5, groundwater flows very slowly to eventual discharge points along the West Waterway and Elliot Bay. In the area north of RA-3 and west of the RA-4 slurry wall, somewhat higher gradients suggest Fill Aquifer flow groundwater flows more rapidly to Elliot Bay in this area.

7.2.2 *Estuarine Aquifer*

Averaged groundwater elevation contour maps of the Estuarine Aquifer over the monitoring period are presented on Figures 7.12 through 7.15. To facilitate comparison of pre- and post-redevelopment groundwater flow conditions in the Estuarine Aquifer, a map representing pre-redevelopment (1994) average Estuarine Aquifer groundwater flow conditions is presented sequentially in Figure 7.16. The Estuarine Aquifer groundwater flow conditions for the monitoring period, and comparison to pre-redevelopment conditions (1994), are described below.

7.2.2.1 Flow Direction

Figures 7.12 through 7.15, depicting post-redevelopment groundwater flow condition in the Estuarine Aquifer, indicate that groundwater in the Estuarine Aquifer generally flows from the southwest toward the northeast, with discharge to Elliot Bay and the West Waterway. As with the Fill Aquifer, recharge for the portion of the Estuarine Aquifer flowing beneath the site is primarily in the West Seattle Highlands to the west of Harbor Avenue. No significant post-redevelopment seasonal changes in Estuarine Aquifer flow conditions are noted. Comparison of current conditions to Figure 7.16, depicting pre-redevelopment flow conditions, confirms that current Estuarine Aquifer groundwater flow is similar to post-redevelopment conditions.

Estuarine Aquifer flow was not characterized beneath the northern, EPA-regulated portion of RA-4 during this study. The slurry wall installed along the seaward portion of this area extends to a depth of approximately 50 bgs feet. Given this depth of installation, it is likely that flow through the upper portion of the Estuarine Aquifer is diverted to northeast and northwest around a stagnation zone created by the slurry wall.

7.2.2.2 Horizontal Flow Gradient

Calculated groundwater gradients in the Estuarine Aquifer were as high as 0.004 feet per foot in the northern portion of the site north of RA-3. Gradients in the central portion of the site appear considerably lower, with typical values of 0.001 feet per foot or less

beneath the northern end of the Original Terminal 5 Area and RA-5. Current Estuarine Aquifer groundwater gradients at the site are generally comparable to pre-redevelopment gradients (see Figure 7.16).

7.3 Vertical Groundwater Gradients

Vertical gradients calculated from monitoring data collected from the Fill/Estuarine Aquifer well pairs during the current study are presented as monthly averages in Figure 7.17. Post–redevelopment vertical gradients between the Fill and Estuarine Aquifers were generally weakly downward at most locations monitored, with monthly average magnitudes of approximately 0.01 feet per foot. A maximum monthly average downward vertical gradient of 0.027 feet per foot was recorded at well pair the MW-307 well pair in March 2002. Periodic upward vertical gradients were also observed at the MW-307 and MW-308 well pairs located north of RA-3. Vertical gradient was weakly upward in the MW-308 well pair in late 2002 and early 2003, and more strongly upward in the MW-307 well pair from August 2002 through April 2003, and again from July through November 2003. Monthly average upward gradients in the MW-307 well pair exceeded 0.02 feet per foot in late 2002. The period of upward vertical gradients recorded in the MW-307 and MW-308 well pairs appears to correlate to times of higher than average tides (see Figure 7.17), when higher average induced tidal pressure resulted in increased average heads in the confined Estuarine Aquifer.

7.4 LFOL Flow and Water Quality Data

Calculated average flows measured at each station in the LFOL during the late July 2004 monitoring event ranged from 99 gpm to 107 gpm. These estimates are very close to reported average discharges of 101 gpm into the LFOL between July 28 and 30, 2004, as reported by Nucor Steel (Jeremy Adams, Nucor, personal communication, 2004).

The results of the water quality samples collected from the LFOL are presented in Table 6.3. These data were further evaluated by plotting the laboratory-reported data for each sampling station on a standard trilinear Piper diagram. This diagram is included as Figure 7.18. The sodium and chloride results confirm an increasing seawater component in samples collected progressively closer to the outfall. The Piper diagram confirms this increasing saltwater component, with the plotted samples from the Manhole MH-4 and MH-7 stations converging on the seawater standard. The Piper diagram suggests that seawater mixing with the Nucor Steel baseflow adequately accounts for the compositional changes noted along the course of the LFOL. No additional inputs to inline flow, such as groundwater or storm water discharges, are indicated in the LFOL flow and water quality data collected during this study.

The LFOL water quality data and correlation between metered Nucor discharge and measured LFOL flow, confirm that during the dry summer months, the NUCOR discharge is the primary source of baseflow to the LFOL. The flow and water quality data collected from the LFOL during this study do not indicate the presence of significant groundwater leakage into the LFOL.

8 Comparison of Pre- and Post-Redevelopment Hydrologic Conditions

8.1 Fill Aquifer

Only one historic study of the site, the *Woodward Clyde Tidal Study Report* (1994), presents tidally-averaged groundwater flow conditions that can be directly compared to current conditions documented in this study. Many other RA-specific pre-redevelopment studies were completed, but these generally focus on soil and groundwater chemistry, and contain only localized (individual RA-specific), spot groundwater elevation data. The averaged pre-redevelopment Fill Aquifer flow conditions for early April 1994 documented in the *Tidal Study Report* (Woodward Clyde, 1994) are shown in Figure 7.11. These condition contrast markedly with post-redevelopment averaged Fill Aquifer groundwater flow conditions (see Figures 7.7 through 7.10) largely due to tightlining of the LFOL.

The major change in Fill Aquifer groundwater flow following SWHP redevelopment is the hydraulic influence from the LFOL. The pre-redevelopment April 1994 data indicate that the LFOL's former southern and northern equalization basins acted as strong hydraulic "sinks" in the Fill Aquifer under mean water level conditions (Figure 7.11). Consequently, the mean groundwater flow directions in the Fill Aquifer were locally toward the LFOL within much of RA-2 and RA-3 and the southern portion of RA-4, and the western portion of the original Terminal 5 area. The post-redevelopment data collected during this study confirm that closure of the equalization basins and tightlining of the LFOL across the SWHP has substantially reduced or eliminated the tidal influence within the Fill Aquifer along the LFOL. Under post-redevelopment conditions, the LFOL appears to have negligible influence on groundwater elevations, hydraulic, gradients, and resulting groundwater flow directions; the extensive groundwater lows observed around the equalization basins in the 1994 tidal study are absent. Site wide, the pervasive pre-redevelopment hydraulic gradient toward the LFOL has been eliminated by tightlining the LFOL.

The *Tidal Monitoring Study Report* (Aspect Consulting, 2002b) suggested the possibility of a weak groundwater low centered around the location of the former northern equalization basins in April 2002, which could act as a weak hydraulic sink. However, the maps of averaged Fill Aquifer flow presented in this report, prepared at high and low water periods over the course of the study, do not show a significant groundwater sink in the vicinity of the lower equalization basins. Additionally, the LFOL inspection and flow data collected in July 2004 do not indicate significant groundwater leakage into the LFOL in this area. It is likely that the groundwater sink observed around the former lower equalization basins in April 2002 was related to transient interactions between the Fill and Estuarine Aquifers, rather than communication between the Fill aquifer and the LFOL. Cross-aquifer flow in this area may result due to the absence of an aquitard in this local area resulting from excavation of the equalization basins, and/or through erosion by

the main Longfellow Creek channel. The lack of a significant aquitard near the former lower equalization basins is supported by the observed elevated salinities during the winter months in wells CMP-11, CMP-12 and CMP-13. Landward movement of saline water through the Fill Aquifer to this area is not indicated by the lower salinity levels observed in more seaward fill Aquifer wells (i.e.: MW-308N). The cause of the periodic salinity increases in wells around the former lower equalization basins is best explained through periodic upward movement of deeper, seawater-enriched groundwater from the Estuarine Aquifer.

A weak groundwater high is periodically present in Fill Aquifer in the area of low horizontal gradient that extends from RA-5 southwestward through the northwestern portion of the Original Terminal 5 Area. This feature appears strongest in the late summer/fall months, when site-wide average water levels are lowest. April 1994 averaged water level contours (see Figure 7.11) suggest that this weak groundwater high was also present beneath RA-5 prior to site redevelopment. This groundwater high or ridge may result from the presence of buried bulkheads or other structures generally known to exist in this area (Enviros, 1992), and/or the presence of finer grained soils. These factors could result in delayed drainage (and consequently higher water levels) in this area during the summer and fall, when water levels are dropping.

Pre-redevelopment Fill Aquifer horizontal groundwater gradients were greater than post-redevelopment gradients both beneath the RA-3 and the southern portion of RA-1, where recharge enters the site from adjacent uplands, as well as within the central portion of the site in the vicinity of the former equalization basins. In April 1994 (Woodward Clyde, 1994), horizontal gradients beneath RA-3 (see Figure 7.11) were on the order of 0.02 feet per foot, which are approximately twice the highest gradient of 0.01 feet per foot observed in this area during December 2001 (see Figure 7.7). Historic horizontal gradients as high 0.07 feet per foot were recorded in Fill Aquifer along the west side of the upper equalization basins in 1994. These historic horizontal gradients where much higher than the current Fill Aquifer horizontal gradients, which range from 0.005 feet per foot to less than 0.001 feet per foot.

Water quality parameter data collected during this study shed additional light on post-redevelopment flow conditions. In particular, increasing salinity levels noted during this study in the Fill Aquifer wells along the northern portion of RA-5 suggest continued landward movement of salt water into the Fill Aquifer between early 2002 and late 2003. Measured increases in Fill Aquifer groundwater temperature suggest that ongoing equilibration of the Fill Aquifer to post-redevelopment reduction in recharge of incident precipitation. pH levels in well CMP-4 show an increasing trend through the monitoring period suggestive of an ongoing reduction in impacts from refuse beneath RA-3.

In summary, the monitoring data collected during this study confirm that the SWHP redevelopment activities, including capping of a large portion of the site (and historical contaminant source areas), and the change in the LFOL configuration, have had a significant effect on the Fill Aquifer flow regime. The major change in Fill Aquifer groundwater flow resulting from the SWHP redevelopment is the apparent elimination of the pre-redevelopment hydraulic influence of the equalization basins along the LFOL. The pre-redevelopment data indicate that the LFOL's former southern and northern equalization basins acted as strong hydraulic sinks in the Fill Aquifer under mean water

level conditions. As a result, the mean groundwater flow directions in the Fill Aquifer were toward the LFOL within much of RA-2 and RA-3 and the southern portion of RA-4, and the western portion of the original Terminal 5 area. Prior to the SWHP redevelopment, groundwater flow in the Fill Aquifer beneath the western and central portions of the SWHP was generally toward the LFOL, which served as a significant groundwater discharge pathway to surface water. Closure of the equalization basins and tightlining of the LFOL has effectively eliminated inland propagation of the tidal influence within the Fill Aquifer, as well as Fill Aquifer discharge through the LFOL. Additionally, capping of RA-3 has reduced precipitation recharge and appears to have resulted in lower groundwater elevations and reduced horizontal gradients beneath this area, with a subsequent reduction in groundwater flux through this area into the central portion of the site. Fill Aquifer groundwater under post-redevelopment conditions flows onto the site from recharge areas to the west and south, and then diverges radially to the north and east and discharges along the West Waterway and Elliot Bay. The presence of the slurry wall along the perimeter of RA-4 significantly reduces Fill Aquifer discharge beneath this area, and shallow groundwater flowing north is redirected to discharge Elliot Bay east or west of RA-4. Overall, flow path lengths for Fill Aquifer groundwater are markedly increased over pre-redevelopment conditions, resulting in longer residence times for groundwater migrating across the site to discharge points along the West Waterway and Elliot Bay.

8.2 Estuarine Aquifer

The data collected from the Estuarine Aquifer monitoring wells during this study confirm that the pre-redevelopment groundwater flow directions have not changed appreciably as a result of the SWHP redevelopment. Groundwater in the Estuarine Aquifer continues to flow generally from the southwest toward the northeast, with discharge to Elliot Bay and the West Waterway. Mean groundwater flow directions are generally consistent between pre- and post-redevelopment conditions. In the northern portion of RA-4, it is likely that flow through the upper portion of the Estuarine Aquifer is diverted to northeast and northwest around a stagnation zone created by the slurry wall. Current Estuarine Aquifer groundwater gradients at the site are generally comparable to the pre-redevelopment gradients.

9 Summary of Findings

The Phase I GWCMP has successfully satisfied the general intent of all project objectives identified in the *Monitoring Plan*. A site-wide monitoring network consisting of 25 Fill Aquifer and five Estuarine Aquifer monitoring wells, and several surface water monitoring stations in the LFOL was constructed, and adequate groundwater elevation, tidal influence, and water quality parameter data collected to define the post-redevelopment site-wide groundwater flow regime

Confirmation of the expected post-redevelopment reduction in Fill Aquifer recharge at the site was documented through several lines of evidence, including a decline in groundwater elevations, especially beneath RA-3, and in the southern portion of RA-1 adjacent to recharge areas to the south. Also, site-wide increases in groundwater temperatures over the course of the monitoring period suggest a reduced component of direct infiltration.

Confirmation of anticipated post redevelopment reductions in downward vertical gradients was somewhat hampered by limited available historic data with which to make direct comparison. This limitation notwithstanding, downward post redevelopment vertical gradients between the Fill and Estuarine Aquifers were generally weakly downward except in the area between the northern end of RA-3 and Elliot Bay, where upward gradients were present for extended periods in both 2002 and 2003.

This study has adequately characterized the effect that closing of the LFOL equalization basins and tightlining the LFOL has had on Fill Aquifer flow conditions. Inland tidal influence along the former equalization basins has been eliminated, and the LFOL currently appears to have little or no effect on the Fill Aquifer flow regime. Fill Aquifer groundwater no longer discharges to the LFOL through the equalization basins, but instead flows north and east across the site along much longer flow paths, eventually discharging along the West Waterway and Elliot Bay. Post-redevelopment Fill Aquifer water levels beneath the main portion of the site could not be directly compared to historic data, due to a lack of available data and the complicating effect of the former equalization basins. However, pre-redevelopment Fill Aquifer horizontal gradients recorded in the vicinity of the former equalization basins were as much as an order of magnitude higher than average post-redevelopment gradients, indicating that groundwater discharge rates, especially for water flowing beneath RA-3, were considerably higher under pre-redevelopment conditions, when much of the Fill Aquifer "short circuited" into the equalization basins and out the LFOL. Under post redevelopment conditions, the low horizontal Fill Aquifer gradients beneath RA-5 and the Original Terminal 5 Area confirm that shallow groundwater water is moving very slowly towards the West Waterway and Elliot Bay.

The expected post redevelopment reduction in leachate generation from the former West Seattle Landfill (RA-3) can be demonstrated through several lines of evidence. Reduced precipitation infiltration through the solid waste is evidenced by the generally lower post-redevelopment groundwater elevations and horizontal gradients beneath RA-3 recorded

during this study. Additionally, generally increasing pH levels in well CMP-4 along the eastern margin of RA-3 suggest that lower water levels beneath RA-3 are resulting in decreased water quality impacts from saturated refuse.

10 Recommended Phase II Water Quality Monitoring Program

The findings of the Phase I GWCMP indicate that overall Fill Aquifer flow conditions at the site have equilibrated sufficiently to proceed with water quality evaluation. Continued equilibration of Fill Aquifer water quality is possible into the future, since aquifer residence times are high and it may take an extended period of time for groundwater representative of pre-redevelopment conditions to flush from the site. However, given that flow conditions at the site appear to have stabilized, it is appropriate to initiate a preliminary evaluation of site groundwater quality.

The following sections document recommended Fill Aquifer monitoring locations and analytes for preliminary evaluation of post-redevelopment groundwater quality at the site, a preliminary schedule for future groundwater sampling events, and a suggested methodology for evaluation of compliance with surface water quality criteria.

10.1 Recommended Fill Aquifer Monitoring Locations

Figure 10.1 presents the location of Fill Aquifer monitoring wells that are recommended for a preliminary evaluation of post-development groundwater quality upgradient of discharge points along the West Waterway and Elliot Bay. Wells MW-308N and CMP-15 are located along flow paths for Fill Aquifer groundwater moving beneath the northern portion of RA-3 and subsequently discharging to Elliot Bay to the east and west of the RA-4 slurry wall. Wells MW-26R, CMP-18 and CMP-20 are located in the Original Terminal 5 Area along the western margin of the West Waterway, and will monitor Fill Aquifer Water moving through RA-1, RA-2, RA-3 and the southern portion of RA-4 in the central part of the site. Well CMP-17, located along West Marginal Way SW near the head of the West Waterway, will monitor groundwater flowing to the West Waterway through the eastern portion of RA-2 and the portion of RA-1 between West Marginal Way SW and SW Spokane Street.

Several upgradient Fill Aquifer wells are also recommended to monitor the quality of upgradient groundwater entering the SWHP. Well CMP-5 is located immediately upgradient of RA-3 along the flow path of recharge from the adjacent West Seattle highlands. Well CMP-2 will monitor groundwater quality entering the site from the present and historic commercial/industrial areas located immediately southwest of the RA-2. Recommended background wells CMP-1 and FM-105 are located on the southern border of RA-2 and RA-1, respectively. These wells are situated along the path of Fill Aquifer groundwater flowing southward onto the SWHP from beneath Nucor Steel facility and SW Spokane Street.

It is anticipated that the initial groundwater quality evaluation will involve sampling the wells twice yearly for 3 years, as stipulated in the *Ground Water Conceptual Letter* (Port of Seattle, 1999). Sampling will take place during the periods of seasonal low (September/October) and seasonal high (December/January/February) groundwater

levels. Complete documentation of the planned groundwater sampling schedule, sampling procedures, and sample handling/management will be detailed in a GWCMP Phase II Monitoring Plan to be submitted for Ecology approval prior to the initiation of groundwater sampling.

10.2 Recommended Analytical Program

The recommended analytical program for the first six monitoring events, summarized below, is based on the analytical schedule in the *Ground Water Conceptual Letter* (Port of Seattle, 1999), modified as appropriate based on Phase I findings and current site conditions. This program may be modified, with Ecology approval, after analysis of data from the first two sampling events. Complete documentation of the planned groundwater analyses, analytical methods, specific quantitation limit requirements, QA/QC sample requirements, and data management/data validation procedures will be detailed in the forthcoming GWCMP Phase II Monitoring Plan.

- **All Wells**:

  Field Parameters: pH, Conductivity, Dissolved Oxygen, and Temperature.

  Inorganics: Arsenic, Lead.

  Organics: Carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs), Total Petroleum Hydrocarbons as Diesel and Oil, Bis(2-ethyl hexyl) phthalate.

- **CMP-17 and FM-105 (RA-1, Former Spokane Street Properties)**

  Additional Organics: Chlorinated Volatile Organics (CVOCs).

- **CMP-15, MW-26R (RA-5, Former Lockheed Site)**

  Additional Inorganics: Antimony, Chromium, Copper, Nickel.

The *Ground Water Conceptual Letter* (Port of Seattle, 1999) required that cyanide be analyzed in wells downgradient of RA-1 if the adjacent ringwall structures were used for stormwater and/or treated wastewater disposal. The ringwall structures have not to our knowledge been used for this purpose, and therefore analyses of cyanide is not proposed.

11 References

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Limitations

Work for this project was performed and this report prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Port of Seattle for specific application to the referenced property. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

Table 4.1
Summary of Monitoring Program Objectives and Findings
SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

PROJECT OBJECTIVE	OBJECTIVE STATUS	FINDINGS TO DATE
Objective #1 - Implement a site-wide ground water monitoring network to establish the SWHP post-development flow regime and support development of the Phase II ground water quality monitoring network, including assisting in defining compliance points.	Objective accomplished.	Site-wide monitoring network installed and 2 years of water level and water quality parameter monitoring completed.
Objective #2 - Document post-development assumption of reduced recharge to Fill and Estuarine Aquifers.	Objective accomplished. Adequate hydrologic information collected to satisfy Objective #2.	Documented through several lines of evidence, including reduced groundwater levels, especially beneath RA-3 and in the southern portion of RA-2 and by site-wide increases in groundwater temperatures.
Objective #3 - Confirm post-development assumption of reduction in downward vertical gradient between Fill and Estuarine Aquifers.	Objective accomplished. Adequate hydrologic information collected to satisfy Objective #3.	Post-development vertical gradients between the Fill and Estuarine Aquifers were weakly downward except in the area between the northern end of RA-3 and Elliot Bay, where upward gradients were documented.
Objective #4 - Document post-development assumption of reduced discharge to the Elliot Bay and the West Waterway from the Fill Aquifer.	Objective accomplished. Adequate hydrologic information collected to satisfy Objective #4.	Lower post-redevelopment Fill Aquifer water levels and reduced horizontal gradients, coupled with lack of discharge "short-circuiting" through the LFOL, confirm reduced post-redevelopment groundwater discharge from the site.
Objective #5 - Document post-development assumption that LFOL repair and closing of equalization basins has resulted in reduced discharge of the Fill Aquifer through or around the LFOL. Determine the post-development effect of the LFOL on the SWHP ground water system.	Objective accomplished. Adequate hydrologic information collected to satisfy Objective #5.	Tightling of LFOL appears to have resulted in elimination of groundwater discharge to the LFOL. In-line flow rate monitoring and water quality data indicate LFOL is not receiving significant groundwater leakage.
Objective #6 - Document assumed post-development reduction in leachate production from RA-3, and subsequent reduction in leachate loading to the Fill and Estuarine Aquifers.	Objective accomplished. Adequate hydrologic information collected to satisfy Objective #6.	Documented significant post-redevelopment reduction in Fill Aquifer water levels beneath RA-3, resulting in reduced saturated refuse thickness. Upward pH trend in well CMP-4 downgradient of RA-3 confirms reduced leachate generation.

Table 6.1
Summary of Phase I Monitoring Network
SWHP Phase 1 Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

Well Identification	Aquifer Unit	Installation Date	Total Boring Depth (feet bgs)	Screen Interval Depth (feet bgs)	Data Collection Method	General Site Location and Monitoring Purpose
CMP-1	Fill	9/19/2001	19	7 to 17	Manual	Upgradient of RA-2.
CMP-2	Fill	9/18/2001	19	7 to 17	8000	Upgradient of RA-2.
CMP-3	Fill	9/19/2001	17.5	6 to 16	8000	Downgradient of RA-2.
CMP-4	Fill	9/18/2001	17.5	7 to 17	8000	Upgradient of RA-1, downgradient of RA-3.
CMP-5	Fill	10/29/2001	19	5 to 15	Manual	Upgradient of RA-3.
CMP-6	Fill	9/18/2001	17.5	7 to 17	8000	Downgradient of RA-1 and RA-3, paired with Estuarine Aquifer well CMP-7.
CMP-8	Fill	9/18/2001	19	7 to 17	8000	Downgradient of RA-1 and RA-3.
CMP-9	Fill	9/18/2001	19	7 to 17	Manual	Downgradient of RA-1 and RA-3.
CMP-10	Fill	9/19/2001	16.5	5 to 15	Manual	Downgradient of RA-1, RA-3, and RA-4.
CMP-11	Fill	9/17/2001	19	6 to 16	8000	Downgradient of RA-1 and RA-3, LFOL north-south transect well.
CMP-12	Fill	9/17/2001	19	6 to 16	8000	Downgradient of RA-1 and RA-3, LFOL north-south transect well.
CMP-13	Fill	9/17/2001	19	6 to 16	8000	Downgradient of RA-1 and RA-3, LFOL north-south transect well.
CMP-14	Fill	11/5/2001	17	6.5 to 16.5	8000	Downgradient of RA's 1, 3, and 4, paired with Estuarine Aquifer well MW-36.
CMP-15	Fill	11/5/2001	17.4	7 to 17	Manual	Downgradient portion of RA-5.
CMP-16	Fill	11/5/2001	17	6.2 to 16.2	4000	Downgradient portion of RA-5.
CMP-17	Fill	11/6/2001	16.5	6 to 16	Manual	Downgradient of RA-1.
CMP-18	Fill	4/2/2003	19	7 to 17	MiniTroll	In old Terminal 5 Area, downgradient of RA's 1, 2, and 3.
CMP-19	Fill	4/2/2003	19	7 to 17	MiniTroll	In old Terminal 5 Area, downgradient of RA's 1, 3, and 4.
CMP-20	Fill	4/2/2003	19	7 to 17	MiniTroll	In old Terminal 5 Area, downgradient of RA's 1, 3, and 4.
MW-26R	Fill	11/6/2001	17	6.5 to 16.5	8000	Downgradient of RA-5, paired with Estuarine Aquifer well MW-44.
MW-5	Fill	8/3/1989	25	5 to 25	Manual	Downgradient of RA-5.
MW-125	Fill	5/13/1994	16.5	5 to 15	Manual	Downgradient of RA-1.
MW-307A	Fill	4/7/1994	26.5	15 to 20	8000	Cross/downgradient of RA-3, paired with MW-307-B, LFOL north-south transect well.
MW-308N	Fill	4/5/1994	21.5	12.5 to 17.5	8000	Downgradient of RA-1 and RA-3, paired with Fill Aquifer well MW-308-S.
FM-105	Fill	9/29/1992	19	7 to 17	Manual	Upgradient of RA-1.
CMP-7	Estuarine	11/7/2001	49	37 to 47	4000	Downgradient of RA-1 and RA-3, paired with Fill Aquifer well CMP-6.
MW-307BR	Estuarine	11/9/2001	40	29 to 39	4000	Downgradient of RA-3, paired with Estuarine Aquifer well MW-307A.
MW-36	Estuarine	7/8/1990	73	58 to 73	4000	Downgradient of RA-1 and RA-3, cross/downgradient of RA-4, upgradient of RA-5, paired with MW-8.
MW-44	Estuarine	6/23/1992	78.5	59 to 74	4000	Downgradient in RA-5, paired with Fill Aquifer well MW-26.
MW-308S	Estuarine	4/6/1994	40	35 to 40	4000	Downgradient of RA-1 and RA-3, paired with Estuarine Aquifer well MW-308-N.

Table 6.2
Allowable Time Windows for LFOL Flow and Water Quality Sampling
July 2004 Sampling Event

SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

Date	Lower-low Tide		MH-7		MH-4		MH-1	
	Time	Tide Level	Sampling Elevation - Low Tide	Time Window for Sampling	Sampling Elevation - Low Tide	Time Window for Sampling	Sampling Elevation - Low Tide	Time Window for Sampling
	(PDT)	(ft MLLW)	(ft)	(h:mm)	(ft)	(h:mm)	(ft)	(h:mm)
7/26/2004	6:42	0.32	-3.79	0:15	0.29	0:20	0.56	0:30
7/27/2004	7:48	-0.84	-2.63	0:15	1.45	1:10	1.72	1:25
7/28/2004	8:36	-1.89	-1.58	0:15	2.50	1:40	2.77	1:50
7/29/2004	9:36	-2.71	-0.76	0:15	3.32	1:55	3.59	2:00
7/30/2004	10:24	-3.22	-0.25	0:15	3.83	2:05	4.10	2:10
7/31/2004	11:18	-3.33	-0.14	0:15	3.94	2:05	4.21	2:10

Note:

Time window indicates allowable period for water sampling to occur at each location.

Table 6.3

Summary of LFOL Water Sample Analyses

SWHP Phase I Groundwater Confirmation Monitoring Program

Hydrologic Characterization Report

Chemical Name/Parameter	Sample Location, Designator and Date Collected		
	MANHOLE MH-1	MANHOLE MH-4	MANHOLE MH-7
	MH1-W-072804 07/28/04	MH4-W-072904 07/29/04	MH7-W-073004 07/30/04
Octasulfur in uS/cm	812	4360	8270
pH in pH Units	9.15	9.13	7.61
Total Dissolved Solids in mg/l	400	2000	4300
Total Suspended Solids in mg/l	4.0 U	4.0 U	400
Turbidity in NTU	1.00 U	2.6	157
Sulfate in mg/l	32.4	182	328
Chloride in mg/l	158	1300	2330
Total Alkalinity in mg/L as CaCO3	107	102	244
Ammonia-Nitrogen in mg/l as N	0.158	0.336	2.01
Nitrate/Nitrite-Nitrogen in mg/l as N	0.291	0.156	0.0318
Total Iron in mg/l	0.150 U	0.238	42.2
Total Potassium in mg/l	10.7	35.6	66
Total Sodium in mg/l	112	722	1380
Total Calcium in mg/l	31.1	45.8	111
Ferric Iron in mg/l	0.250 U	0.250 U	42
Total Magnesium in mg/l	12.3	80.8	166

Table 6.4

LFOL Channel Dimension Measurements and Flow Rate Calculations

SWHP Phase I Groundwater Confirmation Monitoring Program

Hydrologic Characterization Report

LFOL MH-1

Approximately 600' downstream from SW Spokane ST

Location (ft)	Depths (ft)	Adj. Depths (ft)	10' Travel Time (sec)
0.00	0.01	0.01	10
0.20	0.10	0.10	11
0.40	0.23	0.10	10
0.60	0.21	0.10	14
0.80	0.13	0.10	10
1.00	0.18	0.10	
1.20	0.10	0.10	
1.40	0.10	0.10	
1.60	0.18	0.18	
1.80	0.20	0.20	
2.00	0.22	0.22	
2.20	0.22	0.22	
2.40	0.25	0.25	
2.60	0.24	0.24	
2.80	0.19	0.19	
3.00	0.11	0.11	
3.20	0.01	0.01	
Width of Channel (ft)	**3.20**		
Average Depth (ft)		**0.14**	
Average Travel Time (s)			**11.0**
Velocity at Channel Surface (ft/s)			**0.91**
Average Channel Velocity (60% surface velocity) (ft/s)			**0.55**
Average Flow Rate (cfs)			**0.24**
Average Flow Rate (gpm)			**107**

LFOL MH-4

Approximately 1400' downstream of MH-1

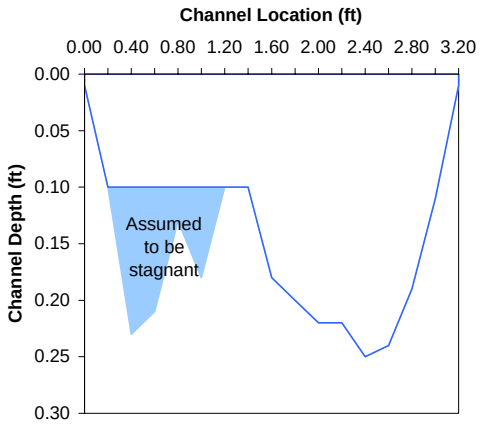
Location (ft)	Depths (ft)	10' Travel Time (sec)
0.00	0.05	12
0.40	0.10	11
0.80	0.12	11
1.20	0.14	11
1.60	0.12	11
2.00	0.14	
2.40	0.14	
2.80	0.15	
3.20	0.18	
3.60	0.00	
3.6		
	0.11	
		11.2
		0.89
		0.54
		0.22
		99

LFOL MH-7

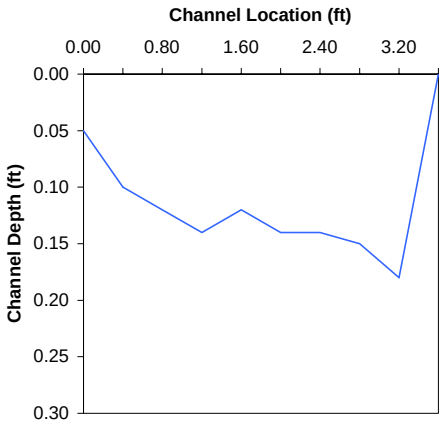
Approximately 2050' downstream of MH-4

Location (ft)	Depths (ft)	10' Travel Time (sec)
0.00	0.00	12
0.40	0.25	8
0.80	0.20	9
1.20	0.18	9
1.60	0.20	9
2.00	0.16	
2.40	0.07	
2.80	0.04	
3.00	0.00	
3		
	0.12	
		9.4
		1.06
		0.64
		0.23
		105

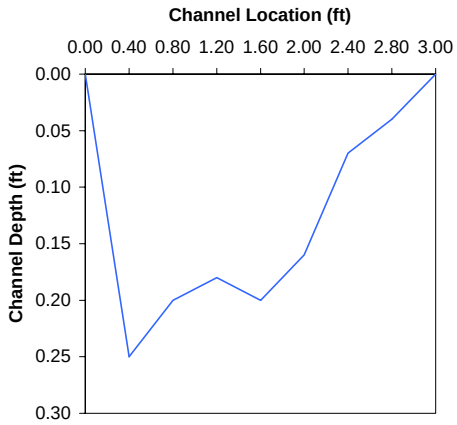
MH-1 Channel Profile

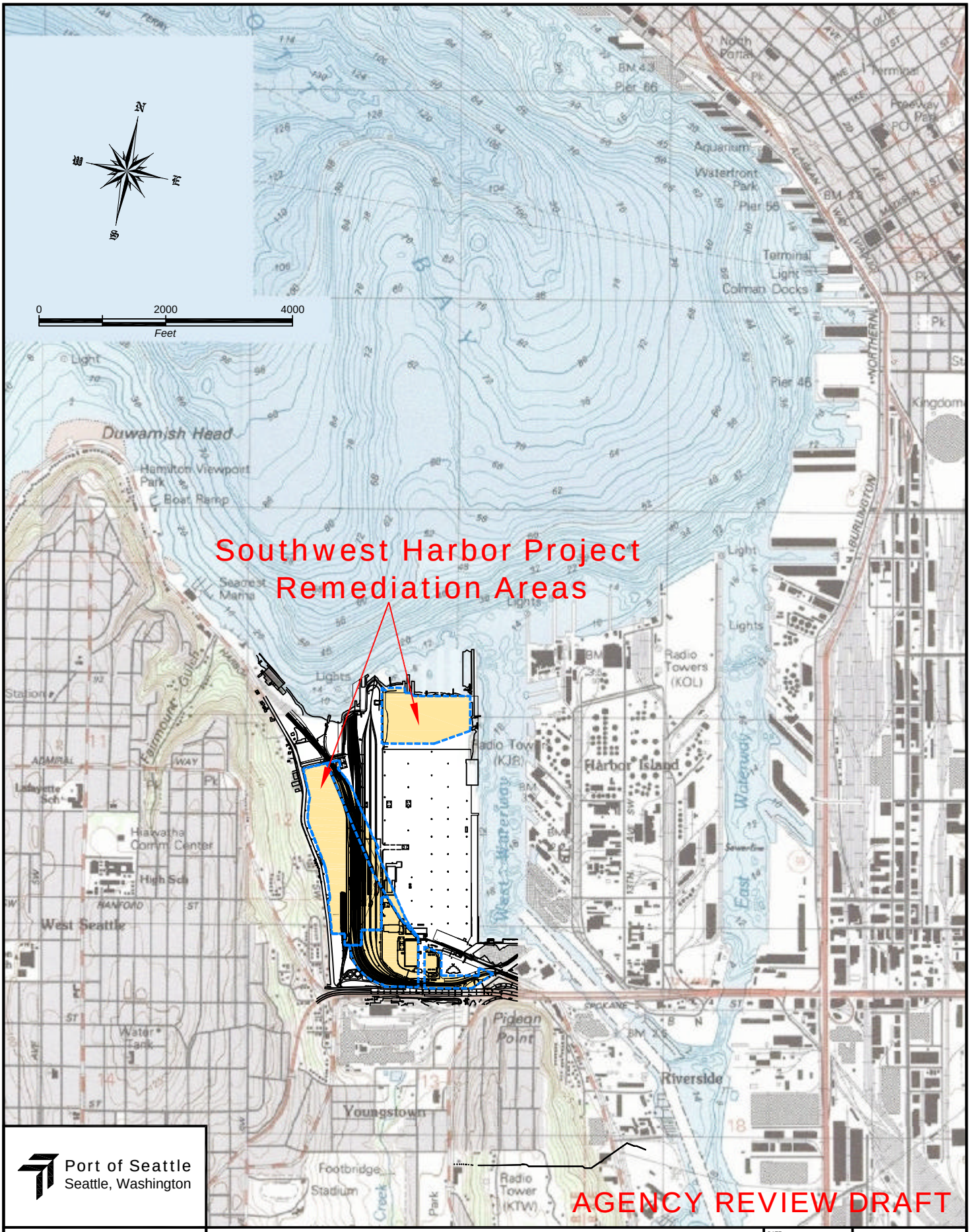


MH-4 Channel Profile



MH-7 Channel Profile





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Site Vicinity Map

SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE: March 2005	PROJECT NO. 990106
DESIGNED BY: WVG	
DRAWN BY: JJR	FIGURE NO. 2.1
REVISED BY: SDM/PMB	

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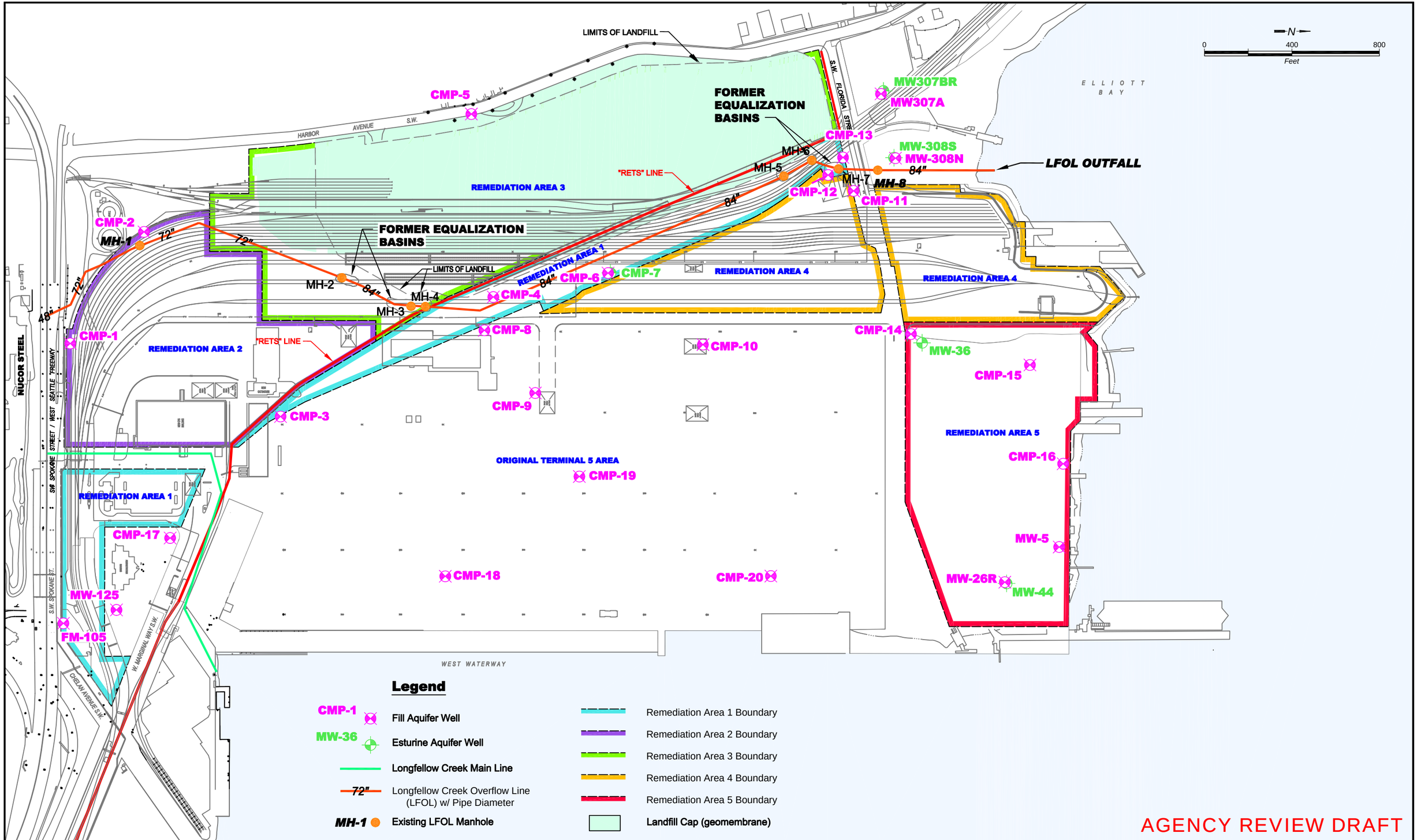

Legend

- CMP-1 — Fill Aquifer Well
- MW-36 — Esturine Aquifer Well
- Longfellow Creek Main Line
- 72" — Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
- MH-1 — Existing LFOL Manhole
- Remediation Area 1 Boundary
- Remediation Area 2 Boundary
- Remediation Area 3 Boundary
- Remediation Area 4 Boundary
- Remediation Area 5 Boundary
- Landfill Cap (geomembrane)

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Survey Update 1/8/02

Ground Water Elevation Datum: MLLW

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Site Plan

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Hydrologic Characterization Report

DATE: March 2005	PROJECT NO. 990106
DESIGNED BY: WVG	
DRAWN BY: PMB	FIGURE NO. 2.2
REVISED BY: PMB	

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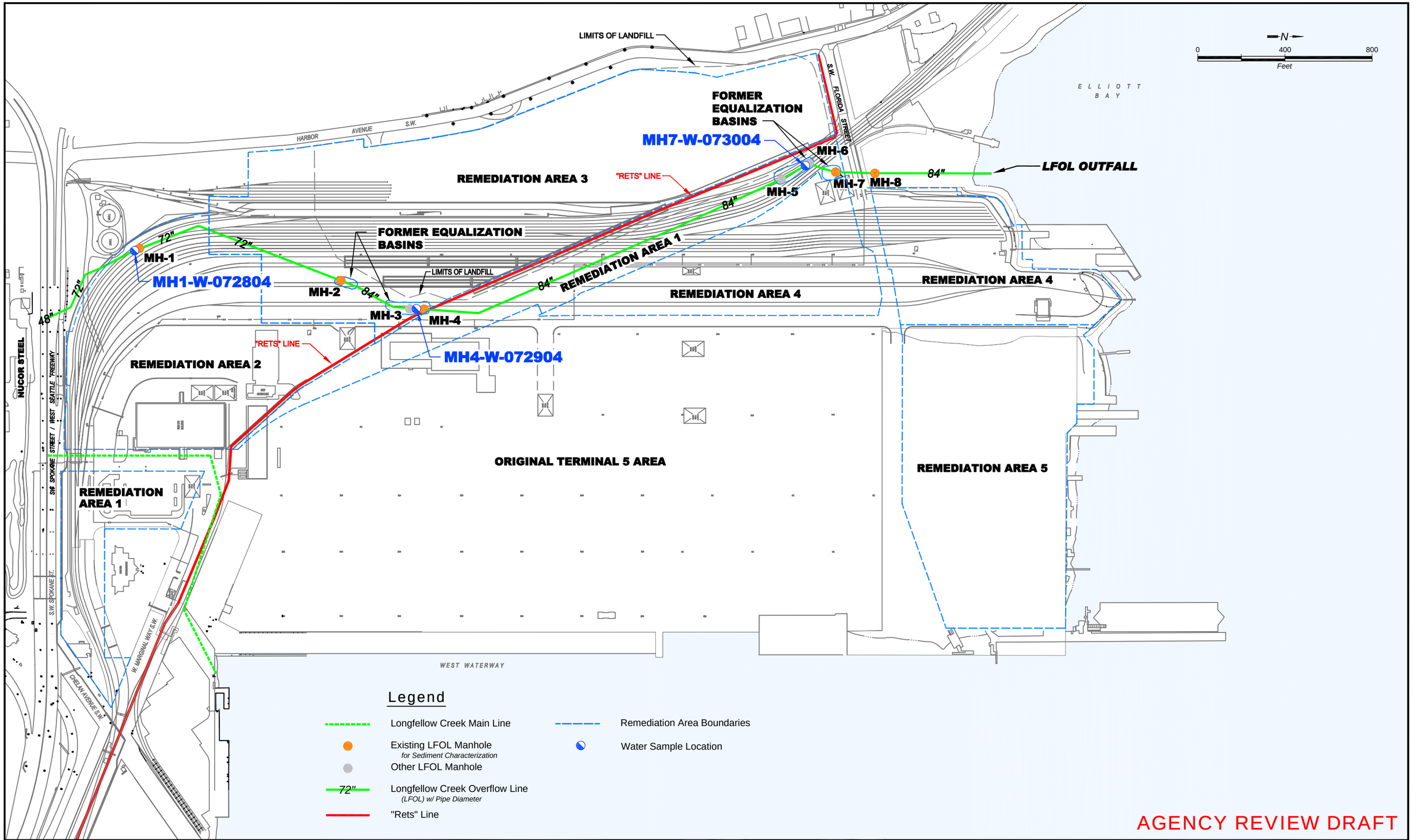

Legend

- Longfellow Creek Main Line
- Existing LFOL Manhole *for Sediment Characterization*
- Other LFOL Manhole
- 72" Longfellow Creek Overflow Line *(LFOL) w/ Pipe Diameter*
- "Rets" Line
- Remediation Area Boundaries
- Water Sample Location

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LFOL Water Quality and Flow Monitoring Stations

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Hydrologic Characterization Report

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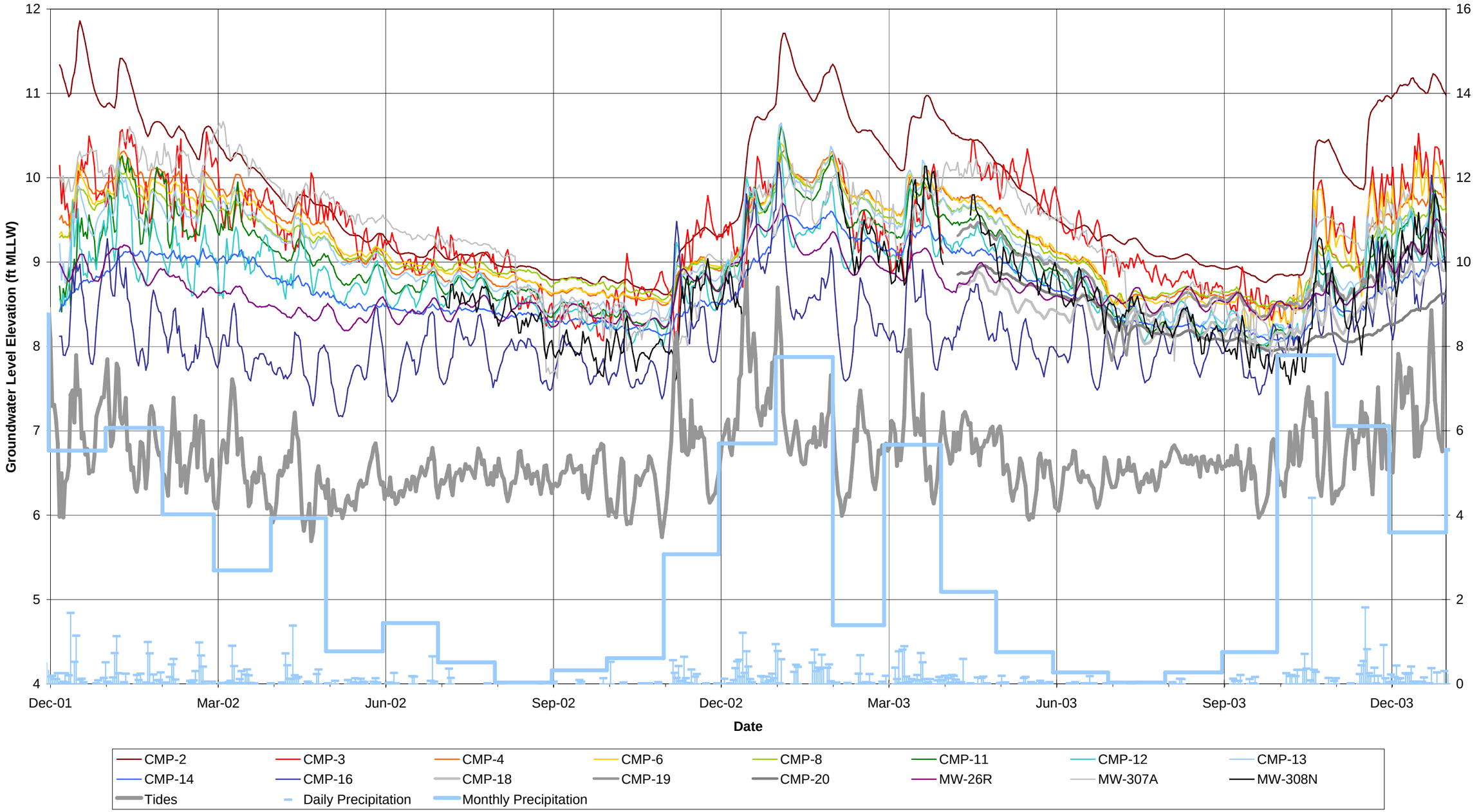

Daily Average Groundwater Level in Fill Aquifer Wells
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

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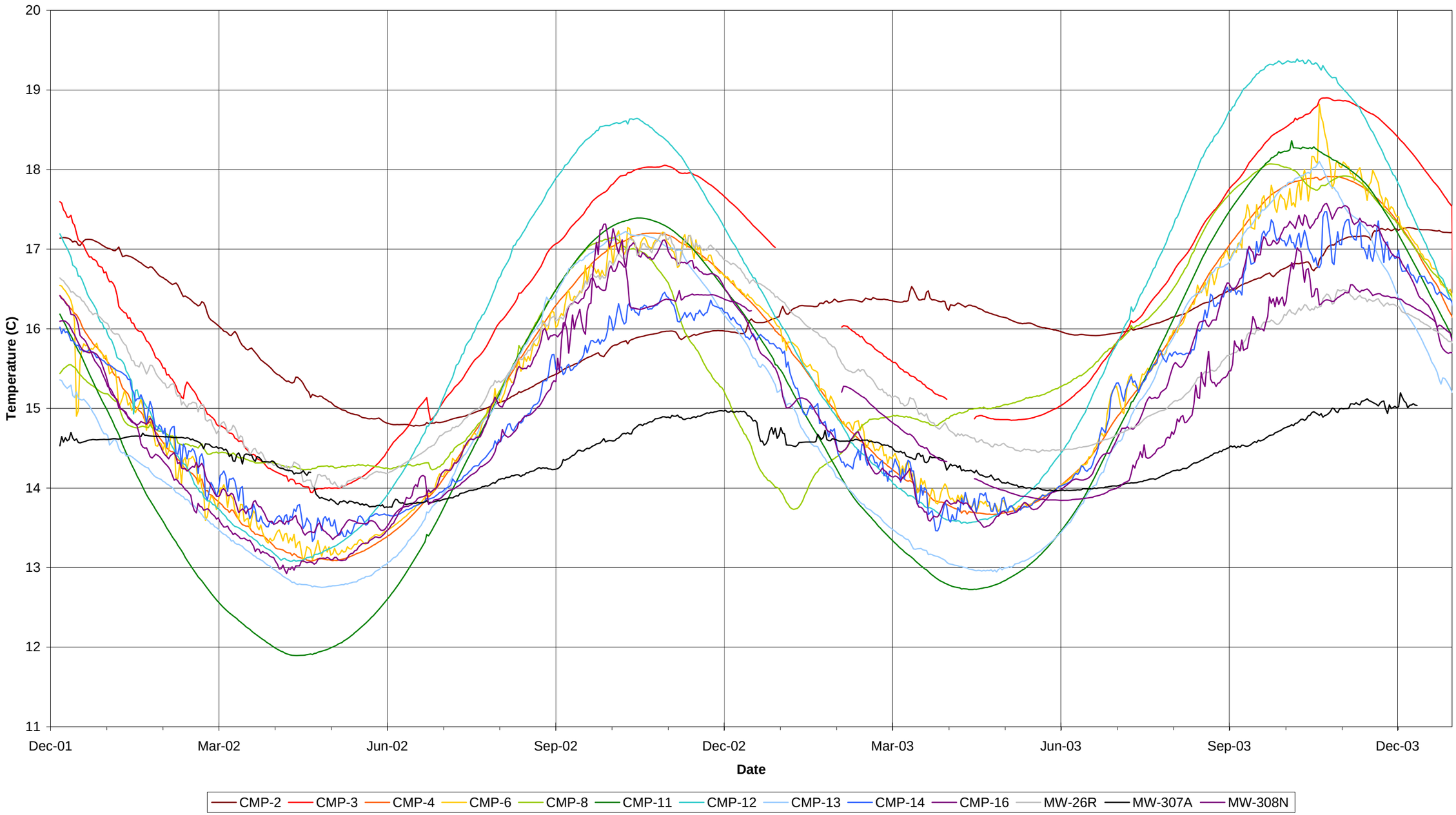
Figure 7.1



Daily Average Temperature in Fill Aquifer Wells
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

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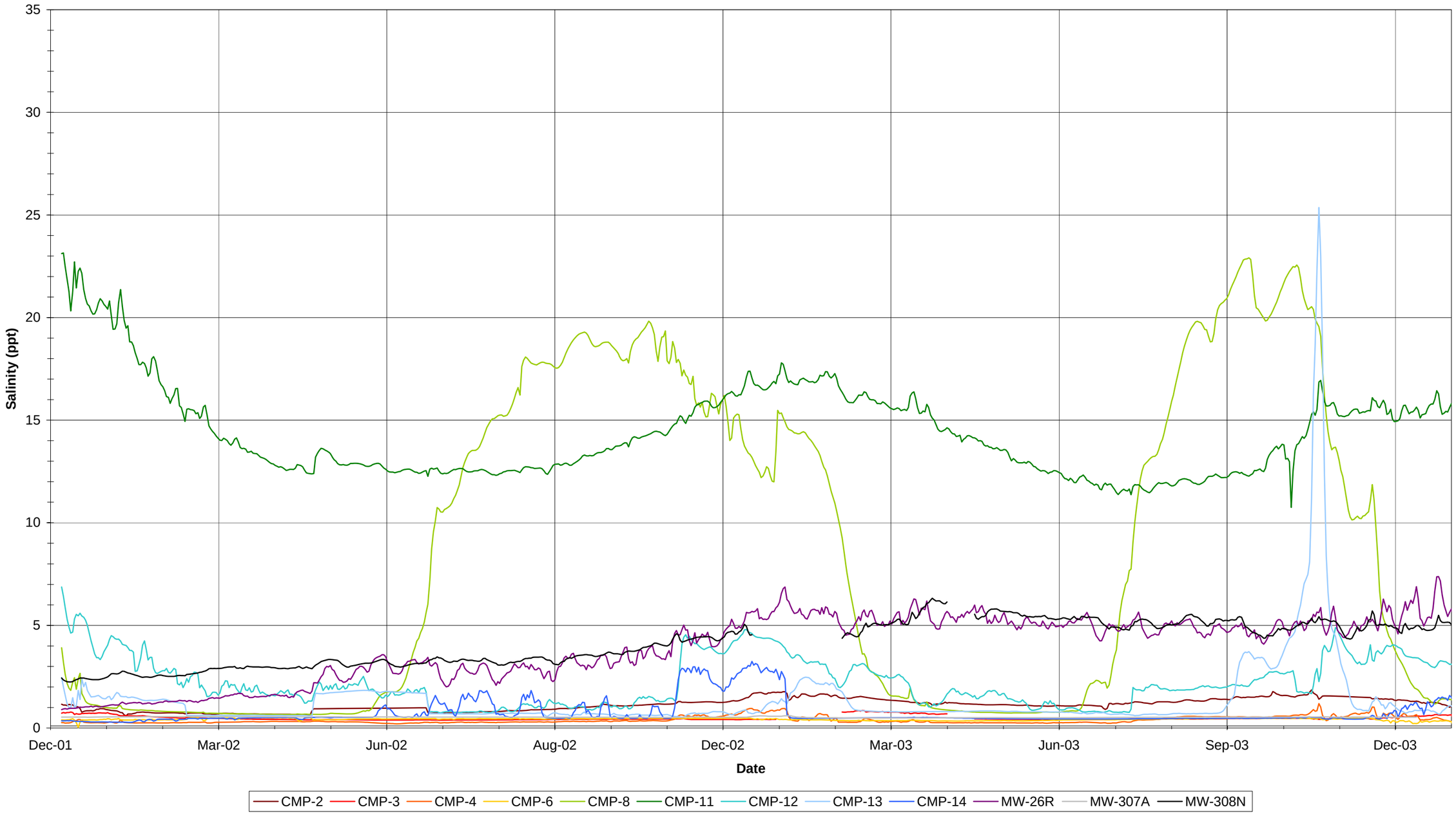
Figure 7.2



Daily Average Salinity in Fill Aquifer Wells
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

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Figure 7.3

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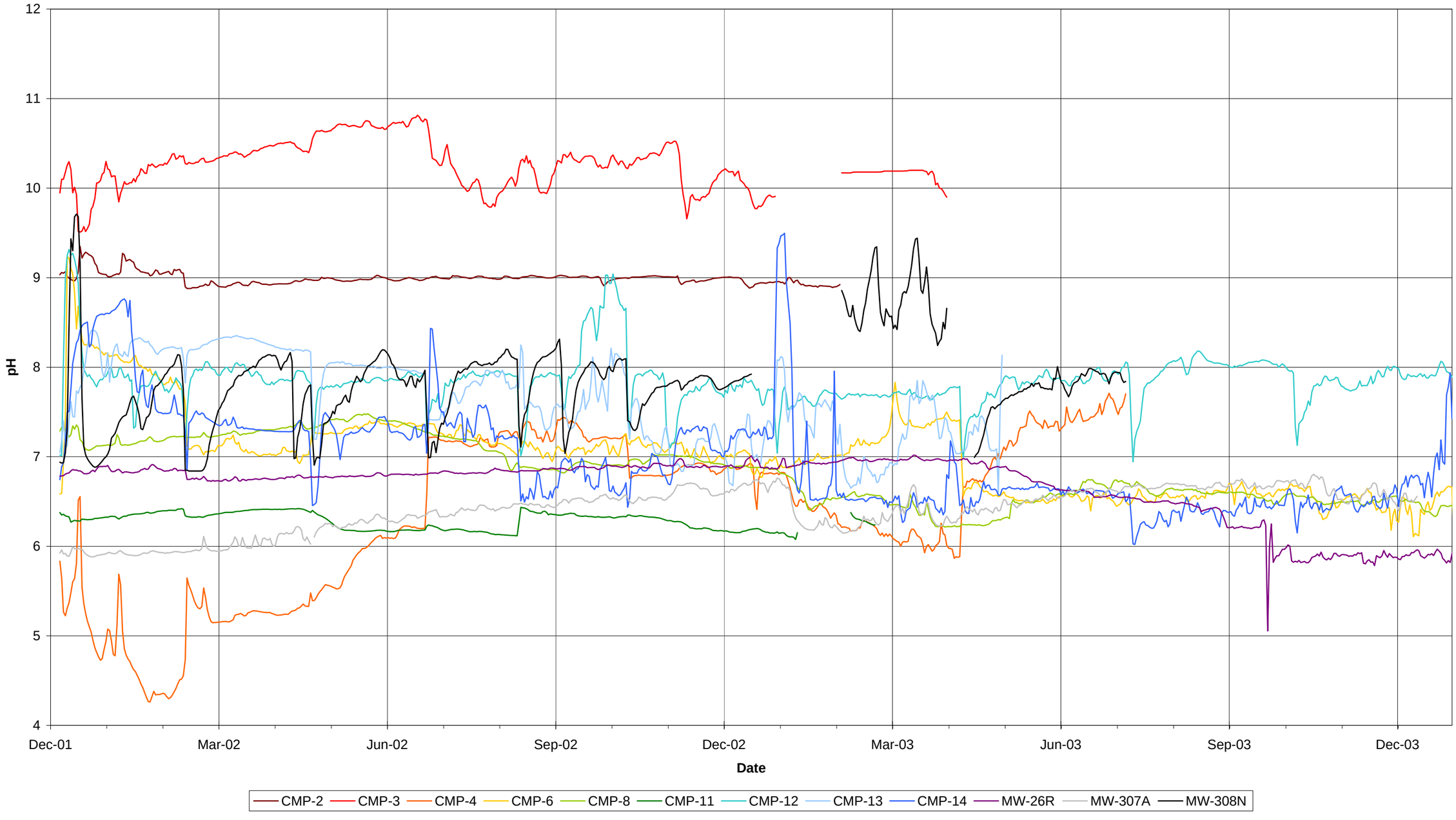

Daily Average pH in Fill Aquifer Wells
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

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Figure 7.4

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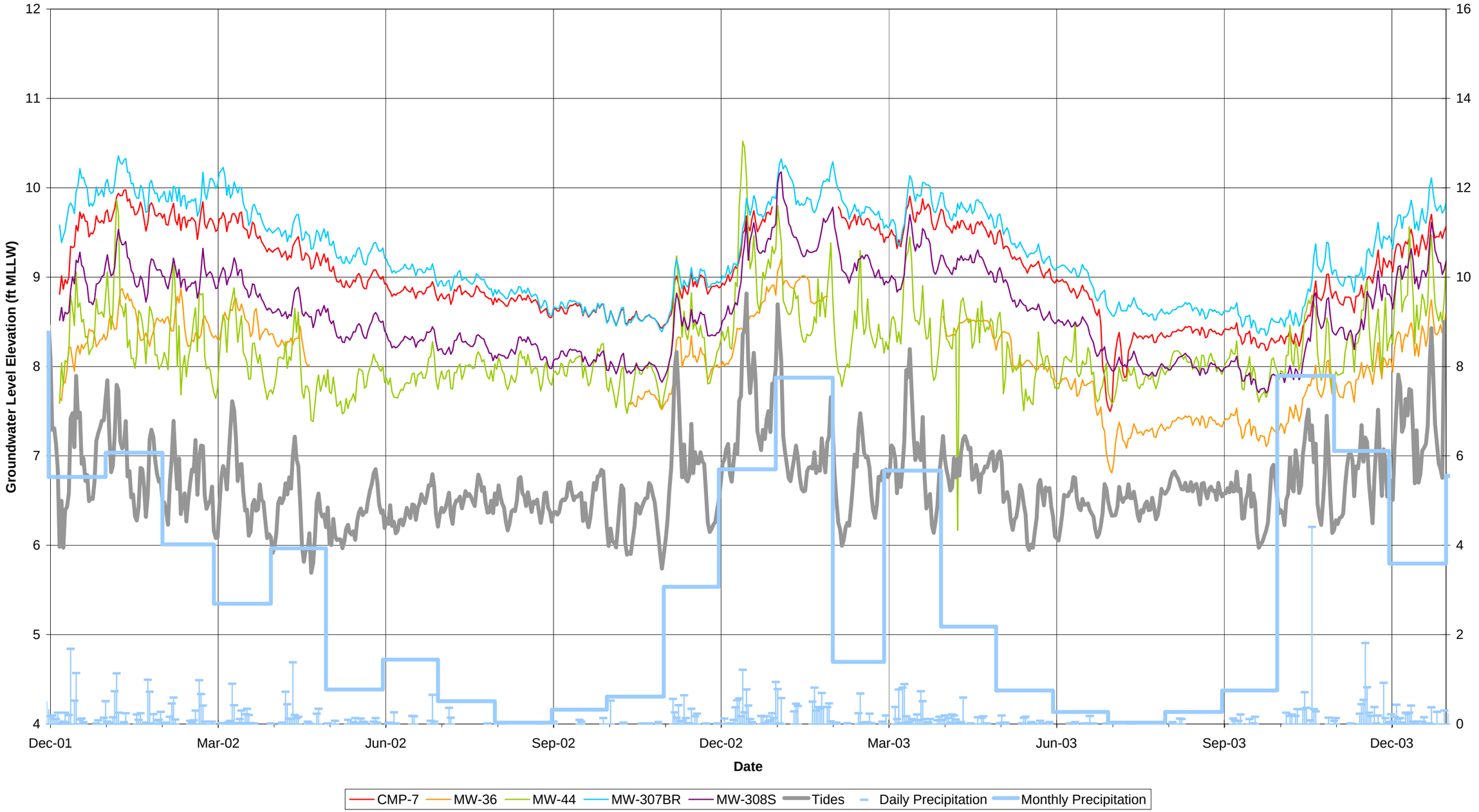

Daily Average Groundwater Level Elevation in Estuarine Aquifer Wells
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

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Figure 7.5

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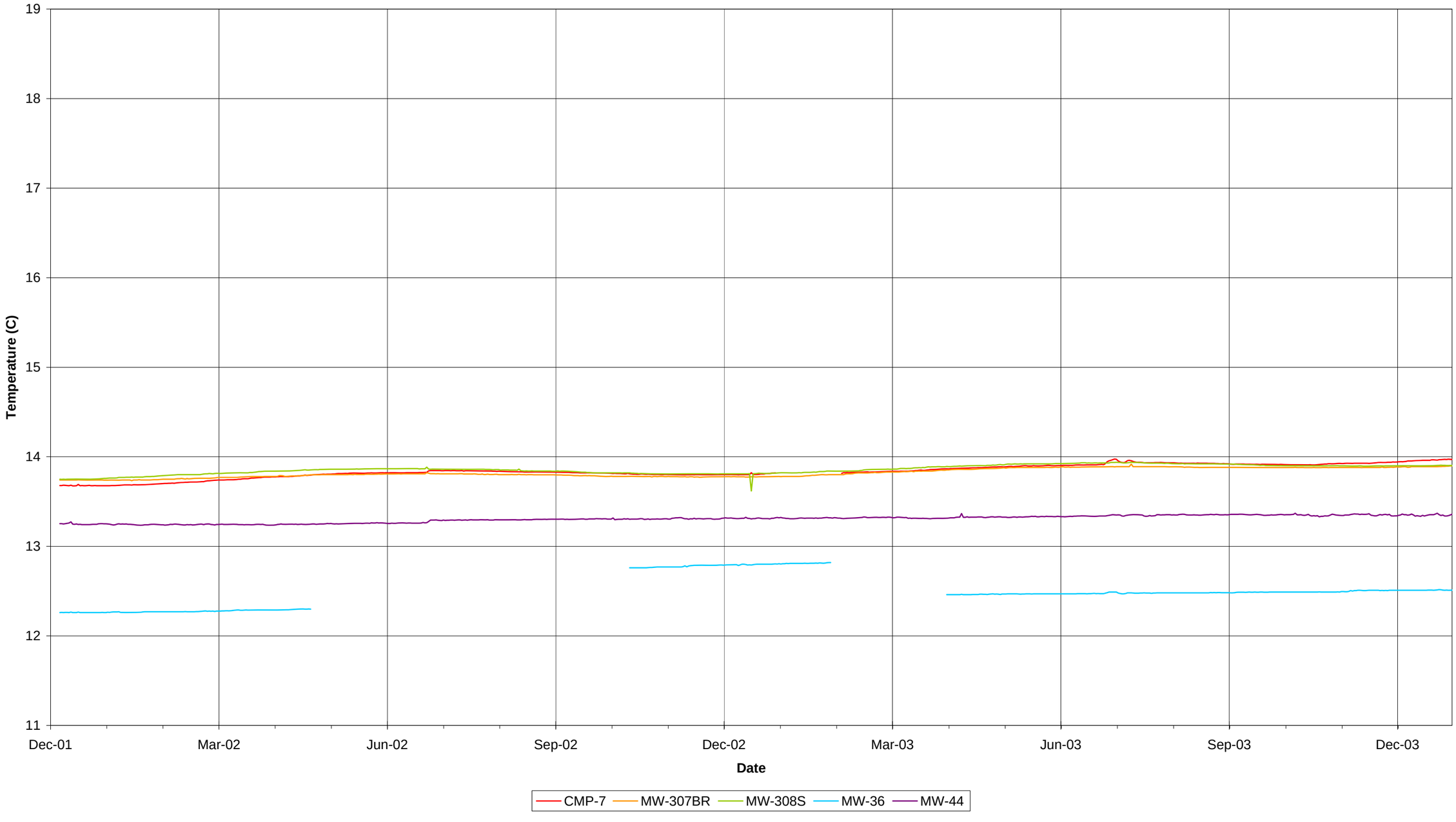

Daily Average Temperature in Estuarine Aquifer Wells
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

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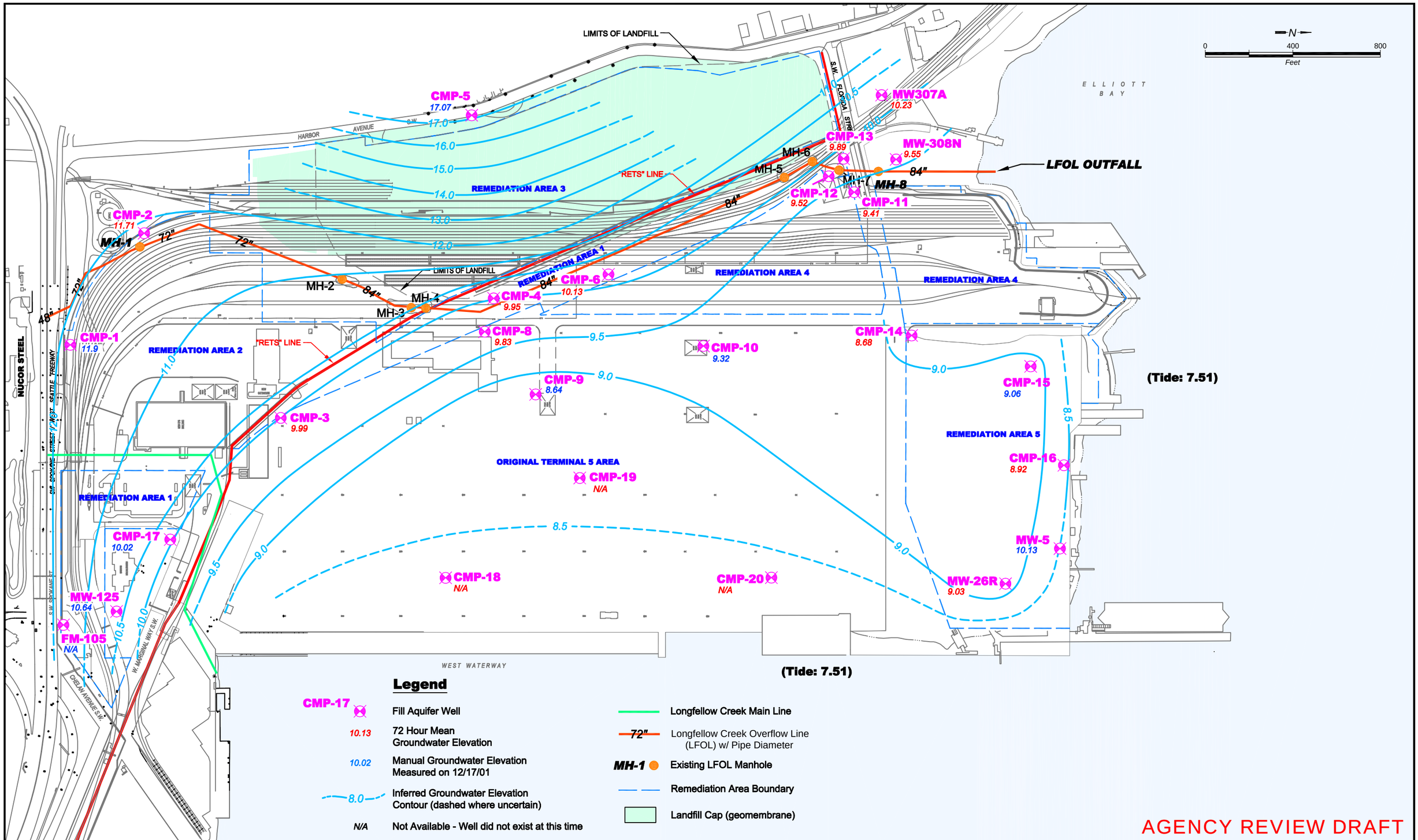
Figure 7.6



Legend

CMP-17	Fill Aquifer Well
10.13	72 Hour Mean Groundwater Elevation
10.02	Manual Groundwater Elevation Measured on 12/17/01
8.0	Inferred Groundwater Elevation Contour (dashed where uncertain)
N/A	Not Available - Well did not exist at this time
	Longfellow Creek Main Line
72"	Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
MH-1	Existing LFOL Manhole
	Remediation Area Boundary
	Landfill Cap (geomembrane)

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Survey Update 1/8/02

Note: Manual data from MW-5 not used in contouring.

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Fill Aquifer Groundwater Elevation Contours
72 Hour Mean 12-17-01

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Hydrologic Characterization Report

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DRAWN BY: PMB	FIGURE NO. 7.7
REVISED BY: PMB	

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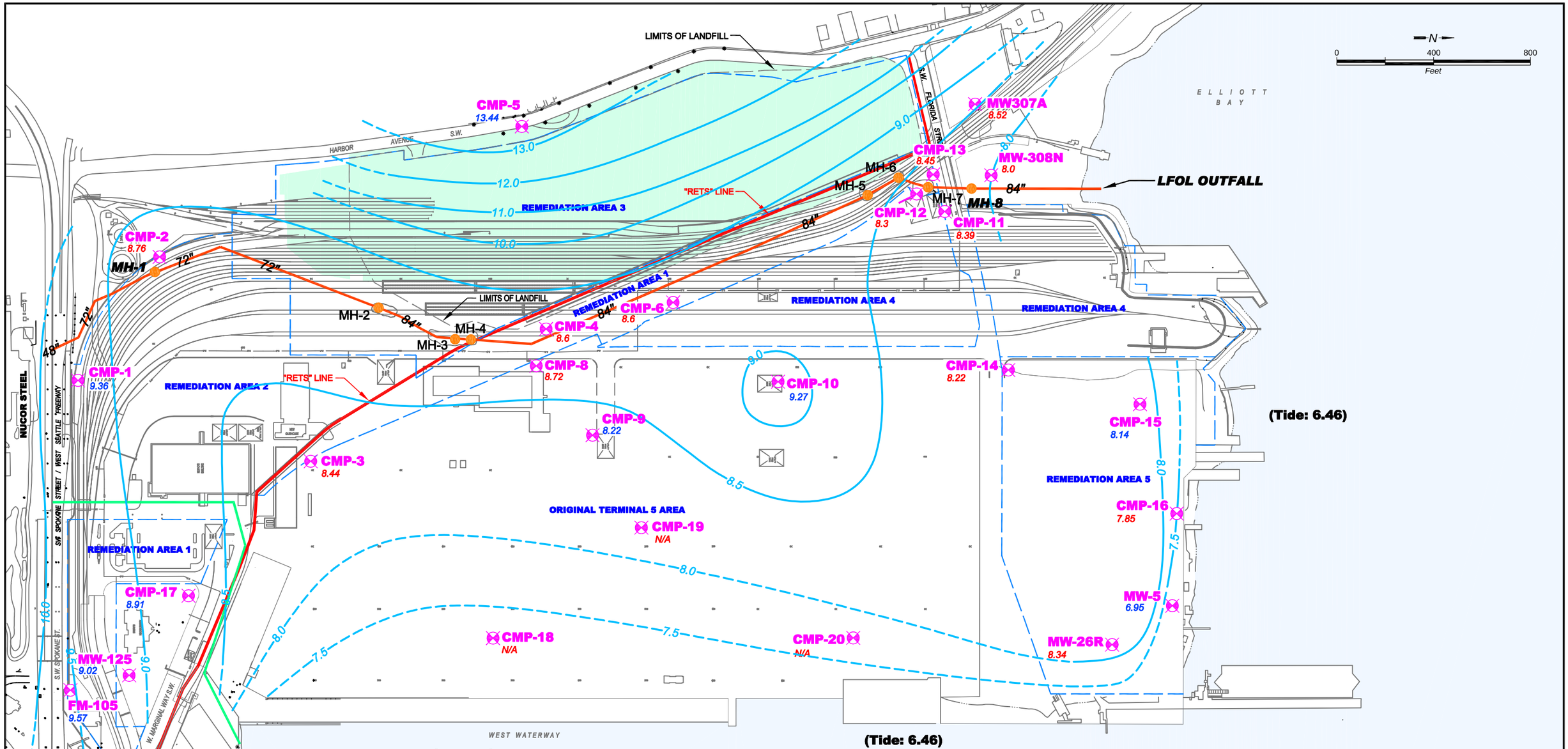

Legend

CMP-17	Fill Aquifer Well
8.44	72 Hour Mean Groundwater Elevation
8.91	Manual Groundwater Elevation Measured on 10/08/02
8.0	Inferred Groundwater Elevation Contour (dashed where uncertain)
N/A	Not Available - Well did not exist at this time
	Longfellow Creek Main Line
72"	Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
MH-1	Existing LFOL Manhole
	Remediation Area Boundary
	Landfill Cap (geomembrane)

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Survey Update 1/8/02

Note: Manual data from MW-5 not used in contouring.

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Fill Aquifer Groundwater Elevation Contours
72 Hour Mean 10-08-02

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Hydrologic Characterization Report

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DRAWN BY: PMB	FIGURE NO. 7.8
REVISED BY: PMB	

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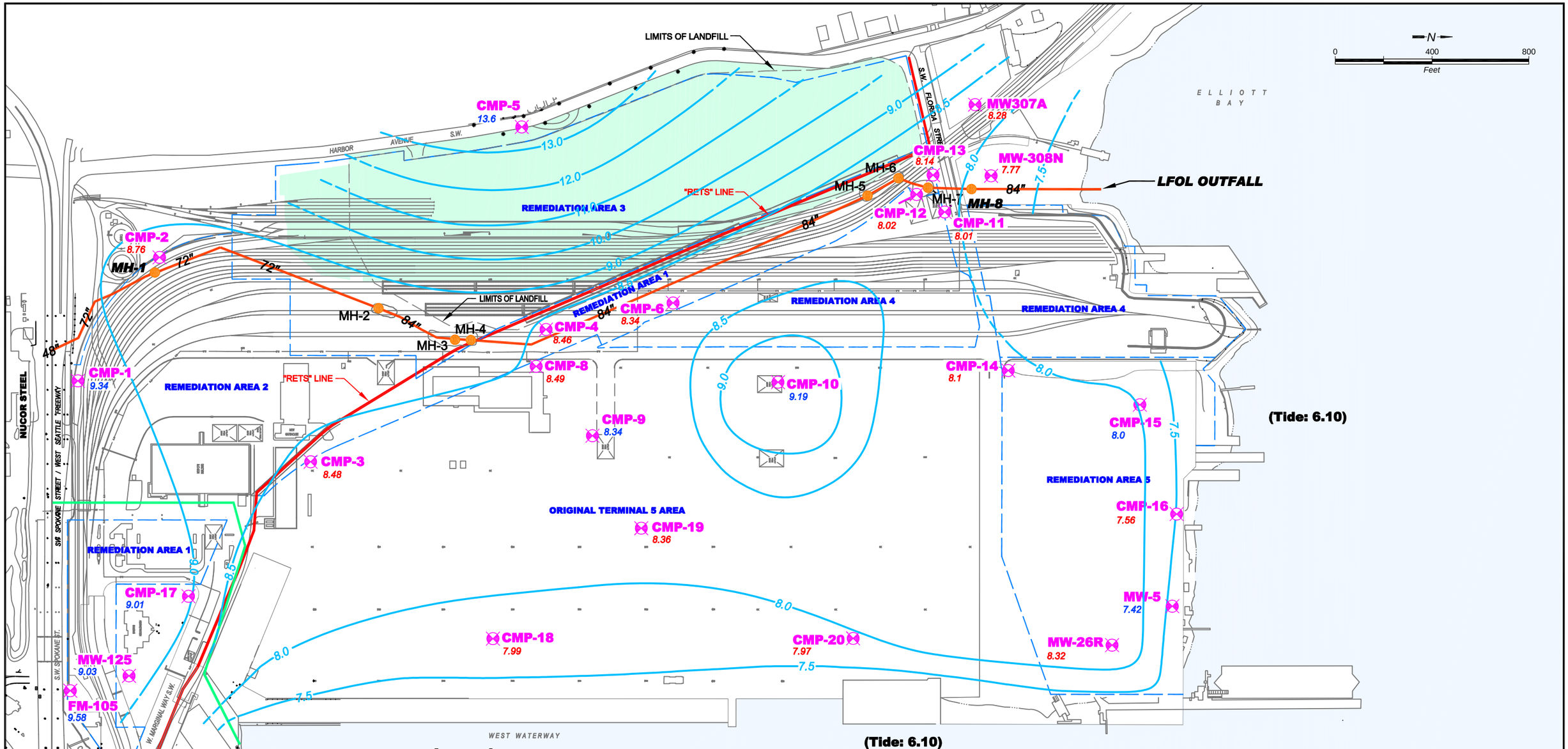

Legend

CMP-17	Fill Aquifer Well
7.99	72 Hour Mean Groundwater Elevation
9.01	Manual Groundwater Elevation Measured on 09/24/03
8.0	Inferred Groundwater Elevation Contour (dashed where uncertain)
N/A	Not Available - Well did not exist at this time
	Longfellow Creek Main Line
72"	Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
MH-1	Existing LFOL Manhole
	Remediation Area Boundary
	Landfill Cap (geomembrane)

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Fill Aquifer Groundwater Elevation Contours
72 Hour Mean 09-24-03
SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE: March 2005	PROJECT NO. 990106
DESIGNED BY: WVG	
DRAWN BY: PMB	FIGURE NO. 7.9
REVISED BY: PMB	

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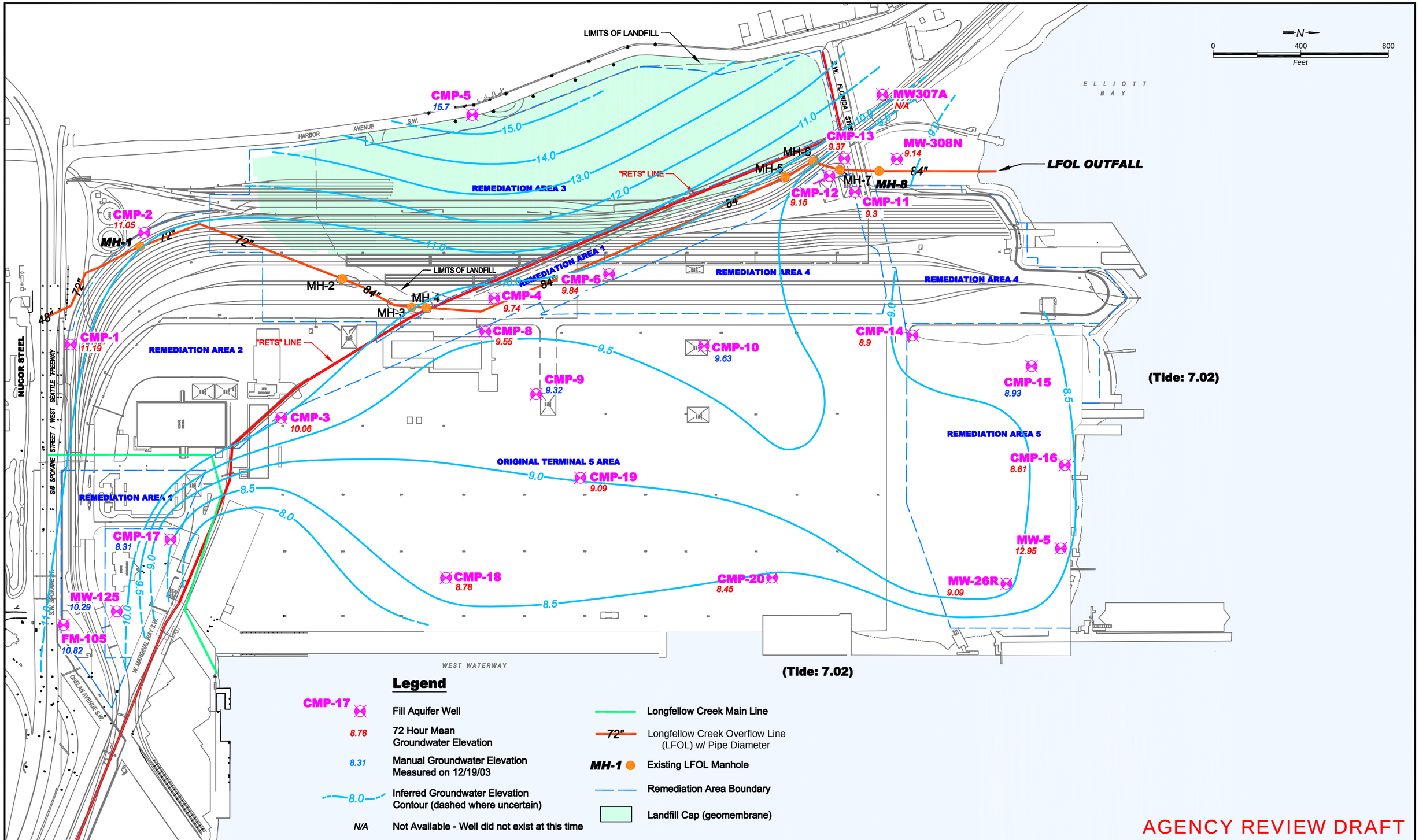

Legend

CMP-17	Fill Aquifer Well
8.78	72 Hour Mean Groundwater Elevation
8.31	Manual Groundwater Elevation Measured on 12/19/03
8.0	Inferred Groundwater Elevation Contour (dashed where uncertain)
N/A	Not Available - Well did not exist at this time
	Longfellow Creek Main Line
72"	Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
MH-1	Existing LFOL Manhole
	Remediation Area Boundary
	Landfill Cap (geomembrane)

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Survey Update 1/8/02

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Fill Aquifer Groundwater Elevation Contours
72 Hour Mean 12-19-03

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DRAWN BY: PMB	FIGURE NO. 7.10
REVISED BY: PMB	

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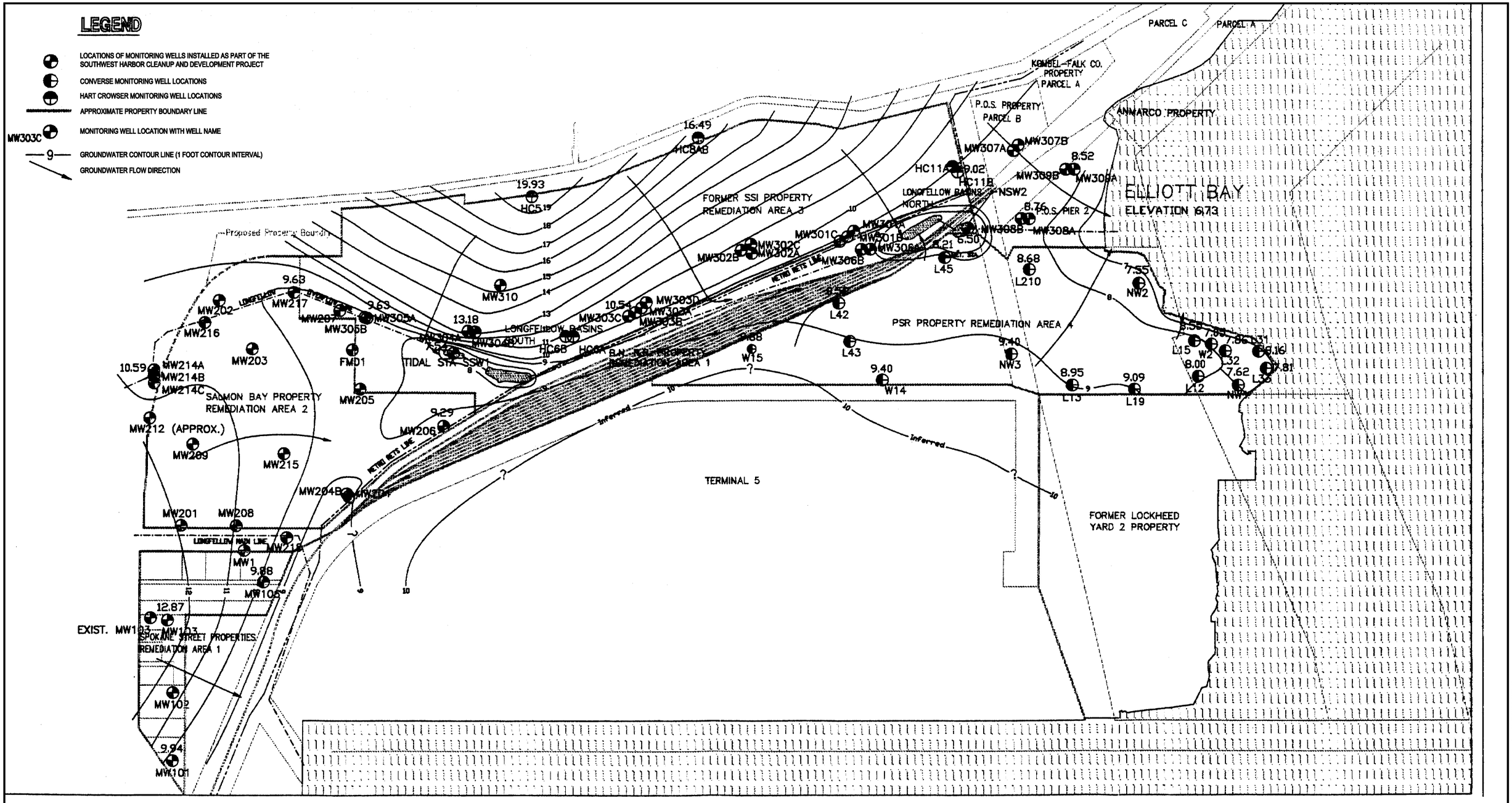
LEGEND

- LOCATIONS OF MONITORING WELLS INSTALLED AS PART OF THE SOUTHWEST HARBOR CLEANUP AND DEVELOPMENT PROJECT
- CONVERSE MONITORING WELL LOCATIONS
- HART CROWSER MONITORING WELL LOCATIONS
- APPROXIMATE PROPERTY BOUNDARY LINE
- MW303C — MONITORING WELL LOCATION WITH WELL NAME
- 9 — GROUNDWATER CONTOUR LINE (1 FOOT CONTOUR INTERVAL)
- GROUNDWATER FLOW DIRECTION



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0 400 800 1600

SCALE FEET

AGENCY REVIEW DRAFT

NOTES:

1. Elevation referenced to Port of Seattle Datum (-6.21 feet from mean sea level)
2. Elliott Bay elevation measured at Coleman Dock (located in Downtown Seattle)

Reference:

Woodward-Clyde Consultants
Tidal Study Report - Figure 3
Southwest Harbor Project - July, 1994

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Fill Aquifer Groundwater Elevation Contours (72-Hour Mean) 4-29-94

SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

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DRAWN BY: JJR	FIGURE NO. 7.11
REVISED BY: PMB	

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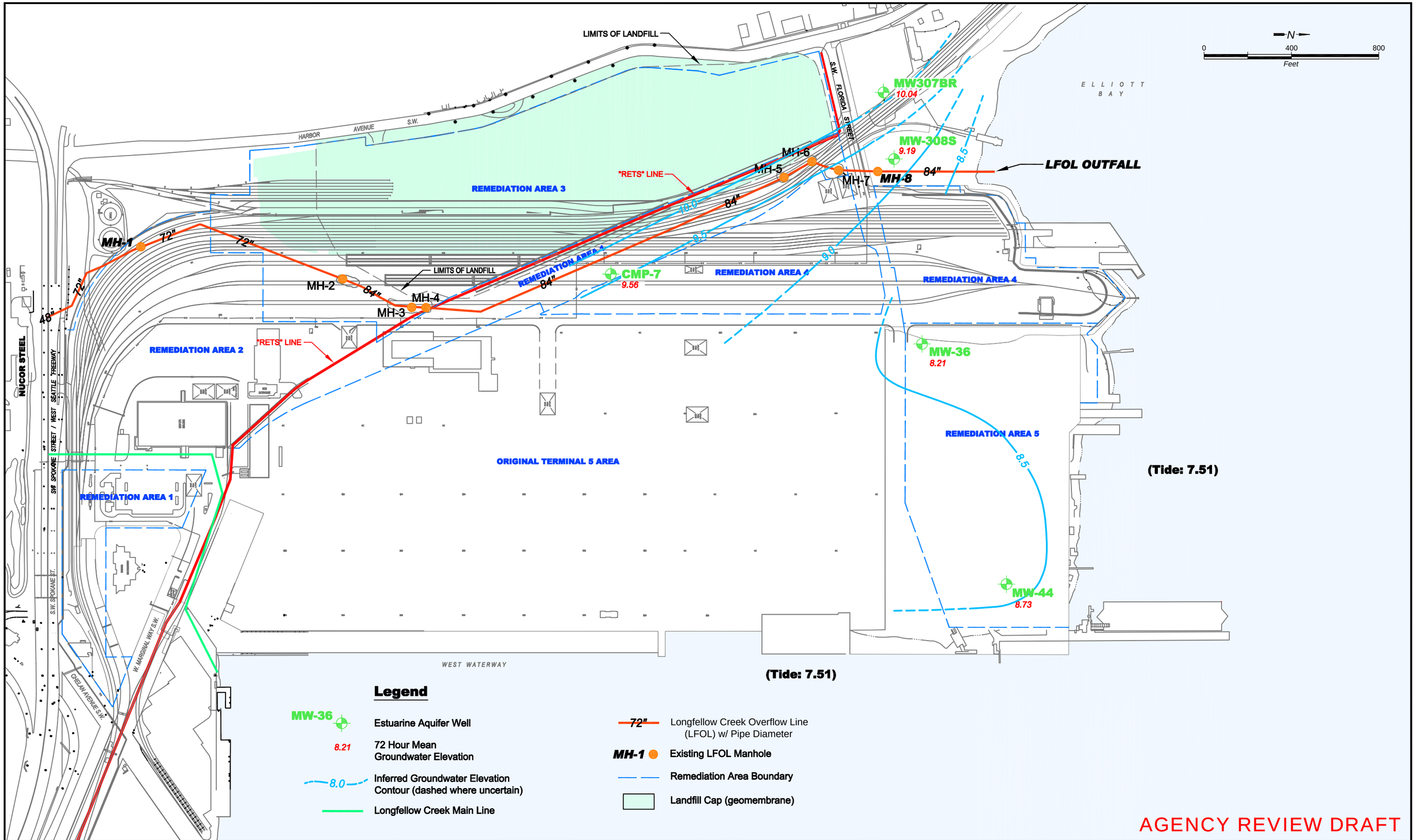

Legend

- MW-36 — Estuarine Aquifer Well
- 8.21 — 72 Hour Mean Groundwater Elevation
- 8.0 — Inferred Groundwater Elevation Contour (dashed where uncertain)
- Longfellow Creek Main Line
- 72" — Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
- MH-1 — Existing LFOL Manhole
- Remediation Area Boundary
- Landfill Cap (geomembrane)

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Survey Update 1/8/02

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Estuarine Aquifer Groundwater Elevation Contours
72 Hour Mean 12-17-01

SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE: March 2005	PROJECT NO. 990106
DESIGNED BY: WVG	
DRAWN BY: PMB	FIGURE NO. 7.12
REVISED BY: PMB	

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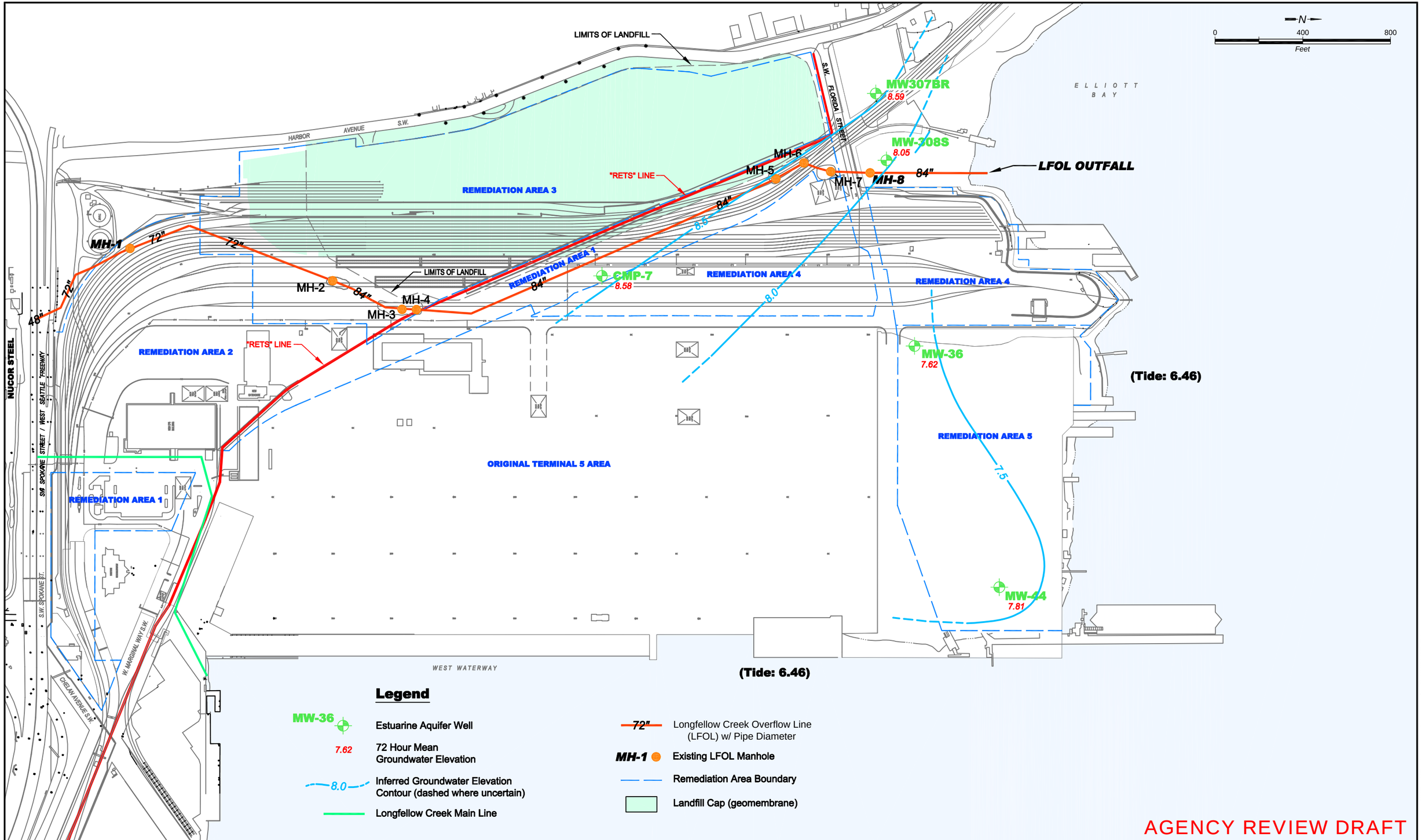

Legend

- MW-36 — Estuarine Aquifer Well
- 7.62 — 72 Hour Mean Groundwater Elevation
- 8.0 — Inferred Groundwater Elevation Contour (dashed where uncertain)
- Longfellow Creek Main Line
- 72" — Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
- MH-1 — Existing LFOL Manhole
- Remediation Area Boundary
- Landfill Cap (geomembrane)

AGENCY REVIEW DRAFT

Survey Update 1/8/02

Note: Elevation for MW-36 collected manually.

Ground Water Elevation Datum: MLLW

Port of Seattle
Seattle, Washington

Aspect consulting
IN-DEPTH PERSPECTIVE
179 Madrone Lane North
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(206) 780-9370
811 First Avenue #480
Seattle, WA 98104
(206)-328-7443

Estuarine Aquifer Groundwater Elevation Contours
72 Hour Mean 10-08-02

SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE: March 2005	PROJECT NO. 990106
DESIGNED BY: WVG	
DRAWN BY: PMB	FIGURE NO. 7.13
REVISED BY: PMB	

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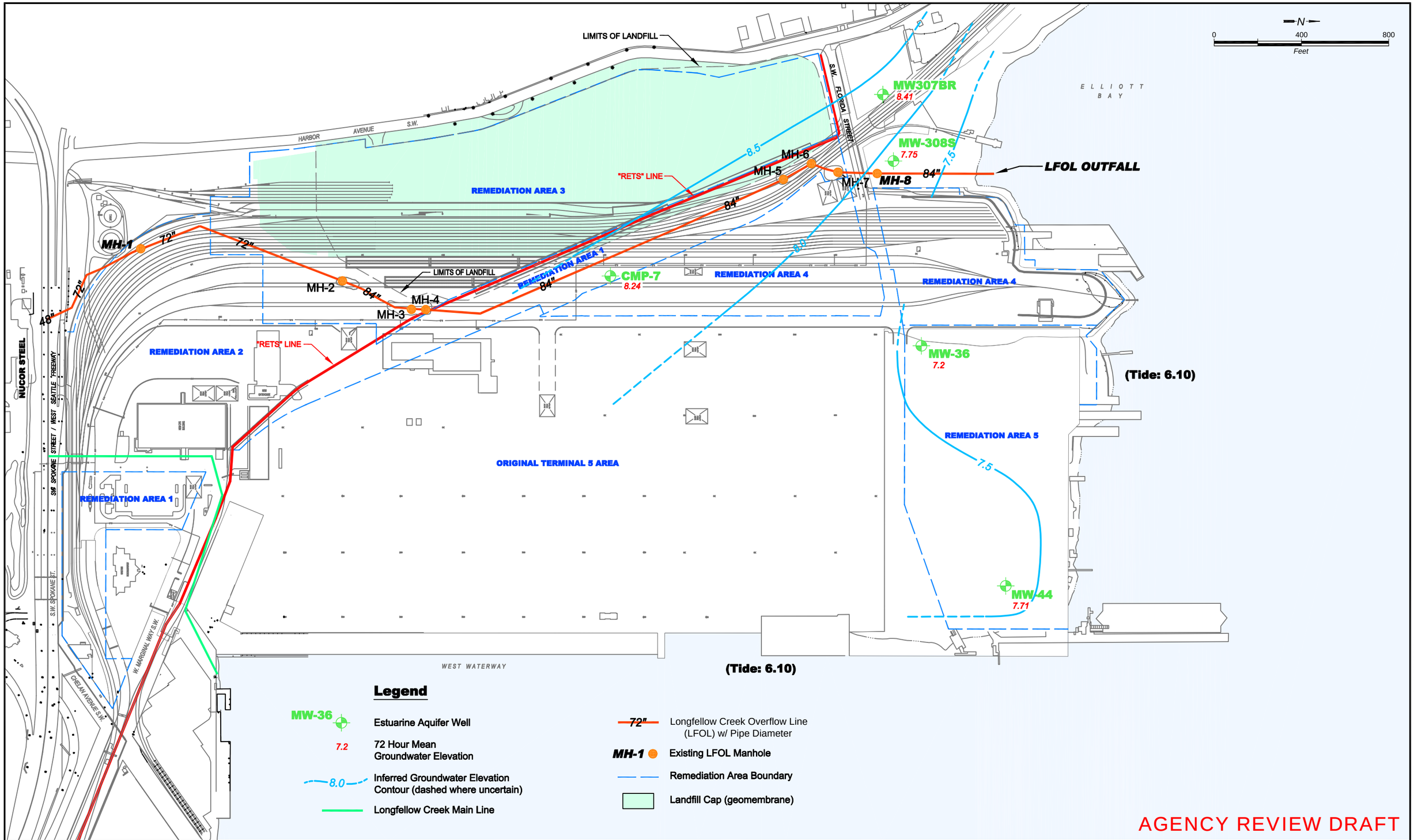

Legend

- MW-36 — Estuarine Aquifer Well
- 7.2 — 72 Hour Mean Groundwater Elevation
- 8.0 — Inferred Groundwater Elevation Contour (dashed where uncertain)
- Longfellow Creek Main Line
- 72" — Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
- MH-1 — Existing LFOL Manhole
- Remediation Area Boundary
- Landfill Cap (geomembrane)

AGENCY REVIEW DRAFT

Survey Update 1/8/02

Ground Water Elevation Datum: MLLW

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Estuarine Aquifer Groundwater Elevation Contours
72 Hour Mean 09-24-03
SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE: March 2005	PROJECT NO. 990106
DESIGNED BY: WVG	
DRAWN BY: PMB	FIGURE NO. 7.14
REVISED BY: PMB	

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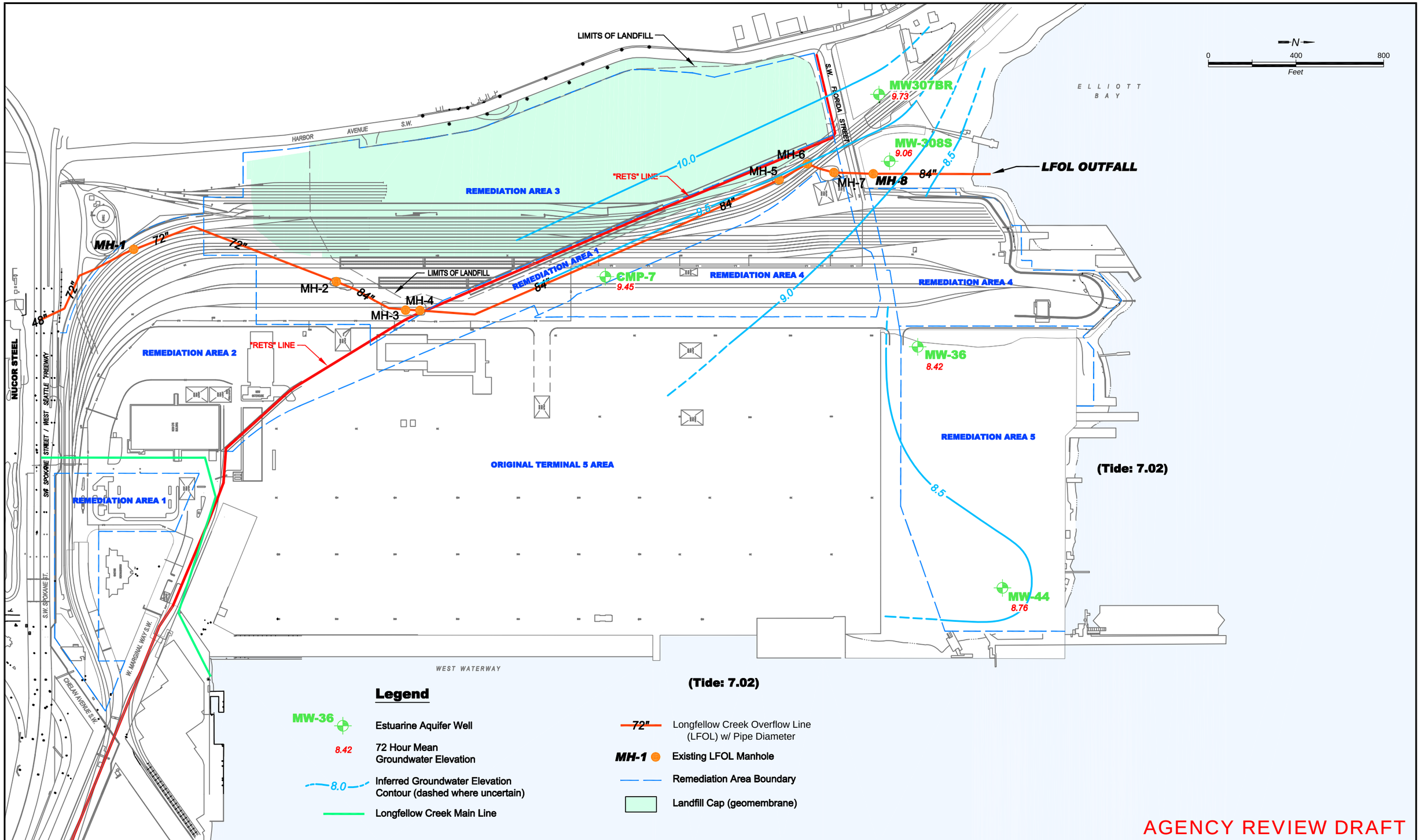

Legend

- MW-36 — Estuarine Aquifer Well
- 8.42 — 72 Hour Mean Groundwater Elevation
- 8.0 — Inferred Groundwater Elevation Contour (dashed where uncertain)
- Longfellow Creek Main Line
- 72" — Longfellow Creek Overflow Line (LFOL) w/ Pipe Diameter
- MH-1 — Existing LFOL Manhole
- Remediation Area Boundary
- Landfill Cap (geomembrane)

AGENCY REVIEW DRAFT

Survey Update 1/8/02

Ground Water Elevation Datum: MLLW

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Seattle, Washington

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Seattle, WA 98104
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Estuarine Aquifer Groundwater Elevation Contours
72 Hour Mean 12-19-03
SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE:	PROJECT NO.
March 2005	990106
DESIGNED BY: WVG	
DRAWN BY: PMB	FIGURE NO. 7.15
REVISED BY: PMB	

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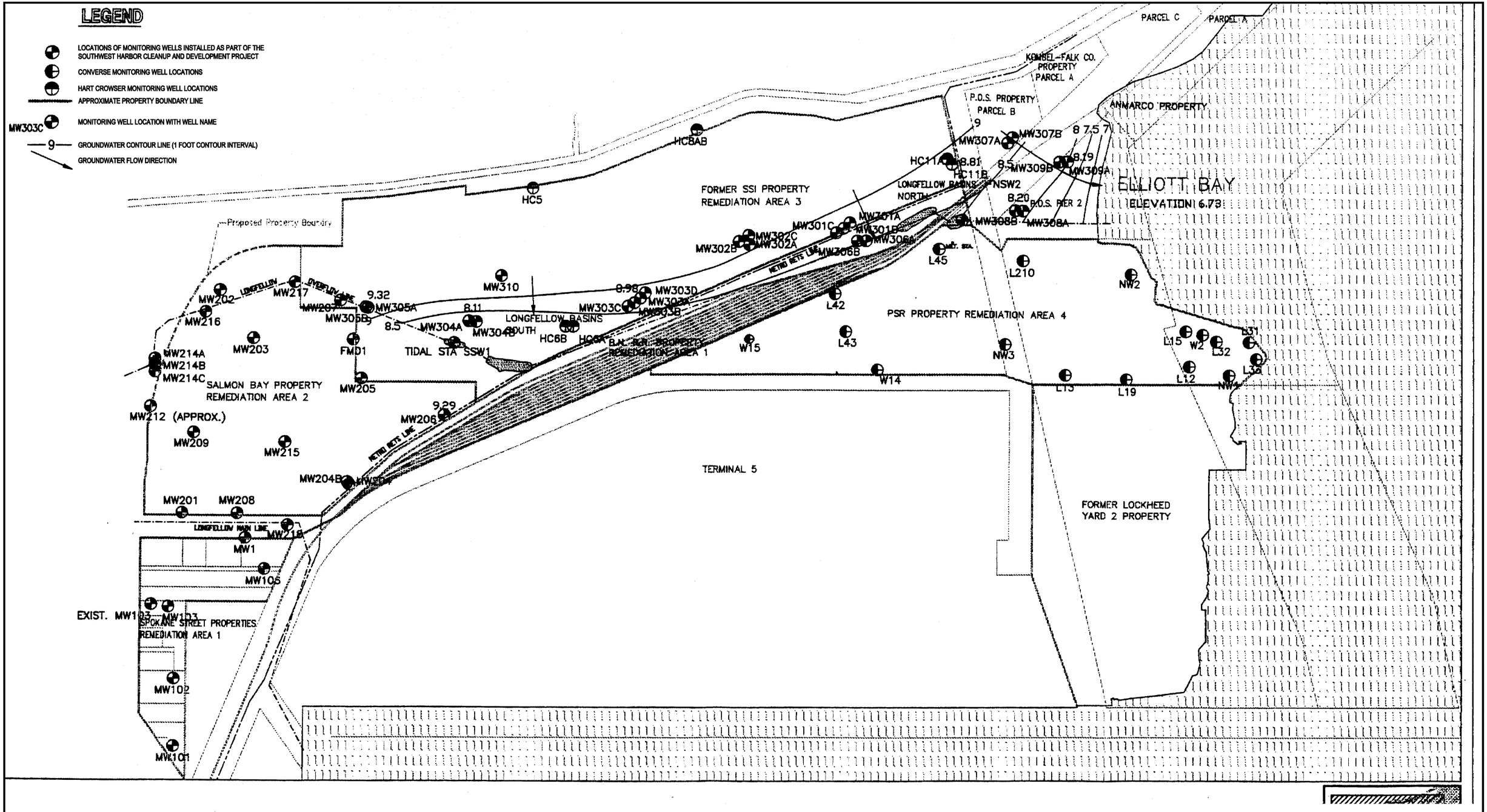
LEGEND

- LOCATIONS OF MONITORING WELLS INSTALLED AS PART OF THE SOUTHWEST HARBOR CLEANUP AND DEVELOPMENT PROJECT
- CONVERSE MONITORING WELL LOCATIONS
- HART CROWSER MONITORING WELL LOCATIONS
- APPROXIMATE PROPERTY BOUNDARY LINE
- MW303C — MONITORING WELL LOCATION WITH WELL NAME
- 9 — GROUNDWATER CONTOUR LINE (1 FOOT CONTOUR INTERVAL)
- GROUNDWATER FLOW DIRECTION



N

0 400 800 1600

SCALE FEET

NOTES:

1. Elevation referenced to Port of Seattle Datum (-6.21 feet from mean sea level)
2. Elliott Bay elevation measured at Coleman Dock (located in Downtown Seattle)

Reference:

Woodward-Clyde Consultants
Tidal Study Report - Figure 7
Southwest Harbor Project - July, 1994

AGENCY REVIEW DRAFT

Port of Seattle
Seattle, Washington

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Estuarine Aquifer Groundwater Elevation Contours (72-Hour Mean) 4-29-94

SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE:	PROJECT NO.
March 2005	990106
DESIGNED BY: WVG/SJG	
DRAWN BY: JJR	FIGURE NO. 7.16
REVISED BY: PMB	

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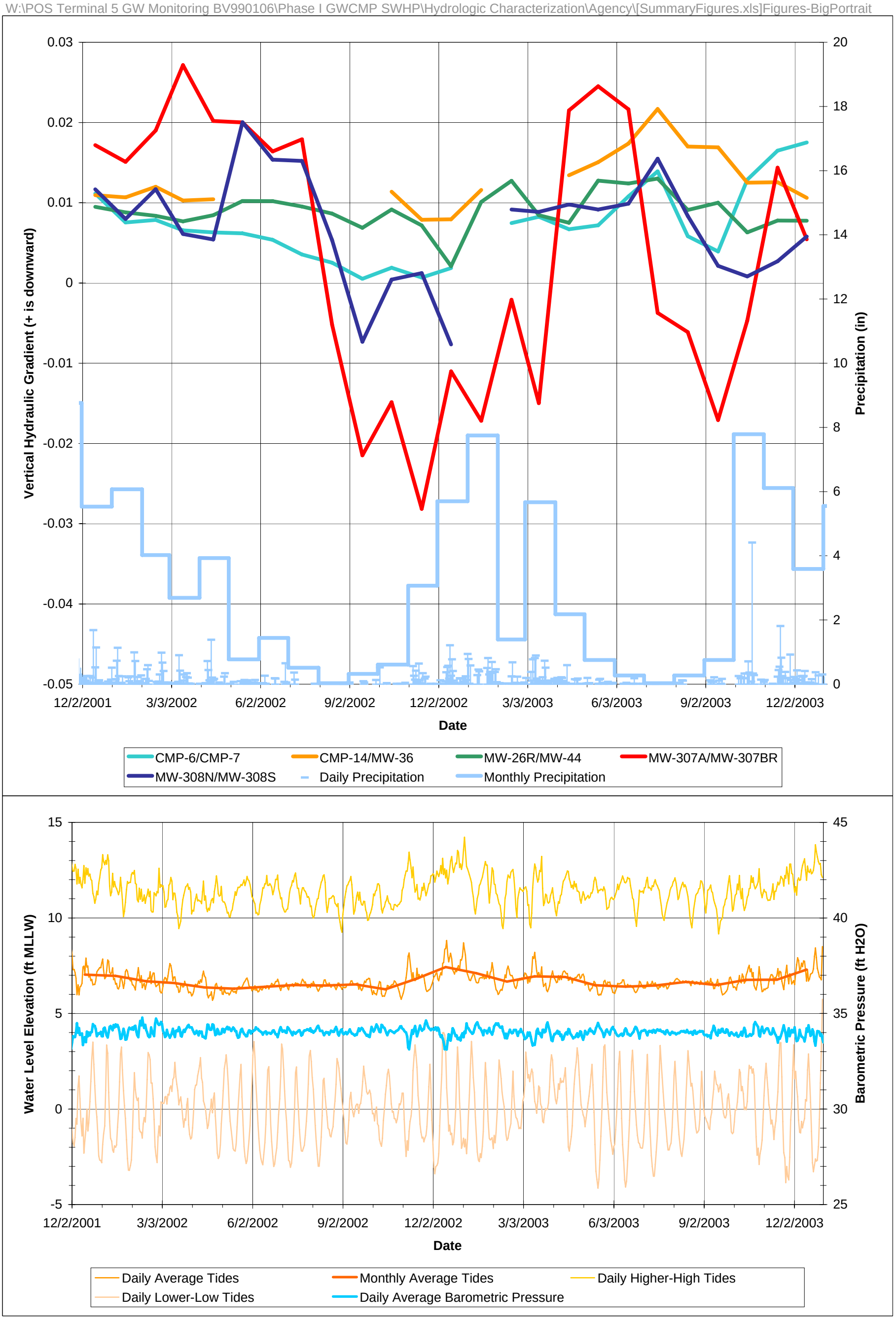
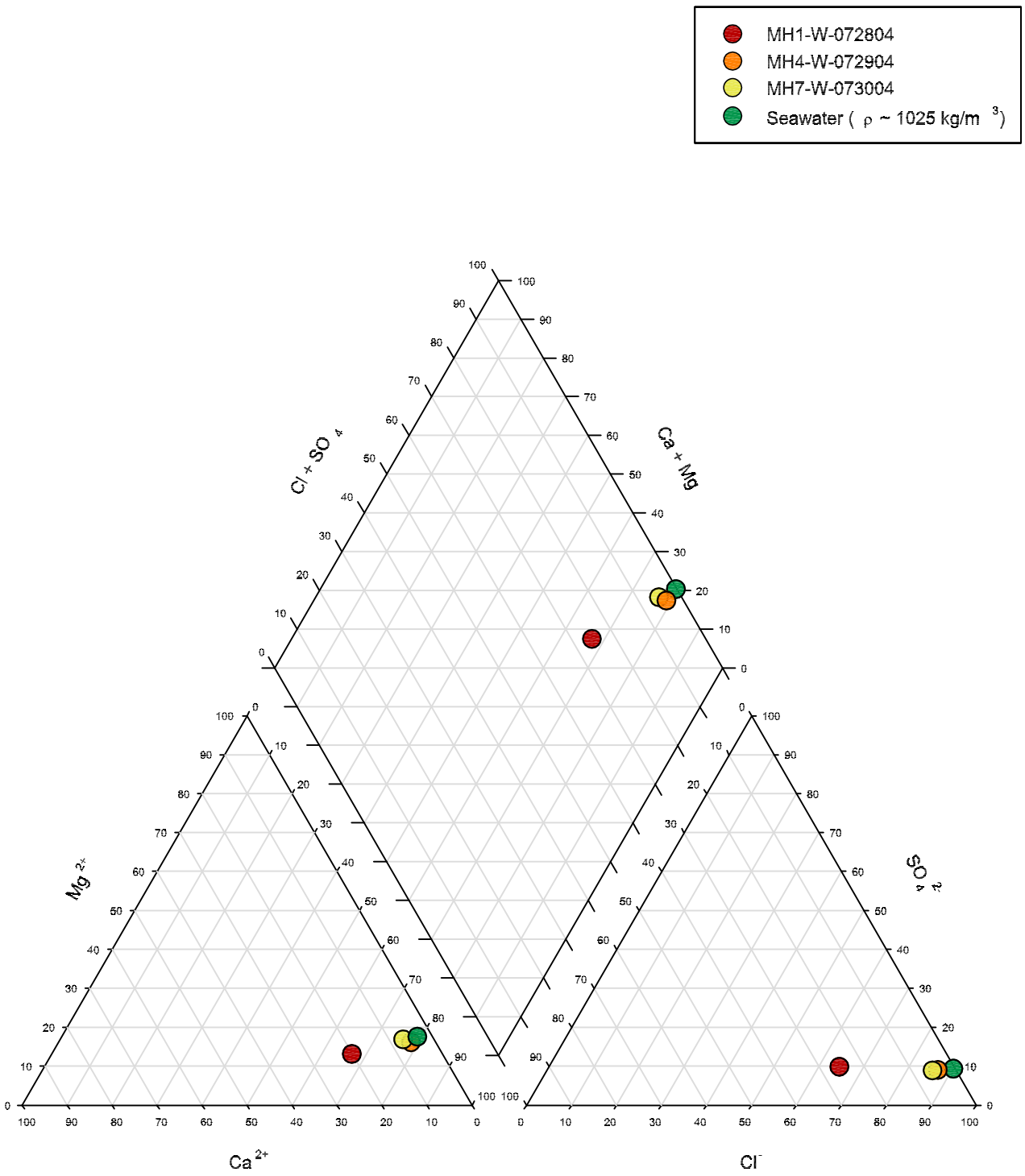


Monthly Average Vertical Groundwater Gradients and Tidal Data
Fill Aquifer/Estuarine Aquifer Well Pairs
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Aspect consulting
IN-DEPTH PERSPECTIVE

Figure 7.17

AGENCY REVIEW DRAFT



Seawater Composition From:
Drever, J.I. (1982). The Geochemistry of Natural Waters. Eaglewood Cliffs: Prentice-Hall.

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Ternary (Piper) Diagram of Major Ions
LFOL Samples
SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE: March 2005	PROJECT NO. 990106
DESIGNED BY: WVG	
DRAWN BY: PMB	FIGURE NO. 7.18
REVISED BY: PMB	

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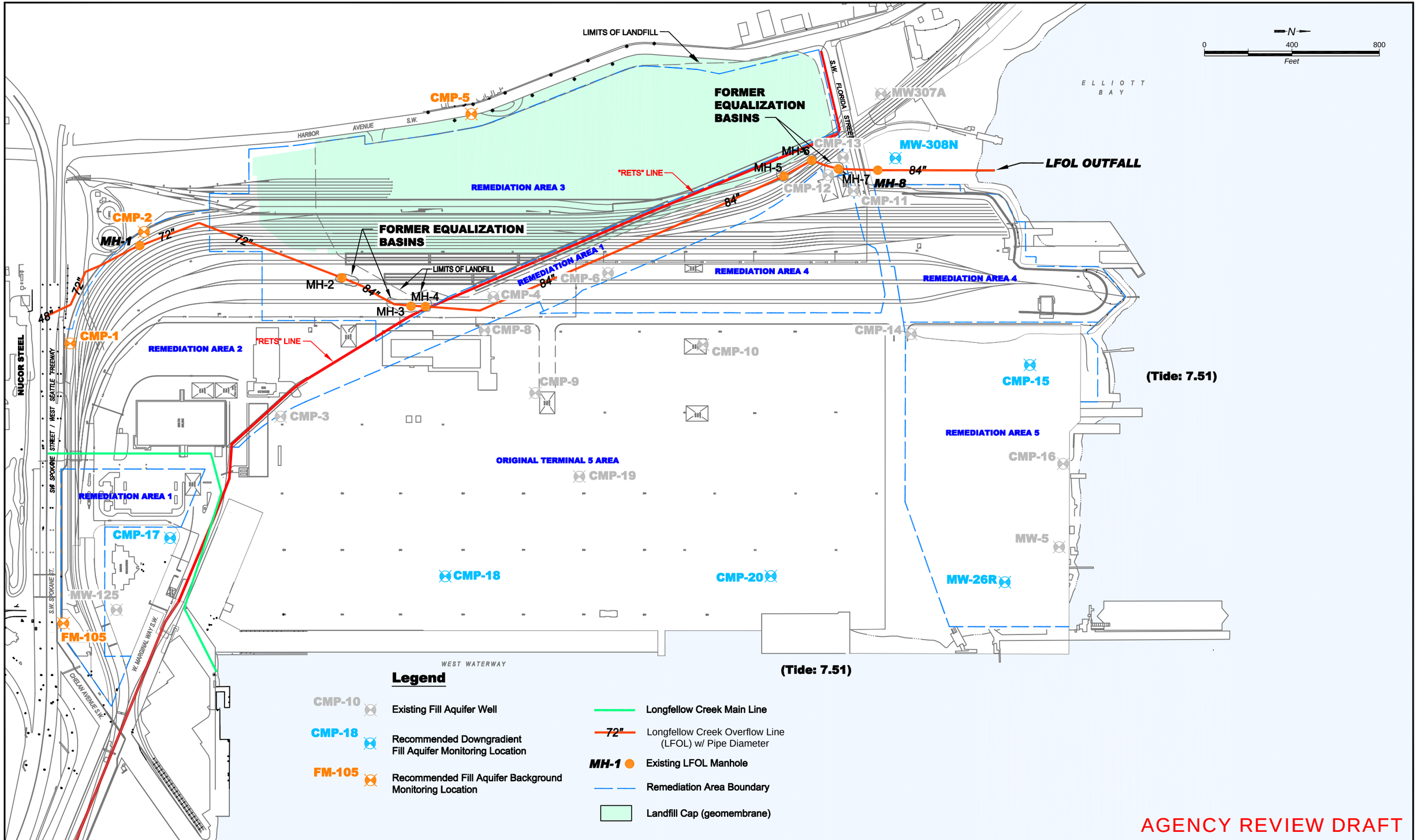

AGENCY REVIEW DRAFT

Survey Update 1/8/02

Ground Water Elevation Datum: MLLW

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Seattle, Washington

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Recommended Phase II GWCMP Fill Aquifer Monitoring Locations

SWHP Phase I Groundwater Confirmation Monitoring Program
Hydrologic Characterization Report

DATE: March 2005	PROJECT NO. 990106
DESIGNED BY: WVG	
DRAWN BY: PMB	FIGURE NO. 10.1
REVISED BY: PMB	

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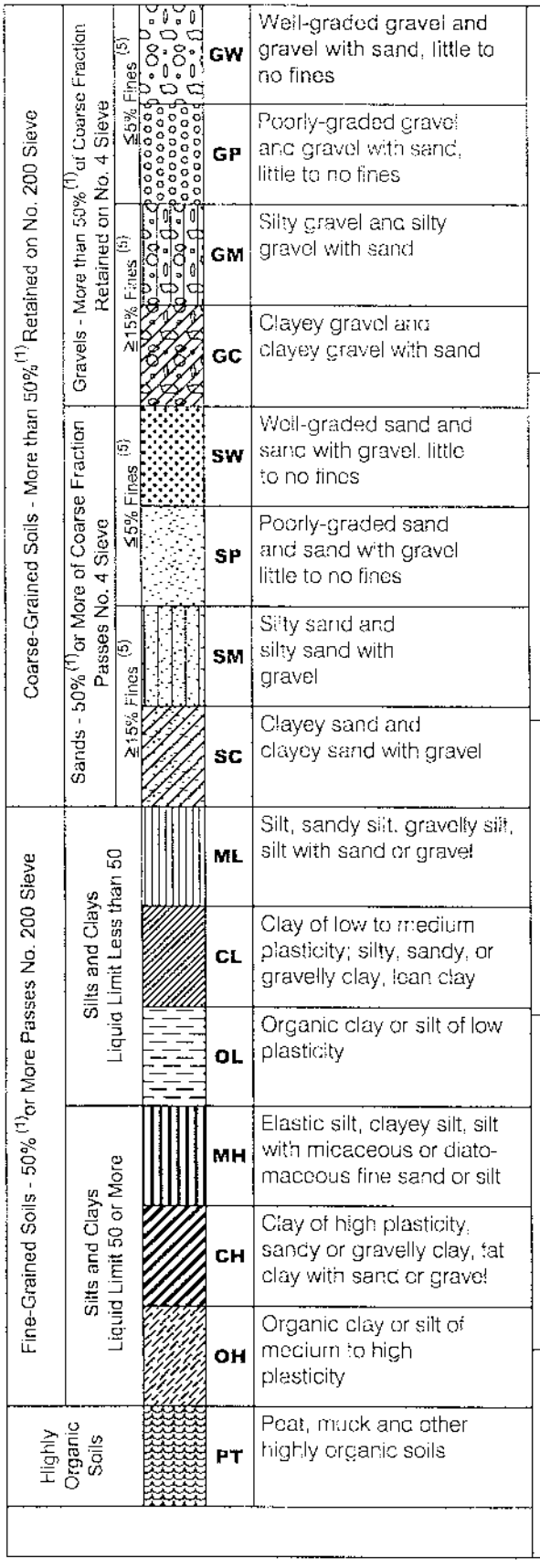
APPENDIX A

Monitoring Well Construction Logs – Wells CMP- 18, 19, and 20



GW	Well-graded gravel and gravel with sand, little to no fines	
GP	Poorly-graded gravel and gravel with sand, little to no fines	
GM	Silty gravel and silty gravel with sand	
GC	Clayey gravel and clayey gravel with sand	
SW	Well-graded sand and sand with gravel, little to no fines	
SP	Poorly-graded sand and sand with gravel little to no fines	
SM	Silty sand and silty sand with gravel	
SC	Clayey sand and clayey sand with gravel	
ML	Silt, sandy silt, gravelly silt, silt with sand or gravel	
CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay	
OL	Organic clay or silt of low plasticity	
MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt	
CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel	
OH	Organic clay or silt of medium to high plasticity	
PT	Peat, muck and other highly organic soils	

Terms Describing Relative Density and Consistency

Coarse-Grained Soils	Density	SPT[2] blows/foot
	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

Fine-Grained Soils	Consistency	SPT[2] blows/foot
	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

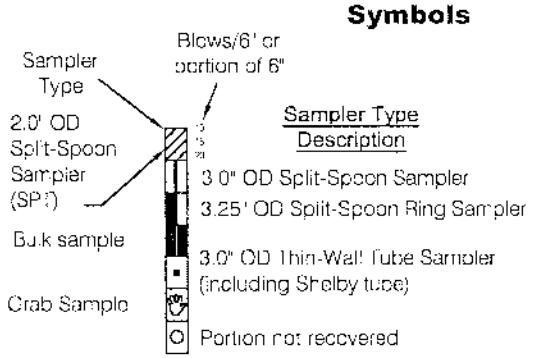
[3] Estimated Percentage

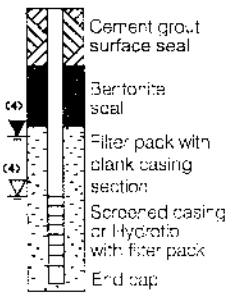
Percentage by Weight	Modifier
<5	Trace
5 to 15	Slightly (sandy, silty, clayey, gravelly)
15 to 30	Sandy, silty, clayey, gravelly)
34 to 49	Very (sandy, silty, clayey, gravelly)

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols





(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of groundwater
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 15% as estimated in General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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501 First Avenue #462
Seattle, WA 98104
(206) 329-7440

Exploration Log Key

DATE:	PROJECT NO.
DESIGNED BY:	
DRAWN BY:	FIGURE NO.
REVISED BY:	A-1

Q:_ACAD Standards\Drawings\Exploration Log Key.dwg

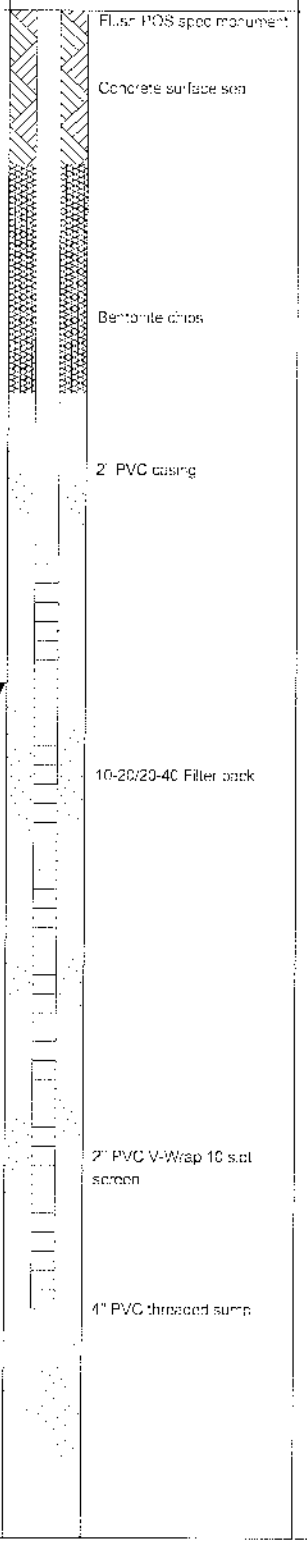
Aspect consulting
IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-18	1 of 1

Project Name: Southwest Harbor Project
Location: Seattle, Washington
Drilling Method: 4" Hollow Stem Auger ; Holt Drilling
Sampling Method: 2" Diameter, Split Spoon Sampler, 140 lb hammer

Top of PVC Casing Elev. (ft mllw):
Depth to Water (ft BTC):
Start Date: April 2, 2003
Finish Date: April 2, 2003



Depth feet	Well Construction	Sample Drive/Recovery	Blows/ 6"	Sample ID	Mtl. Graphic	Description
						ASPHALT
						Base course 1-1/4" minus GRAVEL (GW) with sand
			10 50/3	S-1		very dense, damp, brown sandy GRAVEL (GW); rock in shoe smooth after 3 feet
			6 12 12	S-2		medium dense, moist, brown SAND; sand fine to medium (SW)
			4 7 8	S-3		medium dense, wet, dark gray SAND (SW); sand fine to medium
			1 2 3	S-4		loose, wet, dark gray SAND; sand fine to medium (SW)
			3 4 8	S-5		stiff, wet, gray SILT (MH); trace sand and organics
						Bottom of boring at 19 feet

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

PID - Photoionization Detector
▼ Water Level (ATD)
Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

MW_GINT_SWHARBOR.GPJ March 3, 2005

Aspect consulting
IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-19	1 of 1

Project Name: Southwest Harbor Project
Location: Seattle, Washington
Drilling Method: 4" Hollow Stem Auger ; Holt Drilling
Sampling Method: 2" Diameter, Split Spoon Sampler, 140 lb hammer

Top of PVC Casing Elev. (ft mllw):
Depth to Water (ft BTC):
Start Date: April 2, 2003
Finish Date: April 2, 2003

Depth feet	Well Construction	Sample Drive/Recovery	Blows/ 6"	Sample ID	Lith. Graphic	Description
	Flush POS spec monument					**ASPHALT**
	Concrete surface seal					Dense, damp, dark brown SAND (SW); sand fine to medium; trace brick
	Bentonite Chips Medium	0.9	12 22 21	S-1		
5	2" PVC casing	0.2	5 8 8	S-2		Medium dense, damp, dark brown to black sandy GRAVEL; Trace silt with steef debris - slag like material; Iron staining
	10/20 Filter pack	0.2	2 3 3	S-3		Loose, very moist to wet, brown gravelly SAND with silt; trace wood and slag-like material
10						Medium dense, wet, gray-brown SAND; trace silt with silty interbeds; sands fine - grades to
	2" PVC V-Wrap, .10 slot screen	0.3	3 6 17	S-4		
15		0.3	6 9 12	S-5		Medium dense, wet, gray-brown silty SAND with silty interbeds; sand fine
	4" Sump					stiff, wet, gray SILT; trace sand and organics
		0.3	2 3 3	S-6		
						Bottom of boring at 19 feet

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

PID - Photoionization Detector
Water Level (ATD)
Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

MW_GEOLG SWHARBOR.GPJ March 3, 2005

Aspect consulting
IN-DEPTH PERSPECTIVE

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
990106	CMP-20	1 of 1

Project Name: Southwest Harbor Project
Location: Seattle, Washington
Drilling Method: 4" Hollow Stem Auger ; Holt Drilling
Sampling Method: 2" Diameter, Split Spoon Sampler, 140 lb hammer

Top of PVC Casing Elev. (ft mllw):
Depth to Water (ft BTC):
Start Date: April 2, 2003
Finish Date: April 2, 2003

Depth feet	Well Construction	Sample Driven/Recovery	Blows/ 6"	Sample ID	Mt Graphic	Description
	Flush POS spec monument					**ASPHALT**
	Concrete Seal					Base Course, 1 1/4" minus GRAVEL with sand
		0	13 16 21	S-1		
	Bentonite Chips					Dense, moist, light brown sandy GRAVEL; trace silt, concrete at 3.5 feet; dark brown sandy silt in shoe
5	2" PVC casing					
		0	7 9 10	S-2		Medium dense, wet, brown SAND; sand fine to medium
10	10-20/20-40 Filter pack					
		0	3 8 8	S-3		Medium dense, wet, gray silty SAND; silt inner beds; sand fine
15	2" PVC V-Wrap 10 slot screen	0	3 6 5	S-4		Medium dense, wet, silty fine SAND
	4" PVC threaded sump					
		0	3 5 9	S-5		Stiff, wet, gray SILT; trace sand and organics
						Bottom of boring at 19 feet

Sampler Type (ST):
- 3.25" OD D & M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

PID - Photoionization Detector
- Water Level (ATD)
- Static Water Level

Logged by: RRH
Approved by: WVG
Figure No.

M:\W_GEOLG_SW\HARBOR.GPJ March 3, 2005

APPENDIX B

Field Reports

Associated Earth Sciences, Inc.
179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DAILY REPORT

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/10/01	BV99106	Southwest Harbor Project	Clear 70's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED Holt Drilling B-59, compressor, jack hammer, backhoe			

THE FOLLOWING WAS NOTED:

Start-up of field work for the southwesr harbor project. Met on-site with Holt Drilling dropped off equipment. Picked up steel plates from terminal 91 to cover wells during construction. Began abandonning MW-22. Monument construction does not meet estimate. Abundant rebar and 8" well casing used in former retrofitting. Kathy Bahnick contacted regarding possible variance from Ecology to abandon without over-drilling. Kathy Bahnick is fine with variance if Ecology agrees. Chip Goodhue will contact Ecology regarding variance.

Plan to abandon MW-25, 27 and 31 tomorrow.

COPIES TO: File, Client	**FIELD REP.:** Bob Hanford
Page No. 1 **of** 1	**AESI PROJECT MANAGER:** Chip Goodhue

Associated Earth Sciences, Inc.

DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/11/01	BV99106	Southwest Harbor Project	Clear 70's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED B-59, backhoe, compressor,jackhammer

THE FOLLOWING WAS NOTED:

Continued with well abandonments at terminal 5. Wells abandoned today were MW-25, 27 and 31. MW-31 located in a pit was abandoned by pulling casing back 2-feet using a backhoe, then breaking out the bottom of the well using a steel bar followed by filling hole with bentonite chips hydrated with water.

MW- 25 and MW-27 were abandoned by overdrilling and grouting hole with a bentonite slurry by tremie.

Still waiting for Ecology response on variance for abandonments.

Tomorrow will begin retrofitting of wells outside of RA-5.

Contacted Garth Olson at GT Towing to get bus moved to allow access to 307 wells. Should be moved by tomorrow.

Called 1-call for utility locates for all well locations. Called Lee Miller KCDNR regarding locating along the rets line.

Began locating boring locations.

COPIES TO: File, Client

FIELD REP.: Bob Hanford

AESI PROJECT MANAGER: Chip Goodhue

Associated Earth Sciences, Inc.

DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/12/01	BV99106	Southwest Harbor Project	Clear 70's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: B-59, compressor, jack hammer, backhoe

THE FOLLOWING WAS NOTED:

Holt Drilling on site to continue abandonments and retrofits. Old monuments were jack hammered out and holes excavated to 18-inches on wells MW-308N, 307A and 307B. The monument from FM-105 was removed and replaced per POS specifications. On well MW-X2 the monument was removed and drill rig was set up over hole for overdrilling tomorrow.

All soil cuttings placed on visqueen and covered. POS is scheduling delivery of drop box for cuttings.

All open holes covered with steel plates awaiting concrete next week.

Seatte Water Department on site and cleared all monitoring well locations of water lines.

Lee Davidson from King Co. will be on site tomorrow to clear well locations for RETS line.

Left message with Jimmy Pang BNRR to contact me regarding CMP-1 and 2.

Tomorrow will set monuments and rebar in retrofit wells above.

Awaiting word on variance for abandonments.

Jjkjjk	FIELD REP.: Bob Hanford
Page No. 1 of 1	AESI PROJECT MANAGER: Chip Goodhue

Associated Earth Sciences, Inc.

DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/13/01	BV99106	Southwest Harbor Project	Clear 80's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED B-59, Backhoe Compressor, Jackhammer

THE FOLLOWING WAS NOTED:

Holt overdrilled MW-X2 and pulled casing and well screen. Bentonite grout was tremied down augers while pulling out. A head of grout was kept in the augers at all times. The surfaced will be filled with concrete next week. A steel plate was placed over the opening.

Monuments and rebar was placed in all retrofit wells prepared yesterday.

Still awaiting Ecology response on abandonment variances.

AESI met with Lee Davidson from King CO. to obseve placement of monitoring wells. All wells were cleared for drilling in regards to the RETS line. CMP-3 was moved 25-feet to the northeast at the request of Mr. Davidson.

Met with Kelly Garbar from APL. Visited each well site. AESI will keep Mr. Garbar informed of activities and will supply a tentative schedule on Monday. Mr. Garbar will be the point man for APL and will notify stack train, container yard, maintenance and security personel.

Left message for Jimmy Pang BNRR regarding CMP-1 and 2 drilling. No return call.

Discussed CMP-5 location with Warren Hansen. He will look at as-builts and get back to me. Liner apparently goes all the way to the curb and dives deep under the bike path. Will probably need to drill in street. Locate will clear 50-foot radius from center of Harbor AVE and Harbor drive.

Holt will not be on-site tomorrow but will return Monday.

Locate meeting scheduled for 0800 tomorrow.

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Page No. 1 of 1	**AESI PROJECT MANAGER:** Chip Goodhue

Associated Earth Sciences, Inc.

DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/14/01	BV99106	Southwest Harbor Project	Clear 70's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED			

THE FOLLOWING WAS NOTED:

On site at 0700 to complete locate for proposed monitoring wells. APS and Locating Inc. were on site at 0800. Locating Inc. cleared wells CMP-11, 12, 13, 1 and 2 for PSE, and QUEST. APS completed the private locate for all wells but will return Monday to recheck CMP-3, 8, 9, and 10. In addition wells 3, 8, 9, and 10 will be cleared by APS using a air/vacuum utility potholer. APS potholer will be on-site Monday at 1200. Seattle City Light did not show up at locate and was requested to site Monday the 17th. In addition Metro sewer was requested on site Monday.

Talked with Gary Wallinder regarding BNSF and CMP-1 and 2. Gary called Jimmy Pang and ok'd drilling locations. No permitting will be required per Gary Wallinder.

Met with Warren Hansen to review drilling locations. Observed locations of CMP-1, 2, 5, 11, 12 and 13. All locations appeared fine to Mr. Hansen. Retuned to office on the 2:10 boat.

Holt Drilling not on site today will return on Monday.

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Associated Earth Sciences, Inc.

DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/17/01	BV99106	Southwest Harbor Project	O/C 60's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED B-61 drill, backhoe, Air Vacuum potholer

THE FOLLOWING WAS NOTED:

On site at 0700 to clear power utilities and sewer. Seattle City light cleared all public power at monitoring wells. Only CMP-5 and CMP-1 have public power near them. Metro sewer did not show.

Holt Drilling on-site at 0830. Completed, except for monuments were CMP-11, 12, and 13. Wells completed today were screened with 10-feet of 10-slot screen from 6 to 16 feet. See boring logs for detailed information on drilling and well installation. Steel plates were placed over wells until concrete seals and monuments are placed on Friday. All soil cuttings were placed on visqeen and covered inside the fenced area at the north end of RA-1. All auger and drill tools were steam cleaned between each boring. Decon water is presently being stored in the decon trailer until a tank is delivered to the site. Holt has several 55-gallon drums if needed for water storage.

Samples were collected at 2.5 to 5 foot intervals. All samples were screened using a Mini-Rae photo-ionization detector. Periodic air monitoring was completed during drilling using the PID and a H2S meter. No hydrgen sulfide or PID readings were noted.

All wells were drilled and installed according to work plan specification with the following exception. Ten slot rather than V-wrap screen was installed due to shipping problem encountered from last week terrorist attack. Per conversation with Chip Goodhue it was approved to use the ten slot screen. CMP-11 was moved approximately 25-feet north of location shown in work plan and addendum. Per conversation with Chip Goodhue this was due to a bad plot on the maps. The new location placed Cmp-11 outside of area RA-4 as intended.

APS locating was on site with the Air vac potholer to further check on utility locations that were in question. Well locations CMP-11, CMP-9 and CMP-8 were air-vac'd to depths of 11.0, 10.8 and 8.0 feet respectively. APS will return on Thurday to vacuum CMP-1 and CMP-3. APS was on site today from 1200 to 1800.

Activities for tomorrow include CMP-8, 9, 4 and 6.

Holt on site today from 0830 to 1600.

APS on site today for 3-hours. APS locating (not vacuum) total hours 12.0

AESI REP on site from 0700 to 1800.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/18/01	BV99106	Southwest Harbor Project	O/C 50's & 60's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED B-61 Drill Rig, Backhoe

THE FOLLOWING WAS NOTED:

Holt on site at 0615. Drilled and installed CMP-4, CMP-6, CMP-2, CMP-9 and CMP-8. See Boring Logs for detailed information on drilling and well construction.

Steel plates were placed over wells until concrete seals and monuments are placed on Friday. All soil cuttings were placed on visqeen and covered inside the fenced area at the north end of RA-1. All auger and drill tools were steam cleaned between each boring. Decon water is presently being stored in the decon trailer until a tank is delivered to the site. Holt has several 55-gallon drums if needed for water storage.

Samples were collected at 2.5 to 5 foot intervals. All samples were screened using a Mini-Rae photo-ionization detector. Periodic air monitoring was completed during drilling using the PID and a H2S meter. No hydrgen sulfide or PID readings were noted.

All wells were drilled and installed according to work plan specification with the following exception. Ten slot rather than V-wrap screen was installed due to shipping problem encountered from last weeks terrorist attack. Per conversation with Chip Goodhue it was approved to use the ten slot screen.

Activities for tomorrow include drilling and installation of CMP-3, 10, and 1 and if variance is in place abandonment of wells MW-1, 6, 21 AND X1.

Holt took monument lids back to shop to weld in ID numbers. Monitoring well placards will be glued onto lids using epoxy. Sealant for the concrete/asphalt needs to have concrete cured for at least a week and will be applied on Holt's next mobilization to the site.

APS Air Vac was cancelled for Thursday due to expected slag material at CMP-1.

Holt on site today from 0615 to 1730.

AESI REP on site from 0615 to 1730.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/19/01	BV99106	Southwest Harbor Project	Ptly Cldy, 60's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED B-61 drill, backhoe			

THE FOLLOWING WAS NOTED:

Arrived on site with Holt drilling at 0615. Drilled and installed monitoring wells at CMP-3, CMP-10, AND CMP-1. See boring logs for drilling and installation details.

Locating Inc. cleared PSE and telephone on CMP-10.

Steel plates were placed over wells until concrete seals and monuments are placed on Friday. All soil cuttings were placed on visqeen and covered inside the fenced area at the north end of RA-1. All auger and drill tools were steam cleaned between each boring. Decon water is presently being stored in the decon trailer and a 55-gallon drum. An 1100 gallon water tank will be delivered mid day tomorrow per conversation with Eric Lottsfeldt POS.

Samples were collected at 2.5 to 5 foot intervals. All samples were screened using a Mini-Rae photo-ionization detector. Periodic air monitoring was completed during drilling using the PID and a H2S meter. No hydrgen sulfide or PID readings were noted.

All wells were drilled and installed according to work plan specification with the following exceptions.Ten slot rather than V-wrap screen was installed due to shipping problem encountered from last weeks terrorist attack. Per conversation with Chip Goodhue it was approved to use the ten slot screen. Per discussion with Chip Goodhue, CMP-10 was complete and screened from 5 to 15 feet. Due to the silt encountered in the screened interval observations including water levels and some developing will be collected prior to completing monument. If insufficient water is noted in CMP-10, the monument will not be installed and the well will be abandoned.

Activities for tomorrow include abandonment of wells MW-1, 6, 21 AND X1 and retrofit of wells MW-5, 26, 36, AND 44. Retrofits for above wells will include placing a rubber packer a minimum of 3 feet below first joint in 4-inch PVC riser pipe and placing cement/bentonite grout in the anular space between the 2 and 4 inch riser pipe.

Holt on site today from 0615 to 1500.

AESI REP on site from 0615 to 1500.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/20/01	BV99106	Southwest Harbor Project	Cloudy, 60's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED B-61 drill			

THE FOLLOWING WAS NOTED:

Arrived on site with Holt drilling at 0800. Concrete for monuments will be delivered Friday at 1000.

Abandoned wells MW-1, MW-6, MW-22, and MW-X1. All wells grouted in place with tremied bentonite grout, as specified in the variance received from the Dept. of Ecology (9/19/01).

Retrofitted wells MW-5, MW-26, MW-36, MW-44. Retrofits for above wells included placing a rubber packer a minimum of 3 feet below first joint in 4-inch PVC riser pipe, hydrating bentonite chips in the first 1.5 feet of the annular space between the 2 and 4 inch riser pipe, and placing cement/bentonite grout in the remaining annular space.

Installed monuments in wells CMP-4, and CMP-6.

Performed pump test on well CMP-10. SWL initially 7.83 ft. Pumped well dry with 12-V pump – total pumpage 4 gal over 1 min. Recovered to 12.8 ft after 3 min.

Tasks for tomorrow (Friday) include attaching Ecology Well IDs, installing monuments, and collecting a complete round of SWLs.

Holt on site today from 0800 to 1530.

AESI REP on site from 0800 to 1530.

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DAILY REPORT

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
9/21/01	BV99106	Southwest Harbor Project	Cloudy, 60's
CLIENT Port of Seattle		PROJECT LOCATION Terminal 5	
EQUIPMENT USED Backhoe, water level indicator			

THE FOLLOWING WAS NOTED:

Arrived on site with Holt drilling at 0830.

Holt arrived on site at 0900. Concrete truck arrived on site at 1000.

5 monuments picked up from T-30. Associated o-rings, lids, bolts, and washers also picked up.

Monuments installed at CMP-1, CMP-2, CMP-3, CMP-8, CMP-9, CMP-10, CMP-11, CMP-12, CMP-13, MW-307A, MW-307B, MW-308A.

Water levels taken in CMP-1, CMP-2, CMP-3, CMP-4, CMP-6, CMP-8, CMP-9, CMP-10, CMP-11, CMP-12, CMP-13, FM-105, MW-5, MW-26, MW-36, MW-44, MW-125, MW-307A, MW-307B, MW-308A.

Holt on site today from 0900 to 1530.

Concrete truck on site today from 1000 to 1500.

AESI REP on site from 0830 to 1700.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
10/17/01	BV99106	Southwest Harbor Project	Prtly Cldy 55
CLIENT Port of Seattle		PROJECT LOCATION Terminal 5	
EQUIPMENT USED Sounder, Truck, Weighted tape			

THE FOLLOWING WAS NOTED:

AESI Rep. On site to begin development activities of the new and retrofitted wells. Wells MW- 5, 26, 44 and CMP-1,2,3,4,6,8,and 9 were sounded for water level and depth to sediment. Set up staging area for development water and decon. Development water will be transported in 55-gallon drums to the fenced area and pumped into the 1100-gallon storage tank provided by the POS. Actual well development will begin tomorrow 10-18-01.

Aesi REP on site 12:30 to 16:30.

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179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
10/18/01	BV99106	Southwest Harbor Project	Cloudy, 50's
CLIENT Port of Seattle		PROJECT LOCATION Terminal 5	
EQUIPMENT USED Sounder, Truck, Weighted tape, EC,PH, turbidity, 12volt sub.Homda pump waterra system			

THE FOLLOWING WAS NOTED:

AESI Rep. On site to development monitoring wells. Wells developed today included CMP-1, 2 ,and13. Wells were developed using a Waterra foot valve with a surge block, followed with pumping using a 12-volt submersible pump.

Additiional surging was performed intermittent with pumping. All wells were developed until clear with no sediment and below 10 ntu turbidity.

All development water was pumped into an 1100-gallon storage tank in the fenced area at the north end of RA-1. Development equipment was deconed in between wells using an alconox wash and a tap water rinse. All development data was recorded on a well development spread sheet as readings were collected.

AESI Rep. On site 0800 to 1630.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
10/23/01	BV99106	Southwest Harbor Project	Mostly sunny, 50's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED Sounder, Truck, Weighted tape, EC,PH, turbidity, 12volt sub.Homda pump waterra system			

THE FOLLOWING WAS NOTED:

AESI Reps. On site to development monitoring wells. Wells developed today included CMP-10, 4,and11, 12 and MW-26. Wells were developed using a Waterra foot valve with a surge block, followed with pumping using a 12-volt submersible pump.

Additiional surging was performed intermittent with pumping. Wells CMP-4 and CMP-11 were developed until clear with no sediment. Both wells developed to below 10 ntu turbidity. Wells CMP-10 and CMP-12 had very slow recovery and cannot be fully developed due to lack of water in the wells.

Well MW-26 in RA-5 was found to have an apparent broken well screen at 17.5 feet. Total depth of well was reported to be 25 feet. Durring attmpted development approximatly 1 foot of sand (both black marine silts and fine sand and silica sand) was removed from well. Maximum depth attained today was 19.6 feet with a "soft bottom". Well appears to make sand when pumped and it is recommended that this well be abandoned and replaced prior to the tidal study tentatively scheduled for December.

The damage to this well would appear consistent with earthquake damage to other wells in the vicinity.

All development water was pumped into an 1100-gallon storage tank in the fenced area at the north end of RA-1. Development equipment was deconed in between wells using an alconox wash and a tap water rinse. All development data was recorded on a well development spread sheet as readings were collected.

A Street Use/Utility Permit was aquired from the City of Seattle today for the completion of CMP-5.

AESI Rep. On site 0800 to 1630.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
10/25/01	BV99106	Southwest Harbor Project	Mostly sunny, 50's
CLIENT Port of Seattle		PROJECT LOCATION Terminal 5	
EQUIPMENT USED Sounder, Truck, Weighted tape, EC,PH, turbidity, 12volt sub.Homda pump waterra system			

THE FOLLOWING WAS NOTED:

AESI Reps. On site to development monitoring wells. Wells developed today included CMP-3, 8, 9, MW-308N (south), MW-308S(north), MW-36 and MW-44. Wells were developed using a Waterra foot valve with a surge block, followed with pumping using a 12-volt submersible pump. Additiional surging was performed intermittent with pumping. Wells were developed until clear with no sediment and below 10 ntu turbidity. Well MW-308S had very slow recovery and could not be fully developed at this time.

CMP-3 had an elevated temperature and Ph. Temperature ranged from 28 to 23 celsius and ph from 9.8 to 10.1.

There is some confusion regarding well cluster MW-308. MW-308A(the north well) was retrofitted in error. It is the shallow well with a depth of 18 feet. The 12 volt pump could make it to the bottom of the well. MW-308B (the deep well to the south had depth of approximately 40 feet. The deep well in this cluster should have been retrofitted. Both wells are 2".

All development water was pumped into an 1100-gallon storage tank in the fenced area at the north end of RA-1. Development equipment was deconed in between wells using an alconox wash and a tap water rinse. All development data was recorded on a well development spread sheet as readings were collected.

Approximately 450 gallons are now in the 1100 gallon storage tank.

AESI Rep. On site 0900 to 1730.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
10/29/01	BV99106	Southwest Harbor Project	Ptly Cldy, 50's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED B-61 Mobile Drill			

THE FOLLOWING WAS NOTED:

Arrived on site with Holt drilling at 0900. Cascade Coring under subcontract with Holt Drilling cut a 2.5X2.5 square in 9-inch road surface. Holt drilled and installed monitoring well at CMP-5 location in turn lane at Sw Harbor Avenue and Harbor Lane. See boring logs for drilling and installation details. Boring was advance to 16.0 feet with monitoring well installed from 15.2 to 5.2 feet.

A Morris flush mount monument was used instead of the Port monument to eliminate 1/8" stickup of lid in roadway.

City of Seattle inspector Janelle Trokey was notified by voice mail on 10/25/01 that work on permit #71843 would be performed today. A second message was left 10/26/01 and also this morning.

All soil cuttings were placed on visqeen and covered inside the fenced area at the north end of RA-1. All auger and drill tools were steam cleaned before and after drilling. Decon water was placed in the 1100 gallon water tank at the north end of RA-1.

Samples were collected at 2.5 to 5 foot intervals. All samples were screened using a Mini-Rae photo-ionization detector. Periodic air monitoring was completed during drilling using the PID and a H2S meter. No hydrgen sulfide or PID readings were noted.

CMP was drilled and installed according to work plan specification. Ten slot V-wrap screen was installed.

Activities will resume on Wednesday 10/31 with the drilling of CMP-7

Holt personnel sealed all joints in well installs and abandonments completed to date.

Holt on site today from 0900 to 1700.

AESI Rep completed development of the shallow well Mw-308A see well development spread sheet for details. It does not appear that the kink noted in EQ evaluations will effect placement of Troll data logger in well. The well cleared to below 10 NTU with no sediment.

Attempted development of MW-307B (deep well) The well clean up adequately but a bend in casing was noted 4 to 5 feet beow ground surface. The lower stage of the 12 volt submersible pump hung up on bend and was lost down hole.

The bend in the casing appears to be consistent with earthquake related damage seen at other locations on site. No EQ evaluation was completed on this well because access was blocked by wrecked bus.

AESI REP on site from 0830 to 1630.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
10/31/01	BV99106	Southwest Harbor Project	Windy, 50's Showers

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED B-59 Mobile Drill, Backhoe

THE FOLLOWING WAS NOTED:

Arrived on site at 0800. Holt drilling on site at 0845. See boring log for drilling information. Boring was advance to 25.0 feet with 10-inch ID HAS then backed out 5 feet. Betonite chips were placed in the boriing from 20 to 25 feet then the 10-inch ID auger was set back at 25 feet. Four inch ID hollow stem auger was then advanced through the 10 inch to a depth of 49 feet. Durring the drilling and well installation the 10 inch auger dropped at least 10 feet below ground surface. Holt attempted to recover auger with no success today. Holt will attempt to retrieve auger again tomorrow. It is likely that this boring will have to be abandoned and another installed.

A tremied bentonite slurry was placed durring the install and is currently at 10 feet below ground surface.

Cuttings were placed on visqueen until a backhoe was delivered to the site at 11:30. All cutting were moved to the fenced area at the north end of RA-1. A new stockpile was started for cuttings for CMP-7 due to the presence of creosote like materials in the drill cuttings.

The drill site was cleaned up and the hole covered with a steel plate prior to Holt leaving site.

Chip Goodhue on site from 10:30 to 14:00.

AESI REP on site from 0830 to 17:15

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/01/01	BV99106	Southwest Harbor Project	O/C 50's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED B-59 Mobile Drill, Backhoe			

THE FOLLOWING WAS NOTED:

Holt Drilling on-site to try and retrieve 10-inch auger lost in the ground during the installation of CMP-7. Holt used 4-inch auger to try and lock on to the larger diameter auger. The ten inch auger is located 15-feet below ground surface. Holt had hold of the auger but could not retrieve it. Due to stack train operations Friday additional efforts to retrieve auger will take place next week.

Aspect representative developed CMP-5 using the waterra system for purging and surging and pumping until clear using a peristaltic pump. See well development spread sheet for parameters and other development data. Development water was pumped into 1000 gallon storage tank at the north end of RA-1.

Aspect on site 13:00 to 17:30.

Holt on-site 0900 to 15:00. No charge Holt working to retrieve auger.

Work will resume on Monday, November 05, 2001. Holt has indicated that they will work on the earthquake replacement wells on Monday and have a second rig available on Tuesday to allow for fishing for the auger.

All drilling an abandonments are scheduled to be complete next week.

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DAILY REPORT

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/05/01	BV99106	Southwest Harbor Project	Ptly Cldy, 50's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED B-61 drill, backhoe

THE FOLLOWING WAS NOTED:

Arrived on site with Holt drilling at 0800. Drilled and installed monitoring wells at CMP-16, CMP-14, AND CMP-15. See boring logs for drilling and installation details.

All well location cleared for utilities.

Steel plates were placed over wells until concrete seals and monuments are placed. All soil cuttings were placed on visqeen and covered inside the fenced area at the north end of RA-1. Cuttings were placed in a third stockpiled to keep the earthquake replacement cuttings separate. All auger and drill tools were steam cleaned between each boring. Decon water was stored in 55-gallon drums.

Samples were collected at 2.5 to 5 foot intervals. All samples were screened using a Mini-Rae photo-ionization detector. Periodic air monitoring was completed during drilling using the PID and a H2S meter. No hydrgen sulfide or PID readings were noted.

All wells were drilled and installed according to work plan specification with ten slot V-wrap screen.

Activities for tomorrow include completion of wells MW-26R, and CMP-17, auger retrieval from CMP-7 redrill and installation of CMP-7 and possible abandoments.

Holt on site today from 0830 to 1700

AESI REP on site from 0800 to 1700.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/06/01	BV99106	Southwest Harbor Project	Ptly Cldy, 40's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED Lars 10-T drill, backhoe			

THE FOLLOWING WAS NOTED:

Arrived on site with Holt drilling at 0900. Drilled and installed monitoring wells MW-26R, and CMP-17. See boring logs for drilling and installation details. These wells were replaced under the earthquake damaged well contract. Wells drilled today were completed with a track mounted Lars 10-T auger drill.

All well location cleared for utilities.

Steel plates were placed over wells until concrete seals and monuments are placed. All soil cuttings were placed on visqeen and covered inside the fenced area at the north end of RA-1. Cuttings were placed in a third stockpiled to keep the earthquake replacement cuttings separate. All auger and drill tools were steam cleaned between each boring. Decon water was stored in 55-gallon drums.

Samples were collected at 2.5 to 5 foot intervals. All samples were screened using a Mini-Rae photo-ionization detector. Periodic air monitoring was completed during drilling using the PID and a H2S meter. No hydrgen sulfide or PID readings were noted.

All wells were drilled and installed according to work plan specifications with pvc, ten slot V-wrap screen.

Activities for tomorrow include completion of well monuments MW-26R, CMP-17, CMP-14, CMP-15 and CMP-16.

A second Holt rig on-site today to attempt retrieval of 10-inch auger from CMP-7.

Contacted City of Seattle regarding Street Use Permit for CMP-5. Jennelle Troskey reported that work was completed satisfactory and permit conditions were fullfilled. OK to do monitoring in future.

Holt Crew (Lars Rig) on site today from 0900 to 1700
Holt Crew (B-59) on site today from 0900 to
AESI REP on site from 0800 to 1700.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/07/01	BV99106	Southwest Harbor Project	Sunny, 50's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED Lars B-59 drill, backhoe			

THE FOLLOWING WAS NOTED:

Arrived on site with American Leak Detection at 0900. Videoed MW-26 and MW-307B. Recorded on tape. MW-26 showed what appeared to be separated casing at 16.1'. The top of a rectanglular block (1" x 0.5"?) was at 17.7'. Sediment started at 18.7'. SWL at 10.15'. Retrofit is readily seen in video.

MW-307B (northern well) has an apparent failure at 3-4'. SLW at 8.0'

American Leak Detection left site at approx. 1130.

Developed well CMP-14. Initial SWL/TD = 10.1'/16.0' (soft). Surged with Watera system and pumped with peristaltic pump. Temperature was 18C. pH was 8.1. Conductivity was 400 microSiemens. Turbidity was 300 NTUs after 50 gallons.

Drilled and installed CMP-7 at new location 10 feet north of CMP-6. Drilled to 20 feet using 10-inch id casing with samples collected at 15, 17.5, and 20 feet. No recovery was achieved in any of the above sample intervals due to abundant gravels encountered in boring believed to be an old railroad grade. The 10 inch was pulled back to 19-feet and bentonite chips were place in hole. The ten inch auger was redrilled to 20 feet and 3-feet of bentonite chips were placed in auger. Hole was then completed to 47.5 feet using 4-inch id auger and a 2-inch monitoring well installed with 10 feet of v-wrap 10-slot screen from 37 ro 47 feet.

A steel plate was placed over well until concrete seal and monument is placed. All soil c uttings were placed on visqeen and covered inside the fenced area at the north end of RA-1. Cuttings were placed in in the same stockpile as cuttings from the first CMP-7 attempt. Soil were observed to have a creosote like odor and sheen. All auger and drill tools were steam cleaned between borings. Decon water pumped into 1000 gallon storage tank.

Samples were collected at 2.5 to 5 foot intervals below 15 feet. All samples were screened using a Mini-Rae photo-ionization detector. Periodic air monitoring was completed during drilling using the PID and a H2S meter. No hydrgen sulfide or PID readings were noted.

All wells were drilled and installed according to work plan specifications with pvc, ten slot V-wrap screen.

Holt completed monumonts on CMP-14, 15, 16, 17, and MW-26R.
Holt Crew (B-59) on site today from 0800 to 1730
AESI REPs on site from 0845 to 1715.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/08/01	BV99106	Southwest Harbor Project	Sunny, 50's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED Lars B-59 drill, backhoe			

THE FOLLOWING WAS NOTED:

Arrived on site with Holt Drilling at 0830. Baker tank volume at 490 gallons. Decon water and development water from 11/7 transferred to baker tank.

Drilled MW-307B R (EQD replacement). Drilled and set 10" casing to 22'. Set chips in bottom of hole. Let set for approx. ½ hour. Continued drilling 4" hollow stem auger to 41.5'. Well completed at approx. 40' with screen from 30'-40'. Sand approx 27' to 41.5'.

MW-307A developed. Tubidity at 26 NTU after approx 25 gallons.

MW-307B abandoned by filling well with bentonite slurry.

Development water transferred to baker tank.

Transferred cuttings to stockpile. Recovered all three stockpiles with new plastic.

Holt Crew (B-59) on site today from 0830 to 1630

Aspect REPs on site from 0800 to 1630.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/09/01	BV99106	Southwest Harbor Project	Sunny, 50's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	
EQUIPMENT USED Lars B-59 drill			

THE FOLLOWING WAS NOTED:

Arrived on site at 0830. Holt drilling already there.

Baker tank volume at 550 gallons. Decon water from 11/7-11/8 (EQD) transferred to baker tank. Estimated 100 gal added.

MW-307B R (EQD replacement) monument installed. MW-307B cemented to grade.

MW-8 abandoned with bentonite slurry, bentonite chips, and cement to grade. Total depth of 22.5' 4" casing filled with approx. 30 gal of slurry, with difference of chips and cement.

MW-33 abandoned as above. TD of 22.5' 4" casing filled with approx. 30 gal slurry, with difference of chips and cement.

MW-26 abandoned as above. TD of 20' 4" casing with 2" retrofit filled with approx. 20 gal slurry, with difference of chips and cement.

MW-13 abandoned as above. TD of 29' 4" casing filled with approx. 40 gal slurry with difference of chips and cement.

MW-149 abandoned as above. TD of 15.3' 2" casing filled with approx. 10 gal slurry with difference of chips and cement.

CMP-7 monument installed. Cemented abandoned hole to grade.

Transferred decon dregs to CMP-7 stockpile.

Holt Crew (B-59) on site today from 0800 to 1430

Aspect REP on site from 0830 to 1430.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/15/01	BV99106	Southwest Harbor Project	Partly cloudy, 50's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED

THE FOLLOWING WAS NOTED:

Arrived on site at 10:00. Met with Eric Lottsfeldt and Joel from the POS survey crew. Eric left site and Aspect rep. Escorted survey crew to all well and LFOL manhole locations. Survey crew expects to begin survey this afternoon or tomorrow.

Survey crew to survey X,Y and elevation. Elevation measurments to be collectd from ground surface, monument rim and top of PVC casing on the north side.

Aspect rep worked on sealing monuments the remainder of the day. Rubber gromets were placed on all bolts and extra set of bolt holes sealed with silicon caulkin. Work on monuments will continue tomorrow with installation of Troll hinged well caps. Most wells will need to be cut down to facilitate well caps.

Received lap top computer and rubber seals for monuments from Eric Lottsfeldt today.
Aspect REP on site from 10:00 to 17:00.

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DAILY REPORT

DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/16/01	BV99106	Southwest Harbor Project	Partly cloudy, 50's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED

THE FOLLOWING WAS NOTED:

Arrived on site at 07:30. Aspect rep worked on sealing monuments. Rubber gromets were placed on all bolts and extra set of bolt holes sealed with silicon caulkin. Troll hinged well caps were installed on wells MW-125, CMP-5, CMP-11, CMP-12, CMP-13, MW-308S, CMP-8 and CMP-9.

Monuments were bailed out and monument vacumned clean. Wet dry vac. Worked extremely good cleaning out well.

Remaining caps will be completed on Monday.
Aspect REP on site from 0730 to 17:00.

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DAILY REPORT

DATE	PROJECT NO.	PROJECT NAME	WEATHER
11/19/01	BV99106	Southwest Harbor Project	Heavy rain, 40's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED

THE FOLLOWING WAS NOTED:

Arrived on site at 08:00. Aspect rep worked on sealing monuments. Rubber gromets were placed on all bolts and extra set of bolt holes sealed with silicon caulkin. Troll hinged well caps were installed on wells CMP-17, FM-105, CMP-1, CMP-2, CMP-7, CMP-6, CMP-4, CMP-3, MW-44 and MW-26R. Monuments were bailed out and monument vacumned clean. Wet dry vac. Worked extremely good cleaning out well.

Remaining caps will be completed on Monday.

Aspect REP on site from 0730 to 17:00.

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DAILY REPORT

DATE	PROJECT NO.	PROJECT NAME	WEATHER
12/06/01	BV99106	Southwest Harbor Project	Heavy rain, 40's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: Laptop, water level indicator, total depth indicator, vacuum

THE FOLLOWING WAS NOTED:

Arrived on site at 08:00. Aspect reps installed calibrated and programmed TROLL probes in respective wells. The typical procedure included installing a well cap and measuring the top of the well cap to a surveyed point (if necessary); measuring the total depth of the well; measuring the depth to water in the well; installing sample tubing for chloride sampling on the probe (if necessary); installing the probe to the proscribed depth (typically 2 to 3 feet above the bottom of the well); connecting the probe to the laptop to verify programmed data and take initial readings.

TROLL probes were installed in the following wells: CMP-2, CMP-3, CMP-4, CMP-6, CMP-7, CMP-8, CMP-11, CMP-12, CMP-13, CMP-14, CMP-16, MW-26R, MW-36, MW-44, MW-307A, MW-307BR, MW-308N, MW-308S.

The TROLL temperature and pressure probes were factory-calibrated by In-Situ, Inc. Where necessary, pH and conductivity probes were calibrated by Aspect representatives. pH was calibrated using two-point calibration (7 and 10 calibration solutions). Conductivity was calibrated for 5 different conductivities (450, 1413, 4500, 12880, and 45000 uS/cm).

Aspect REP on site from 0730 to 1700.

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DAILY REPORT

DATE	PROJECT NO.	PROJECT NAME	WEATHER
12/10/01	BV99106	Southwest Harbor Project	Heavy rain, 40's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Laptop, total depth indicator, vacuum

THE FOLLOWING WAS NOTED:

Arrived on site at 1400. Aspect reps installed calibrated and programmed TROLL probes in respective wells. The typical procedure included measuring the total depth of the well; installing the probe to the proscribed depth (typically 2 to 3 feet above the bottom of the well); connecting the probe to the laptop to verify programmed data and take initial readings.

TROLL probes were installed in the following wells: CMP-9, CMP-15, CMP-17, MW-5, MW-125, MH-1, and MH-8.

The TROLL temperature and pressure probes were factory-calibrated by In-Situ, Inc. Where necessary, pH and conductivity probes were calibrated by Aspect representatives. pH was calibrated using two-point calibration (7 and 10 calibration solutions). Conductivity was calibrated for 5 different conductivities (450, 1413, 4500, 12880, and 45000 uS/cm).

Aspect REP on site from 1400 to 2000.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
01/15/02	990106-004-10	Southwest Harbor Project	Cloudy, 40's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Waterra system, 12-V submersible pump, handheld water quality sensors, water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0845.

Developed MW-5 to 32.5 NTU. Total discharge: 18 gallons.

Developed MW-125 to 68.0 NTU. Total discharge: 16 gallons.

Developed FM-105 to 71.4 NTU. Total discharge: 15 gallons.

Redeveloped MW-307BR to 73.1 NTU. T-4000 removed before development and reinstalled after development. Total discharge: 30 gallons.

All development water was pumped into baker tank. The tank held 790 gallons upon arrival.

Replaced o-rings in CMP-14, CMP-15, and CMP-16.

Left site at 1640.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
01/16/02	990106-004-10	Southwest Harbor Project	Cloudy, 40's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Waterra system, 12-V submersible pump, handheld water quality sensors, water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0845.

Redeveloped CMP-12 (slow recovery well) to 53.3 NTU. T-8000 removed before development, placed in purge water to keep pH bulb wet during development, and reinstalled after development. Total discharge: 20 gallons.

Redeveloped CMP-10 (slow recovery well) to 156 NTU. Spent a total of 4 hours developing. Two feet of recovery required approximately 30 minutes. Total discharge: 13 gallons.

Redeveloped CMP-9 to 82.5 NTU. Total discharge: 15 gallons.

Redeveloped CMP-6 to 87.1 NTU. T-8000 removed before development, placed in purge water to keep pH bulb wet during development, and reinstalled after development. Total discharge: 27.5 gallons.

All development water was pumped into baker tank.

The following monuments did not collect water and the o-rings were in good condition: MW-308N(A), MW-308S(B), CMP-6, CMP-10, CMP-11, CMP-12, CMP-13.

CMP-9 monument was full of water (to the vent in the well cap), and the o-ring was in good condition. The monument rim, the o-ring seat, and the lid were thoroughly cleaned and vacuumed before resealing the lid.

The lid for MW-308N(A) needs the well ID welded on it.

Left site at 1600.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
01/17/02	990106-004-08	Southwest Harbor Project	Cloudy, 40's
CLIENT Port of Seattle		PROJECT LOCATION Terminal 5	

EQUIPMENT USED: Honda pump, 12-V submersible pump, soil sampling kit, level and tape measure

THE FOLLOWING WAS NOTED:

Arrived on site at 0845.

Waited for BNSF flagger until 0915 (was scheduled to arrive at 0900). Called Jimmy Pang to confirm a flagger had been sent. He said one would arrive at 1000.

Pumped remaining purge water into baker tank. Final volume was 940 gallons. Took water samples from baker tank.

Met with BNSF flagger at 1000. Measured MH-1 rim to top of PVC casing and rim to top of top rung. Removed PVC casing.

Took 3-point composite soil samples from each stockpile: main stockpile, earthquake damaged well stockpile, and CMP-7 stockpile. Recovered all stockpiles with tarp.

Measured MH-8 rim to top of PVC casing. Removed PVC casing.

Organized site.

Left site at 1145.

Delivered samples to a North Creek Analytical courier at 1200.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
02/08/02	990106-004-15	Southwest Harbor Project	Cloudy, 40's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: YSI-33 (T,C,S), water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0800.

Recorded water level (w/ time) and temperature/conductivity (w/ depth) for all the non-instrumented monitoring wells, including: CMP-1, CMP-5, FM-105, MW-125, CMP-17, CMP-10, CMP-9, CMP-15.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature and conductivity were measured near the top of the water column and approximately every two feet until the bottom of the well was reached.

Any water in the monument was noted and then removed.

The water level indicator and YSI-33 were decontaminated using potable water w/ alconox and a DI water rinse. Decon water (~3 gallons) was added to the storage tank.

Left site at 12:45.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
02/12/02	990106-004-15	Southwest Harbor Project	Clear, 40's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Laptop, TROLL calibration kit, YSI-33 (T,C,S), water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0830.

For the instrumented monitoring wells, including: CMP-2, MW-308A (N), MW-308B (S), CMP-13, CMP-12, CMP-11, MW-307A (S), MW-307BR (N), CMP-3, CMP-8.

- Recorded water level (w/ time) and temperature/conductivity (w/ depth);
- Downloaded data set (Short-term TS, 10-min intervals) and deleted test;
- Installed new test (Long-term TS, 1-hour intervals) to begin the following hour;
- Calibrated pH (one-point) and conductivity probes (two-point) on T-8000s.

All manual measurements were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database. Water levels were usually measured before and after calibration. Temperature and conductivity were usually measured before the instrument was extracted, starting near the top of the water column and then approximately every two feet.

The calibration procedure included:

1. extracting the instrument from the well,
2. rinsing the instrument in deinonized water,
3. rinsing the instrument in a calibration rinse solution,
4. setting the instrument in calibration solution for calibration,
5. repeating steps 2-4 for other calibration solutions,
6. reinstalling the instrument in the well.

Any water in the monument was noted and then removed.

The cable holders were secured with zip-ties at the top and bottom of the holder. Zip-ties were added to prevent any slipping.

Excess cable was coiled around the casing inside the well monument. The connector was placed inside the casing. Where necessary, the hinged cap was removed and placed inside the monument. This was done to minimize movement of the instrument during downloads.

The water level indicator and YSI-33 were decontaminated using potable water w/ alconox and a DI water rinse. Decon water (~3 gallons) was added to the storage tank.

Left site at 15:20.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
02/13/02	990106-004-15	Southwest Harbor Project	Clear, 40's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Laptop, TROLL calibration kit, YSI-33 (T,C,S), water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0830.

For the instrumented monitoring wells, including: CMP-7, CMP-6, CMP-14, MW-36, CMP-4, CMP-16, MW-26R, MW-44

- Recorded water level (w/ time);
- Recorded temperature/conductivity (w/ depth) for deep wells only;
- Downloaded data set (Short-term TS, 10-min intervals) and deleted test;
- Installed new test (Long-term TS, 1-hour intervals) to begin the following hour;
- Calibrated pH (one-point) and conductivity probes (one- or two-point) on T-8000s.

All manual measurements were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database. Water levels were usually measured before and after calibration. Temperature and conductivity were usually measured before the instrument was extracted, starting near the top of the water column and then approximately every five feet.

The calibration procedure included:

1. extracting the instrument from the well,
2. rinsing the instrument in deinonized water,
3. rinsing the instrument in a calibration rinse solution,
4. setting the instrument in calibration solution for calibration,
5. repeating steps 2-4 for other calibration solutions,
6. reinstalling the instrument in the well.

Any water in the monument was noted and then removed.

The cable holders were secured with zip-ties at the top and bottom of the holder. Zip-ties were added to prevent any slipping.

Excess cable was coiled around the casing inside the well monument. The connector was placed inside the casing. Where necessary, the hinged cap was removed and placed inside the monument. This was done to minimize movement of the instrument during downloads.

The water level indicator and YSI-33 were decontaminated using potable water w/ alconox and a DI water rinse. Decon water (~3 gallons) was added to the storage tank.

Left site at 15:00.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
03/12/02	990106-004-07	Southwest Harbor Project	Raining, windy, 30's

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: Case 580B backhoe, dump truck

THE FOLLOWING WAS NOTED:

Arrived on site at 0745 to meet with Phillip Environmental and Clearcreek Contractors.

Phillip arrived at 0800, directed them to drums and container, where they began pumping water into truck.

Phillip completed pumping at 0830. Five drums were sealed, labeled as empty and turned over for future use.

Phillip left site at 0835

Clearcreek Contractors arrived at 0830. Began loading miscellaneous bags, broken PVC pipe and other un-usable materials into truck. Volume of soil in 3 stockpiles was estimated before being loaded onto truck.

SOIL VOLUMES: CMP-7 = 3 cy; EQ Damage = 4 cy; SWHP = 6 cy. All estimates are approximate

Clearcreek personnel cleaned up site with broom and shovel before leaving for Rabanco disposal facility. Empty drums, wash tub, and steel monuments were placed around water tank for storage.

Clearcreek and JJM left site at 1130.

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Aspect Project Manager: Chip Goodhue

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
04/12/02	990106-004-15	Southwest Harbor Project	Raining, Cloudy, 50's
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: YSI-33 (T,C,S), water level indicator

THE FOLLOWING WAS NOTED:

Arrived on site at 14:30

Recorded water level (w/ time) and conductivity (w/ depth) for all the non-instrumented monitoring wells, including: CMP-1, CMP-5, FM-105, MW-125, MW-5, CMP-10, CMP-9, CMP-15, RW-12S, EW-6, EW-7.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature and conductivity were measured near the top and middle of the water column.

Any water in the monument was removed.

The water level indicator and YSI-33 were decontaminated using potable water w/ alconox and a DI water rinse.

Left site at 18:00.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
04/22/02	990106-004-15	Southwest Harbor Project	Overcast, Mist, 50s
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Laptop, TROLL calibration kit, water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0800.

For the instrumented monitoring wells, including: CMP-2, CMP-3, CMP-4, CMP-11, CMP-6, CMP-7, CMP-8, CMP-14, CMP-16, MW-26R, MW-36, MW-44, MW-307A (S), MW-307BR (N):

- For T-8000s, recorded static water level (w/ time); logger battery and memory remaining; manual electronic probe readings of temperature, pressure, pH, and conductivity (w/ logger time); field checked pH and conductivity (if field check indicated probe out of calibration, a field calibration was performed);
- For T-4000s, recorded static water level (w/ time); logger battery and memory remaining; manual electronic probe readings of temperature and pressure;
- Downloaded data set (Long-term TS, 1-hour intervals);
- Reinstalled probe and recorded static water level (w/ time) and manual electronic probe readings.

All measurements and parameters were recorded on a field data sheet. Static water levels will be input into the POS FSDS database. Water levels were measured before moving the probe and after the probe was reinstalled.

The calibration procedure included:

1. Extracting the instrument from the well,
2. rinsing the instrument in deinonized water,
3. rinsing the instrument in a calibration rinse solution,
4. setting the instrument in calibration solution for calibration,
5. repeating steps 2-4 for other calibration solutions,
6. reinstalling the instrument in the well.

The probe in MW-36 did not communicate with the laptop software. Probe readings could not be made, nor could the data set be downloaded. Troubleshooting attempts included testing alternate computer cables and alternate probe cables. The probe was removed from the well to be sent to the manufacturer for evaluation.

Left site at 1530.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
04/23/02	990106-004-15	Southwest Harbor Project	Clear, 50s
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Laptop, TROLL calibration kit, water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0830.

For the instrumented monitoring wells, including: CMP-11, CMP-12, CMP-13, MW-308A (N), MW-308B (S):

- For T-8000s, recorded static water level (w/ time); logger battery and memory remaining; manual electronic probe readings of temperature, pressure, pH, and conductivity (w/ logger time); field checked pH and conductivity (if field check indicated probe out of calibration, a field calibration was performed);
- For T-4000s, recorded static water level (w/ time); logger battery and memory remaining; manual electronic probe readings of temperature and pressure;
- Downloaded data set (Long-term TS, 1-hour intervals);
- Reinstalled probe and recorded static water level (w/ time) and manual electronic probe readings.

All measurements and parameters were recorded on a field data sheet. Static water levels will be input into the POS FSDS database. Water levels were measured before moving the probe and after the probe was reinstalled.

The calibration procedure included:

1. Extracting the instrument from the well,
2. rinsing the instrument in deinonized water,
3. rinsing the instrument in a calibration rinse solution,
4. setting the instrument in calibration solution for calibration,
5. repeating steps 2-4 for other calibration solutions,
6. reinstalling the instrument in the well.

Left site at 1030.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
06/19/02	990106-004-15	Southwest Harbor Project	Sunny, 70s
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: YSI-30 and water level indicator

THE FOLLOWING WAS NOTED:

Arrived on site to measure water levels at 08:30

Recorded water levels, conductivity, temperature and salinity for all the non-instrumented monitoring wells, including: CMP-5, FM-105, MW-125, MW-5, CMP-9, CMP-15, RW-12S, EW-6, EW-7. CMP-10 was scheduled for measurement, but was covered by a container at the time of our visit.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature, conductivity and salinity were measured near the top and bottom of the water column.

Any water in the monument was removed, and monuments were cleaned as needed.

The water level indicator and YSI-30 were decontaminated using an alconox wash, potable water rinse, hexane rinse and final DI water rinse.

Water level measurements were completed at 12:30

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
06/24/02	990106-004-15	Southwest Harbor Project	Clear, 70's

CLIENT	PROJECT LOCATION
Port of Seattle	Terminal 5

EQUIPMENT USED: Laptop, TROLL calibration kit, YSI-30 (T,C,S), water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0730.

For the instrumented monitoring wells, including: CMP-2, CMP-4, CMP-11, CMP-12, CMP-13, CMP-14, MW-307A (S), MW-307BR (N), MW-308N (A), MW-308S (B)

- For T-8000s, recorded static water level (w/ time); logger battery and memory remaining; manual electronic probe readings of temperature, pressure, pH, and conductivity (w/ logger time); field checked pH and conductivity (if field check indicated probe out of calibration, a field calibration was performed);
- For T-4000s, recorded static water level (w/ time); logger battery and memory remaining; manual electronic probe readings of temperature and pressure; and YSI-30 measurements of temperature, conductivity, and salinity at the water table and the deepest available location (top of transducer or 50 ft);
- Downloaded data set (Long-term TS, 1-hour intervals);
- Installed spacer in well for probe to rest on;
- Reinstalled probe on spacer;
- Attached desiccant pack to surface connector.

All measurements and parameters were recorded on a field data sheet. Static water levels will be input into the POS FSDS database. Water levels were measured before moving the probe. Measurements made with the YSI-30 were made before the probe was moved.

The calibration procedure included:

1. extracting the instrument from the well,
2. rinsing the instrument in deionized water,
3. rinsing the instrument in a calibration rinse solution,
4. setting the instrument in calibration solution for calibration,
5. repeating steps 2-4 for other calibration solutions,
6. reinstalling the instrument in the well.

Spacers were installed to provide a constant probe elevation. Stainless steel wire connected to the spacers is attached to the well cap for removing the spacer.

Desiccant packs were installed to prevent moisture from entering the vent tube and corroding the circuitry.

The gate to CMP-12 and CMP-13 was inaccessible because of the configuration of the locks and chain.

The APL stack train rail yard supervisor requested that permission to enter the rail yard be acquired (daily) prior to any future visits – for safety reasons – from the personnel on the 5th floor of the yard control tower. Frank ??? (933-4705); Gene ??? (933-4501); John ??? (933-4579); Craig Johnston (948-3828).

Left site at 1630.

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File, Client	Peter Bannister, Kristin Nilsen
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Aspect consulting
IN-DEPTH PERSPECTIVE

DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
06/25/02	990106-004-15	Southwest Harbor Project	Clear, 70's

CLIENT Port of Seattle	**PROJECT LOCATION** Terminal 5

EQUIPMENT USED: Laptop, TROLL calibration kit, YSI-30 (T,C,S), water level indicator.

THE FOLLOWING WAS NOTED:

Arrived on site at 0730.

Received permission from Craig Johnston for visiting CMP-6 and CMP-7 within the APL stack train rail yard area.

For the instrumented monitoring wells, including: CMP-3, CMP-6, CMP-7, CMP-8, CMP-16, MW-26R, MW-36, MW-44:

- For T-8000s, recorded static water level (w/ time); logger battery and memory remaining; manual electronic probe readings of temperature, pressure, pH, and conductivity (w/ logger time); field checked pH and conductivity (if field check indicated probe out of calibration, a field calibration was performed);
- For T-4000s and Mini-Troll, recorded static water level (w/ time); logger battery and memory remaining; manual electronic probe readings of temperature and pressure; and YSI-30 measurements of temperature, conductivity, and salinity at the water table and the deepest available location (top of transducer or 50 ft);
- Downloaded data set (Long-term TS, 1-hour intervals);
- Installed spacer in well for probe to rest on;
- Reinstalled probe on spacer;
- Attached desiccant pack to surface connector.

All measurements and parameters were recorded on a field data sheet. Static water levels will be input into the POS FSDS database. Water levels were measured before moving the probe. Measurements made with the YSI-30 were made before the probe was moved.

The calibration procedure included:

1. extracting the instrument from the well,
2. rinsing the instrument in deinonized water,
3. rinsing the instrument in a calibration rinse solution,
4. setting the instrument in calibration solution for calibration,
5. repeating steps 2-4 for other calibration solutions,
6. reinstalling the instrument in the well.

Spacers were installed to provide a constant probe elevation. Stainless steel wire connected to the spacers is attached to the well cap for removing the spacer.

The spacers in MW-36 and MW-44 were connected directly to the probe, due to the well retrofit installation and the potential for the probe to slip past the spacer if not connected.

A Mini-Troll was installed in MW-36 to replace a faulty T-4000. The logger name, clock, and data collection setup were reset to be consistent with the other probes.

Desiccant packs were installed to prevent moisture from entering the vent tube and corroding the circuitry.

Left site at 1230.

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179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
06/26/02	990106-004-15	Southwest Harbor Project	Sunny, 70s
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: YSI-30 and water level indicator

THE FOLLOWING WAS NOTED:

Arrived on site at 07:30

Recorded water level, conductivity, temperature and salinity in CMP-1 for input into the POS FSDS database.

Temperature, conductivity and salinity were measured near the top and bottom of the water column. Water in the monument was removed, and the monument was cleaned. The water level indicator and YSI-30 were decontaminated using an alconox wash, potable water rinse, hexane rinse and final DI water rinse.

Collected ground water samples from wells MW-36, MW-44, and CMP-308S. Sampling procedures included the installation of dedicated 3/8" ID polyethylene tubing to a depth above the newly installed instrumentation. Approximately 1 gallon of water (> 3 tubing volumes) was pumped from each well using a peristaltic pump, and then a sample was collected through the pump into a 500 ml poly bottle, labeled and placed on ice in a cooler.

GW levels were recorded in each well before installing the poly tubing.

MW-36 – 9.64 @ 0923

MW-44 – (see 6/19/02 data) @ 0945

CMP-308S – 5.91 @ 0830

Left site at 10:30

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
08/09/02	990106-004-15	Southwest Harbor Project	Sunny, 70s

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: YSI-30, water level indicator, peristaltic pump, sample equipment, decon equp.

THE FOLLOWING WAS NOTED:

Arrived on site to measure water levels at 07:30

Recorded water levels, conductivity, temperature and salinity for all the non-instrumented monitoring wells, including: CMP-1, CMP-5, FM-105, MW-125, MW-5, CMP-9, CMP-10, CMP-15. We also collected ground water levels, conductivity and temperature in monitoring wells MW-36, MW-44, and MW-308S.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature, conductivity and salinity were measured at the bottom of the water column.

Any water in the monument was removed, and monuments were cleaned as needed.

The water level indicator and YSI-30 were decontaminated between wells using an alconox wash, potable water rinse, hexane rinse and final DI water rinse.

Ground water samples were collected from wells MW-36, MW-44, and CMP-308S. Approximately 1 gallon of water (> 3 tubing volumes) was pumped from each well before sampling, using a peristaltic pump, and then a sample was collected through the pump into a 500 ml poly bottle, labeled and placed on ice in a cooler. The 3 ground water samples were delivered under chain of custody to the North Creek Analytical laboratory in Bothell, WA for analysis.

Water level measurements and ground water sampling were completed at 12:30

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DAILY REPORT

DATE	PROJECT NO.	PROJECT NAME	WEATHER
8/13/02	990106-004-15	Southwest Harbor Project	Clear, 80s

CLIENT Port of Seattle | **PROJECT LOCATION** Terminal 5

EQUIPMENT USED: Laptop, Troll calibration kit, water level indicator, YSI-30 salinity probe

THE FOLLOWING WAS NOTED:

Arrived on site at 0800.

Downloaded and calibrated (if necessary) Troll probes. Procedure at each well included:

1) Static water level measured with water level indicator and recorded – without moving probe. Salinity measured with YSI-30 and recorded – without moving probe
2) Troll probe connected to computer. Corresponding electronic readings recorded, including battery remaining, memory remaining, temperature, pressure, pH, and conductivity. Data downloaded from probe.
3) Probe removed from well for field check and rinsed in deionized water.
4) pH field check involved putting probe in standard pH calibration solution near the last reading (usually pH 7.0). An equilibrium electronic reading was taken. If reading was off by more than 0.25 pH, a one-point recalibration was made. The corresponding slope (5309) and offset were recorded.
5) Conductivity field check involved putting probe in a standard specific conductance solution near the last reading. Specific conductance = actual conductivity/(1+0.0191*(temperature(°C) – 25)). An equilibrium electronic reading was taken. If reading was off more than 10%, a recalibration was made. The corresponding Kcell was recorded.
6) Probe was reinstalled in well. If a calibration was made, a new data collection schedule was loaded into the probe.

The probes in all of the instrumented wells were downloaded, including: CMP-2, -3, -4, -6, -7, -8, -11, -12, -13, -14, -16, MW-26R, -36, -44, -307A, -307BR, -308N, -308S.

The following probes were recalibrated for pH: CMP-8 and CMP-11.

The following probes were recalibrated for conductivity: CMP-6, -8, MW-26R.

Left site at 1600.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
10/08/02	990106-004-15	Southwest Harbor Project	Overcast 60s
CLIENT Port of Seattle		PROJECT LOCATION Terminal 5	

EQUIPMENT USED: YSI-30, water level indicator, peristaltic pump, sample equipment, decon equp.

THE FOLLOWING WAS NOTED:

Arrived on site to measure water levels at 10:30

Recorded water levels, conductivity, temperature and salinity for all the non-instrumented monitoring wells, including: CMP-1, CMP-5, FM-105, MW-125, MW-5, CMP-9, CMP-10, CMP-15. We also collected ground water levels, conductivity and temperature in monitoring wells MW-36, MW-44, and MW-308S.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature, conductivity and salinity were measured at the bottom of the water column.

Any water in the monument was removed, and monuments were cleaned as needed.

The water level indicator and YSI-30 were decontaminated between wells using an alconox wash, potable water rinse, hexane rinse and final DI water rinse.

Ground water samples were collected from wells MW-36, MW-44, and CMP-308S. Approximately 1 gallon of water (> 3 tubing volumes) was pumped from each well before sampling, using a peristaltic pump, and then a sample was collected through the pump into a 500 ml poly bottle, labeled and placed on ice in a cooler. The 3 ground water samples were delivered under chain of custody to the North Creek Analytical laboratory in Bothell, WA for analysis.

Water level measurements and ground water sampling were completed at 16:00

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DAILY REPORT

DATE	PROJECT NO.	PROJECT NAME	WEATHER
10/11/02	990106-004-15	Southwest Harbor Project	Partly Cloudy, 60s
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Laptop, Troll calibration kit, water level indicator, YSI-30 salinity probe

THE FOLLOWING WAS NOTED:

Arrived on site at 0900.

Downloaded and calibrated (if necessary) Troll probes. Procedure at each well included:

1) Static water level measured with water level indicator and recorded – without moving probe. Salinity measured with YSI-30 and recorded – without moving probe
2) Troll probe connected to computer. Corresponding electronic readings recorded, including battery remaining, memory remaining, temperature, pressure, pH, and conductivity. Data downloaded from probe.
3) Probe removed from well. A zero-pressure probe reading was recorded. The probe was rinsed in deionized water.
4) Total depth to spacer at bottom of well measured and recorded. The measured transducer elevation was compared to the elevation calculated from electronic measurements and SWL.
5) pH field check involved putting probe in standard pH calibration solution near the last reading (usually pH 7.0). An equilibrium electronic reading was taken. If reading was off by more than 0.25 pH, a one-point recalibration was made. The corresponding slope (5309) and offset were recorded.
6) Conductivity field check involved putting probe in a standard specific conductance solution near the last reading. Specific conductance = actual conductivity/(1+0.0191*(temperature(°C) – 25)). An equilibrium electronic reading was taken. If reading was off more than 10%, a recalibration was made. The corresponding Kcell was recorded.
7) Probe was reinstalled in well. If a calibration was made, a new data collection schedule was loaded into the probe.

Data were recorded electronically on field sheets on the laptop (FieldSheets_Filled 10-11-02.xls).

The probes in all of the instrumented wells were downloaded, including: CMP-2, -3, -4, -6, -7, -8, -11, -12, -13, -14, -16, MW-26R, -36, -44, -307A, -307BR, -308N, -308S.

The MiniTroll in MW-36 was extracted and sent to In-Situ to evaluate the transducer (drift in pressure indicates failed transducer). A rental MiniTroll was hung in the well – the 50 ft length of cable precluded using the spacer.

The salinity tubing in MW-44 was lost down the hole when the probe was lifted to measure the total depth of the hole.

The following probe was recalibrated for pH: CMP-4.

None of the probes required conductivity recalibration.

The following probes exceeded the 0.05% psi range accuracy (0.008 psi [0.02 ft] for 15-psi probes, 0.015 psi [0.03 ft] for 30-psi probes) for zero pressure: CMP-3 (0.289 psi), CMP-8 (0.033 psi), CMP-12 (0.010 psi), CMP-13 (0.01 psi), CMP-16 (0.139 psi), MW-26R (0.014 psi), MW-44 (0.067 psi), MW-307BR (0.074 psi), MW-308S (0.032 psi).

The following probes exceeded the 0.05% psi range + 0.05 ft accuracy (0.07 ft for 15-psi probes, 0.08 for 30-psi probes) for transducer elevation: CMP-2 (0.12 ft), CMP-3 (0.74 ft), CMP-4 (0.18 ft), CMP-6 (0.11 ft), CMP-7 (0.11 ft), CMP-8 (0.18 ft), CMP-11 (0.15 ft), CMP-12 (0.16 ft), CMP-13 (0.14 ft), CMP-16 (0.10 ft), MW-26R (0.12 ft), MW-44 (0.09 ft), MW-307A (0.17 ft), MW-308N (1.02 ft), MW-308S (0.35 ft).

Left site at 1630.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
12/10/02	990106-004-15	Southwest Harbor Project	Raining, 40s

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: YSI-30, water level indicator, peristaltic pump, sample equipment, decon equp.

THE FOLLOWING WAS NOTED:

Aspect representative arrived on site to measure water levels and conductivity in selected wells at 11:30

Recorded water levels, conductivity, temperature and salinity for all the non-instrumented monitoring wells, including: CMP-1, CMP-5, FM-105, MW-125, MW-5, CMP-9, and CMP-10. CMP-15 was covered by containers, and was not monitored. We also collected ground water levels, conductivity and temperature in monitoring wells MW-36 and MW-308S before sampling.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature, conductivity and salinity were measured at the bottom of the water column.

Any water in the monument was removed, and monuments were cleaned as needed.

The water level indicator and YSI-30 were decontaminated between wells using an alconox wash, potable water rinse, and final DI water rinse.

Ground water samples were collected from wells MW-36 and CMP-308S. Approximately 1-½ gallons of water (> 3 tubing volumes) was pumped from each well before sampling, using a peristaltic pump. A sample was collected through the pump into a 500 ml poly bottle, labeled and placed on ice in a cooler. The 3 ground water samples were delivered under chain of custody to the North Creek Analytical laboratory in Bothell, WA for analysis.

Water level measurements and ground water sampling were completed at 15:30

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
12/17/02	990106-004-15	Southwest Harbor Project	Raining, 40s

CLIENT	PROJECT LOCATION
Port of Seattle	Terminal 5

EQUIPMENT USED: YSI-30, water level indicator, field laptop computer, calibration and maintenance kit, decon equp.

THE FOLLOWING WAS NOTED:

Aspect representatives arrived on site to perform download/calibration procedures for Troll probes at 8:30.

The probes in the following wells were downloaded and field checked: CMP-7, CMP-13, CMP-16, MW-44, MW-307BR, MW-308N, MW-308S. Measured water levels and salinity in each well before moving probe. Downloaded dataloggers.

The probe in MW-308N could not be removed from the well for field checks. Initially the probe would not move from the bottom of the well, where it was resting on a spacer, as though it was hooked on something. After jiggling the cable, the probe moved approximately ½ foot up before stopping, as though it had become wedged. Visual inspection of the well showed the cable entering the water in the western quarter, as opposed to the center. One possible reason for this was the ~10 ft pile of gravel stored approximately 40 feet to the west of the well.

The probe in CMP-13 could not be field checked for pressure.

Aspect representatives left the site at 16:00.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE Wednesday 01/22/03	PROJECT NO. 990106-004-15	PROJECT NAME Southwest Harbor Project	WEATHER Raining, 40s
CLIENT Port of Seattle		PROJECT LOCATION Terminal 5	
EQUIPMENT USED:			

THE FOLLOWING WAS NOTED:

Aspect representatives arrived at the MW-308 compound at 17:00 to observe current site conditions.

Many areas of distressed asphalt paving were noted between the gate and the north fence (the driving areas). Several areas of standing water were observed along the north and east fence lines. Approximately 10,000 square feet of water was noted in the northeast corner of the compound, and a pond of water was noticed between MW-308N and MW-308S.

We noted stockpiles of soil, crushed rock and asphalt in the western part of the compound.

Aspect representatives left the site at 17:30.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
01-29-03	990106-004-15	Southwest Harbor Project	Raining, 40s

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: Water level indicator

THE FOLLOWING WAS NOTED:

Aspect arrived on site at 8:45 to exchange the rental transducer in MW-36 with the new transducer. The transducer and spacer bar was set up and at 9:05 a water level was taken. The rental transducer was then removed from the well and the new transducer with spacer attached was inserted.

Aspect left the site at 9:15.

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Aspect PROJECT MANAGER: Chip Goodhue

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
03-11-03	990106-004-15	Southwest Harbor Project	Raining, 40s
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: YSI-30, water level indicator, peristaltic pump, sample equipment, decon equipment

THE FOLLOWING WAS NOTED:

11:30 Aspect representative arrived on site to measure water levels and conductivity in selected groundwater monitoring wells

Recorded water levels, conductivity, temperature and salinity for all the non-instrumented monitoring wells, including: CMP-1, CMP-5, FM-105, MW-125, MW-5, CMP-9, CMP-10, and CMP-15. We also collected ground water levels, conductivity and temperature in monitoring wells MW-36 and MW-308S before sampling.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature, conductivity and salinity were measured at the bottom of the water column.

Any water in the monument was removed, and monuments were cleaned as needed.

The water level indicator and YSI-30 were decontaminated between wells using an alconox wash, potable water rinse, and final DI water rinse.

Ground water samples were collected from wells MW-36 and CMP-308S. Approximately 1-½ gallons of water (> 3 tubing volumes) was pumped from each well before sampling, using a peristaltic pump. A sample was collected through the pump into a 500 ml poly bottle, labeled and placed on ice in a cooler. The 2 ground water samples were delivered under chain of custody to the North Creek Analytical laboratory in Bothell, WA for analysis.

16:30 Water level measurements and ground water sampling were completed

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
3/31/03	990106	Southwest Harbor Project	Partly Cloudy, 50s
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Holt Drilling Mobile B-59

THE FOLLOWING WAS NOTED:

On-site at 0830

Aspect Consulting on-site to meet with utility locators to clear monitoring well locations CMP-18, 19, and 20. All water, electrical, phone and gas utilities are clear at the marked location. Metro sewer had previously cleared all sites.

Left site at 1130

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DAILY REPORT

DATE	PROJECT NO.	PROJECT NAME	WEATHER
4/02/03	990106	Southwest Harbor Project	Partly Cloudy, 50s
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Holt Drilling Mobile B-59

THE FOLLOWING WAS NOTED:

Aspect Consulting on-site to observe the drilling and installation of three monitoring wells as part of the SW Harbor Project. Holt Drilling arrived on-site at 0800 with a truck mounted Mobile B-59 hollow stem auger drill rig. All monitoring well locations had previously been marked and cleared off all utilities. All boring were completed to the apparent native silt deposits. Wells were screened above the native silt deposits. All three monitoring wells completed today were screened from 7 to 17-feet below ground surface. Soil samples were collected every 5 feet with one extra sample collected at 15-feet. All wells were screened using a 2-inch, 10-slot PVC wire wrapped screen. Sand packs consisted of 10/20 Colorado sand to 7-feet and 20/40 Colorado sand to 5 feet. Flush mount traffic bearing monuments supplied by the Port were used in completion. The permanent well designation was stamped on the lid of each monument. All drilling and installation information was recorded on Aspect Consulting Boring Log forms and As-Built Monitoring Well forms.

All drill cuttings were placed in 55-gallon DOT approved drums and moved to the Northeast corner of the terminal for storage. Decon water from steam cleaning operations was placed in a 55-gallon drum and stored with the soil drums. There are four soil drums, 1 decon water drum and 2 empty drums currently on-site. All drums were labeled with source and date.

Well development will be completed next week.

Kathy Bahnick form the POS and Chip Goodhue from Aspect visited the drilling operation today along with a representative from Ecology.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
04-02-03	990106-004-15	Southwest Harbor Project	40s, overcast

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: Water level indicator, InSitu download kit, Troll replacement battery packs

THE FOLLOWING WAS NOTED:

Aspect representatives arrived on site at 7:30.

Probes in wells CMP-2, CMP-3, CMP-13, CMP-14, CMP-16, MW-26R, MW-36, MW-44, MW-307A, MW-307BR, MW-308N and MW-308S were field checked for pressure, pH (if necessary), conductivity (if necessary). Probes from CMP-3 and MW-308N were removed to have the pressure sensor checked in the lab. Battery packs were replaced if necessary.

Aspect representatives left the site at 15:00.

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DATE	PROJECT NO.	PROJECT NAME	WEATHER
04-10-03	990106-004-15	Southwest Harbor Project	40s, overcast
CLIENT Port of Seattle		**PROJECT LOCATION** Terminal 5	

EQUIPMENT USED: Water level indicator, InSitu download kit, Troll replacement battery packs

THE FOLLOWING WAS NOTED:

Aspect representatives arrived on site at 7:30.

Probes in wells CMP-4, CMP-6, CMP-7, CMP-8, CMP-11, CMP-12 were field checked for pressure, pH (if necessary), conductivity (if necessary). Probes from CMP-3 and MW-308N were removed to have the pressure sensor checked in the lab. Battery packs were replaced if necessary.

New wells (CMP-18, CMP-19, and CMP-20) were developed. Due to time constraints, only ~25 gallons were developed from each well. Further development is necessary to achieve the <100 NTU turbidity.

Aspect representatives left the site at 16:00.

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179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
07-08-03	990106-004-15	Southwest Harbor Project	Cloudy, 60s

CLIENT Port of Seattle | **PROJECT LOCATION** Terminal 5

EQUIPMENT USED: YSI-30, water level indicator, peristaltic pump, sample equipment, decon equipment

THE FOLLOWING WAS NOTED:

08:00 Aspect personnel arrived on site to measure water levels and conductivity in selected groundwater monitoring wells

Recorded water levels, conductivity, temperature and salinity for all the non-instrumented monitoring wells, including: CMP-1, CMP-5, FM-105, MW-125, MW-5, CMP-9, CMP-10, and CMP-15. We also collected ground water levels, conductivity and temperature in monitoring wells MW-36 and MW-308S before sampling.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature, conductivity and salinity were measured at the bottom of the water column.

Any water in the monument was removed, and monuments were cleaned as needed.

The water level indicator and YSI-30 were decontaminated between wells using an alconox wash, potable water rinse, and final DI water rinse.

Ground water samples were collected from wells MW-36 and CMP-308S. Approximately 1-½ gallons of water (> 3 tubing volumes) was pumped from each well before sampling, using a peristaltic pump. A sample from each well was collected through the pump into 1-liter amber bottle, labeled and placed on ice in a cooler. The 2 ground water samples were delivered under chain of custody protocol to North Creek Analytical laboratory in Bothell, WA for analysis.

13:30 Water level measurements and ground water sampling were completed

COPIES TO: File, Client	**FIELD REP.:** John McNulty
Page No. 1 of 1	**Aspect PROJECT MANAGER:** Chip Goodhue

Aspect consulting
IN-DEPTH PERSPECTIVE

DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
07-11-03	990106-004-15	Southwest Harbor Project	Sunny, 60-70

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: Water level indicator, InSitu download kit, Troll replacement battery packs, laptop PC

THE FOLLOWING WAS NOTED:

Aspect representatives arrived on site at 8:00.

Probes in wells CMP-2, CMP-3, CMP-8, CMP-11, CMP-12, CMP-13, CMP-14, CMP-16, CMP-19, CMP-20, MW-26R, MW-36, MW-44, MW-307A, MW-307BR, MW-308N and MW-308S were field checked for pressure, pH (if necessary), conductivity (if necessary). Static water levels were measured before each download.

Aspect representatives left the site at 17:00.

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
07-16-03	990106-004-15	Southwest Harbor Project	Sunny, 70s

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: Water level indicator, InSitu download kit, Troll replacement battery packs, laptop PC

THE FOLLOWING WAS NOTED:

Aspect representatives arrived on site at 15:00.

Probes in wells CMP-4, CMP-6, CMP-7, and CMP-18 were field checked for pressure, pH (if necessary), conductivity (if necessary).

Aspect representatives left the site at 17:00.

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DAILY REPORT

179 Madrone Lane North
Bainbridge Island, Washington 98110
(206) 780-9370

811 First Avenue, Suite 480
Seattle, Washington 98104
(206) 328-7443

DATE: 7/31& 8/4/03	**PROJECT NO.** 990106	**WEATHER:** Sunny, 70s
PROJECT NAME: Terminal 5	**CLIENT:** POS	
EQUIPMENT USED: -	**PROJECT LOCATION:** -	

THE FOLLOWING WAS NOTED:

JM visited T-5 to inventory drums and miscellaneous materials located within the 308 compound, and also in the northeast corner of the main terminal.

DRUMS IN NE CORNER OF PIER:

4 SOIL, 2 WATER, 1 EMPTY from installation of CMP-18, CMP19, CMP-20

Miscellaneous Materials
1 – approx. 500 gallon poly tank
3 – steel monuments
1 – 10" diameter x 6' steel pipe filled with cement
1 – 10' x 1½" PVC
6 – 10' x ¾" threaded PVC
2 – plastic tubs
2 – rubber hoses

NORTH OF POLY TANK
10 – 55 gallon drums (empty)
5 – 85 gallon overpack drums (empty)
6 – 55 gallon drums of soil (RETEC drums)

SOUTH OF POLY TANK
27 – 55 gallon drums – RETEC soil
2 – PPE drums
1 bag of absorbent boom material

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FIELD REP.: John McNulty

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DAILY REPORT

179 Madrone Lane North Bainbridge Island, Washington 98110 (206) 780-9370

DATE	PROJECT NO.	PROJECT NAME	WEATHER
12-19-03	990106-004-15	Southwest Harbor Project	Overcast, 50s

CLIENT Port of Seattle

PROJECT LOCATION Terminal 5

EQUIPMENT USED: YSI-30, water level indicator, peristaltic pump, sample equipment, decon equipment

THE FOLLOWING WAS NOTED:

09:00 Aspect personnel arrived on site to measure water levels and conductivity in selected groundwater monitoring wells

Recorded water levels, conductivity, temperature and salinity for all the non-instrumented monitoring wells, including: CMP-1, CMP-5, FM-105, MW-125, MW-5, CMP-9, CMP-10, and CMP-15. We also collected ground water levels, conductivity and temperature in monitoring wells MW-36 and MW-308S before sampling.

All data were recorded on a "Ground Water Sampling Record" sheet to be later input into the POS FSDS database.

Temperature, conductivity and salinity were measured at the bottom of the water column.

Any water in the monument was removed, and monuments were cleaned as needed.

The water level indicator and YSI-30 were decontaminated between wells using an alconox wash, potable water rinse, and final DI water rinse.

Ground water samples were collected from wells MW-36 and CMP-308S. Approximately 2- gallons of water (> 3 tubing volumes) was pumped from each well before sampling, using a peristaltic pump. A sample from each well was collected through the pump into 500 ml poly bottles, labeled and placed on ice in a cooler. The two groundwater samples were delivered under chain of custody protocol to North Creek Analytical laboratory in Bothell, WA for analysis.

13:30 Water level measurements and ground water sampling were completed

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Page No. 1 of 1	**Aspect PROJECT MANAGER:** Chip Goodhue

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DAILY REPORT

179 Madrone Lane North
Bainbridge Island, Washington 98110
(206) 780-9370

811 First Avenue, Suite 480
Seattle, Washington 98104
(206) 328-7443

DATE: June 3, 2004	**PROJECT NO.** 990106	**WEATHER:** Clear, 70s
PROJECT NAME: Southwest Harbor Project	**CLIENT:** Pos	
EQUIPMENT USED: Confined Space Entry - Harness, Tripod, Air Monitoring Equipment	**PROJECT LOCATION:** Terminal 5 - Longfellow Overflow Line	

THE FOLLOWING WAS NOTED:

0900 – Arrived on site with BNSF flagger. Set up for confined space. Waited approximately ½ hour for train activity to cease.

0930 – Entered MH-1 for observations and to install data logger. Depth of sediment at and upstream of culvert lip was 1.6 feet. Depth of sediment in manhole sump was 2.85. Approximate depth of flowing water in culvert was 0.25 feet. Width of channel was 1.6 feet. Diameter of culvert up stream and down stream was 72 inches.

Installed 2" pvc screen in man hole for transducer.

1100 – Entered MH-7. Depth of sediment in culvert 0.7 feet. Sediment in sump was a gravely sand. Depth of flowing water in 1.5 foot channel was 0.3 feet.

Installed 2" pvc screen in man hole for transducer.

1345 – Entered MH-4. 84" concrete culvert up stream and 84" corrugated steel culvert down stream. Sediment in sump was 2.5 feet deep and consisted very soft clayey silt. Depth of flowing water in 5.2 foot channel was 0.15 feet.

Installed 2" pvc screen in man hole for transducer.

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FIELD REP.: Name, Designation

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DAILY REPORT

179 Madrone Lane North
Bainbridge Island, Washington 98110
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DATE: July 6, 2004	**PROJECT NO.** 990106	**WEATHER:** Clear 70's
PROJECT NAME: T-5 SW Harbor	**CLIENT:** Port Of Seattle	
EQUIPMENT USED:	**PROJECT LOCATION:** T-5	

THE FOLLOWING WAS NOTED:

0810 Peter Bannister arrived on site and met with Warren Hansen to discuss LFOL and contributing surface and storm water drains.

0830 – Pulled T-8000 from MH-7

1000 – Pulled T-8000 from MH-4.

1010 – Pulled T-8000 from MH-1.

1020 – Left site.

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FIELD REP.: Peter Bannister

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DAILY REPORT

179 Madrone Lane North
Bainbridge Island, Washington 98110
(206) 780-9370

811 First Avenue, Suite 480
Seattle, Washington 98104
(206) 328-7443

DATE: July 28, 2004	PROJECT NO. 990106	WEATHER: Clear 70's
PROJECT NAME: T-5 SW Harbor	CLIENT: Port Of Seattle	
EQUIPMENT USED: Confine Space Entry	PROJECT LOCATION: T-5	

THE FOLLOWING WAS NOTED:

0630 - Bob Hanford and Peter Bannister arrived on site at MH-2, Called Stack Train Operations for OK to proceed. Set up for confined space entry. Calibrated air monitoring equipment. Set up tripod. Completed entry form.

0700 – Bob Hanford entered MH-2. Upstream was 72-inch corrugated steel culvert. Down stream is a 84-inch concrete culvert. No audible falling water or inlets visible. Sediment thickness up stream is 1.35 feet. Collected sediment sample from 25' upstream of the sump. Sediment sample was collected with a 3" polybicarbonate core tube from the surface down 1 foot. The core tube was pushed into the sediment, top cap placed on core tube, then a bottom cap placed on tube prior to removing sample. Clear water was visible above the sediment in the tube and recovery was 100%.

Down stream sediment thickness 1.25 feet. Sediment thickness in manhole sump 3.05 feet. A stream channel is present on top of the sediment. Stream channel is approximately 3-feet across and 2-inches deep and is consistent from up stream through the culvert and continues down stream. Barnacles and mussels visible to 4.3 feet above culvert bottom. Sediment thickness and descriptions recorded. Exit MH-2 at 0830.

0900 – Set up at MH-1. BNSF flagger onsite. Waited approximately ½ hour for train activity to cease.

0930 – Bob Hanford entered MH-1 after completing initial air monitoring and entry form. Corrugated steel culverts 72 "up stream and down stream. Culvert sump is brick lined at the bottom with concrete on the upper portion. Minor seepage was visible from the brick and at culvert joints. Sediment thickness in the sump was 3.1 feet. Up stream and down stream sediment thicknesses were 1.9 and 1.15 feet respectively.

Collected a water sample from 25' up stream of the culvert. Water was collected by directly filling a new clean 1-liter glass jar and transferring the water into the appropriate jar. Water was observe to be clear and colorless. No field parameters were collected due to the confined space entry.

Collected sediment sample from 25" upstream of the sump. Sediment sample was collected with a 3" polybicarbonate core tube from the surface down 1 foot. The core tube was pushed into the sediment, top cap placed on core tube, then a bottom cap placed on tube prior to removing sample. Clear water was visible above the sediment in the tube and recovery was 100%. Sediment thickness and descriptions recorded. Exited manhole at 10:15.

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DATE: July 29, 2004	**PROJECT NO.** 990106	**WEATHER:** Clear 70's
PROJECT NAME: T-5 SW Harbor	**CLIENT:** Port Of Seattle	
EQUIPMENT USED: Confine Space Entry	**PROJECT LOCATION:** T-5	

THE FOLLOWING WAS NOTED:

0830 - Bob Hanford, Dave Heffner and Peter Bannister arrived on site at MH-8. Set up for confined space entry. Calibrated air monitoring equipment. Set up tripod. Completed entry form.

0900 – Bob Hanford and Peter Bannister entered MH-8. Upstream was 84-inch concrete culvert. Down stream was 84-inch concrete culvert. A 24" steel culvert enters from the east side into the LFOL at the manhole. Approximate flow 15 to 20 gpm. No other inlets visible at MH-8. Approximate water level in culvert 3.5'. Sediment thickness 10' up stream is 1.75 feet. Sediment thicknesses down stream at 10', 50', 100', and 150' respectively were 2.0, 1.35, 1.05, and 1.15. Collected sediment samples from 50', 100, and 150 down stream of the sump. Sediment samples were collected with a 3" polybicarbonate core tube from the surface down 1 foot. The core tube was pushed into the sediment at each location, top cap placed on core tube, then a bottom cap placed on tube prior to removing sample. Clear water was visible above the sediment in all samples and recovery was above 90%. Sediment thickness at the sump was not measured but was observed to be about 1 foot deep of sandy gravel. Exit MH-8 at 0930.

1030 – Set up at MH-4. Contacted stack train operations. OK to proceed.

1040 – Bob Hanford and Peter Bannister entered MH-4 after completing initial air monitoring and entry form. Corrugated steel culvert 72 "down stream and 84" concrete up stream. Culvert sump is concrete. No seepage was visible from the sump or culverts. Sediment thickness in the sump was 2.4 feet. Up stream and down stream sediment thicknesses twenty and thirty feet from the man hole were 1.2 and 1.10 feet respectively.

Collected water and sediment sample from thirty feet up stream of sump. Water was collected by directly filling a new clean 1-liter glass jar and transferring the water into the appropriate jar. Water was observed to be clear and colorless. No field parameters were collected due to the confined space entry.

Collected sediment sample from 30 feet upstream of the sump. Sediment sample was collected with a 3" polybicarbonate core tube from the surface down 1 foot. The core tube was pushed into the sediment, top cap placed on core tube, then a bottom cap placed on tube prior to removing sample. Clear water was visible above the sediment in the tube and recovery was over 90%. Sediment thickness and descriptions recorded.

A stream channel is present on top of the sediment. Stream channel is approximately 4.2-feet across and 1 to 2-inches deep and is consistent from up stream through the culvert and continues down stream. Barnacles and mussels visible to top of culvert. Sediment thickness and descriptions recorded. Exit MH-4 at 1100.

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Aspect Consulting PROJECT MANAGER: Chip Goodhue

FIELD REP.: Bob Hanford, Peter Bannister and Dave Heffner

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DAILY REPORT

179 Madrone Lane North
Bainbridge Island, Washington 98110
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Seattle, Washington 98104
(206) 328-7443

DATE: July 30, 2004	**PROJECT NO.** 990106	**WEATHER:** Clear 70's
PROJECT NAME: T-5 SW Harbor	**CLIENT:** Port Of Seattle	
EQUIPMENT USED: Confine Space Entry	**PROJECT LOCATION:** T-5	

THE FOLLOWING WAS NOTED:

0930 - Dave Heffner and Peter Bannister arrived on site at MH-7. Set up for confined space entry. Calibrated air monitoring equipment. Set up tripod. Completed entry form.

1000 –Peter Bannister entered MH-7. Upstream was 84-inch concrete culvert. Down stream was an 84-inch corrugated culvert. Two inlets were observed at the manhole location. A 12" concrete pipe enters from the SW with a flow estimated at 5 gpm. The second pipe is an 8" pvc pipe with a slight flow entering the man hole from the SE.

Sediment thickness 1' down stream is 1.45 feet of sandy gravel. At the sump the sediment thickness was measured at 3.0 feet of coarse sand and gravel. Sediment thickness at 1' up stream was 1.0 foot.

Flow between MH-7 and MH-6 was noted as very turbid. Collected water sample from 140 feet up stream of sump (13' upstream of MH-6). Water was collected by directly filling a new clean 1-liter glass jar and transferring the water into the appropriate jar. Water was observed to be clear and colorless. No field parameters were collected due to the confined space entry.

Collected a sediment samples from 160' up stream of the sump (33 feet up stream of MH-6). Sediment sample were collected with a 3" polybicarbonate core tube from the surface down 1 foot. The core tube was pushed into the sediment at each location, top cap placed on core tube, then a bottom cap placed on tube prior to removing sample. Clear water was visible above the sediment in all samples and recovery was above 90%. Exit MH-7 at 1115. Water flow had reversed flow and was moving up stream

Sediment thickness and descriptions recorded.

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Aspect Consulting PROJECT MANAGER: Chip Goodhue

FIELD REP.: Peter Bannister and Dave Heffner

APPENDIX C

Laboratory Results – Groundwater Chloride Analyses

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Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
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503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588

09 February 2002

Chip Goodhue
Aspect Consulting
179 Madrone Lane N
Bainbridge Island, WA/USA 98110

RE: SW Harbor

Enclosed are **amended** results of analyses for samples received by the laboratory on 12/19/01 09:30. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Scott A. Woerman
Project Manager

www.ncalabs.com

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541.383.9310 Fax 541.382.7588

February 08, 2002

Aspect Consulting
Attn.: Mr. Chip Goodhue
179 Madrone Lane N
Bainbridge Island, WA 98110

Subject: Chloride Analysis for Work Order Number B1L0486

Mr. Goodhue:

NCA's QA department reviewed the chloride data associated with the aforementioned work order when notified by NCA Project Manager Scott Woerman of discrepancies in the results reported for samples MW-44121301 (B1L0486-07) and CMP-11121701 (B1L0486-20). In the course of this review, additional data was discovered that confirmed the chloride results for most of the other samples in this work order. This data came predominantly from less than optimal dilutions, which are adequate for the purpose of screening or confirming. The comparison of this supplemental data with the reported results also uncovered a new discrepancy pertaining to sample CMP-12121701 (B1L0486-19). A split of this sample and the other samples, for which confirmation data did not initially exist, were prepared and introduced into the lab as blind duplicates (different client name, different project name and different work order number). For sample CMP-12121701 (B1L0486-19), the result from the split agreed favorably with a dilution not associated with the result originally reported. Therefore, the result originally reported for this sample is suspect. The results obtained from the splits of the other samples agreed favorably with those previously reported.

Based on this review, its believed that incorrect dilution factors were applied in the original analysis of samples MW-44121301 (B1L0486-07) and CMP-11121701 (B1L0486-20) and that a sample misidentification occurred in the original analysis CMP-12121701 (B1L0486-19). An amended report was issued for this work order.

North Creek Analytical regrets any inconvenience this may have caused. If you have any questions or need additional information, please let me know.

Sincerely,
North Creek Analytical

D. A. Wunderlich

Dave Wunderlich
QA Manager

www.ncalabs.com

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425.420.9200 fax 425.420.9210
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Aspect Consulting
179 Madrone Lane N
Bainbridge Island WA/USA, 98110

Project: SW Harbor
Project Number: BU 99106
Project Manager: Chip Goodhue

Amended Report
Issued: 02/09/02 14:03

ANALYTICAL REPORT FOR SAMPLES - Amended

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
CMP-2121201	B1L0486-01	Water	12/12/01 12:10	12/19/01 09:30
MW-808N121201	B1L0486-02	Water	12/12/01 12:55	12/19/01 09:30
CMP-13121201	B1L0486-03	Water	12/12/01 13:55	12/19/01 09:30
CMP-12121201	B1L0486-04	Water	12/12/01 13:35	12/19/01 09:30
CMP-11121201	B1L0486-05	Water	12/12/01 13:50	12/19/01 09:30
CMP-8121201	B1L0486-06	Water	12/12/01 14:40	12/19/01 09:30
MW-44121301	B1L0486-07	Water	12/13/01 11:50	12/19/01 09:30
MW-26R121301	B1L0486-08	Water	12/13/01 12:30	12/19/01 09:30
MW-5121301	B1L0486-09	Water	12/13/01 13:00	12/19/01 09:30
CMP-16121301	B1L0486-10	Water	12/13/01 13:25	12/19/01 09:30
CMP-7121301	B1L0486-11	Water	12/13/01 14:30	12/19/01 09:30
MW-308S121301	B1L0486-12	Water	12/13/01 15:15	12/19/01 09:30
MW-36121301	B1L0486-13	Water	12/13/01 15:45	12/19/01 09:30
MW-308N121701	B1L0486-14	Water	12/17/01 09:30	12/19/01 09:30
MW-5121701	B1L0486-15	Water	12/17/01 10:50	12/19/01 09:30
CMP-2121701	B1L0486-16	Water	12/17/01 13:45	12/19/01 09:30
MW-308S121701	B1L0486-17	Water	12/17/01 14:05	12/19/01 09:30
CMP-13121701	B1L0486-18	Water	12/17/01 14:25	12/19/01 09:30
CMP-12121701	B1L0486-19	Water	12/17/01 14:40	12/19/01 09:30
CMP-11121701	B1L0486-20	Water	12/17/01 14:55	12/19/01 09:30
CMP-8121701	B1L0486-21	Water	12/17/01 16:40	12/19/01 09:30
CMP-7121701	B1L0486-22	Water	12/17/01 17:25	12/19/01 09:30
MW-36121701	B1L0486-23	Water	12/17/01 18:15	12/19/01 09:30
CMP-16121701	B1L0486-24	Water	12/17/01 18:40	12/19/01 09:30
MW-44121701	B1L0486-25	Water	12/17/01 18:55	12/19/01 09:30
MW-26R121701	B1L0486-26	Water	12/17/01 19:05	12/19/01 09:30

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Scott A. Woerman, Project Manager

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Aspect Consulting	Project: SW Harbor	
179 Madrone Lane N	Project Number: BU 99106	**Amended Report**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	Issued: 02/09/02 14:03

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
CMP-2121201 (B1L0486-01) Water Sampled: 12/12/01 12:10 Received: 12/19/01 09:30									
Chloride	487	20.0	mg/l	100	1L28007	12/27/01	12/27/01	EPA 300.0	
MW-808N121201 (B1L0486-02) Water Sampled: 12/12/01 12:55 Received: 12/19/01 09:30									
Chloride	992	20.0	mg/l	100	1L26020	12/22/01	12/22/01	EPA 300.0	
CMP-13121201 (B1L0486-03) Water Sampled: 12/12/01 13:55 Received: 12/19/01 09:30									
Chloride	769	20.0	mg/l	100	1L26042	12/22/01	12/22/01	EPA 300.0	
CMP-12121201 (B1L0486-04) Water Sampled: 12/12/01 13:35 Received: 12/19/01 09:30									
Chloride	2020	100	mg/l	500	1L26045	12/22/01	12/22/01	EPA 300.0	
CMP-11121201 (B1L0486-05) Water Sampled: 12/12/01 13:50 Received: 12/19/01 09:30									
Chloride	12400	1000	mg/l	5000	1L26045	12/22/01	12/22/01	EPA 300.0	
CMP-11121201 (B1L0486-05RE1) Water Sampled: 12/12/01 13:50 Received: 12/19/01 09:30									
Chloride	14800	1000	mg/l	5000	2A25031	01/23/02	01/23/02	EPA 300.0	I-02
CMP-8121201 (B1L0486-06) Water Sampled: 12/12/01 14:40 Received: 12/19/01 09:30									
Chloride	851	20.0	mg/l	100	1L26020	12/22/01	12/22/01	EPA 300.0	
MW-44121301 (B1L0486-07) Water Sampled: 12/13/01 11:50 Received: 12/19/01 09:30									
Chloride	44900	1000	mg/l	5000	1L26045	12/22/01	12/22/01	EPA 300.0	
MW-44121301 (B1L0486-07RE1) Water Sampled: 12/13/01 11:50 Received: 12/19/01 09:30									
Chloride	19400	1000	mg/l	5000	2A25031	01/23/02	01/23/02	EPA 300.0	I-02

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Scott A. Woerman, Project Manager

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Aspect Consulting	Project: SW Harbor	
179 Madrone Lane N	Project Number: BU 99106	**Amended Report**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	Issued: 02/09/02 14:03

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-26R121301 (B1L0486-08) Water Sampled: 12/13/01 12:30 Received: 12/19/01 09:30									
Chloride	**412**	40.0	mg/l	200	1L26020	12/22/01	12/22/01	EPA 300.0	
MW-5121301 (B1L0486-09) Water Sampled: 12/13/01 13:00 Received: 12/19/01 09:30									
Chloride	**13800**	1000	mg/l	5000	1L26045	12/22/01	12/22/01	EPA 300.0	
CMP-16121301 (B1L0486-10) Water Sampled: 12/13/01 13:25 Received: 12/19/01 09:30									
Chloride	**9500**	1000	mg/l	5000	1L26045	12/22/01	12/22/01	EPA 300.0	
CMP-7121301 (B1L0486-11) Water Sampled: 12/13/01 14:30 Received: 12/19/01 09:30									
Chloride	569	20.0	mg/l	100	1L26020	12/22/01	12/22/01	EPA 300.0	
MW-308S121301 (B1L0486-12) Water Sampled: 12/13/01 15:15 Received: 12/19/01 09:30									
Chloride	8730	1000	mg/l	5000	1L26045	12/22/01	12/22/01	EPA 300.0	
MW-36121301 (B1L0486-13) Water Sampled: 12/13/01 15:45 Received: 12/19/01 09:30									
Chloride	15400	1000	mg/l	5000	1L26056	12/23/01	12/23/01	EPA 300.0	
MW-308N121701 (B1L0486-14) Water Sampled: 12/17/01 09:30 Received: 12/19/01 09:30									
Chloride	962	40.0	mg/l	200	1L26045	12/22/01	12/22/01	EPA 300.0	
MW-5121701 (B1L0486-15) Water Sampled: 12/17/01 10:50 Received: 12/19/01 09:30									
Chloride	12300	1000	mg/l	5000	1L26045	12/22/01	12/22/01	EPA 300.0	
CMP-2121701 (B1L0486-16) Water Sampled: 12/17/01 13:45 Received: 12/19/01 09:30									
Chloride	387	20.0	mg/l	100	1L26020	12/22/01	12/22/01	EPA 300.0	

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Aspect Consulting	Project: SW Harbor	
179 Madrone Lane N	Project Number: BU 99106	**Amended Report**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	Issued: 02/09/02 14:03

Anions by EPA Method 300.0
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-3088121701 (B1L0486-17) Water Sampled: 12/17/01 14:05 Received: 12/19/01 09:30									
Chloride	**8900**	200	mg/l	1000	1L26042	12/22/01	12/22/01	EPA 300.0	
CMP-13121701 (B1L0486-18) Water Sampled: 12/17/01 14:25 Received: 12/19/01 09:30									
Chloride	**232**	20.0	mg/l	100	1L26056	12/23/01	12/23/01	EPA 300.0	
CMP-12121701 (B1L0486-19) Water Sampled: 12/17/01 14:40 Received: 12/19/01 09:30									
Chloride	**5070**	200	mg/l	1000	1L27005	12/26/01	12/26/01	EPA 300.0	
CMP-12121701 (B1L0486-19RE1) Water Sampled: 12/17/01 14:40 Received: 12/19/01 09:30									
Chloride	**2470**	200	mg/l	1000	2B01015	01/31/02	01/31/02	EPA 300.0	I-02
CMP-11121701 (B1L0486-20) Water Sampled: 12/17/01 14:55 Received: 12/19/01 09:30									
Chloride	**52700**	2000	mg/l	10000	1L27005	12/26/01	12/26/01	EPA 300.0	
CMP-11121701 (B1L0486-20RE1) Water Sampled: 12/17/01 14:55 Received: 12/19/01 09:30									
Chloride	**13700**	1000	mg/l	5000	2A25031	01/24/02	01/24/02	EPA 300.0	I-02
CMP-8121701 (B1L0486-21) Water Sampled: 12/17/01 16:40 Received: 12/19/01 09:30									
Chloride	**880**	40.0	mg/l	200	1L26056	12/23/01	12/23/01	EPA 300.0	
CMP-7121701 (B1L0486-22) Water Sampled: 12/17/01 17:25 Received: 12/19/01 09:30									
Chloride	**519**	20.0	mg/l	100	1L26056	12/23/01	12/23/01	EPA 300.0	
MW-36121701 (B1L0486-23) Water Sampled: 12/17/01 18:15 Received: 12/19/01 09:30									
Chloride	**15500**	1000	mg/l	5000	1L26056	12/23/01	12/23/01	EPA 300.0	

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Aspect Consulting	Project: SW Harbor	
179 Madrone Lane N	Project Number: BU 99106	**Amended Report**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	Issued: 02/09/02 14:03

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
CMP-16121701 (B1L0486-24) Water	**Sampled: 12/17/01 18:40**		**Received: 12/19/01 09:30**						
Chloride	**11500**	400	mg/l	2000	1L26056	12/23/01	12/23/01	EPA 300.0	
MW-44121701 (B1L0486-25) Water	**Sampled: 12/17/01 18:55**		**Received: 12/19/01 09:30**						
Chloride	**18200**	1000	mg/l	5000	1L26056	12/23/01	12/23/01	EPA 300.0	
MW-44121701 (B1L0486-25RE1) Water	**Sampled: 12/17/01 18:55**		**Received: 12/19/01 09:30**						
Chloride	**18900**	1000	mg/l	5000	2A25031	01/23/02	01/23/02	EPA 300.0	1-02
MW-26R121701 (B1L0486-26) Water	**Sampled: 12/17/01 19:05**		**Received: 12/19/01 09:30**						
Chloride	**357**	20.0	mg/l	100	1L26056	12/23/01	12/23/01	EPA 300.0	

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Aspect Consulting	Project: SW Harbor	
179 Madrone Lane N	Project Number: BU 99106	**Amended Report**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	Issued: 02/09/02 14:03

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1L26020: Prepared 12/22/01 Using General Preparation										
Blank (1L26020-BLK1)										
Chloride	ND	0.200	mg/l							
LCS (1L26020-BS1)										
Chloride	1.91	0.200	mg/l	2.00		95.5	90-110			
LCS Dup (1L26020-BSD1)										
Chloride	1.97	0.200	mg/l	2.00		98.5	90-110	3.09	20	
Duplicate (1L26020-DUP1)					**Source: B1L0486-16**					
Chloride	283	20.0	mg/l		387			31.0	25	Q-07
Matrix Spike (1L26020-MS1)					**Source: B1L0486-16**					
Chloride	489	20.0	mg/l	200	387	51.0	54-124			Q-15
Batch 1L26042: Prepared 12/22/01 Using General Preparation										
Blank (1L26042-BLK1)										
Chloride	ND	0.200	mg/l							
LCS (1L26042-BS1)										
Chloride	1.99	0.200	mg/l	2.00		99.5	90-110			
LCS Dup (1L26042-BSD1)										
Chloride	1.97	0.200	mg/l	2.00		98.5	90-110	1.01	20	
Duplicate (1L26042-DUP1)					**Source: B1L0343-12**					
Chloride	1480	100	mg/l		1470			0.678	25	

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Aspect Consulting	Project: SW Harbor	
179 Madrone Lane N	Project Number: BU 99106	**Amended Report**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	Issued: 02/09/02 14:03

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch IL26042: Prepared 12/22/01 Using General Preparation										
Duplicate (IL26042-DUP2)					**Source: B1L0343-01**					
Chloride	1130	40.0	mg/l		1120			0.889	25	
Matrix Spike (IL26042-MS1)					**Source: B1L0343-12**					
Chloride	2350	100	mg/l	1000	1470	88.0	54-124			
Matrix Spike (IL26042-MS2)					**Source: B1L0343-01**					
Chloride	1540	40.0	mg/l	400	1120	105	54-124			
Batch IL26045: Prepared 12/22/01 Using General Preparation										
Blank (IL26045-BLK1)										
Chloride	ND	0.200	mg/l							
LCS (IL26045-BS1)										
Chloride	2.00	0.200	mg/l	2.00		100	90-110			
LCS Dup (IL26045-BSD1)										
Chloride	1.99	0.200	mg/l	2.00		99.5	90-110	0.501	20	
Duplicate (IL26045-DUP1)					**Source: B1L0486-14**					
Chloride	930	40.0	mg/l		962			3.38	25	
Matrix Spike (IL26045-MS1)					**Source: B1L0486-14**					
Chloride	1340	40.0	mg/l	400	962	94.5	54-124			
Batch IL26056: Prepared 12/23/01 Using General Preparation										
Blank (IL26056-BLK1)										
Chloride	ND	0.200	mg/l							

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179 Madrone Lane N	Project Number: BU 99106	**Amended Report**
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Anions by EPA Method 300.0 - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1L26056: Prepared 12/23/01 Using General Preparation										
LCS (1L26056-BS1)										
Chloride	2.12	0.200	mg/l	2.00		106	90-110			
LCS Dup (1L26056-BSD1)										
Chloride	2.12	0.200	mg/l	2.00		106	90-110	0.00	20	
Duplicate (1L26056-DUP2)					Source: B1L0486-18					
Chloride	208	20.0	mg/l		232			10.9	25	
Matrix Spike (1L26056-MS2)					Source: B1L0486-18					
Chloride	397	20.0	mg/l	200	232	82.5	54-124			
Batch 1L27005: Prepared 12/26/01 Using General Preparation										
Blank (1L27005-BLK1)										
Chloride	ND	0.200	mg/l							
LCS (1L27005-BS1)										
Chloride	1.82	0.200	mg/l	2.00		91.0	90-110			
LCS Dup (1L27005-BSD1)										
Chloride	1.84	0.200	mg/l	2.00		92.0	90-110	1.09	20	
Duplicate (1L27005-DUP3)					Source: B1L0343-11					
Chloride	4700	400	mg/l		4650			1.07	25	
Matrix Spike (1L27005-MS3)					Source: B1L0343-11					
Chloride	8390	400	mg/l	4000	4650	93.5	54-124			

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179 Madrone Lane N	Project Number: BU 99106	**Amended Report**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	Issued: 02/09/02 14:03

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1L28007: Prepared 12/27/01 Using General Preparation										
Blank (1L28007-BLK1)										
Chloride	ND	0.200	mg/l							
LCS (1L28007-BS1)										
Chloride	1.83	0.200	mg/l	2.00		91.5	90-110			
LCS Dup (1L28007-BSD1)										
Chloride	1.84	0.200	mg/l	2.00		92.0	90-110	0.545	20	
Duplicate (1L28007-DUP1)					**Source: B1L0486-01**					
Chloride	456	20.0	mg/l		487			6.57	25	
Duplicate (1L28007-DUP2)					**Source: B1L0528-01**					
Chloride	10600	400	mg/l		10700			0.939	25	
Matrix Spike (1L28007-MS1)					**Source: B1L0486-01**					
Chloride	654	20.0	mg/l	200	487	83.5	54-124			
Matrix Spike (1L28007-MS2)					**Source: B1L0528-01**					
Chloride	14400	400	mg/l	4000	10700	92.5	54-124			
Batch 2A25031: Prepared 01/23/02 Using General Preparation										
Blank (2A25031-BLK1)										
Chloride	ND	0.200	mg/l							
LCS (2A25031-BS1)										
Chloride	1.17	0.200	mg/l	1.20		97.5	90-110			

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Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2A25031: Prepared 01/23/02 Using General Preparation										
LCS Dup (2A25031-BSD1)										
Chloride	1.17	0.200	mg/l	1.20		97.5	90-110	0.00	20	
Duplicate (2A25031-DUP1)					**Source: B1L0486-20RE1**					
Chloride	13900	1000	mg/l		13700			1.45	25	
Matrix Spike (2A25031-MS1)					**Source: B1L0486-20RE1**					
Chloride	19100	1000	mg/l	6000	13700	90.0	54-124			
Batch 2B01015: Prepared 01/31/02 Using General Preparation										
Blank (2B01015-BLK1)										
Chloride	ND	0.200	mg/l							
LCS (2B01015-BS1)										
Chloride	1.10	0.200	mg/l	1.20		91.7	90-110			
LCS Dup (2B01015-BSD1)										
Chloride	1.09	0.200	mg/l	1.20		90.8	90-110	0.913	20	
Duplicate (2B01015-DUP2)					**Source: B2A0625-10**					
Chloride	2380	200	mg/l		2470			3.71	25	
Matrix Spike (2B01015-MS2)					**Source: B2A0625-10**					
Chloride	2970	200	mg/l	1200	2470	41.7	54-124			Q-15

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Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	Issued: 02/09/02 14:03

Notes and Definitions

I-02	This sample was analyzed outside of the recommended holding time.
Q-07	The RPD value for this QC sample is above the established control limit. Review of associated QC indicates the high RPD does not represent an out-of-control condition for the batch.
Q-15	Analyses are not controlled on matrix spike RPD and/or percent recoveries when the sample concentration is significantly higher than the spike level.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

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CHAIN OF CUSTODY REPORT

Work Order #: B1C0486

CLIENT: Aspect Consulting LLC
REPORT TO: Chip Goodhue
ADDRESS: 179 Madrone LN N
Bainbridge Island WA 98110
PHONE: 206 780 9370 FAX: 206 780 9438

INVOICE TO: SAME
P.O. NUMBER:

PROJECT NAME: SW Harbor
PROJECT NUMBER: BU 99106
SAMPLED BY: Peter Bannister

TURNAROUND REQUEST in Business Days*
Organic & Inorganic Analyses: ~~10~~ 7 5 4 3 2 1 <1 (STD.)
Petroleum Hydrocarbon Analyses: 5 4 3 2 1 <1 (STD.)
OTHER Please Specify
*Turnaround Requests less than standard may incur Rush Charges.

REQUESTED ANALYSES

CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	CI EPA 300	MATRIX (W, S, O)	# OF CONT.	COMMENTS	NCA WO ID
1. MW-308N121701	12-17-01 / 0930	X	W	1		14
2. MW-5 121701	12-17-01 / 1050	X	W	1		15
3. CMP-2 121701	12-17-01 / 1345	X	W	1		16
4. MW-308S121701	12-17-01 / 1405	X	W	1		17
5. CMP-13 121701	12-17-01 / 1425	X	W	1		18
6. CMP-12 121701	12-17-01 / 1440	X	W	1		19
7. CMP-11 121701	12-17-01 / 1455	X	W	1		20
8. CMP-8 121701	12-17-01 / 1640	X	W	1		21
9. CMP-7 121701	12-17-01 / 1725	X	W	1		22
10. MW-36 121701	12-17-01 / 1815	X	W	1		23
11. CMP-16 121701	12-17-01 / 1840	X	W	1		24
12. MW-44 121701	12-17-01 / 1855	X	W	1		25
13. MW-26R 121701	12-17-01 / 1905	X	W	1		26
14.						
15.						

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RECEIVED BY: [signature] DATE: 12/19/01
PRINT NAME: BRANLY TONTZ FIRM: NCA TIME: 0930
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20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711 (541) 383-9310 FAX 382-7588

CHAIN OF CUSTODY REPORT

Work Order #: BIL0486

CLIENT: Aspect Consulting LLC
REPORT TO: Chip Goodhue
ADDRESS: 179 Madrone LN N
Bainbridge Is WA 98110
PHONE: 206 780 9370 FAX: 206-780
PROJECT NAME: SW Harbor
PROJECT NUMBER: BV 99106
SAMPLED BY: Bob Hanford

INVOICE TO: SAME
P.O. NUMBER: BV99106

TURNAROUND REQUEST in Business Days*
Organic & Inorganic Analyses: 10 (STD.) | 7 | 5 | 4 | 3 | 2 | 1 | <1
Petroleum Hydrocarbon Analyses: 5 (STD.) | 4 | 3 | 2 | 1 | <1
OTHER Please Specify
*Turnaround Requests less than standard may incur Rush Charges.

REQUESTED ANALYSES

CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	Cl EPA 300	MATRIX (W, S, O)	# OF CONT.	COMMENTS	NCA WO ID
1. CMP-2 121201	12/12/01 12:10	x	W	1		01
2. MW-808N 121201	12/12/01 1255	x		1		02
3. CMP-13 121201	12/12/01 1325	x		1		03
4. CMP-12 121201	12/12/01 1335	x		1		04
5. CMP-11 121201	12/12/01 1350	x		1		05
6. CMP-8 121201	12/12/01 1440	x		1		06
7. MW-44 121301	12/13/01 1150	x		1		07
8. MW-26R 121301	12/13/01 1230	x		1		08
9. MW-5 121301	12/13/01 1300	x		1		09
10. CMP-16 121301	12/13/01 1325	x		1		10
11. CMP-7 121301	12/13/01 1430	x		1		11
12. MW-308S 121301	12/13/01 155	x		1		12
13. MW-36 121301	12/13/01 1545	x		1		13
14.						
15.						

RELINQUISHED BY: [signature] DATE: 12-18-00
PRINT NAME: PETER BANNISTER FIRM: Aspect TIME: 1015
RECEIVED BY: [signature] DATE: 12/19/01
PRINT NAME: PRANY TONTY FIRM: NCA TIME: 0930
RELINQUISHED BY: DATE:
PRINT NAME: FIRM: TIME:
RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS: W/CS TEMP: 4.6 PAGE OF

COC REV 3/99

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509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588

JUL 15 2002

Aspect Consulting	Project: T5 - Earthquake Repair	
179 Madrone Lane N	Project Number: [none]	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	07/12/02 10:37

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW36	B2F0772-01	Water	06/26/02 09:35	06/28/02 09:30
MW44	B2F0772-02	Water	06/26/02 09:50	06/28/02 09:30
CMP 308S	B2F0772-03	Water	06/26/02 09:00	06/28/02 09:30

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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541.383.9310 fax 541.382.7588

Aspect Consulting	Project: T5 - Earthquake Repair	
179 Madrone Lane N	Project Number: [none]	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	07/12/02 10:37

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW36 (B2F0772-01) Water Sampled: 06/26/02 09:35 Received: 06/28/02 09:30									
Chloride	**12700**	2000	mg/l	5000	2G02013	07/01/02	07/01/02	EPA 300.0	
MW44 (B2F0772-02) Water Sampled: 06/26/02 09:50 Received: 06/28/02 09:30									
Chloride	**47.3**	10.0	mg/l	25	2G02013	07/01/02	07/01/02	EPA 300.0	
CMP 308S (B2F0772-03) Water Sampled: 06/26/02 09:00 Received: 06/28/02 09:30									
Chloride	**8610**	800	mg/l	2000	2G02013	07/01/02	07/01/02	EPA 300.0	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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541.383.9310 Fax 541.382.7588

Aspect Consulting	Project: T5 - Earthquake Repair	
179 Madrone Lane N	Project Number: [none]	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	07/12/02 10:37

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2G02013: Prepared 07/01/02 Using General Preparation										
Blank (2G02013-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (2G02013-BS1)										
Chloride	2.02	0.400	mg/l	2.00		101	90-110			
LCS Dup (2G02013-BSD1)										
Chloride	1.99	0.400	mg/l	2.00		99.5	90-110	1.50	20	
Duplicate (2G02013-DUP1)					**Source: B2F0758-01**					
Chloride	2.97	0.400	mg/l		3.14			5.56	25	
Matrix Spike (2G02013-MS1)					**Source: B2F0758-01**					
Chloride	7.84	0.800	mg/l	4.00	3.14	118	54-124			

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588

Aspect Consulting	Project: T5 - Earthquake Repair	
179 Madrone Lane N	Project Number: [none]	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	07/12/02 10:37

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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CHAIN OF CUSTODY REPORT

Work Order #: B2F0772

CLIENT: Aspect Consulting
REPORT TO: Chip Goodhue
ADDRESS: 179 Madrone Lane N
Bainbridge Is, WA 98110
PHONE: 206 780 9370 FAX: 206 780-9438

INVOICE TO: Aspect
P.O. NUMBER:

PROJECT NAME: T5
PROJECT NUMBER:
SAMPLED BY: John McNulty

TURNAROUND REQUEST in Business Days*
Organic & Inorganic Analyses: 10 STD. | 7 | 5 | 4 | 3 | 2 | 1 | <1
Petroleum Hydrocarbon Analyses: 5 STD. | 4 | 3 | 2 | 1 | <1
OTHER Please Specify
*Turnaround Requests less than standard may incur Rush Charges.

#	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	REQUESTED ANALYSES: Chloride EPA 300	MATRIX (W, S, O)	# OF CONT.	COMMENTS	NCA WO ID
1.	MW 36	6-26-02 0935	✓	W	1		-01
2.	MW 44	6-26-02 0950	✓	W	1		-02
3.	CMP 30BS	6-21-02 0900	✓	W	1		-03
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.						Samples were not @ 2-6C Upon Receipt	
13.							
14.							
15.							

RELINQUISHED BY: John McNulty
PRINT NAME: John McNulty FIRM: Aspect DATE: 6/27/02 TIME: 0900

RECEIVED BY: Cathy Crumble
PRINT NAME: Cathy Crumble FIRM: NCA DATE: 6/28/02 TIME: 9:30

RELINQUISHED BY:
PRINT NAME: FIRM: DATE: TIME:

RECEIVED BY:
PRINT NAME: FIRM: DATE: TIME:

ADDITIONAL REMARKS: w/CS

TEMP: 10.6

COC REV 3/99

PAGE OF

Aspect Consulting	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	08/26/02 16:39

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-36	B2H0201-01	Water	08/09/02 10:30	08/09/02 12:57
MW-44	B2H0201-02	Water	08/09/02 09:50	08/09/02 12:57
MW-3085	B2H0201-03	Water	08/09/02 11:15	08/09/02 12:57

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

Aspect Consulting 179 Madrone Lane N Bainbridge Island WA/USA, 98110	Project: T-5 PSR Project Number: 990106 Project Manager: Chip Goodhue	**Reported:** 08/26/02 16:39

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-36 (B2H0201-01) Water Sampled: 08/09/02 10:30 Received: 08/09/02 12:57									
Chloride	**12300**	1600	mg/l	4000	2H26014	08/25/02	08/25/02	EPA 300.0	
MW-44 (B2H0201-02) Water Sampled: 08/09/02 09:50 Received: 08/09/02 12:57									
Chloride	**63.0**	8.00	mg/l	20	2H26014	08/25/02	08/25/02	EPA 300.0	
MW-3085 (B2H0201-03) Water Sampled: 08/09/02 11:15 Received: 08/09/02 12:57									
Chloride	**8440**	800	mg/l	2000	2H26014	08/25/02	08/25/02	EPA 300.0	

North Creek Analytical - Bothell

Jeff Gerdes

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Jeff Gerdes, Project Manager

Aspect Consulting	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	08/26/02 16:39

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2H26014: Prepared 08/25/02 Using General Preparation										
Blank (2H26014-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (2H26014-BS1)										
Chloride	1.95	0.400	mg/l	2.00		97.5	90-110			
LCS Dup (2H26014-BSD1)										
Chloride	1.98	0.400	mg/l	2.00		99.0	90-110	1.53	20	
Duplicate (2H26014-DUP1)					**Source: B2H0463-02**					
Chloride	52.2	8.00	mg/l		50.9			2.52	25	
Duplicate (2H26014-DUP2)					**Source: B2H0463-04**					
Chloride	36.4	4.00	mg/l		36.2			0.551	25	
Matrix Spike (2H26014-MS1)					**Source: B2H0463-02**					
Chloride	148	20.0	mg/l	100	50.9	97.1	54-124			
Matrix Spike (2H26014-MS2)					**Source: B2H0463-04**					
Chloride	80.8	10.0	mg/l	50.0	36.2	89.2	54-124			

North Creek Analytical - Bothell

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Jeff Gerdes, Project Manager

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

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CHAIN OF CUSTODY REPORT

Work Order #: B2H2001

CLIENT: Aspect Consulting
REPORT TO: Chip Goodhue
ADDRESS: 179 Madrone Lane N
Bainbridge Is, 98110
PHONE: 206 780 9370 FAX: 780-9138

INVOICE TO: SAME
P.O. NUMBER:

PROJECT NAME: T5
PROJECT NUMBER: 990106
SAMPLED BY: J McNulty

TURNAROUND REQUEST in Business Days*
Organic & Inorganic Analyses: (10) STD. | 7 | 5 | 4 | 3 | 2 | 1 | <1
Petroleum Hydrocarbon Analyses: 5 STD. | 4 | 3 | 2 | 1 | <1
OTHER — Please Specify
*Turnaround Request less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	REQUESTED ANALYSES: Chloride EPA 300.0	MATRIX (W, S, O)	# OF CONT.	COMMENTS	NCA WO ID
1.	MW-36	8-9-02 1030	✓			confirm method	-01
2.	MW-44	950	✓				-02
3.	MW-3085	1115	✓				-03
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							

RELINQUISHED BY: John McNulty — DATE: 8/9/02 — TIME: 1251
PRINT NAME: JOHN McNULTY — FIRM: Aspect
RECEIVED BY: Colette Weaver — DATE: 8-9-02 — TIME: 1257
PRINT NAME: Colette Weaver — FIRM: NCA

RELINQUISHED BY: — DATE: — TIME:
PRINT NAME: — FIRM:
RECEIVED BY: — DATE: — TIME:
PRINT NAME: — FIRM:

ADDITIONAL REMARKS:

COC REV 3/99

TEMP: 8.9°C

PAGE OF

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106-004-15	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	10/22/02 15:58

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-36	B2J0248-01	Water	10/08/02 15:00	10/09/02 10:30
MW-44	B2J0248-02	Water	10/08/02 14:40	10/09/02 10:30
MW-30BS	B2J0248-03	Water	10/08/02 15:40	10/09/02 10:30

North Creek Analytical - Bothell

Jeff Gerdes

Jeff Gerdes, Project Manager

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Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106-004-15	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	10/22/02 15:58

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-36 (B2J0248-01) Water Sampled: 10/08/02 15:00 Received: 10/09/02 10:30									
Chloride	**14000**	2000	mg/l	5000	2J16011	10/15/02	10/15/02	EPA 300.0	
MW-44 (B2J0248-02) Water Sampled: 10/08/02 14:40 Received: 10/09/02 10:30									
Chloride	**90.2**	20.0	mg/l	50	2J16011	10/15/02	10/15/02	EPA 300.0	
MW-30BS (B2J0248-03) Water Sampled: 10/08/02 15:40 Received: 10/09/02 10:30									
Chloride	**9540**	800	mg/l	2000	2J16011	10/15/02	10/15/02	EPA 300.0	

North Creek Analytical - Bothell

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Jeff Gerdes, Project Manager

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106-004-15	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	10/22/02 15:58

Anions by EPA Method 300.0 - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2J16011: Prepared 10/15/02 Using General Preparation										
Blank (2J16011-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (2J16011-BS1)										
Chloride	1.97	0.400	mg/l	2.00		98.5	90-110			
LCS Dup (2J16011-BSD1)										
Chloride	2.01	0.400	mg/l	2.00		100	90-110	2.01	20	
Duplicate (2J16011-DUP2)					**Source: B2J0223-03**					
Chloride	1.54	0.400	mg/l		1.49			3.30	25	
Matrix Spike (2J16011-MS2)					**Source: B2J0223-01**					
Chloride	3.36	0.400	mg/l	2.00	1.49	93.5	54-124			

North Creek Analytical - Bothell

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Jeff Gerdes, Project Manager

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106-004-15	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	10/22/02 15:58

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

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20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711 (541) 383-9310 FAX 382 7588

CHAIN OF CUSTODY REPORT

Work Order #: B2J0248

CLIENT: Aspect Consulting
REPORT TO: Chip Groshue
ADDRESS: 179 Madrone Lane N
Bainbridge IS, WA
PHONE: 206 780-9370 FAX: 780-[illegible]38

INVOICE TO: Aspect
P.O. NUMBER:

PROJECT NAME: 990106-004-15
PROJECT NUMBER: T-5
SAMPLED BY: JMcAuley

TURNAROUND REQUEST in Business Days*

Organic & Inorganic Analyses: [10] STD. | 7 | 5 | 4 | 3 | 2 | 1 | <1

Petroleum Hydrocarbon Analyses: [5] STD. | 4 | 3 | 2 | 1 | <1

OTHER Please Specify

*Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	Chloride EPA 300	MATRIX (W, S, O)	# OF CONT.	COMMENTS	NCA WO ID
1.	MW-36	10-8-02/1500	✓	W	1		-01
2.	MW-44	/1440	✓	W	1		-02
3.	MW-30BS	/1540	✓	W	1		-03
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							

RELINQUISHED BY: JMcAuley
PRINT NAME: John McAuley FIRM: Aspect DATE: 10/9/02 TIME: 0830

RECEIVED BY: Cathy Cramb
PRINT NAME: Cathy Cramb FIRM: NCA DATE: 10/9/02 TIME: 10:30

RELINQUISHED BY:
PRINT NAME: FIRM: DATE: TIME:

RECEIVED BY:
PRINT NAME: FIRM: DATE: TIME:

ADDITIONAL REMARKS: w/ICS

TEMP: 9.0

COC REV 3/99

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Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.274.9333 fax 907.274.9338

DEC 2 4 2002

Aspect Consulting - Bainbridge Island	Project: Not Provided	
179 Madrone Lane N	Project Number: Not Provided	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	12/20/02 17:30

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-308 S	B2L0247-01	Water	12/10/02 12:30	12/11/02 10:20
MW-36	B2L0247-02	Water	12/10/02 15:00	12/11/02 10:20

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

Aspect Consulting - Bainbridge Island	Project: Not Provided	
179 Madrone Lane N	Project Number: Not Provided	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	12/20/02 17:30

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-3085 (B2L0247-01) Water Sampled: 12/10/02 12:30 Received: 12/11/02 10:20									
Chloride	**8010**	800	mg/l	2000	2L16005	12/15/02	12/15/02	EPA 300.0	
MW-36 (B2L0247-02) Water Sampled: 12/10/02 15:00 Received: 12/11/02 10:20									
Chloride	**4660**	400	mg/l	1000	2L14001	12/13/02	12/13/02	EPA 300.0	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes

Jeff Gerdes, Project Manager

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Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

Aspect Consulting - Bainbridge Island	Project: Not Provided	
179 Madrone Lane N	Project Number: Not Provided	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	12/20/02 17:30

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2L14001: Prepared 12/13/02 Using General Preparation										
Blank (2L14001-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (2L14001-BS1)										
Chloride	1.98	0.400	mg/l	2.00		99.0	90-110			
LCS Dup (2L14001-BSD1)										
Chloride	1.95	0.400	mg/l	2.00		97.5	90-110	1.53	20	
Duplicate (2L14001-DUP2)					Source: B2L0169-01					
Chloride	18.4	2.00	mg/l		18.3			0.545	25	
Matrix Spike (2L14001-MS2)					Source: B2L0169-01					
Chloride	20.4	2.00	mg/l	2.00	18.3	105	54-124			
Batch 2L16005: Prepared 12/15/02 Using General Preparation										
Blank (2L16005-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (2L16005-BS1)										
Chloride	1.96	0.400	mg/l	2.00		98.0	90-110			
LCS Dup (2L16005-BSD1)										
Chloride	1.96	0.400	mg/l	2.00		98.0	90-110	0.00	20	
Duplicate (2L16005-DUP2)					Source: B2L0247-01					
Chloride	7860	800	mg/l		8010			1.89	25	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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907.561.9200 fax 907.561.9201

Aspect Consulting - Bainbridge Island	Project: Not Provided	
179 Madrone Lane N	Project Number: Not Provided	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	12/20/02 17:30

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2L16005: Prepared 12/15/02 Using General Preparation										
Matrix Spike (2L16005-MS2)					**Source: B2L0247-01**					
Chloride	7460	800	mg/l	2.00	8010	-27500	54-124			Q-15

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907.334.9200 Fax 907.334.9210

Aspect Consulting - Bainbridge Island	Project: Not Provided	
179 Madrone Lane N	Project Number: Not Provided	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	12/20/02 17:30

Notes and Definitions

Q-15	Analyses are not controlled on matrix spike RPD and/or percent recoveries when the sample concentration is significantly higher than the spike level.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes

Jeff Gerdes, Project Manager

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20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711 (541) 383-9310 FAX 382-7588

CHAIN OF CUSTODY REPORT

Work Order #: B21O247

CLIENT: Aspect Consulting
REPORT TO: Chip Goodhue
ADDRESS: 179 Madrone Lane N
Bainbridge Is, WA
PHONE: 206 780-9370 FAX: 206 780-9438

INVOICE TO: Same
P.O. NUMBER:

PROJECT NAME:
PROJECT NUMBER:
SAMPLED BY:

TURNAROUND REQUEST in Business Days*

Organic & Inorganic Analyses: [X] 10 STD. [7] [5] [4] [3] [2] [1] [<1]

Petroleum Hydrocarbon Analyses: [5] STD. [4] [3] [2] [1] [<1]

[OTHER] Please Specify

*Turnaround Requests less than standard may incur Rush Charges.

CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	Chloride EPA 300	MATRIX (W, S, O)	# OF CONT.	COMMENTS	NCA WO ID
1. MW-308S	12-10-02/ 1230	✓	W	1		01
2. MW-36	12-10-02/ 1500	✓	W	1		02
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						

REQUESTED ANALYSES

RELINQUISHED BY: [signature] DATE: 12-11-02
PRINT NAME: John McNulty FIRM: Aspect TIME: 0800
RECEIVED BY: [signature] DATE: 12-11-02
PRINT NAME: Scott Workman FIRM: NCA TIME: 0940

RELINQUISHED BY: [signature] DATE: 12/11/02
PRINT NAME: Scott Workman FIRM: NCA TIME: 1020
RECEIVED BY: [signature] DATE: 12/11/02
PRINT NAME: [illegible] FIRM: TIME: 1020

ADDITIONAL REMARKS:

TEMP: 5.1°C

COC REV 3/99

PAGE OF

1 of 1 COC

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541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	03/25/03 12:52

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-36	B3C0327-01	Water	03/11/03 15:15	03/12/03 14:30
MW-308	B3C0327-02	Water	03/11/03 15:50	03/12/03 14:30

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety

Jeff Gerdes

Jeff Gerdes, Project Manager

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Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	03/25/03 12:52

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-36 (B3C0327-01) Water Sampled: 03/11/03 15:15 Received: 03/12/03 14:30									
Chloride	**10300**	2000	mg/l	5000	3C22012	03/21/03	03/21/03	EPA 300.0	
MW-308 (B3C0327-02) Water Sampled: 03/11/03 15:50 Received: 03/12/03 14:30									
Chloride	**8710**	800	mg/l	2000	3C22012	03/21/03	03/21/03	EPA 300.0	

North Creek Analytical - Bothell

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541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	03/25/03 12:52

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C22012: Prepared 03/21/03 Using General Preparation										
Blank (3C22012-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (3C22012-BS1)										
Chloride	1.98	0.400	mg/l	2.00		99.0	90-110			
LCS Dup (3C22012-BSD1)										
Chloride	2.00	0.400	mg/l	2.00		100	90-110	1.01	20	
Duplicate (3C22012-DUP2)					**Source: B3C0398-02**					
Chloride	4.01	0.800	mg/l		4.01			0.00	25	
Matrix Spike (3C22012-MS2)					**Source: B3C0398-02**					
Chloride	6.00	0.800	mg/l	2.00	4.01	99.5	52-134			

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503.906.9200 fax 503.906.9210
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541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island WA/USA, 98110	Project Manager: Chip Goodhue	03/25/03 12:52

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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CHAIN OF CUSTODY REPORT

Work Order #: B3C0327

CLIENT: Aspect Consulting
REPORT TO: Chip Goodhue
ADDRESS: 179 Madrone Lane N
Bainbridge 98110
PHONE: 206 780-9370 FAX: 206 780 9438

INVOICE TO: Same
P.O. NUMBER:

PROJECT NAME: T-5
PROJECT NUMBER: 990106004.15
SAMPLED BY: John McNulty

TURNAROUND REQUEST in Business Days*
Organic & Inorganic Analyses: 10 (STD.) | 7 | 5 | 4 | 3 | 2 | 1 | <1
Petroleum Hydrocarbon Analyses: 5 (STD.) | 4 | 3 | 2 | 1 | <1
OTHER — Please Specify
*Turnaround Requests less than standard may incur Rush Charges.

CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	REQUESTED ANALYSES: Chloride EPA 300.0	MATRIX (W, S, O)	# OF CONT.	COMMENTS	NCA WO ID
1. MW-36	3-11-03 / 1515	✓	W	1		-01
2. MW-30S	3-11-03 / 1550	✓	W	1		-02
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.					Samples were not @2-6C Upon Receipt	
13.						
14.						
15.						

RELINQUISHED BY: John McNulty — DATE: 3-12-03
PRINT NAME: John McNulty FIRM: Aspect — TIME: 1143
RECEIVED BY: Aaron Dockter — DATE: 3/12/03
PRINT NAME: Aaron Dockter FIRM: NCA — TIME: 11:43

RELINQUISHED BY: Aaron Dockter — DATE: 3/12/03
PRINT NAME: Aaron Dockter FIRM: NCA — TIME: 1430
RECEIVED BY: — DATE: 3/12/03
PRINT NAME: BRANY TONTZ FIRM: NCA — TIME: 1430

ADDITIONAL REMARKS:

No — TEMP: 13.6

COC REV 3/99 — PAGE ___ OF ___

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541.383.9310 fax 541.382.7588
Anchorage 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	07/21/03 13:33

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-36-070803	B3G0200-01	Water	07/08/03 11:30	07/08/03 16:35
MW-308S-070803	B3G0200-02	Water	07/08/03 12:40	07/08/03 16:35

JUL 23 2003

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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Anchorage 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	07/21/03 13:33

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-36-070803 (B3G0200-01) Water	**Sampled: 07/08/03 11:30**		**Received: 07/08/03 16:35**						
Chloride	**10600**	2000	mg/l	5000	3G10054	07/10/03	07/10/03	EPA 300.0	
MW-308S-070803 (B3G0200-02) Water	**Sampled: 07/08/03 12:40**		**Received: 07/08/03 16:35**						
Chloride	**7630**	800	mg/l	2000	3G10054	07/10/03	07/10/03	EPA 300.0	

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541.383.9310 fax 541.382.7588
Anchorage 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	07/21/03 13:33

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3G10054: Prepared 07/10/03 Using General Preparation										
Blank (3G10054-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (3G10054-BS1)										
Chloride	1.94	0.400	mg/l	2.00		97.0	90-110			
LCS Dup (3G10054-BSD1)										
Chloride	1.98	0.400	mg/l	2.00		99.0	90-110	2.04	20	
Duplicate (3G10054-DUP2)					**Source: B3G0014-05**					
Chloride	3.48	0.400	mg/l		3.50			0.573	25	
Matrix Spike (3G10054-MS2)					**Source: B3G0014-05**					
Chloride	5.53	0.800	mg/l	2.00	3.50	102	52-134			

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907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island 179 Madrone Lane N Bainbridge Island, WA/USA 98110	Project: T-5 PSR Project Number: 990106 Project Manager: Chip Goodhue	**Reported:** 07/21/03 13:33

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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3209 Denali St, Anchorage, AK 99503-4030 907-334-9200 FAX 334-9210

CHAIN OF CUSTODY REPORT

Work Order #: B360200

CLIENT: Aspect Consulting
REPORT TO: Chip Goodhue
ADDRESS: 179 Madrone Lane N. Bainbridge Is., WA 98110
PHONE: 206-780-9375 FAX: 206-780-9438
PROJECT NAME: Terminal 5
PROJECT NUMBER: 99106
SAMPLED BY: John McNulty

INVOICE TO: SAME
P.O. NUMBER:

TURNAROUND REQUEST in Business Days *
Organic & Inorganic Analyses: [10 STD.] [7] [5] [4] [3] [2] [1] [<1]
Petroleum Hydrocarbon Analyses: [5 STD.] [4] [3] [2] [1] [<1]
[OTHER] Specify:
* Turnaround Requests less than standard may incur Rush Charges.

CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	PRESERVATIVE	REQUESTED ANALYSES: Chloride BTEX 8021.0	MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	NCA WO ID
1 MW-36-070803	7-8-03/1130		✓	W	1		-01
2 MW-308S-070803	7-8-03/1240		✓	W	1		-02
3							
4							
5							
6							
7							
8							
9							
10							

RELEASED BY: [signature] DATE: 7-8-03
PRINT NAME: John McNulty FIRM: Aspect TIME: 1500
RECEIVED BY: [signature] DATE: 7/8/03
PRINT NAME: PRAMY TONEY FIRM: NCA TIME: 1635

RELEASED BY: DATE:
PRINT NAME: FIRM: TIME:
RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS:
Samples were not @2-6C Upon Receipt
TEMP: 7.5

COC REV 1/03

PAGE OF

W/ES

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22 October 2003

Chip Goodhue
Aspect Consulting - Bainbridge Island
179 Madrone Lane N
Bainbridge Island, WA/USA 98110

OCT 2 4 2003

RE: T-5 PSR

Enclosed are the results of analyses for samples received by the laboratory on 10/09/03 13:00. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jeff Gerdes
Project Manager

www.ncalabs.com

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	10/22/03 08:50

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-36	B3J0272-01	Water	10/08/03 15:00	10/09/03 13:00
MW-308S	B3J0272-02	Water	10/08/03 10:40	10/09/03 13:00

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes

Jeff Gerdes, Project Manager

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	10/22/03 08:50

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-36 (B3J0272-01) Water Sampled: 10/08/03 15:00 Received: 10/09/03 13:00									
Chloride	**11500**	2000	mg/l	5000	3J21015	10/20/03	10/20/03	EPA 300.0	
MW-308S (B3J0272-02) Water Sampled: 10/08/03 10:40 Received: 10/09/03 13:00									
Chloride	**8490**	800	mg/l	2000	3J21015	10/20/03	10/20/03	EPA 300.0	

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Jeff Gerdes, Project Manager

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	10/22/03 08:50

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3J21015: Prepared 10/20/03 Using General Preparation										
Blank (3J21015-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (3J21015-BS1)										
Chloride	1.98	0.400	mg/l	2.00		99.0	90-110			
LCS Dup (3J21015-BSD1)										
Chloride	1.98	0.400	mg/l	2.00		99.0	90-110	0.00	20	
Duplicate (3J21015-DUP1)					**Source: B3J0536-01**					
Chloride	2.14	0.400	mg/l		2.15			0.466	25	
Matrix Spike (3J21015-MS1)					**Source: B3J0536-01**					
Chloride	4.30	0.400	mg/l	2.00	2.15	108	52-134			

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Jeff Gerdes, Project Manager

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Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	10/22/03 08:50

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes, Project Manager

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20332 Empire Ave Suite F-1, Bend, OR 99701-5711 541-383-9310 FAX 382-7588
3209 Denali St, Anchorage, AK 99503-4030 907-334-9200 FAX 334-9210

CHAIN OF CUSTODY REPORT

Work Order #: B3J0272

CLIENT: Aspect Consulting
REPORT TO: Chip Goodhue
ADDRESS: 179 Madrone Lane N. Bainbridge Is, WA 98110
PHONE: 206 780-9370 FAX: 206 780 9438

INVOICE TO: Same
P.O. NUMBER:

PROJECT NAME: Terminal 5
PROJECT NUMBER: 990106
SAMPLED BY: John McNulty

TURNAROUND REQUEST in Business Days *
Organic & Inorganic Analyses: (X) 10 STD. | 7 | 5 | 4 | 3 | 2 | 1 | <1
Petroleum Hydrocarbon Analyses: 5 STD. | 4 | 3 | 2 | 1 | <1
OTHER Specify:
* Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	PRESERVATIVE	REQUESTED ANALYSES: Chloride EPA 300.0	MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	NCA WO ID
1	MW-36	10-8-03/1500		✓	W	1		01
2	MW-308S	10-8-03/1040		✓	W	1		02
3								
4								
5								
6								
7								
8								
9								
10								

RELEASED BY: John McNulty — DATE: 10-9-03 — TIME: ~~0900~~ 1104
PRINT NAME: John McNulty — FIRM: Aspect
RECEIVED BY: [signature] — DATE: 10/9/03 — TIME: 1104
PRINT NAME: Scott Workman — FIRM: NCA

RELEASED BY: [signature] — DATE: 10/9/03 — TIME: 1300
PRINT NAME: Scott Workman — FIRM: NCA
RECEIVED BY: [signature] — DATE: 10/9/03 — TIME: 13:00
PRINT NAME: [illegible] — FIRM: NCA

ADDITIONAL REMARKS:

TEMP: n/o 5.3

COC REV 1/03

PAGE OF

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Seattle: [illegible]
Portland: [illegible]
Bend: [illegible]
Anchorage: [illegible]

JAN - 6 2004

30 December 2003

Chip Goodhue
Aspect Consulting - Bainbridge Island
179 Madrone Lane N
Bainbridge Island, WA/USA 98110
RE: T-5 PSR

Enclosed are the results of analyses for samples received by the laboratory on 12/22/03 14:15. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jeff Gerdes

Jeff Gerdes
Project Manager

www.ncalabs.com

Redmond: [illegible]
Spokane: [illegible]
Portland: [illegible]
Bend: [illegible]
Anchorage: [illegible]

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	12/30/03 17:16

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-36	B3L0733-01	Water	12/19/03 12:25	12/22/03 14:15
MW-3085	B3L0733-02	Water	12/19/03 13:05	12/22/03 14:15

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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Spokane: East 11115 Montgomery, Suite D, Spokane, WA 99206-4778
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Portland: 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.903.9200 fax 503.903.9210
Bend: 20332 Empire Avenue, Suite F, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage: 2000 W International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	12/30/03 17:16

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MW-36 (B3L0733-01) Water Sampled: 12/19/03 12:25 Received: 12/22/03 14:15									
Chloride	**6610**	800	mg/l	2000	3L30002	12/29/03	12/29/03	EPA 300.0	
MW-3085 (B3L0733-02) Water Sampled: 12/19/03 13:05 Received: 12/22/03 14:15									
Chloride	**7380**	800	mg/l	2000	3L30002	12/29/03	12/29/03	EPA 300.0	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

www.ncalabs.com

Aspect Consulting - Bainbridge Island	Project: T-5 PSR	
179 Madrone Lane N	Project Number: 990106	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	12/30/03 17:16

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3L30002: Prepared 12/29/03 Using General Preparation										
Blank (3L30002-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (3L30002-BS1)										
Chloride	2.07	0.400	mg/l	2.00		104	90-110			
LCS Dup (3L30002-BSD1)										
Chloride	1.88	0.400	mg/l	2.00		94.0	90-110	9.62	20	
Duplicate (3L30002-DUP2)					**Source: B3L0739-02**					
Chloride	274	40.0	mg/l		273			0.366	25	
Duplicate (3L30002-DUP3)					**Source: B3L0739-07**					
Chloride	1.99	0.400	mg/l		2.03			1.99	25	
Matrix Spike (3L30002-MS2)					**Source: B3L0739-02**					
Chloride	388	40.0	mg/l	100	273	115	52-134			
Matrix Spike (3L30002-MS3)					**Source: B3L0739-07**					
Chloride	3.71	0.400	mg/l	2.00	2.03	84.0	52-134			

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503.906.9200 fax 503.906.9210
Dead 20332 Empire Avenue, Suite H-1, Dead, OR 97701-7731
541.330.9210 fax 541.382.7588
Anchorage 9000 W International Airport Road, Suite A-17, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island 179 Madrone Lane N Bainbridge Island, WA/USA 98110	Project: T-5 PSR Project Number: 990106 Project Manager: Chip Goodhue	**Reported:** 12/30/03 17:16

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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20332 Empire Ave Suite F-1, Bend, OR 99701-5711 541-383-9310 FAX 382-7588
3209 Denali St, Anchorage, AK 99503-4030 907-334-9200 FAX 334-9210

CHAIN OF CUSTODY REPORT

Work Order #: B312033

CLIENT: Aspect Consulting
INVOICE TO: Aspect
REPORT TO: Chip Goodhue
ADDRESS: 179 madrone Lane N.
Bainbridge Is, WA 98110
PHONE: 206 780 9370 FAX: 206 780 9488
P.O. NUMBER:
PROJECT NAME: Terminal 5
PROJECT NUMBER: 990106
SAMPLED BY: JMcNulty

TURNAROUND REQUEST
in Business Days *
Organic & Inorganic Analyses: [10] STD. [7] [5] [4] [3] [2] [1] [<1]
Petroleum Hydrocarbon Analyses: [5] STD. [4] [3] [2] [1] [<1]
[OTHER] Specify:
* Turnaround Requests less than standard may incur Rush Charges.

PRESERVATIVE

REQUESTED ANALYSES

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	Chloride EPA 300												MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	NCA WO ID
1	MW-36	12-19-03/ 1225	✓												W	1		01
2	MW-308S	12-19-03/ 1305	✓												W	1		02
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

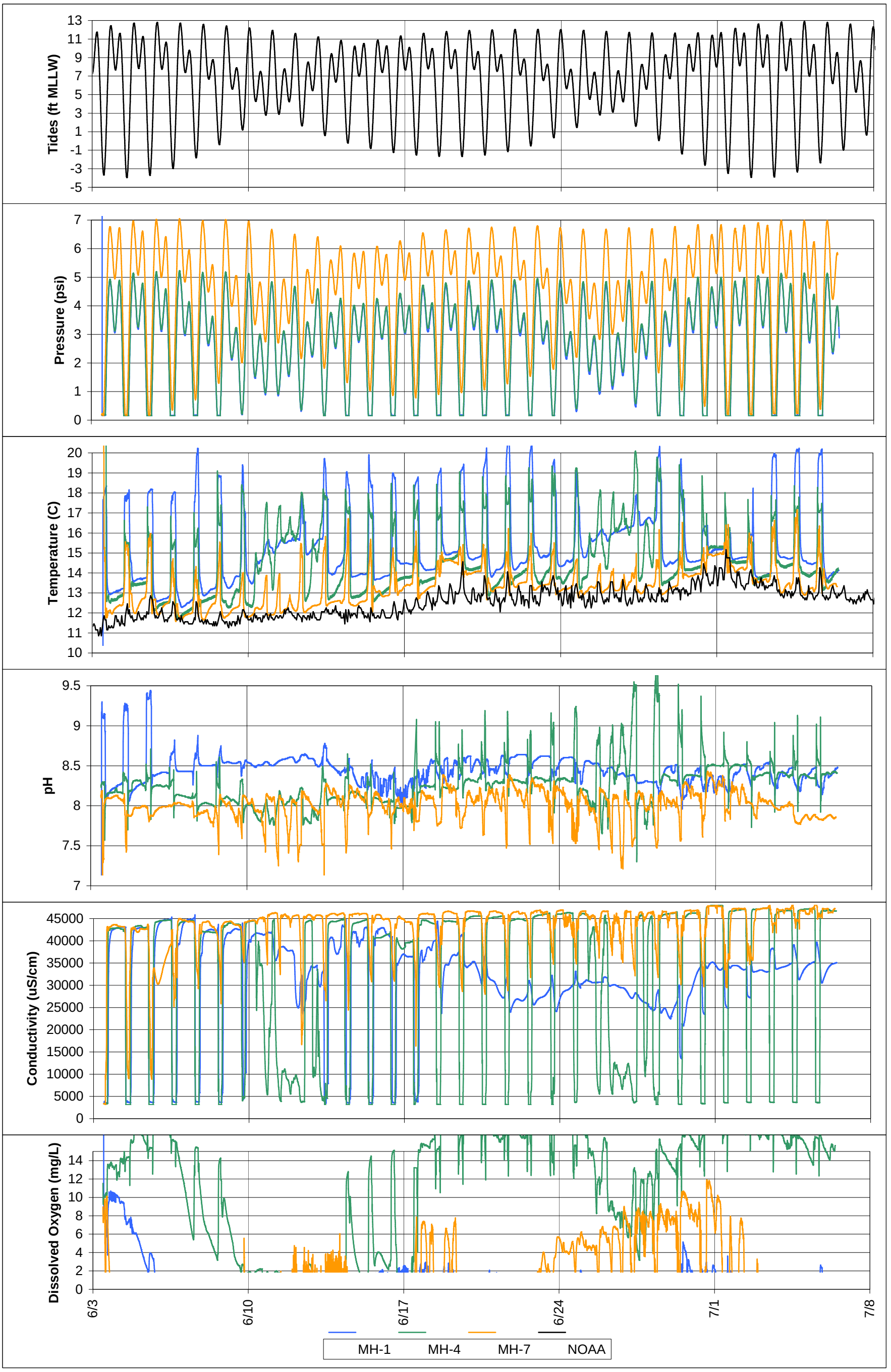
RELEASED BY: John McNulty DATE: 12-22-03
PRINT NAME: John McNulty FIRM: Aspect TIME: 0130
RECEIVED BY: Jenny Slatter DATE: 12-22-03
PRINT NAME: Jenny Slatter FIRM: NCA TIME: 9:45

RELEASED BY: DATE:
PRINT NAME: FIRM: TIME:
RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS: W/CS
TEMP: 4.4
COC REV 1-03
PAGE OF

APPENDIX D

LFOL Flow Monitoring Data



Longfellow Overflow Line Monitoring Data - June 3, 2004 to July 8, 2004

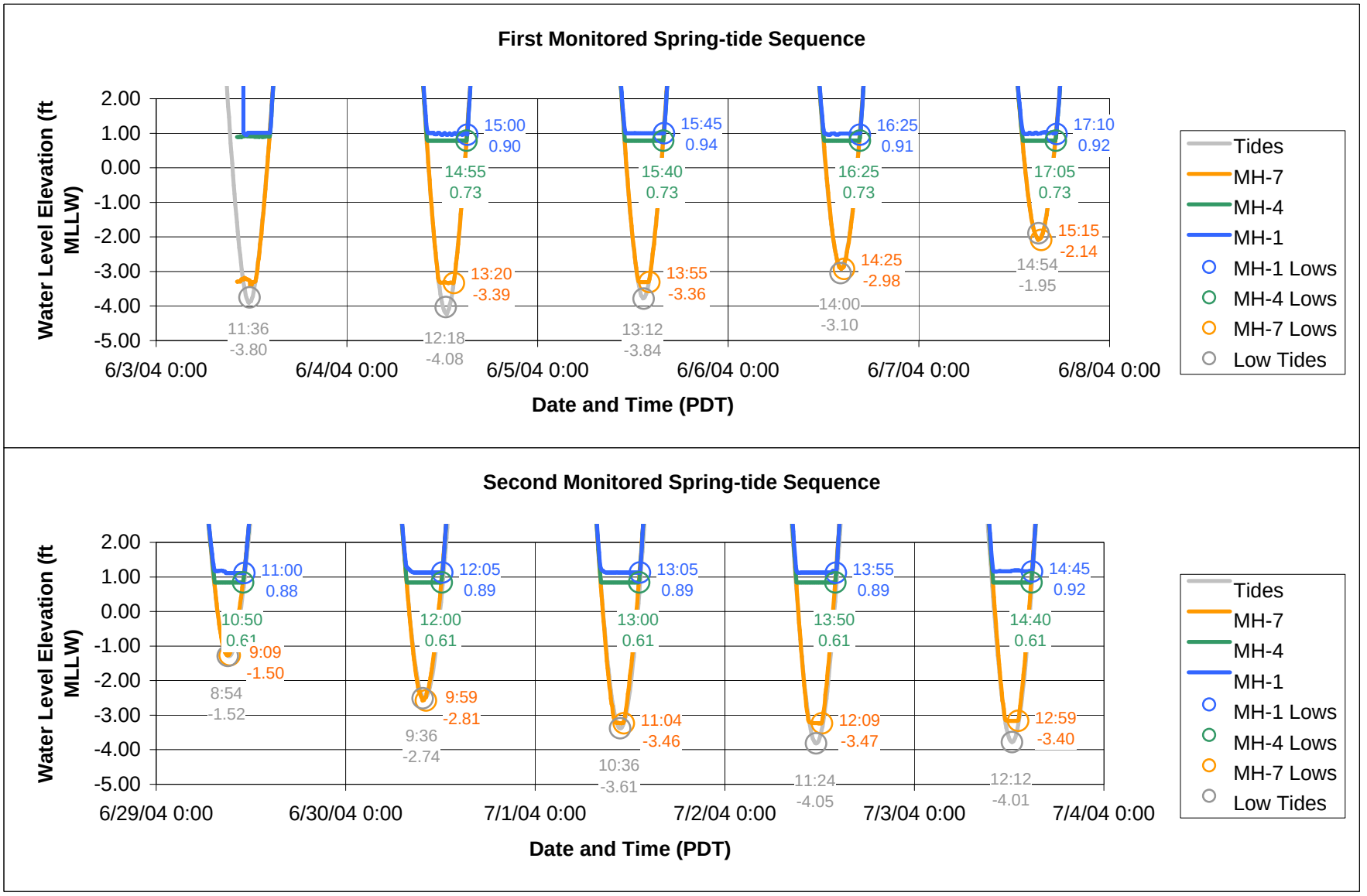
SWHP Phase I Groundwater Confimation Monitoring Program

Hydrologic Characterization Report

Figure D-1

AGENCY REVIEW DRAFT

Aspect consulting
IN-DEPTH PERSPECTIVE



Comparison of Monitored Water Levels During Spring-tide Sequences in LFOL - June/July 2004

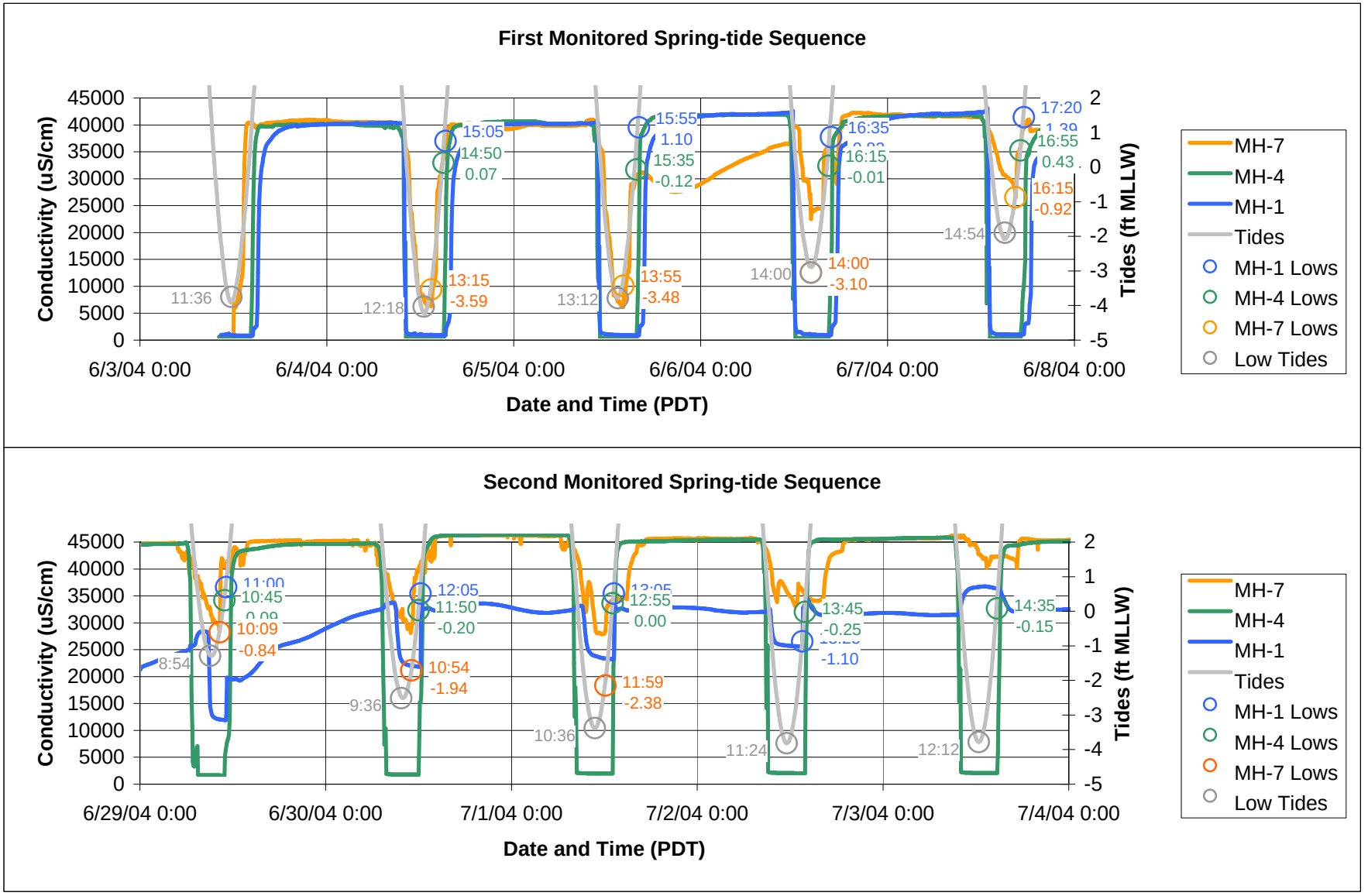
SWHP Phase I Groundwater Confimation Monitoring Program

Hydrologic Characterization Report

Figure D-2

AGENCY REVIEW DRAFT

Aspect consulting
IN-DEPTH PERSPECTIVE



Comparison of Monitored Conductivities During Spring-tide Sequences in LFOL - June/July 2004

SWHP Phase I Groundwater Confimation Monitoring Program

Hydrologic Characterization Report

Figure D-3

AGENCY REVIEW DRAFT

Aspect consulting
IN-DEPTH PERSPECTIVE

APPENDIX E

Laboratory Results – LFOL Water Samples Analyses

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Anchorage 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

11 August 2004

RECEIVED
AUG 20 2004

Chip Goodhue
Aspect Consulting - Bainbridge Island
179 Madrone Lane N
Bainbridge Island, WA/USA 98110

RE: SW Harbor - LFOL

Enclosed are the results of analyses for samples received by the laboratory on 07/28/04 14:30. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jeff Gerdes

Jeff Gerdes
Project Manager

www.ncslabs.com

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541.383.9310 fax 541.382.7588
Anchorage 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MH2-SED-072804	B4G0753-01	Sediment	07/28/04 07:30	07/28/04 14:30
MH1-W-072804	B4G0753-02	Water	07/28/04 09:00	07/28/04 14:30
MH1-SED-072804	B4G0753-03	Sediment	07/28/04 09:45	07/28/04 14:30

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

www.ncalabs.com

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509.924.9200 fax 509.924.9290
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503.906.9200 fax 503.906.9210
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541.383.9310 fax 541.382.7588
Anchorage 2070 W. International Airport Road, Suite A12, Anchorage, AK 99502-1119
907.561.9200 fax 907.561.6210

Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Total Metals by EPA 6000/7000 Series Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH1-W-072804 (B4G0753-02) Water	**Sampled: 07/28/04 09:00**		**Received: 07/28/04 14:30**						
Calcium	**31.1**	0.250	mg/l	1	4G29031	07/29/04	07/30/04	EPA 6010B	
Iron	ND	0.150	"	"	"	"	"	"	
Potassium	**10.7**	2.00	"	"	"	"	"	"	
Magnesium	**12.3**	0.500	"	"	"	"	"	"	
Sodium	**112**	0.250	"	"	"	"	"	"	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

North Creek Analytical, Inc.
Environmental Laboratory Network

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907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Conventional Chemistry Parameters by APHA/EPA Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH1-W-072804 (B4G0753-02) Water	**Sampled: 07/28/04 09:00**		**Received: 07/28/04 14:30**						
Total Alkalinity	**107**	5.00	mg/L as CaCO3	1	4H03034	08/03/04	08/03/04	EPA 310.1	
Ammonia-Nitrogen	**0.158**	0.100	mg/l as N	"	4G29059	07/29/04	07/29/04	EPA 350.3	
Ferric Iron	ND	0.250	mg/l	"	4G29031	07/29/04	08/11/04	SM 3500-Fe D	I-05
Nitrate/Nitrite-Nitrogen	**0.291**	0.0100	mg/l as N	"	4H01002	07/29/04	08/30/04	EPA 353.2	
pH	**9.15**		pH Units	"	4G29048	07/28/04	07/28/04	EPA 150.1	
Total Dissolved Solids	**400**	10	mg/l	"	4H03042	08/03/04	08/05/04	EPA 160.1	
Total Suspended Solids	ND	4.0	"	"	4H03047	"	08/04/04	EPA 160.2	
Turbidity	ND	1.00	NTU	"	4G29047	07/28/04	07/28/04	EPA 180.1	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

North Creek Analytical, Inc.
Environmental Laboratory Network

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907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH1-W-072804 (B4G0753-02) Water	**Sampled: 07/28/04 09:00**		**Received: 07/28/04 14:30**						
Chloride	**158**	20.0	mg/l	50	4H06038	08/05/04	08/05/04	EPA 300.0	
Sulfate	**32.4**	2.00	"	5	4H05020	08/04/04	08/04/04	"	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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Environmental Laboratory Network

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Physical Parameters by APHA/ASTM/EPA Methods

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH1-W-072804 (B4G0753-02) Water Sampled: 07/28/04 09:00 Received: 07/28/04 14:30									
Specific Conductivity	**812**	1.00	uS/cm	1	4G30054	07/29/04	07/29/04	EPA 120.1	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

North Creek Analytical, Inc.
Environmental Laboratory Network

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Total Metals by EPA 6000/7000 Series Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4G29031: Prepared 07/29/04 Using EPA 3010A										
Blank (4G29031-BLK1)										
Calcium	ND	0.250	mg/l							
Iron	ND	0.150	"							
Potassium	ND	2.00	"							
Magnesium	ND	0.500	"							
Sodium	ND	0.250	"							
LCS (4G29031-BS1)										
Calcium	4.85	0.250	mg/l	5.00		97.0	80-120			
Iron	5.02	0.150	"	5.00		100	80-120			
Potassium	9.90	2.00	"	10.0		99.0	80-120			
Magnesium	5.00	0.500	"	5.00		100	80-120			
Sodium	5.09	0.250	"	5.00		102	80-120			
LCS Dup (4G29031-BSD1)										
Calcium	4.70	0.250	mg/l	5.00		94.0	80-120	3.14	20	
Iron	4.87	0.150	"	5.00		97.4	80-120	3.03	20	
Potassium	9.75	2.00	"	10.0		97.5	80-120	1.53	20	
Magnesium	4.85	0.500	"	5.00		97.0	80-120	3.05	20	
Sodium	4.93	0.250	"	5.00		98.6	80-120	3.19	20	
Matrix Spike (4G29031-MS1)					**Source: B4G0718-02**					
Calcium	50.6	0.250	mg/l	5.00	47.5	62.0	75-125			Q-03
Iron	54.6	0.150	"	5.00	50.8	76.0	75-125			
Potassium	14.4	2.00	"	10.0	4.12	103	80-120			
Magnesium	23.8	0.500	"	5.00	19.6	84.0	80-120			
Sodium	62.1	0.250	"	5.00	58.6	70.0	75-125			Q-03
Matrix Spike Dup (4G29031-MSD1)					**Source: B4G0718-02**					
Calcium	49.6	0.250	mg/l	5.00	47.5	42.0	75-125	2.00	20	Q-03
Iron	53.7	0.150	"	5.00	50.8	58.0	75-125	1.66	20	Q-03
Potassium	14.2	2.00	"	10.0	4.12	101	80-120	1.40	20	
Magnesium	23.6	0.500	"	5.00	19.6	80.0	80-120	0.844	20	
Sodium	62.0	0.250	"	5.00	58.6	68.0	75-125	0.161	20	Q-03

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOU	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Total Metals by EPA 6000/7000 Series Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4G29031: Prepared 07/29/04 Using EPA 3010A										
Post Spike (4G29031-PS1)					**Source: B4G0718-02**					
Calcium	49.7		ug/ml	5.00	47.5	44.0	75-125			Q-03
Iron	53.7		"	5.00	50.8	58.0	75-125			Q-03
Potassium	13.7		"	10.0	4.12	95.8	75-125			
Magnesium	23.5		"	5.00	19.6	78.0	75-125			
Sodium	62.2		"	5.00	58.6	72.0	75-125			Q-03

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4G29047: Prepared 07/28/04 Using General Preparation										
Blank (4G29047-BLK1)										
Turbidity	ND	1.00	NTU							
LCS (4G29047-BS1)										
Turbidity	18.4	1.00	NTU	20.0		92.0	85-115			
LCS Dup (4G29047-BSD1)										
Turbidity	18.6	1.00	NTU	20.0		93.0	85-115	1.08	20	
Duplicate (4G29047-DUP1)					**Source: B4G0753-02**					
Turbidity	0.230	1.00	NTU		0.260			12.2	20	
Batch 4G29048: Prepared 07/28/04 Using General Preparation										
Duplicate (4G29048-DUP1)					**Source: B4G0753-02**					
pH	9.15		pH Units		9.15			0.00	10	
Batch 4G29059: Prepared 07/29/04 Using General Preparation										
Blank (4G29059-BLK1)										
Ammonia-Nitrogen	ND	0.100	mg/l as N							
LCS (4G29059-BS1)										
Ammonia-Nitrogen	4.54	0.100	mg/l as N	5.00		90.8	90-110			
LCS Dup (4G29059-BSD1)										
Ammonia-Nitrogen	4.50	0.100	mg/l as N	5.00		90.0	90-110	0.885	20	

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4G29059: Prepared 07/29/04 Using General Preparation										
Duplicate (4G29059-DUP1)					**Source: B4G0736-01**					
Ammonia-Nitrogen	0.199	0.100	mg/L as N		0.198			0.504	25	
Matrix Spike (4G29059-MS1)					**Source: B4G0736-01**					
Ammonia-Nitrogen	4.58	0.100	mg/L as N	5.00	0.198	87.6	75-140			
Batch 4H01002: Prepared 07/29/04 Using General Preparation										
Blank (4H01002-BLK1)										
Nitrate/Nitrite-Nitrogen	ND	0.0100	mg/L as N							
LCS (4H01002-BS1)										
Nitrate/Nitrite-Nitrogen	1.01	0.0100	mg/L as N	1.00		101	90-110			
LCS Dup (4H01002-BSD1)										
Nitrate/Nitrite-Nitrogen	1.02	0.0100	mg/L as N	1.00		102	90-110	0.985	20	
Matrix Spike (4H01002-MS1)					**Source: B4G0743-07**					
Nitrate/Nitrite-Nitrogen	3.12	0.0200	mg/L as N	0.250	2.86	104	36-150			
Matrix Spike Dup (4H01002-MSD1)					**Source: B4G0743-07**					
Nitrate/Nitrite-Nitrogen	3.14	0.0200	mg/L as N	0.250	2.86	112	36-150	0.639	20	
Batch 4H03034: Prepared 08/03/04 Using General Preparation										
Blank (4H03034-BLK1)										
Total Alkalinity	ND	5.00	mg/L as CaCO3							

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Jeff Gerdes, Project Manager

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H03034: Prepared 08/03/04 Using General Preparation										
LCS (4H03034-BS1)										
Total Alkalinity	51.0	5.00	mg/L as CaCO3	50.0		102	90-110			
LCS Dup (4H03034-BSD1)										
Total Alkalinity	49.8	5.00	mg/L as CaCO3	50.0		99.6	90-110	2.38	20	
Duplicate (4H03034-DUP1)					**Source: B4G0638-01**					
Total Alkalinity	42.8	5.00	mg/L as CaCO3		42.8			0.00	20	
Duplicate (4H03034-DUP2)					**Source: B4H0045-03**					
Total Alkalinity	105	5.00	mg/L as CaCO3		107			1.89	20	
Batch 4H03042: Prepared 08/03/04 Using General Preparation										
Blank (4H03042-BLK1)										
Total Dissolved Solids	ND	10	mg/l							
Duplicate (4H03042-DUP1)					**Source: B4G0753-02**					
Total Dissolved Solids	410	10	mg/l		400			2.47	20	
Batch 4H03047: Prepared 08/03/04 Using General Preparation										
Blank (4H03047-BLK1)										
Total Suspended Solids	ND	4.0	mg/l							
Duplicate (4H03047-DUP1)					**Source: B4G0851-01**					
Total Suspended Solids	410	4.0	mg/l		400			2.47	19	

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H05020: Prepared 08/04/04 Using General Preparation										
Blank (4H05020-BLK1)										
Sulfate	ND	0.400	mg/l							
LCS (4H05020-BS1)										
Sulfate	6.09	0.400	mg/l	6.00		102	90-110			
LCS Dup (4H05020-BSD1)										
Sulfate	6.14	0.400	mg/l	6.00		102	90-110	0.818	20	
Duplicate (4H05020-DUP1)					**Source: B4H0074-04**					
Sulfate	35.7	2.00	mg/l		35.4			0.844	25	
Duplicate (4H05020-DUP2)					**Source: B4H0074-06**					
Sulfate	12.7	0.800	mg/l		12.8			0.784	25	
Matrix Spike (4H05020-MS1)					**Source: B4H0074-04**					
Sulfate	41.4	2.00	mg/l	6.00	35.4	100	58-135			
Matrix Spike (4H05020-MS2)					**Source: B4H0074-06**					
Sulfate	18.5	0.800	mg/l	6.00	12.8	95.0	58-135			
Batch 4H06038: Prepared 08/05/04 Using General Preparation										
Blank (4H06038-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (4H06038-BS1)										
Chloride	1.95	0.400	mg/l	2.00		97.5	90-110			

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179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H06038: Prepared 08/05/04 Using General Preparation										
LCS Dup (4H06038-BSD1)										
Chloride	1.95	0.400	mg/l	2.00		97.5	90-110	0.00	20	
Duplicate (4H06038-DUP1)					**Source: B4G0758-01**					
Chloride	1.60	0.400	mg/l		1.61			0.623	25	
Duplicate (4H06038-DUP2)					**Source: B4G0772-03**					
Chloride	2.17	0.400	mg/l		2.25			3.62	25	
Matrix Spike (4H06038-MS1)					**Source: B4G0758-01**					
Chloride	3.28	0.400	mg/l	2.00	1.61	83.5	52-134			
Matrix Spike (4H06038-MS2)					**Source: B4G0772-03**					
Chloride	3.70	0.400	mg/l	2.00	2.25	72.5	52-134			

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179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4G30054: Prepared 07/29/04 Using General Preparation										
Blank (4G30054-BLK1)										
Specific Conductivity	ND	1.00	uS/cm							
LCS (4G30054-BS1)										
Specific Conductivity	991	1.00	uS/cm	1030		96.2	90-110			
LCS Dup (4G30054-BSD1)										
Specific Conductivity	990	1.00	uS/cm	1030		96.1	90-110	0.101	20	
Duplicate (4G30054-DUP1)					**Source: B4G0753-02**					
Specific Conductivity	813	1.00	uS/cm		812			0.123	20	
Duplicate (4G30054-DUP2)					**Source: B4G0795-02**					
Specific Conductivity	4380	1.00	uS/cm		4360			0.458	20	

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Jeff Gerdes

Jeff Gerdes, Project Manager

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/11/04 23:47

Notes and Definitions

I-05	Since the sample was out of hold at the time of receipt, the preparation/analysis of the sample could not be initiated within the method-specified hold time.
Q-03	The percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte already present in the sample.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

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12 August 2004

AUG 1 3 2004

Chip Goodhue
Aspect Consulting - Bainbridge Island
179 Madrone Lane N
Bainbridge Island, WA/USA 98110

RE: SW Harbor - LFOL

Enclosed are the results of analyses for samples received by the laboratory on 07/29/04 14:50. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jeff Gerdes
Project Manager

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MH4-SED-072904	B4G0795-01	Sediment	07/29/04 11:00	07/29/04 14:50
MH4-W-072904	B4G0795-02	Water	07/29/04 10:45	07/29/04 14:50

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Jeff Gerdes, Project Manager

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Total Metals by EPA 6000/7000 Series Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH4-W-072904 (B4G0795-02) Water	**Sampled: 07/29/04 10:45**		**Received: 07/29/04 14:50**						
Calcium	**45.8**	0.250	mg/l	1	4H06019	08/06/04	08/07/04	EPA 6010B	
Iron	**0.238**	0.150	"	"	"	"	"	"	
Potassium	**35.6**	2.00	"	"	"	"	"	"	
Magnesium	**80.8**	0.500	"	"	"	"	"	"	
Sodium	722	2.50	"	10	"	"	08/09/04	"	

North Creek Analytical - Bothell

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Conventional Chemistry Parameters by APHA/EPA Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH4-W-072904 (B4G0795-02) Water	**Sampled: 07/29/04 10:45 Received: 07/29/04 14:50**								
Total Alkalinity	**102**	5.00	mg/L as CaCO3	1	41103034	08/03/04	08/03/04	EPA 310.1	
Ammonia-Nitrogen	**0.336**	0.100	mg/l as N	"	41103038	07/30/04	07/30/04	EPA 350.3	
Ferric Iron	ND	0.250	mg/l	"	41106019	08/06/04	08/11/04	SM 3500-Fe D	I-05
Nitrate/Nitrite-Nitrogen	**0.156**	0.0100	mg/l as N	"	41102048	08/02/04	08/02/04	EPA 353.2	
pH	**9.13**		pH Units	"	41103025	08/03/04	08/03/04	EPA 150.1	I-02
Total Dissolved Solids	**2000**	10	mg/l	"	41103042	08/03/04	08/05/04	EPA 160.1	
Total Suspended Solids	**4.0**	4.0	"	"	41103047	"	08/04/04	EPA 160.2	
Turbidity	**2.60**	1.00	NTU	"	41102047	08/02/04	08/02/04	EPA 180.1	I-02

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
M114-W-072904 (B4G0795-02) Water	**Sampled: 07/29/04 10:45**		**Received: 07/29/04 14:50**						
Chloride	**1300**	200	mg/l	500	4111021	08/10/04	08/10/04	EPA 300.0	
Sulfate	**182**	8.00	"	20	4112014	08/11/04	08/11/04	"	

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179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Physical Parameters by APHA/ASTM/EPA Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH4-W-072904 (B4G0795-02) Water	**Sampled: 07/29/04 10:45**		**Received: 07/29/04 14:50**						
Specific Conductivity	**4360**	1.00	uS/cm	1	4G30054	07/29/04	07/29/04	EPA 120.1	

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Total Metals by EPA 6000/7000 Series Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H06019: Prepared 08/06/04 Using EPA 3010A										
Blank (4H06019-BLK1)										
Calcium	ND	0.250	mg/l							
Iron	ND	0.150	"							
Potassium	ND	2.00	"							
Magnesium	ND	0.500	"							
Sodium	ND	0.250	"							
LCS (4H06019-BS1)										
Calcium	4.81	0.250	mg/l	5.00		96.2	80-120			
Iron	4.89	0.150	"	5.00		97.8	80-120			
Potassium	10.3	2.00	"	10.0		103	80-120			
Magnesium	4.82	0.500	"	5.00		96.4	80-120			
Sodium	4.82	0.250	"	5.00		96.4	80-120			
LCS Dup (4H06019-BSD1)										
Calcium	4.93	0.250	mg/l	5.00		98.6	80-120	2.46	20	
Iron	5.02	0.150	"	5.00		100	80-120	2.62	20	
Potassium	10.0	2.00	"	10.0		100	80-120	2.96	20	
Magnesium	4.96	0.500	"	5.00		99.2	80-120	2.86	20	
Sodium	4.96	0.250	"	5.00		99.2	80-120	2.86	20	
Matrix Spike (4H06019-MS1)					**Source: B4G0865-03**					
Calcium	46.9	0.250	mg/l	5.00	40.0	138	75-125			Q-03
Iron	46.2	0.150	"	5.00	38.9	146	75-125			Q-03
Potassium	15.1	2.00	"	10.0	4.11	110	80-120			
Magnesium	17.6	0.500	"	5.00	12.0	112	80-120			
Sodium	104	0.250	"	5.00	92.6	228	75-125			Q-03
Matrix Spike Dup (4H06019-MSD1)					**Source: B4G0865-03**					
Calcium	46.8	0.250	mg/l	5.00	40.0	136	75-125	0.213	20	Q-03
Iron	46.3	0.150	"	5.00	38.9	148	75-125	0.216	20	Q-03
Potassium	15.0	2.00	"	10.0	4.11	109	80-120	0.664	20	
Magnesium	17.5	0.500	"	5.00	12.0	110	80-120	0.570	20	
Sodium	104	0.250	"	5.00	92.6	228	75-125	0.00	20	Q-03

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Total Metals by EPA 6000/7000 Series Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H06019: Prepared 08/06/04 Using EPA 3010A										
Post Spike (4H06019-PS1)					**Source: B4G0865-03**					
Calcium	43.4		ug/ml	5.00	40.0	68.0	75-125			Q-03
Iron	43.0		"	5.00	38.9	82.0	75-125			
Potassium	14.4		"	10.0	4.11	103	75-125			
Magnesium	16.5		"	5.00	12.0	90.0	75-125			
Sodium	96.8		"	5.00	92.6	84.0	75-125			

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H02047: Prepared 08/02/04 Using General Preparation										
Blank (4H02047-BLK1)										
Turbidity	ND	1.00	NTU							
LCS (4H02047-BS1)										
Turbidity	18.3	1.00	NTU	20.0		91.5	85-115			
LCS Dup (4H02047-BSD1)										
Turbidity	18.4	1.00	NTU	20.0		92.0	85-115	0.545	20	
Duplicate (4H02047-DUP1)					**Source: B4G0795-02**					
Turbidity	2.57	1.00	NTU		2.60			1.16	20	
Batch 4H02048: Prepared 08/02/04 Using General Preparation										
Blank (4H02048-BLK1)										
Nitrate/Nitrite-Nitrogen	ND	0.0100	mg/l as N							
LCS (4H02048-BS1)										
Nitrate/Nitrite-Nitrogen	0.952	0.0100	mg/l as N	1.00		95.2	90-110			
LCS Dup (4H02048-BSD1)										
Nitrate/Nitrite-Nitrogen	0.960	0.0100	mg/l as N	1.00		96.0	90-110	0.837	20	
Matrix Spike (4H02048-MS1)					**Source: B4G0803-01**					
Nitrate/Nitrite-Nitrogen	1.79	0.0100	mg/l as N	0.250	1.47	128	36-150			
Matrix Spike Dup (4H02048-MSD1)					**Source: B4G0803-01**					
Nitrate/Nitrite-Nitrogen	1.80	0.0100	mg/l as N	0.250	1.47	132	36-150	0.557	20	

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179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H03025: Prepared 08/03/04 Using General Preparation										
Duplicate (4H03025-DUP1)					**Source: B4G0795-02**					
pH	9.13		pH Units		9.13			0.00	10	
Batch 4H03034: Prepared 08/03/04 Using General Preparation										
Blank (4H03034-BLK1)										
Total Alkalinity	ND	5.00	mg/L as CaCO3							
LCS (4H03034-BS1)										
Total Alkalinity	51.0	5.00	mg/L as CaCO3	50.0		102	90-110			
LCS Dup (4H03034-BSD1)										
Total Alkalinity	49.8	5.00	mg/L as CaCO3	50.0		99.6	90-110	2.38	20	
Duplicate (4H03034-DUP1)					**Source: B4G0638-01**					
Total Alkalinity	42.8	5.00	mg/L as CaCO3		42.8			0.00	20	
Duplicate (4H03034-DUP2)					**Source: B4H0045-03**					
Total Alkalinity	105	5.00	mg/L as CaCO3		107			1.89	20	
Batch 4H03038: Prepared 07/30/04 Using General Preparation										
Blank (4H03038-BLK1)										
Ammonia-Nitrogen	ND	0.100	mg/l as N							
LCS (4H03038-BS1)										
Ammonia-Nitrogen	4.80	0.100	mg/l as N	5.00		96.0	90-110			

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Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H03038: Prepared 07/30/04 Using General Preparation										
LCS Dup (4H03038-BSD1)										
Ammonia-Nitrogen	4.82	0.100	mg/l as N	5.00		96.4	90-110	0.416	20	
Duplicate (4H03038-DUP1)					**Source: B4G0795-02**					
Ammonia-Nitrogen	0.436	0.100	mg/l as N		0.336			25.9	25	Q-06
Matrix Spike (4H03038-MS1)					**Source: B4G0795-02**					
Ammonia-Nitrogen	2.76	0.100	mg/l as N	2.50	0.336	97.0	75-140			
Batch 4H03042: Prepared 08/03/04 Using General Preparation										
Blank (4H03042-BLK1)										
Total Dissolved Solids	ND	10	mg/l							
Duplicate (4H03042-DUP1)					**Source: B4G0753-02**					
Total Dissolved Solids	410	10	mg/l		400			2.47	20	
Batch 4H03047: Prepared 08/03/04 Using General Preparation										
Blank (4H03047-BLK1)										
Total Suspended Solids	ND	4.0	mg/l							
Duplicate (4H03047-DUP1)					**Source: B4G0851-01**					
Total Suspended Solids	410	4.0	mg/l		400			2.47	19	

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Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H11021: Prepared 08/10/04 Using General Preparation										
Blank (4H11021-BLK1)										
Chloride	ND	0.400	mg/l							
LCS (4H11021-BS1)										
Chloride	2.04	0.400	mg/l	2.00		102	90-110			
LCS Dup (4H11021-BSD1)										
Chloride	2.04	0.400	mg/l	2.00		102	90-110	0.00	20	
Duplicate (4H11021-DUP1)					**Source: B4G0847-01**					
Chloride	0.0310	0.400	mg/l		0.0410			27.8	25	
Matrix Spike (4H11021-MS1)					**Source: B4G0847-01**					
Chloride	2.06	0.400	mg/l	2.00	0.0410	101	52-134			
Batch 4H12014: Prepared 08/11/04 Using General Preparation										
Blank (4H12014-BLK1)										
Sulfate	ND	0.400	mg/l							
LCS (4H12014-BS1)										
Sulfate	6.09	0.400	mg/l	6.00		102	90-110			
LCS Dup (4H12014-BSD1)										
Sulfate	6.15	0.400	mg/l	6.00		102	90-110	0.980	20	
Duplicate (4H12014-DUP1)					**Source: B4G0865-03**					
Sulfate	37.5	2.00	mg/l		38.0			1.32	25	

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Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H12014: Prepared 08/11/04 Using General Preparation										
Duplicate (4H12014-DUP2)					**Source: B4G0638-02**					
Sulfate	8.29	0.400	mg/l		8.31			0.241	25	
Matrix Spike (4H12014-MS1)					**Source: B4G0865-03**					
Sulfate	43.0	2.00	mg/l	6.00	38.0	83.3	58-135			
Matrix Spike (4H12014-MS2)					**Source: B4G0638-02**					
Sulfate	13.7	0.800	mg/l	6.00	8.31	89.8	58-135			
Matrix Spike Dup (4H12014-MSD1)					**Source: B4G0865-03**					
Sulfate	42.8	2.00	mg/l	6.00	38.0	80.0	58-135	0.466	25	

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4G30054: Prepared 07/29/04 Using General Preparation										
Blank (4G30054-BLK1)										
Specific Conductivity	ND	1.00	uS/cm							
LCS (4G30054-BS1)										
Specific Conductivity	991	1.00	uS/cm	1030		96.2	90-110			
LCS Dup (4G30054-BSD1)										
Specific Conductivity	990	1.00	uS/cm	1030		96.1	90-110	0.101	20	
Duplicate (4G30054-DUP1)					**Source: B4G0753-02**					
Specific Conductivity	813	1.00	uS/cm		812			0.123	20	
Duplicate (4G30054-DUP2)					**Source: B4G0795-02**					
Specific Conductivity	4380	1.00	uS/cm		4360			0.458	20	

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/12/04 13:03

Notes and Definitions

I-02	This sample was analyzed outside of the recommended holding time.
I-05	Since the sample was out of hold at the time of receipt, the preparation/analysis of the sample could not be initiated within the method-specified hold time.
Q-03	The percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte already present in the sample.
Q-06	Analyses are not controlled on RPD values from sample concentrations less than 5 times the reporting limit.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

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20332 Empire Ave Suite F-1, Bend, OR 99701-5711 541-383-9310 FAX 382-7588
3209 Denali St, Anchorage, AK 99503-4030 907-334-9200 FAX 334-9210

CHAIN OF CUSTODY REPORT

Work Order #: B4G0795

CLIENT: ASPECT

REPORT TO: CHIP GOODHUE
ADDRESS: 179 Madrone LN N
Bainbridge Island WA 98110
PHONE: FAX:

INVOICE TO: SAME

P.O. NUMBER:

PROJECT NAME: SW HARBOR
PROJECT NUMBER: 990106-084-23
SAMPLED BY: PSB/RRH

TURNAROUND REQUEST in Business Days *
Organic & Inorganic Analyses: ~~10~~ STD. | 7 | 5 | 4 | 3 | 2 | 1 | <1
Petroleum Hydrocarbon Analyses: ~~X~~ STD. | 4 | 3 | 2 | 1 | <1
OTHER Specify:
* Turnaround Requests less than standard may incur Rush Charges.

PRESERVATIVES

REQUESTED ANALYSES

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	Metals (see note)	Ferrous Fe	ALK	Cl⁻	NH4	NO3/NO2	pH	SO4	Conductivity	Turbidity		GRAIN SIZE		MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	NCA WO ID
1	MH4-SED-072904	7/29/04 1100												X				1 CORE → LAB HOLD 1 CORE → ARI	-01
2	MH4-W-072904	7/29/04 1045	X	X	X	X	X	X	X	X	X	X						≡	-02
3																			
4																			
5	NOTE: HOLD 1 CORE SED AT LAB																		
6	FOR POSSIBLE ANALYSES																		
7																			
8																			
9																			
10																			

RELEASED BY: PETER BANNISTER FIRM: ASPECT DATE: 7/29/04 TIME: 12:00
RECEIVED BY: Cathy Crumpton Cathy Crumpton FIRM: NCA DATE: 7/29/04 TIME: 17:30
RELEASED BY: PRINT NAME: FIRM: DATE: TIME:
RECEIVED BY: PRINT NAME: FIRM: DATE: TIME:

ADDITIONAL REMARKS:
* Metals: Ca, Fe, Mg, K, Na
** GRAIN SIZE BY ARI USING SIEVE AND HYDROMETER

TEMP: 2.1°C w/o
PAGE OF

COC REV 1/03

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RECEIVED
AUG 25

17 August 2004

Chip Goodhue
Aspect Consulting - Bainbridge Island
179 Madrone Lane N
Bainbridge Island, WA/USA 98110

RE: SW Harbor - LFOL

Enclosed are the results of analyses for samples received by the laboratory on 07/30/04 17:35. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jeff Gerdes

Jeff Gerdes
Project Manager

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MH7-W-073004	B4G0851-01	Water	07/30/04 10:30	07/30/04 17:35
MH7-SED-073004	B4G0851-02	Sediment	07/30/04 10:55	07/30/04 17:35

North Creek Analytical - Bothell

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Total Metals by EPA 6000/7000 Series Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH7-W-073004 (B4G0851-01) Water	**Sampled: 07/30/04 10:30**		**Received: 07/30/04 17:35**						
Calcium	**111**	0.250	mg/l	1	4H06019	08/06/04	08/07/04	EPA 6010B	
Iron	**42.2**	0.150	"	"	"	"	"	"	
Potassium	**66.0**	2.00	"	"	"	"	"	"	
Magnesium	**166**	0.500	"	"	"	"	"	"	
Sodium	**1380**	2.50	"	10	"	"	08/09/04	"	

North Creek Analytical - Bothell

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Conventional Chemistry Parameters by APHA/EPA Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH7-W-073004 (B4G0851-01) Water	**Sampled: 07/30/04 10:30**		**Received: 07/30/04 17:35**						
Total Alkalinity	**244**	5.00	mg/L as CaCO3	1	4H03034	08/03/04	08/03/04	EPA 310.1	
Ammonia-Nitrogen	**2.01**	0.100	mg/l as N	"	4H03056	"	"	EPA 350.3	
Ferric Iron	**42.0**	0.250	mg/l	"	4H06019	08/06/04	08/13/04	SM 3500-Fe D	I-05
Nitrate/Nitrite-Nitrogen	**0.0318**	0.0100	mg/l as N	"	4H02048	08/02/04	08/02/04	EPA 353.2	
pH	**7.61**		pH Units	"	4H01004	07/31/04	07/31/04	EPA 150.1	
Total Dissolved Solids	**4300**	10	mg/l	"	4H03042	08/03/04	08/05/04	EPA 160.1	
Total Suspended Solids	**400**	4.0	"	"	4H03047	"	08/04/04	EPA 160.2	
Turbidity	**157**	10.0	NTU	10	4H01013	08/01/04	08/01/04	EPA 180.1	

North Creek Analytical - Bothell

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Anions by EPA Method 300.0

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH7-W-073004 (B4G0851-01) Water	**Sampled: 07/30/04 10:30**		**Received: 07/30/04 17:35**						
Chloride	**2330**	200	mg/l	500	4H12014	08/11/04	08/11/04	EPA 300.0	
Sulfate	**328**	20.0	"	50	"	"	"	"	

North Creek Analytical - Bothell

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Jeff Gerdes

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Physical Parameters by APHA/ASTM/EPA Methods

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
MH7-W-073004 (B4G0851-01) Water	**Sampled: 07/30/04 10:30**		**Received: 07/30/04 17:35**						
Specific Conductivity	**8270**	1.00	uS/cm	1	4H02059	08/02/04	08/02/04	EPA 120.1	

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Total Metals by EPA 6000/7000 Series Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H06019: Prepared 08/06/04 Using EPA 3010A										
Blank (4H06019-BLK1)										
Calcium	ND	0.250	mg/l							
Iron	ND	0.150	"							
Potassium	ND	2.00	"							
Magnesium	ND	0.500	"							
Sodium	ND	0.250	"							
LCS (4H06019-BS1)										
Calcium	4.81	0.250	mg/l	5.00		96.2	80-120			
Iron	4.89	0.150	"	5.00		97.8	80-120			
Potassium	10.3	2.00	"	10.0		103	80-120			
Magnesium	4.82	0.500	"	5.00		96.4	80-120			
Sodium	4.82	0.250	"	5.00		96.4	80-120			
LCS Dup (4H06019-BSD1)										
Calcium	4.93	0.250	mg/l	5.00		98.6	80-120	2.46	20	
Iron	5.02	0.150	"	5.00		100	80-120	2.62	20	
Potassium	10.0	2.00	"	10.0		100	80-120	2.96	20	
Magnesium	4.96	0.500	"	5.00		99.2	80-120	2.86	20	
Sodium	4.96	0.250	"	5.00		99.2	80-120	2.86	20	
Matrix Spike (4H06019-MS1)					**Source: B4G0865-03**					
Calcium	46.9	0.250	mg/l	5.00	40.0	138	75-125			Q-03
Iron	46.2	0.150	"	5.00	38.9	146	75-125			Q-03
Potassium	15.1	2.00	"	10.0	4.11	110	80-120			
Magnesium	17.6	0.500	"	5.00	12.0	112	80-120			
Sodium	104	0.250	"	5.00	92.6	228	75-125			Q-03
Matrix Spike Dup (4H06019-MSD1)					**Source: B4G0865-03**					
Calcium	46.8	0.250	mg/l	5.00	40.0	136	75-125	0.213	20	Q-03
Iron	46.3	0.150	"	5.00	38.9	148	75-125	0.216	20	Q-03
Potassium	15.0	2.00	"	10.0	4.11	109	80-120	0.664	20	
Magnesium	17.5	0.500	"	5.00	12.0	110	80-120	0.570	20	
Sodium	104	0.250	"	5.00	92.6	228	75-125	0.00	20	Q-03

North Creek Analytical - Bothell

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Jeff Gerdes, Project Manager

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Total Metals by EPA 6000/7000 Series Methods - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H06019: Prepared 08/06/04 Using EPA 3010A										
Post Spike (4H06019-PS1)					**Source: B4G0865-03**					
Calcium	43.4		ug/ml	5.00	40.0	68.0	75-125			Q-03
Iron	43.0		"	5.00	38.9	82.0	75-125			
Potassium	14.4		"	10.0	4.11	103	75-125			
Magnesium	16.5		"	5.00	12.0	90.0	75-125			
Sodium	96.8		"	5.00	92.6	84.0	75-125			

North Creek Analytical - Bothell

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Jeff Gerdes

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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H01004: Prepared 07/31/04 Using General Preparation										
Duplicate (4H01004-DUP1)					**Source: B4G0851-01**					
pH	7.59		pH Units		7.61			0.263	10	
Batch 4H01013: Prepared 08/01/04 Using General Preparation										
Blank (4H01013-BLK1)										
Turbidity	ND	1.00	NTU							
LCS (4H01013-BS1)										
Turbidity	18.5	1.00	NTU	20.0		92.5	85-115			
LCS Dup (4H01013-BSD1)										
Turbidity	18.5	1.00	NTU	20.0		92.5	85-115	0.00	20	
Duplicate (4H01013-DUP1)					**Source: B4G0850-01**					
Turbidity	ND	1.00	NTU		ND			NA	20	
Batch 4H02048: Prepared 08/02/04 Using General Preparation										
Blank (4H02048-BLK1)										
Nitrate/Nitrite-Nitrogen	ND	0.0100	mg/l as N							
LCS (4H02048-BS1)										
Nitrate/Nitrite-Nitrogen	0.952	0.0100	mg/l as N	1.00		95.2	90-110			
LCS Dup (4H02048-BSD1)										
Nitrate/Nitrite-Nitrogen	0.960	0.0100	mg/l as N	1.00		96.0	90-110	0.837	20	

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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Anchorage 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
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Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOI.	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H02048: Prepared 08/02/04 Using General Preparation										
Matrix Spike (4H02048-MS1)					**Source: B4G0803-01**					
Nitrate/Nitrite-Nitrogen	1.79	0.0100	mg/l as N	0.250	1.47	128	36-150			
Matrix Spike Dup (4H02048-MSD1)					**Source: B4G0803-01**					
Nitrate/Nitrite-Nitrogen	1.80	0.0100	mg/l as N	0.250	1.47	132	36-150	0.557	20	
Batch 4H03034: Prepared 08/03/04 Using General Preparation										
Blank (4H03034-BLK1)										
Total Alkalinity	ND	5.00	mg/L as CaCO3							
LCS (4H03034-BS1)										
Total Alkalinity	51.0	5.00	mg/L as CaCO3	50.0		102	90-110			
LCS Dup (4H03034-BSD1)										
Total Alkalinity	49.8	5.00	mg/L as CaCO3	50.0		99.6	90-110	2.38	20	
Duplicate (4H03034-DUP1)					**Source: B4G0638-01**					
Total Alkalinity	42.8	5.00	mg/L as CaCO3		42.8			0.00	20	
Duplicate (4H03034-DUP2)					**Source: B4H0045-03**					
Total Alkalinity	105	5.00	mg/L as CaCO3		107			1.89	20	
Batch 4H03042: Prepared 08/03/04 Using General Preparation										
Blank (4H03042-BLK1)										
Total Dissolved Solids	ND	10	mg/l							

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509.924.9200 Fax 509.924.9290
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503.906.9200 Fax 503.906.9210
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541.383.9310 Fax 541.382.7588
Anchorage: 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 Fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H03042: Prepared 08/03/04 Using General Preparation										
Duplicate (4H03042-DUP1)					**Source: B4G0753-02**					
Total Dissolved Solids	410	10	mg/l		400			2.47	20	
Batch 4H03047: Prepared 08/03/04 Using General Preparation										
Blank (4H03047-BLK1)										
Total Suspended Solids	ND	4.0	mg/l							
Duplicate (4H03047-DUP1)					**Source: B4G0851-01**					
Total Suspended Solids	410	4.0	mg/l		400			2.47	19	
Batch 4H03056: Prepared 08/03/04 Using General Preparation										
Blank (4H03056-BLK1)										
Ammonia-Nitrogen	ND	0.100	mg/l as N							
LCS (4H03056-BS1)										
Ammonia-Nitrogen	4.64	0.100	mg/l as N	5.00		92.8	90-110			
LCS Dup (4H03056-BSD1)										
Ammonia-Nitrogen	4.66	0.100	mg/l as N	5.00		93.2	90-110	0.430	20	
Duplicate (4H03056-DUP1)					**Source: B4G0851-01**					
Ammonia-Nitrogen	1.99	0.100	mg/l as N		2.01			1.00	25	
Matrix Spike (4H03056-MS1)					**Source: B4G0851-01**					
Ammonia-Nitrogen	6.56	0.100	mg/l as N	5.00	2.01	91.0	75-140			

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes, Project Manager

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503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9214

Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H12014: Prepared 08/11/04 Using General Preparation										
Blank (4H12014-BLK1)										
Chloride	ND	0.400	mg/l							
Sulfate	ND	0.400	"							
LCS (4H12014-BS1)										
Chloride	2.00	0.400	mg/l	2.00		100	90-110			
Sulfate	6.09	0.400	"	6.00		102	90-110			
LCS Dup (4H12014-BSD1)										
Chloride	2.00	0.400	mg/l	2.00		100	90-110	0.00	20	
Sulfate	6.15	0.400	"	6.00		102	90-110	0.980	20	
Duplicate (4H12014-DUP1)					**Source: B4G0865-03**					
Chloride	11.2	2.00	mg/l		11.4			1.77	25	
Sulfate	37.5	2.00	"		38.0			1.32	25	
Duplicate (4H12014-DUP2)					**Source: B4G0638-02**					
Chloride	2.97	0.400	mg/l		2.84			4.48	25	
Sulfate	8.29	0.400	"		8.31			0.241	25	
Matrix Spike (4H12014-MS1)					**Source: B4G0865-03**					
Chloride	13.0	2.00	mg/l	2.00	11.4	80.0	52-134			
Sulfate	43.0	2.00	"	6.00	38.0	83.3	58-135			
Matrix Spike (4H12014-MS2)					**Source: B4G0638-02**					
Chloride	4.80	0.400	mg/l	2.00	2.84	98.0	52-134			
Sulfate	13.7	0.800	"	6.00	8.31	89.8	58-135			
Matrix Spike Dup (4H12014-MSD1)					**Source: B4G0865-03**					
Chloride	13.1	2.00	mg/l	2.00	11.4	85.0	52-134	0.766	25	
Sulfate	42.8	2.00	"	6.00	38.0	80.0	58-135	0.466	25	

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes

Jeff Gerdes, Project Manager

North Creek Analytical, Inc.
Environmental Laboratory Network

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Anchorage 2000 W. International Airport Road, Suite A-1, Anchorage, AK 99502-1119
907.563.9200 fax 907.561.5301

Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOI	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4H02059: Prepared 08/02/04 Using General Preparation										
Blank (4H02059-BLK1)										
Specific Conductivity	ND	1.00	uS/cm							
LCS (4H02059-BS1)										
Specific Conductivity	1010	1.00	uS/cm	1030		98.1	90-110			
LCS Dup (4H02059-BSD1)										
Specific Conductivity	1010	1.00	uS/cm	1030		98.1	90-110	0.00	20	
Duplicate (4H02059-DUP1)					**Source: B4G0851-01**					
Specific Conductivity	8290	1.00	uS/cm		8270			0.242	20	

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907.563.9200 fax 907.563.9210

Aspect Consulting - Bainbridge Island	Project: SW Harbor - LFOL	
179 Madrone Lane N	Project Number: 990106-004-23	**Reported:**
Bainbridge Island, WA/USA 98110	Project Manager: Chip Goodhue	08/17/04 09:47

Notes and Definitions

I-05	Since the sample was out of hold at the time of receipt, the preparation/analysis of the sample could not be initiated within the method-specified hold time.
Q-03	The percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte already present in the sample.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes, Project Manager

Analytical Resources, Incorporated
Analytical Chemists and Consultants

August 17, 2004

Mr. Jeff Gerdes
North Creek Analytical, Inc.
11720 North Creek Parkway, Suite 400
Bothell, WA 98011-8244

Subject: **Project No.: B4G0795, B4G0851, B4H0008**
ARI Project Nos.: GX28, GX29, GX30

Dear Mr. Gerdes;

Samples from the referenced project were received for testing on August 8, 2004. The samples were for ASTM grain size distribution. The results are on the following pages. A copy of this report will be kept in electronic format should you need a copy in the future.

Please call me to discuss any questions, or comments you may have on the data or its presentation.

Best Regards,
Analytical Resources Incorporated

Harold Benny
Geotechnical Division Manager

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Client: North Creek Analytical | Project No.: GX28

Client Project: B4G0795, B4G0851, B4H0008

Case Narrative

1. The samples were submitted for grain size analysis according to ASTM methodology.
2. The samples were run together in a batch.
3. The data is provided in summary tables and plots.
4. There were no noted anomalies in the samples or methods on this project.

Approved by: Harold Benny Date: 8/17/04
Title: Geotechnical Division Manager

12.0°c

SUBCONTRACT ORDER

North Creek Analytical - Bothell

B4H0008

SENDING LABORATORY:

North Creek Analytical - Bothell
11720 North Creek Parkway North, Suite 400
Bothell, WA 98011-8223
Phone: (425) 420-9200
Fax: (425) 420-9210
Project Manager: Jeff Gerdes

RECEIVING LABORATORY:

ARI
4611 S 134th Pl Ste 100
Tukwila, WA/USA 98168
Phone :206-621-6490
Fax: 206-621-7523

Analysis	Due	Expires	Laboratory ID	Comments
Sample ID: B4H0008-01	**Water**	**Sampled:07/29/04 09:10**	GX30A	**ON MISC. SHELF IN WALK IN,OTHER AN.**
Misc. Subcontract I	08/10/04 23:00	01/25/05 09:10		GRAIN SIZE USING SIEVE AND HYDROMETER
Containers Supplied: Plastic Core (A)				
Sample ID: B4H0008-02	**Water**	**Sampled:07/29/04 09:15**	GX30B	**ON MISC. SHELF IN WALK IN, OTHER AN**
Misc. Subcontract I	08/10/04 23:00	01/25/05 09:15		GRAIN SIZE USING SIEVE AND HYDROMETER
Containers Supplied: Plastic Core (A)				
Sample ID: B4H0008-03	**Water**	**Sampled:07/29/04 09:15**	GX30C	**ON MISC. SHELF IN WALK IN, OTHER AN**
Misc. Subcontract I	08/10/04 23:00	01/25/05 09:15		GRAIN SIZE USING SIEVE AND HYDROMETER
Containers Supplied: Plastic Core (B)				

Released By	Date	Received By	Date
[signature]	8-2-04	[signature]	8/2/04 1505

ANALYTICAL RESOURCES INCORPORATED

North Creek Analytical
B4G0795, B4G0851, B4H0008

Percent Finer (Passing) Than the Indicated Size

Sieve Size (microns)	Data Qualifier	3/8"	#4 (4750)	#10 (2000)	#20 (850)	#40 (425)	#60 (250)	#100 (150)	#200 (75)	32	22	13	9	7	3.2	1.3
B4G0795-01		100.0	100.0	98.2	58.9	45.1	41.4	38.9	36.1	34.6	31.7	13.0	7.2	6.5	5.8	4.3
B4G0851-02		100.0	100.0	99.6	81.5	71.0	64.2	58.5	51.0	43.4	35.9	25.4	15.0	13.5	10.5	7.5
B4H0008-01		100.0	99.4	98.3	91.2	86.9	81.4	71.7	56.4	38.7	36.1	28.0	22.0	18.7	12.0	6.7
B4H0008-02		100.0	99.8	98.5	85.1	80.3	77.6	73.9	66.2	53.8	51.0	44.1	38.6	29.7	20.7	11.0
B4H0008-03		100.0	99.9	98.9	88.1	82.6	79.5	75.9	69.1	44.1	38.4	29.9	25.6	19.9	12.8	5.7

Testing performed according to ASTM D421/D422

GX28, GX29, GX30

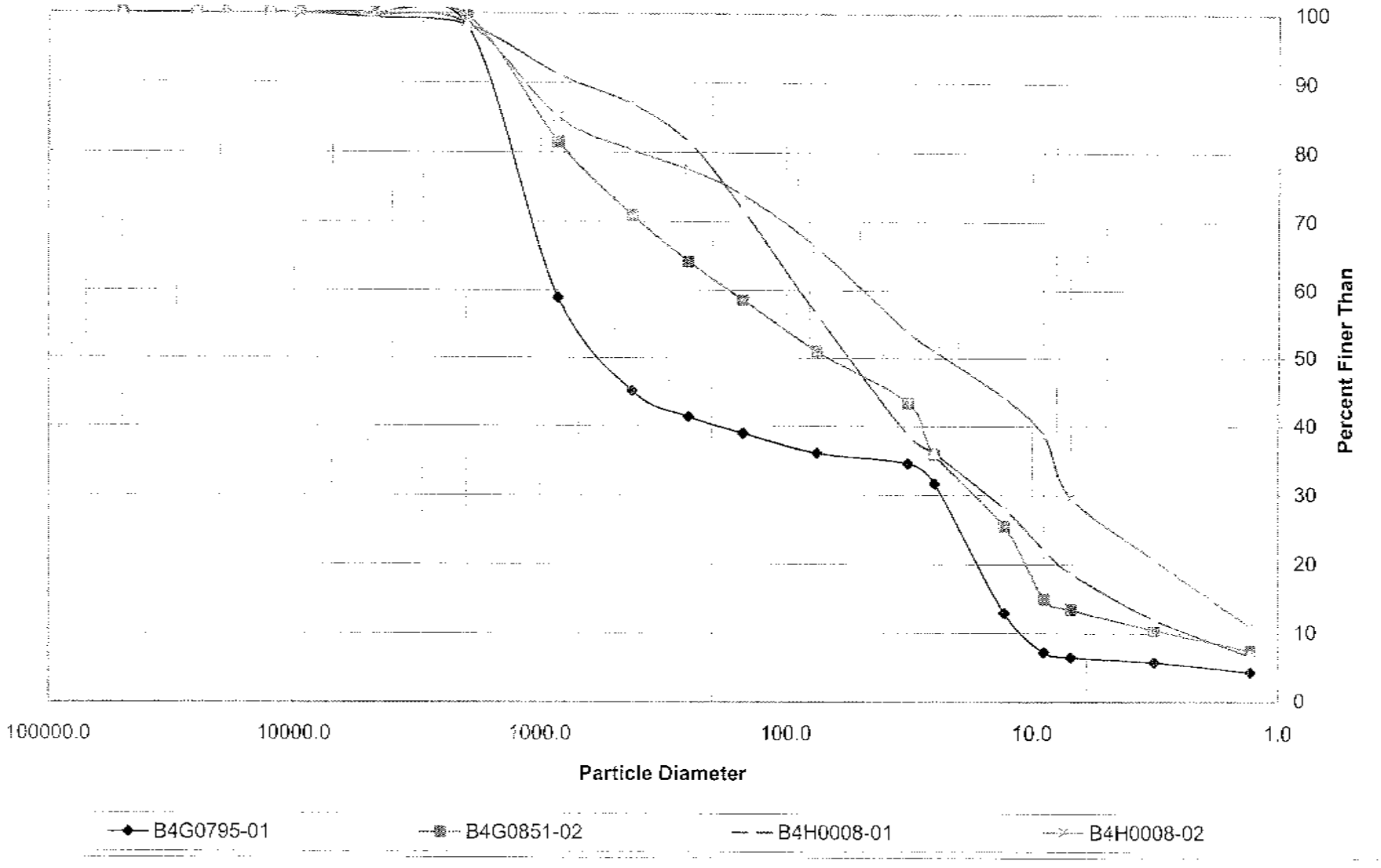
North Creek Analytical
B4G0795, B4G0851, B4H0008

Percent Retained in Each Size Fraction

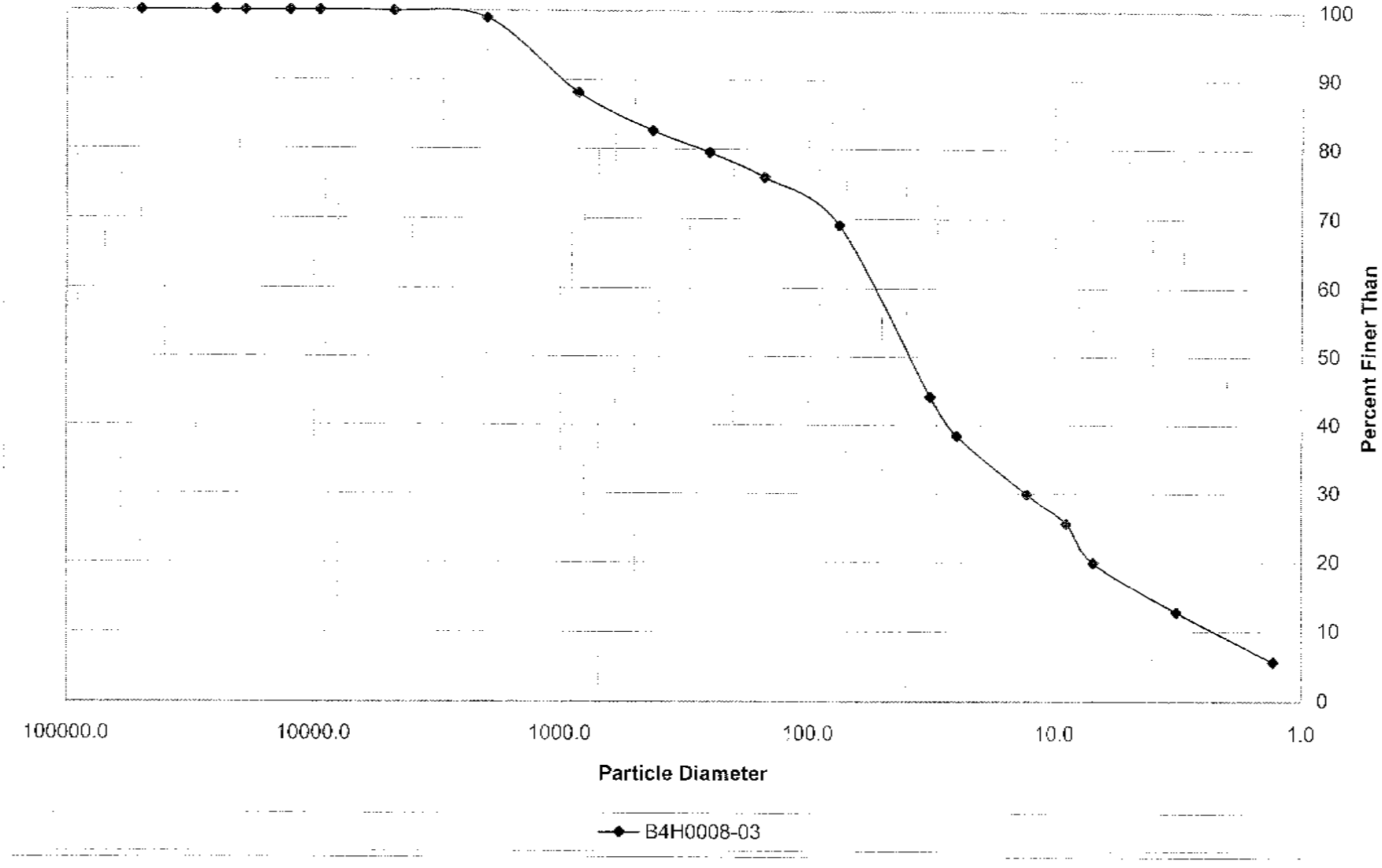
Sample No.	% Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Total Sand	% Very Coarse Silt	% Coarse Silt	% Medium Silt	% Fine Silt	% Very Fine Silt	% Clay
Size (microns)	> 4750	4750-2000	2000-425	425-75	4750-75	75-32	32-22	22-13	13-9	9-3.2	<3.2
B4G0795-01	0.0	1.8	53.1	9.0	63.9	1.5	2.9	18.7	5.8	1.4	5.8
B4G0851-02	0.0	0.4	28.6	20.0	49.0	7.6	7.5	10.5	10.5	4.5	10.5
B4H0008-01	0.6	1.0	11.4	30.5	43.0	17.6	2.7	8.0	6.0	10.0	12.0
B4H0008-02	0.2	1.3	18.2	14.1	33.5	12.5	2.8	6.9	5.5	17.9	20.7
B4H0008-03	0.1	1.0	16.3	13.6	30.9	25.0	5.7	8.5	4.3	12.8	12.8

GX28, GX29, GX30

Grain Size Distribution by Hydrometer



Grain Size Distribution by Hydrometer



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3209 Denali St, Anchorage, AK 99503-4030 907-334-9200 FAX 334-9210

CHAIN OF CUSTODY REPORT

Work Order #: B4G0851

CLIENT: ASPECT

INVOICE TO: same

REPORT TO: CHIP GOODHUE
ADDRESS: 179 Madrone LN N
Bainbridge Island WA 98110
PHONE: FAX:

P.O. NUMBER:

PROJECT NAME: SW Harbor
PROJECT NUMBER: 990106-004-23
SAMPLED BY: PSB

TURNAROUND REQUEST in Business Days *

Organic & Inorganic Analyses: ~~10~~ STD. | 7 | 5 | 4 | 3 | 2 | 1 | <1

Petroleum Hydrocarbon Analyses: ~~5~~ STD. | 4 | 3 | 2 | 1 | <1

OTHER Specify:

* Turnaround Requests less than standard may incur Rush Charges.

PRESERVATIVE

REQUESTED ANALYSES

#	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	Metals*	Ferric Fe	ALK	Cl⁻	NH_4	NO_3/NO_2	pH	SO4	Cond/TDS	Turbidity	GRAIN SIZES**	MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	NCA WO ID
1	MH7-W-073004	7/30/04 1030	X	X	X	X	X	X	X	X	X	X				~~1 CORE~~ →	-01
2	MH7-SED-073004	7/30/04 1055											X			1 CORE → LAB HOLD 1 CORE → ARI	-02
3																	
4																	
5		NOTE: 1.) HOLD 1 SED CORE AT LAB FOR															
6		POSSIBLE ANALYSES															
7		2.) SEND 1 SED CORE TO ARI FOR															
8		GRAIN SIZE USING SIEVE AND															
9		HYDROMETER															
10																	

RELEASED BY: PETER BANNISTER DATE: 7/30/04
PRINT NAME: PETER BANNISTER FIRM: ASPECT TIME: 1215

RECEIVED BY: DATE: 7/30/04
PRINT NAME: FIRM: NCA TIME: 1735

RELEASED BY: DATE:
PRINT NAME: FIRM: TIME:

RECEIVED BY: DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS:
*METALS: Ca, Fe, Mg, K, Na **GRAIN SIZE BY ARI USING SIEVE AND HYDROMETER

TEMP: 20.4

COC REV 1/03

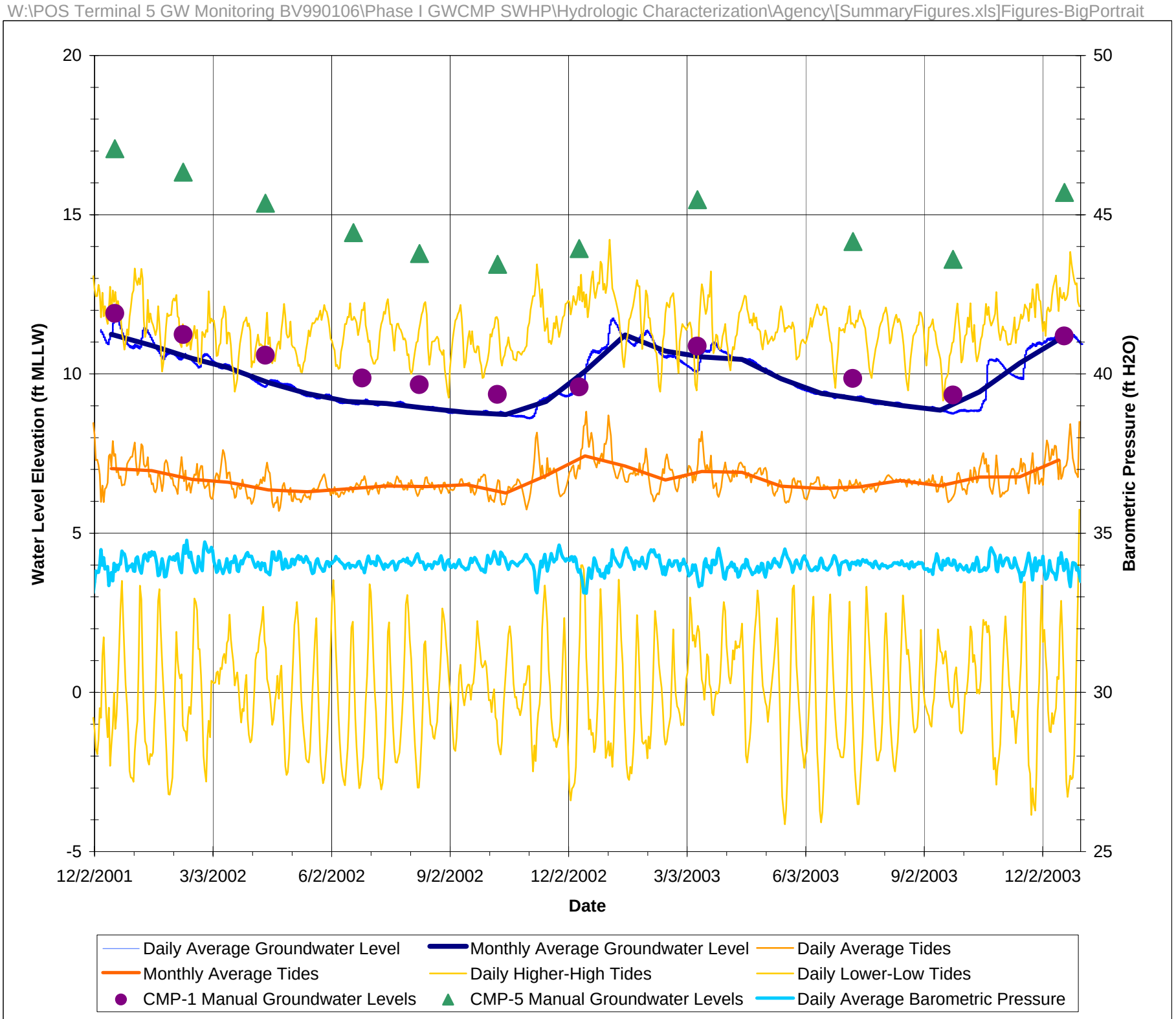
PAGE OF

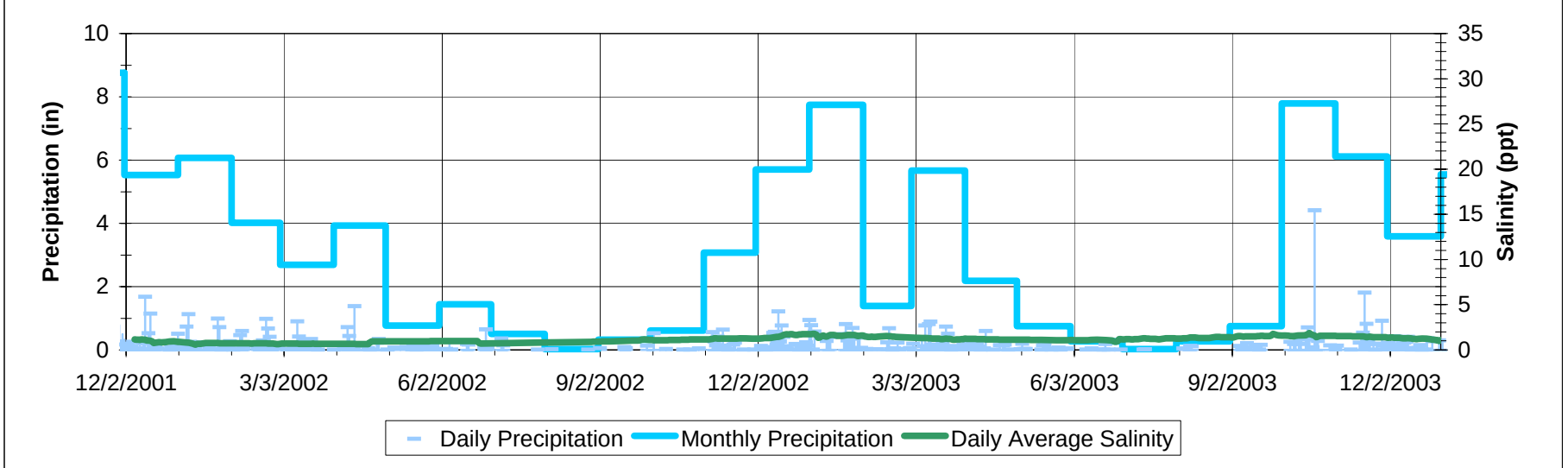
Samples were not @2-6c upon receipt!

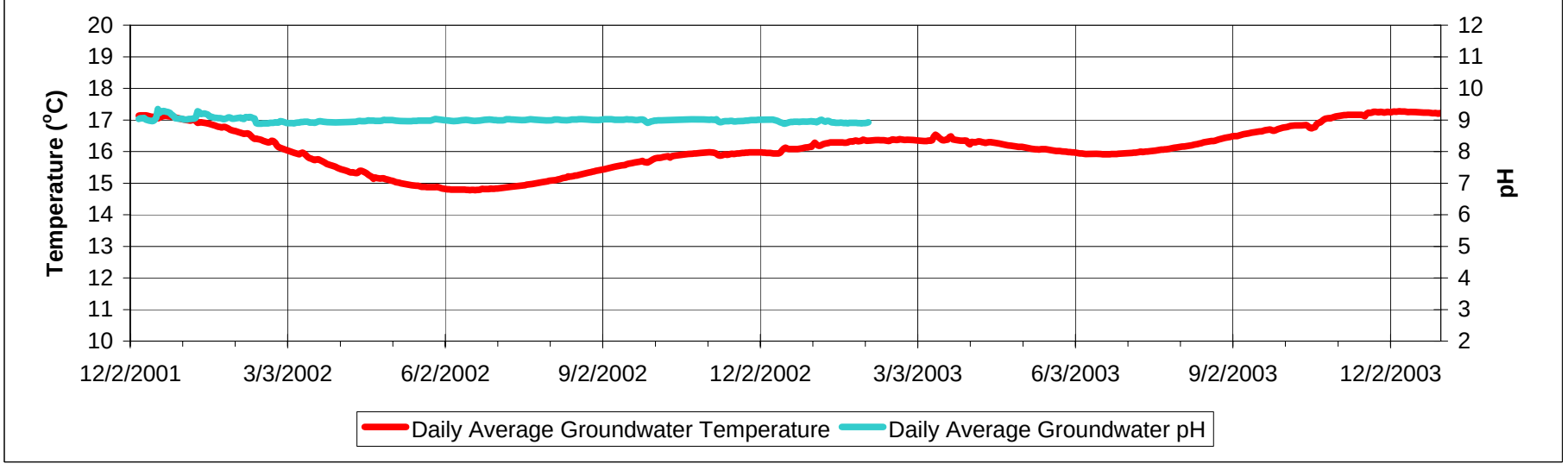
APPENDIX F

Water Level and Water Quality Plots for Individual Wells

W:\POS Terminal 5 GW Monitoring BV990106\Phase I GWCMP SWHP\Hydrologic Characterization\Agency\[SummaryFigures.xls]Figures-BigPortrait





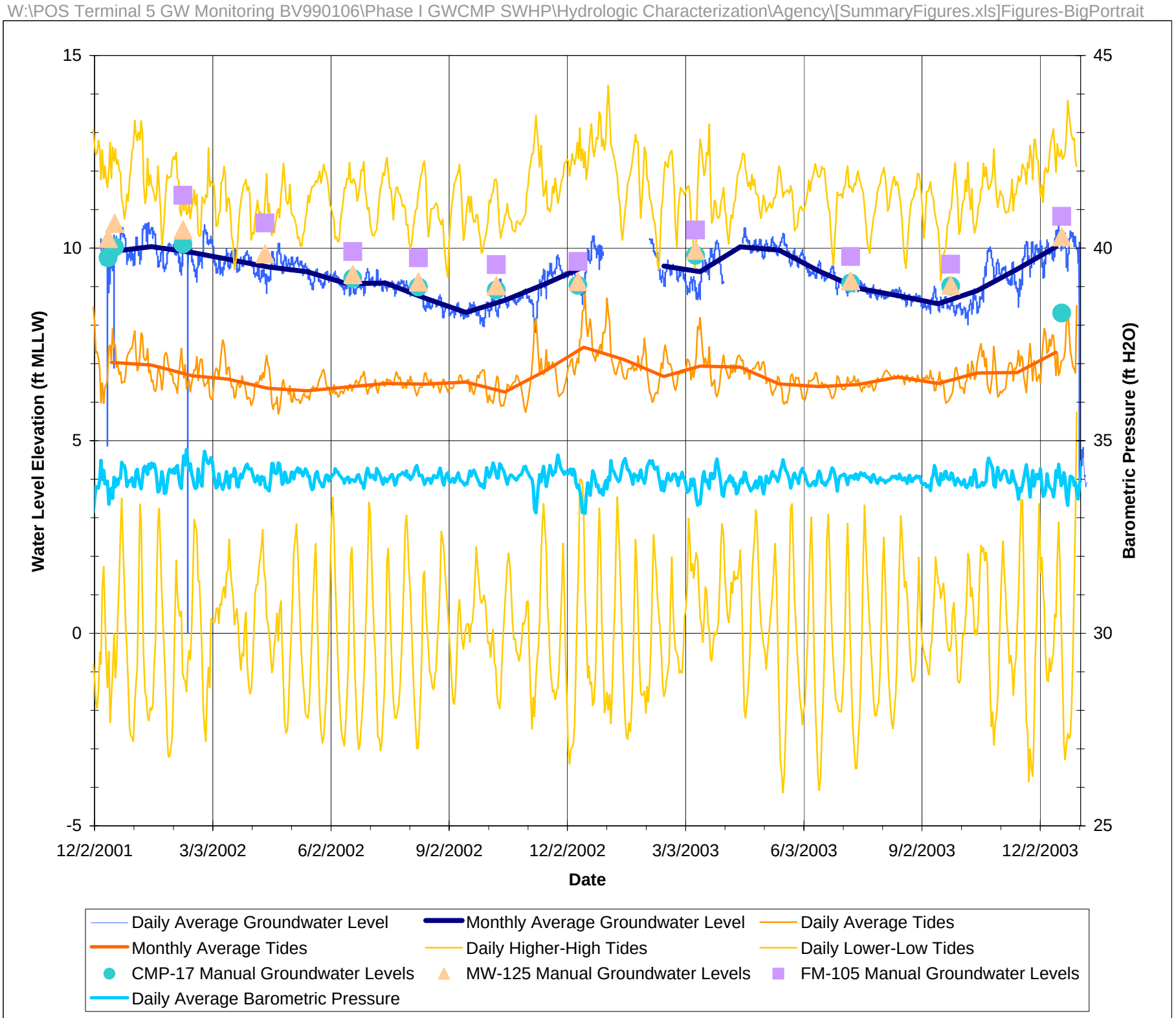


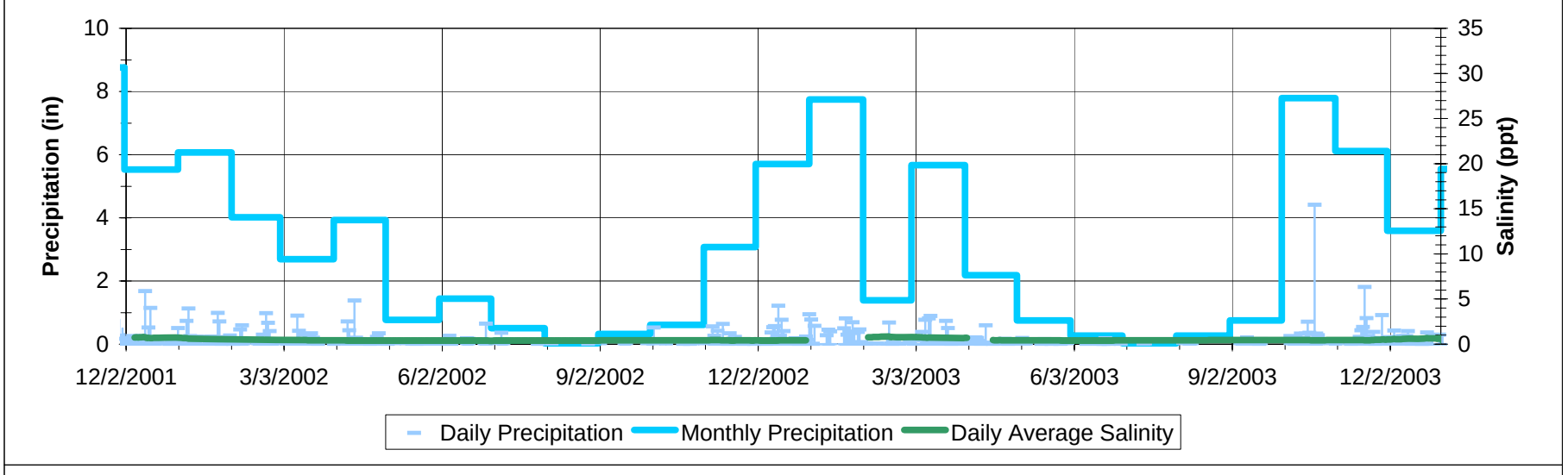
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-2
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

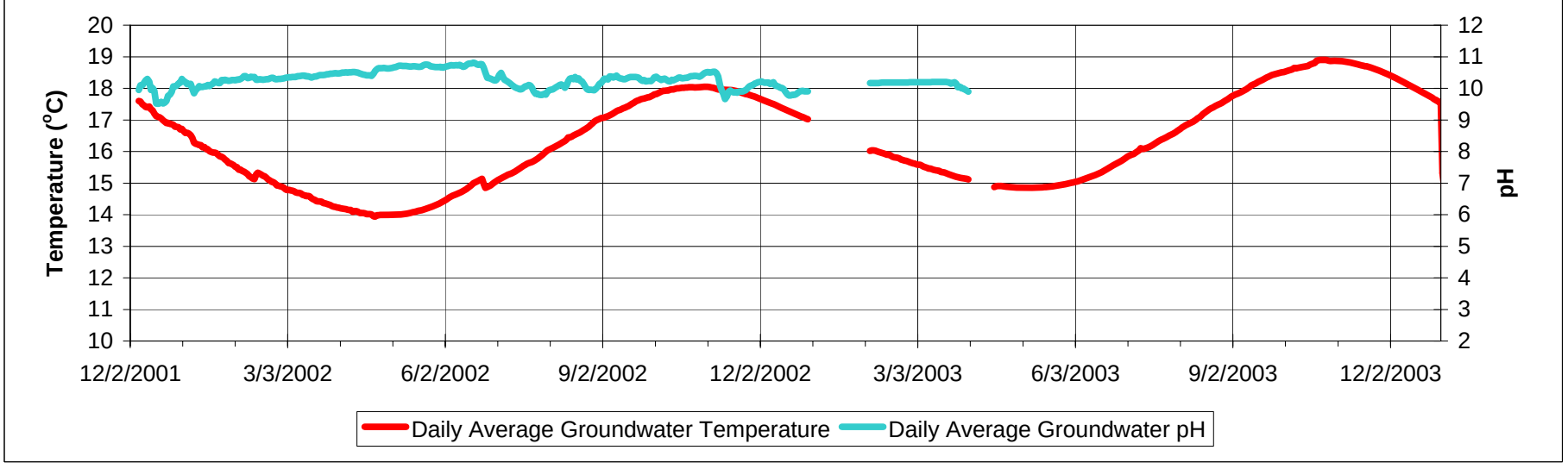
Figure F-1

AGENCY REVIEW DRAFT

W:\POS Terminal 5 GW Monitoring BV990106\Phase I GWCMP SWHP\Hydrologic Characterization\Agency\[SummaryFigures.xls]Figures-BigPortrait





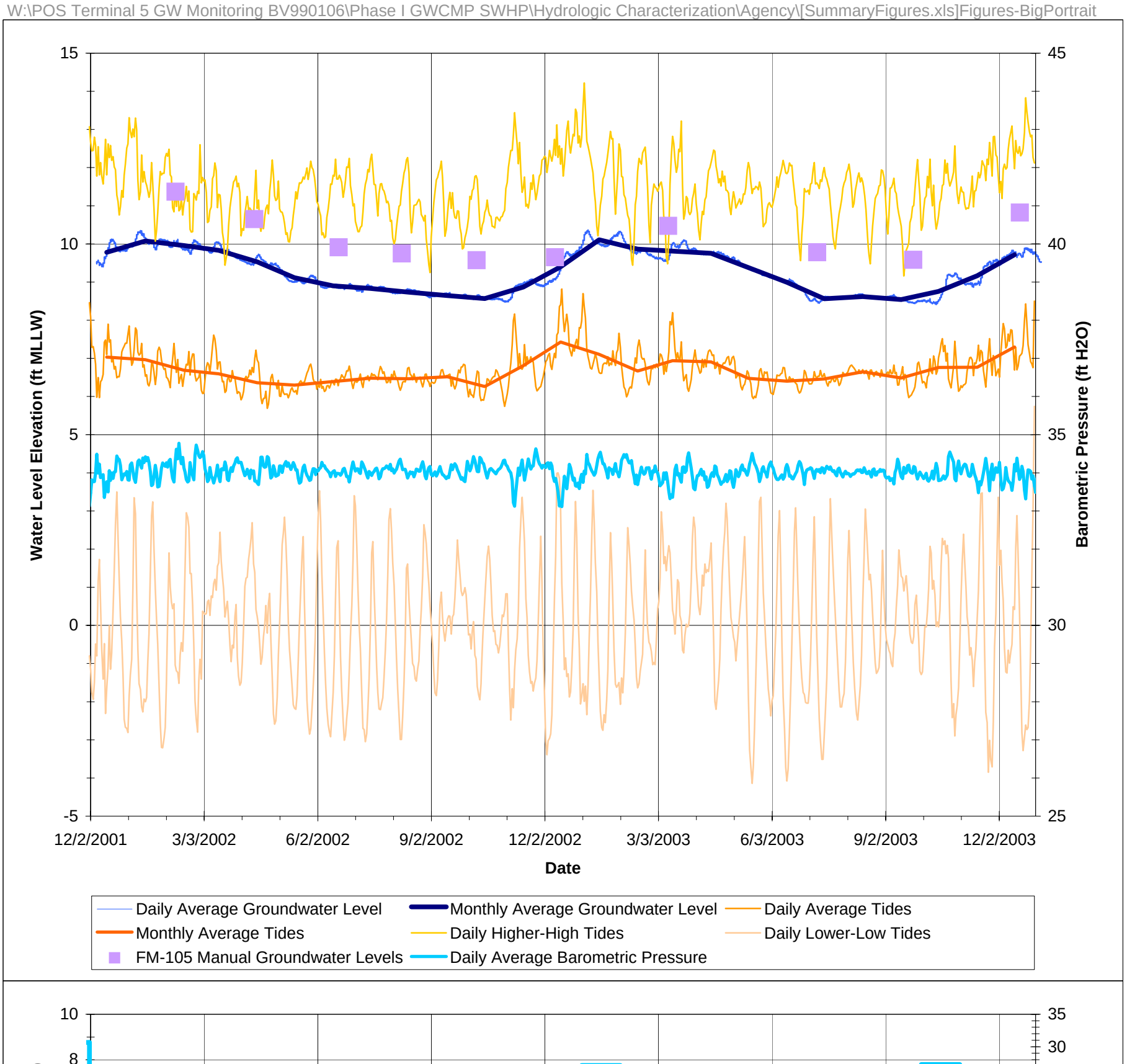


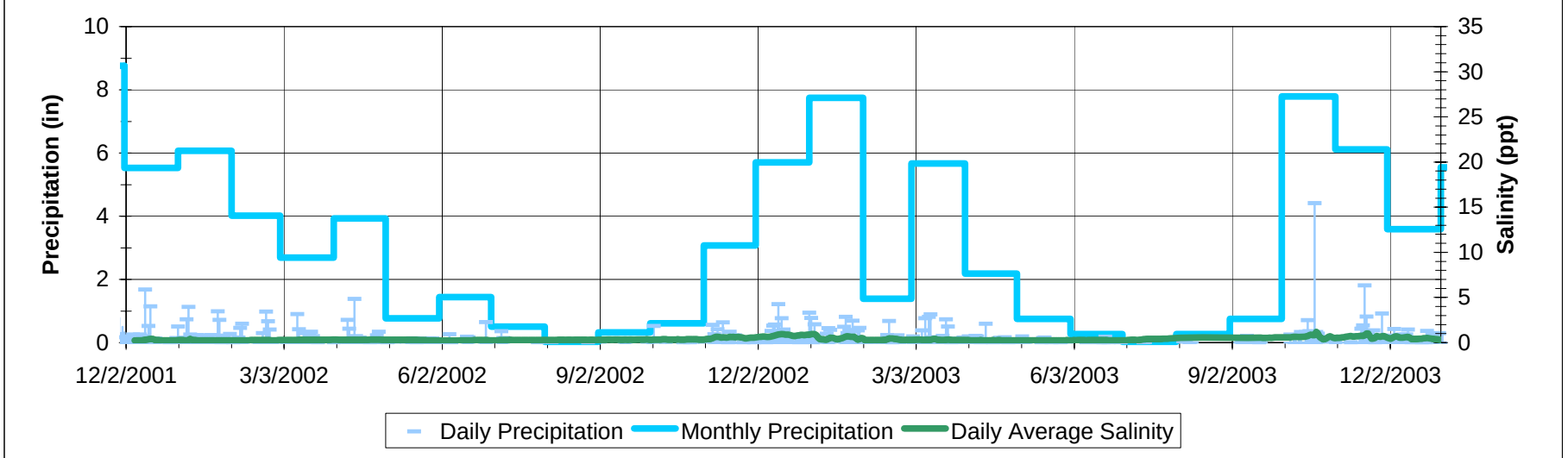
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-3
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

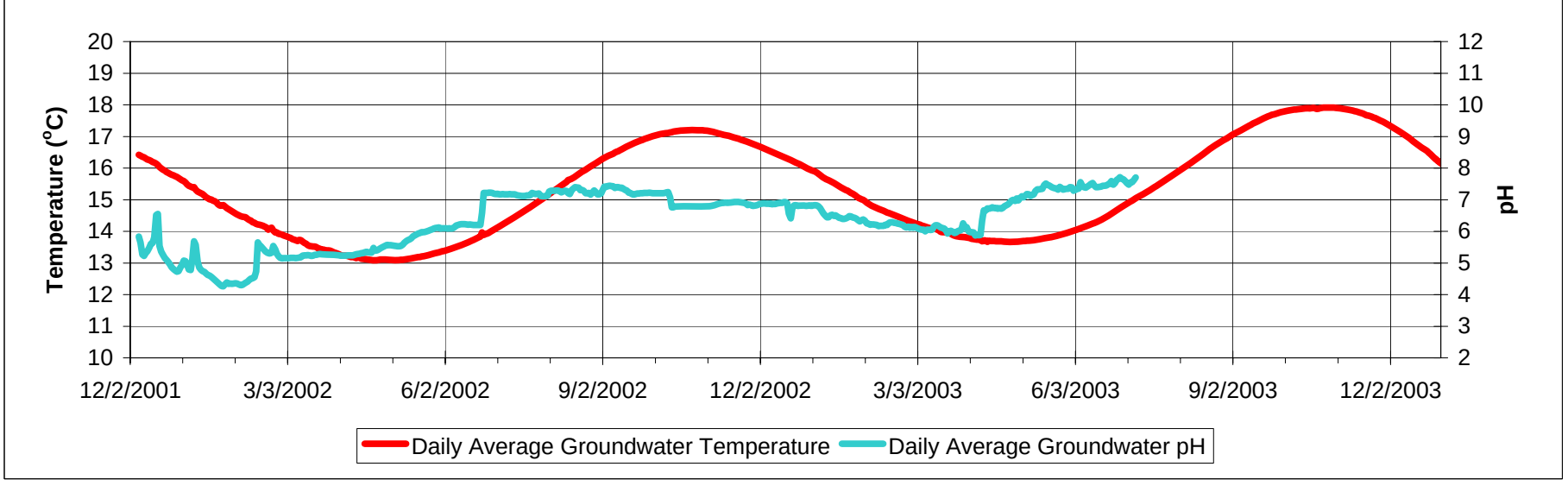
Aspect consulting
IN-DEPTH PERSPECTIVE

Figure F-2

AGENCY REVIEW DRAFT



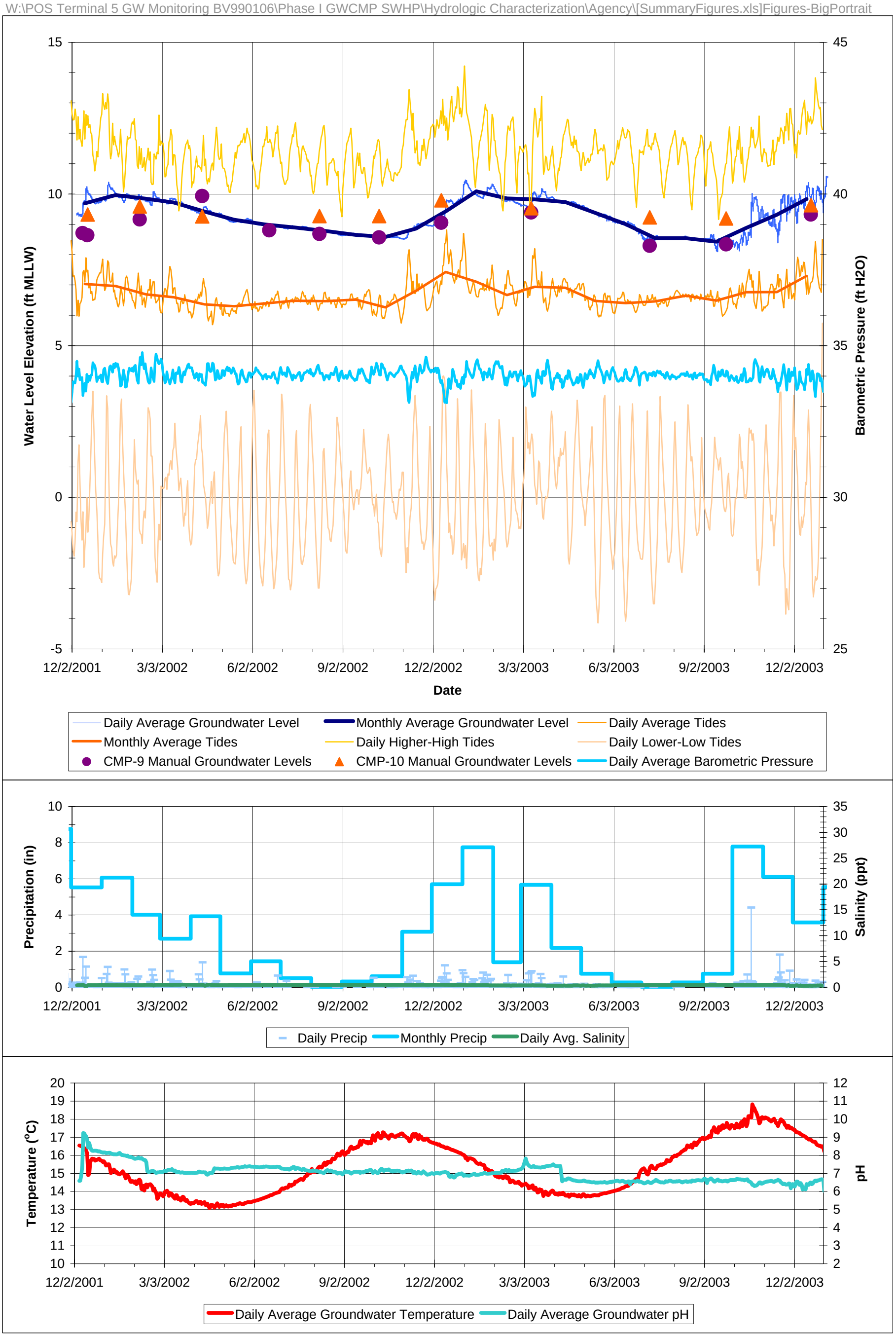




Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-4
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-3

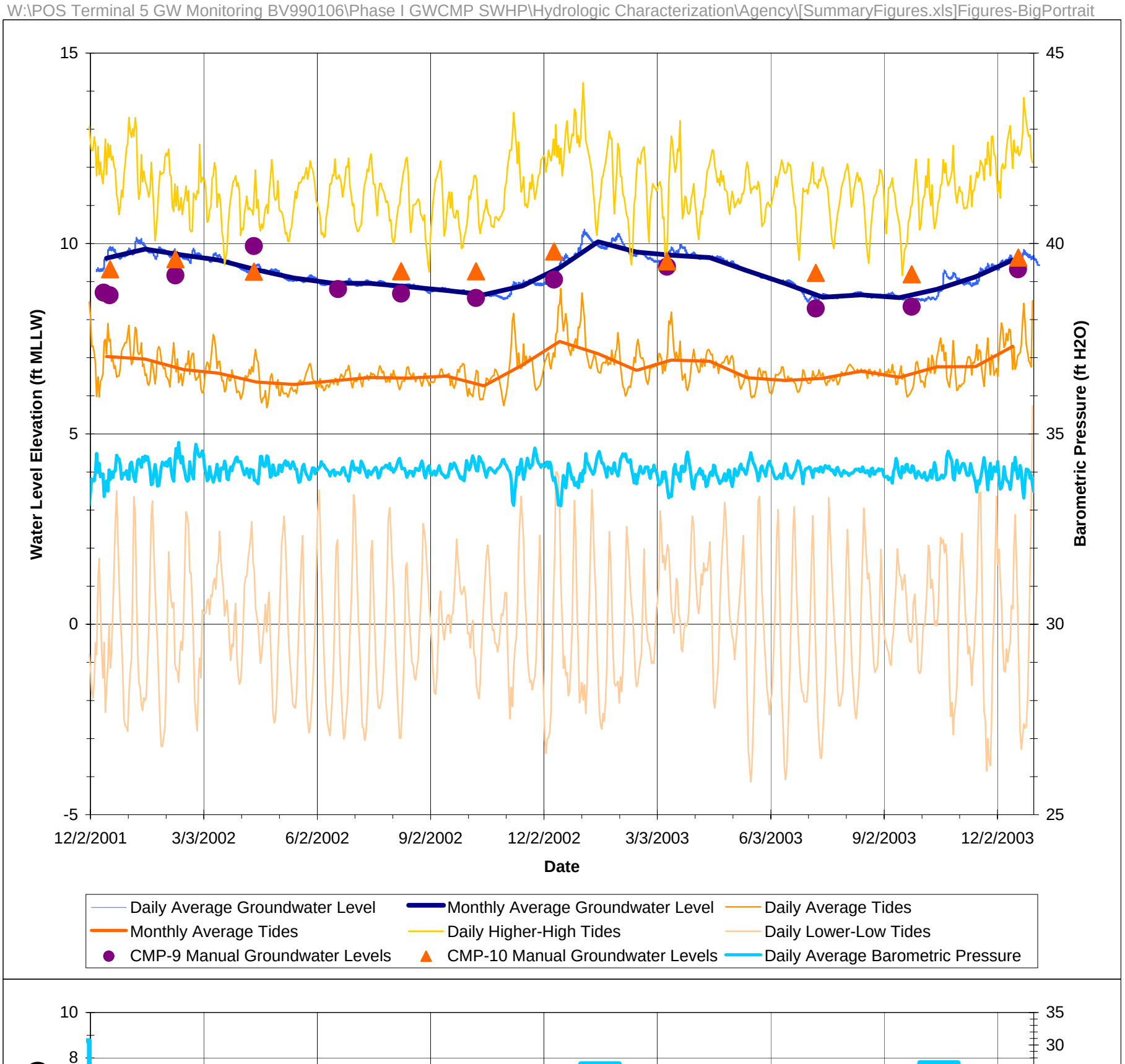
AGENCY REVIEW DRAFT

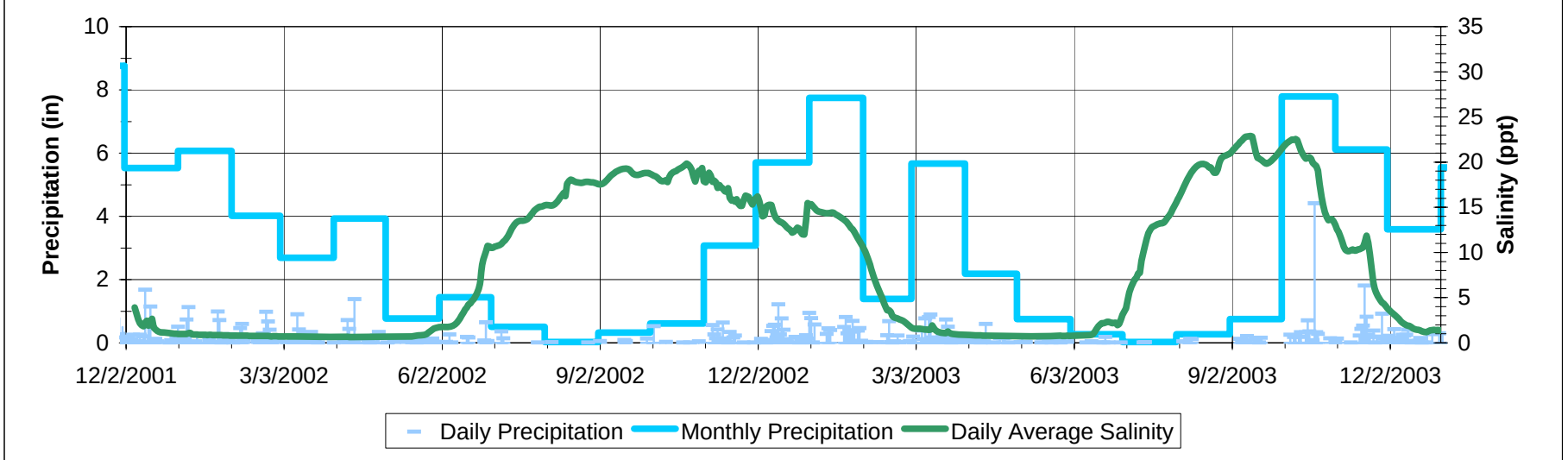


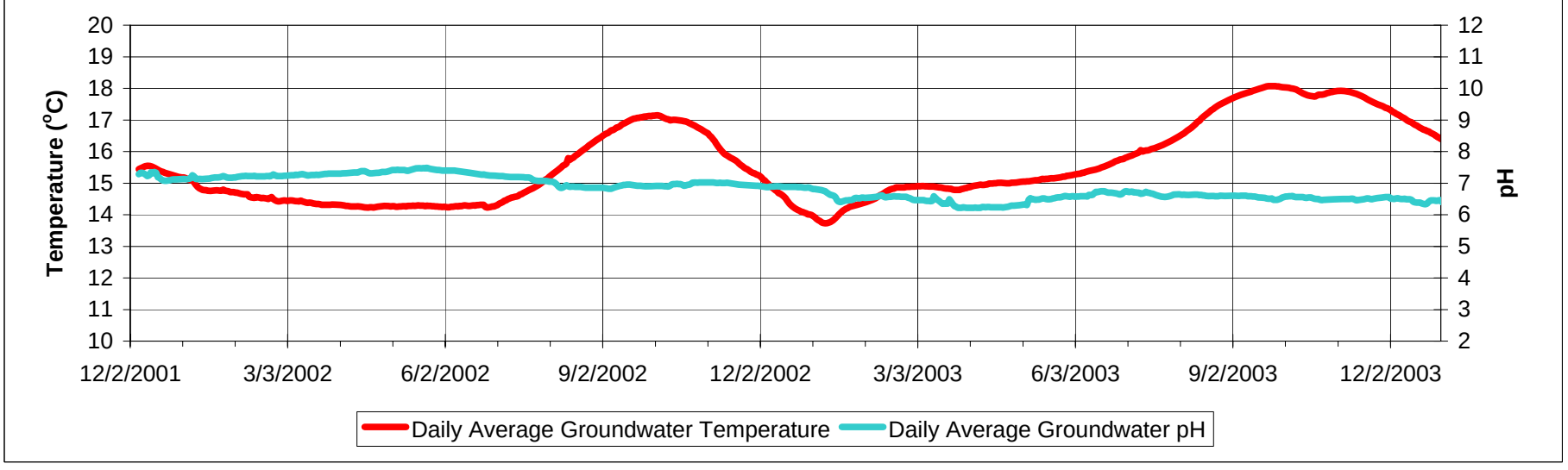
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-6
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-4

AGENCY REVIEW DRAFT



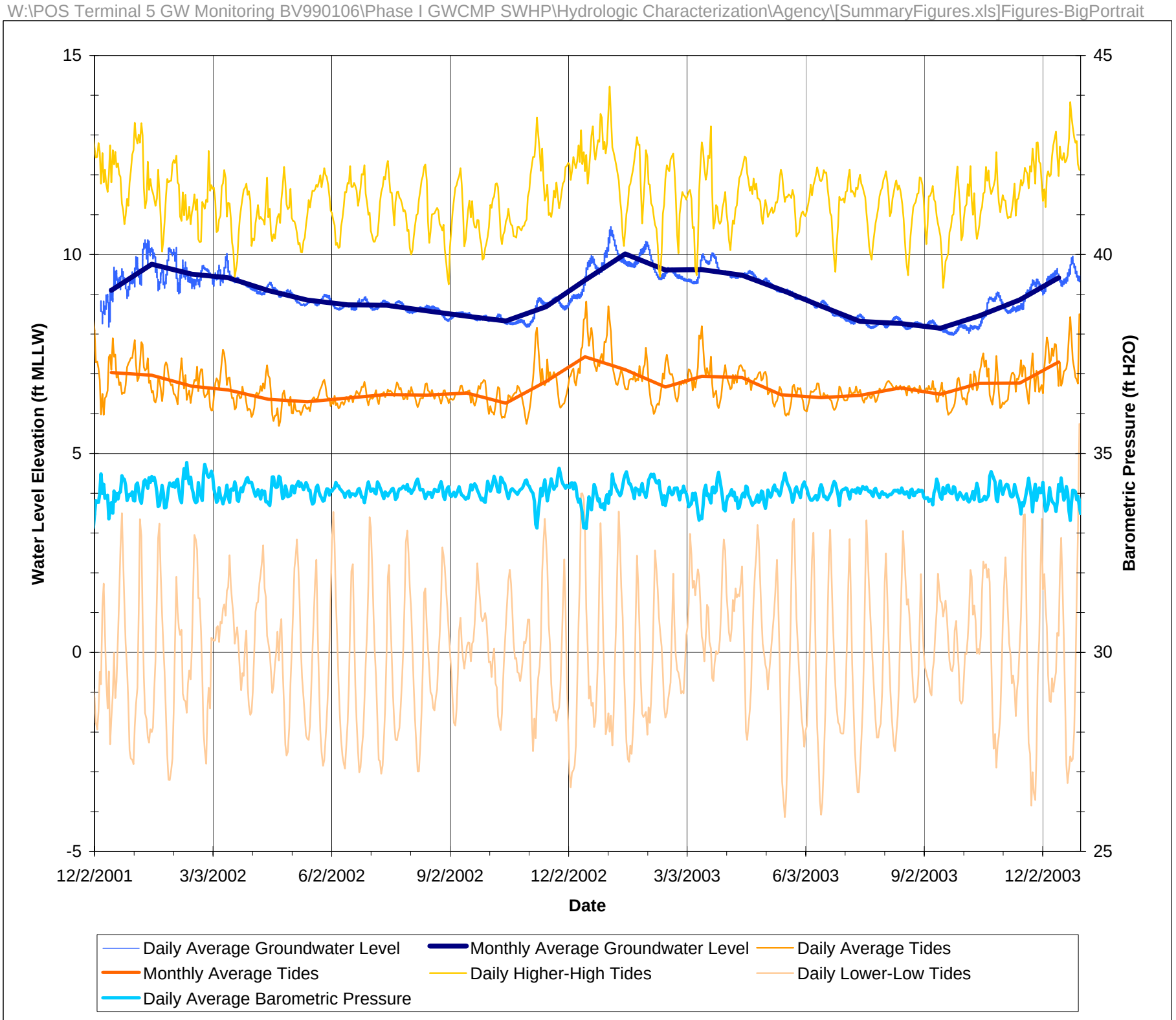


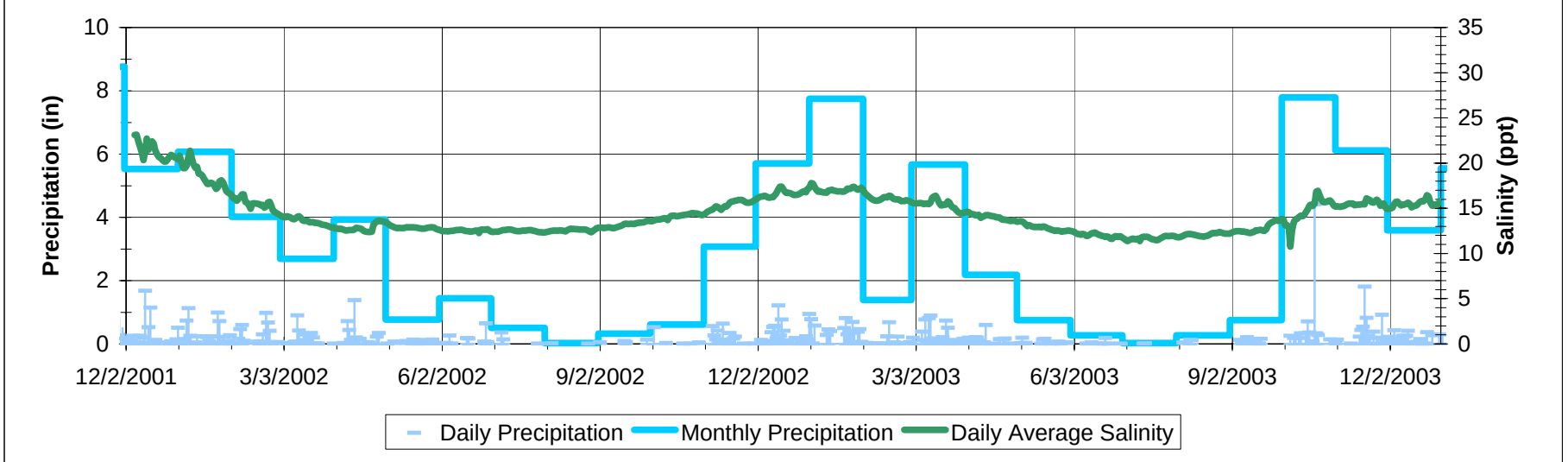


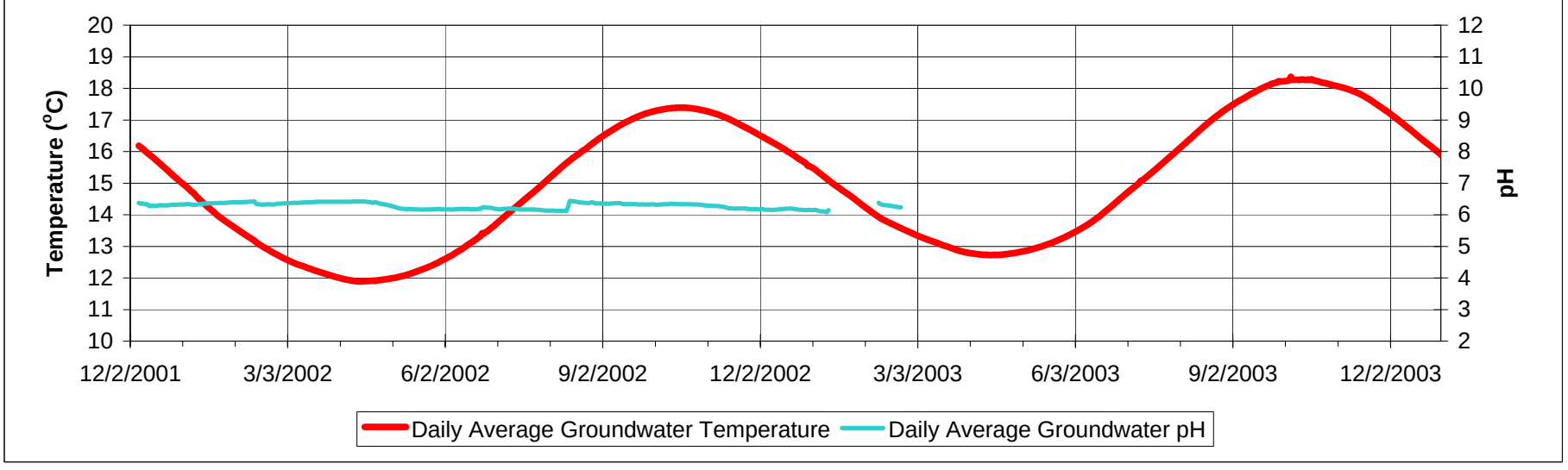
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-8
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-5

AGENCY REVIEW DRAFT



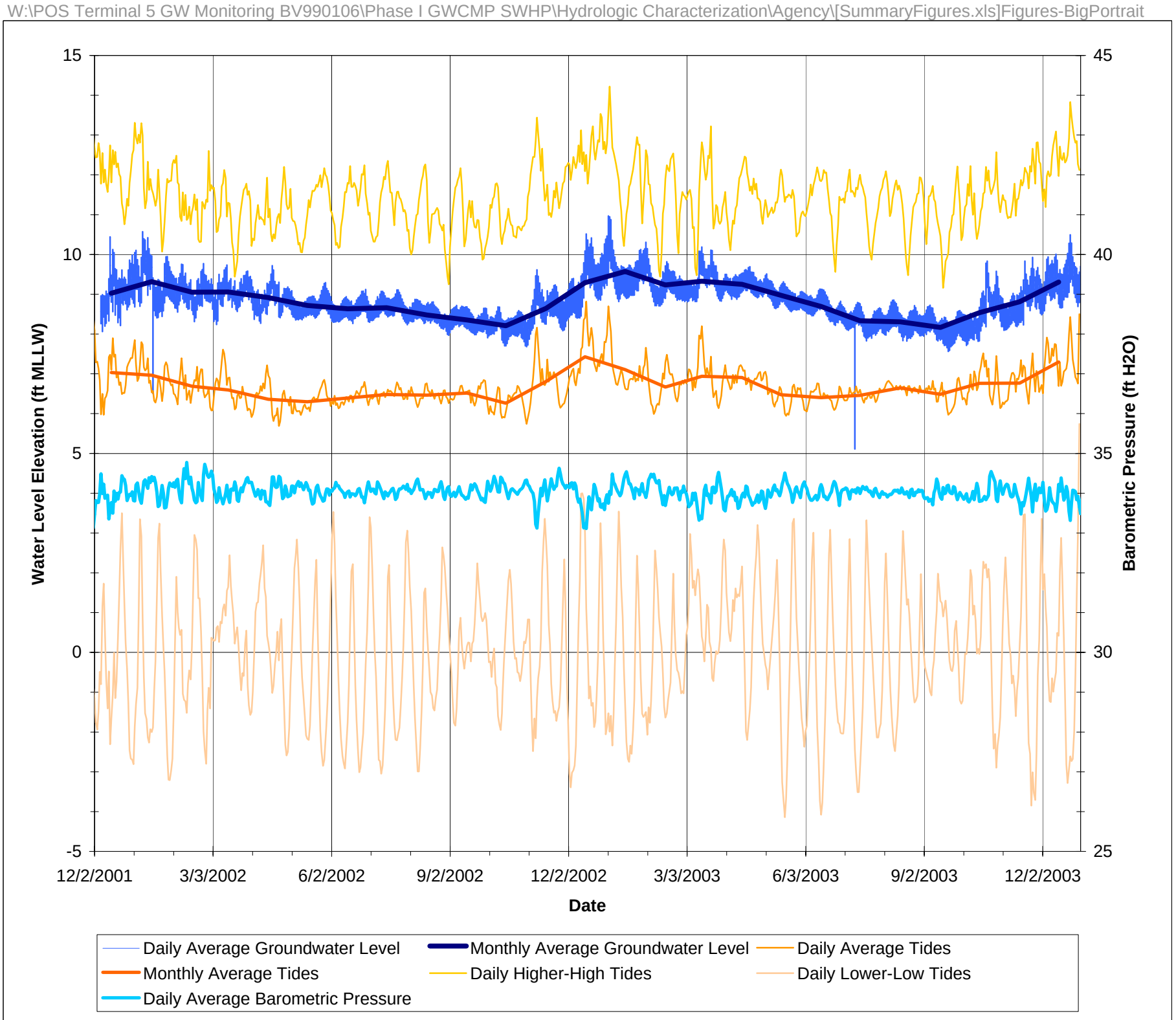


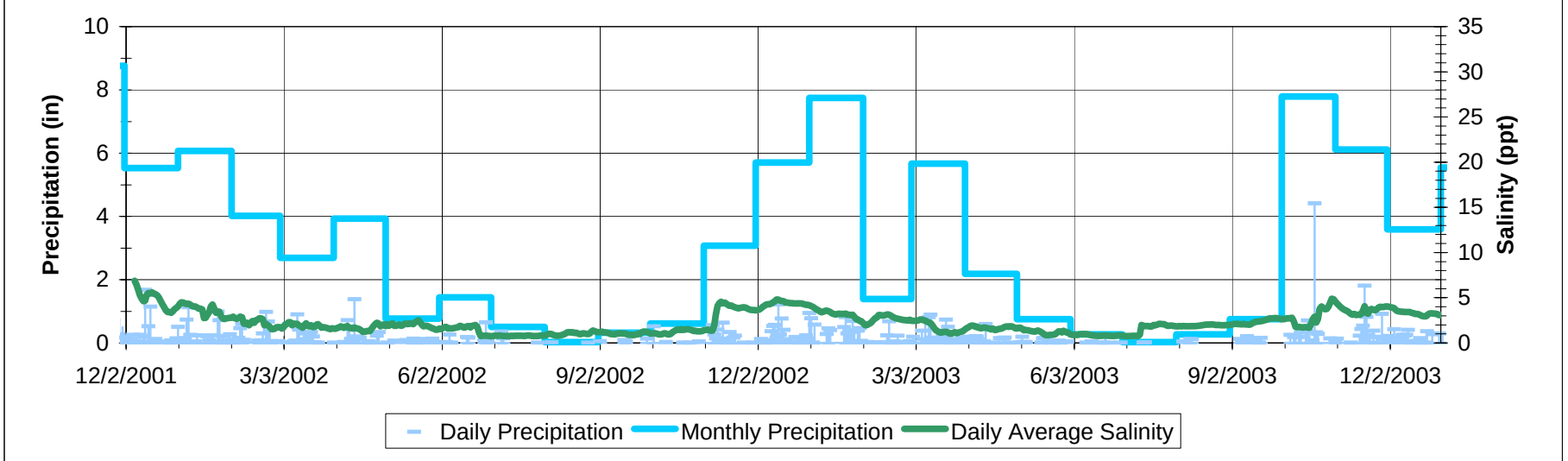


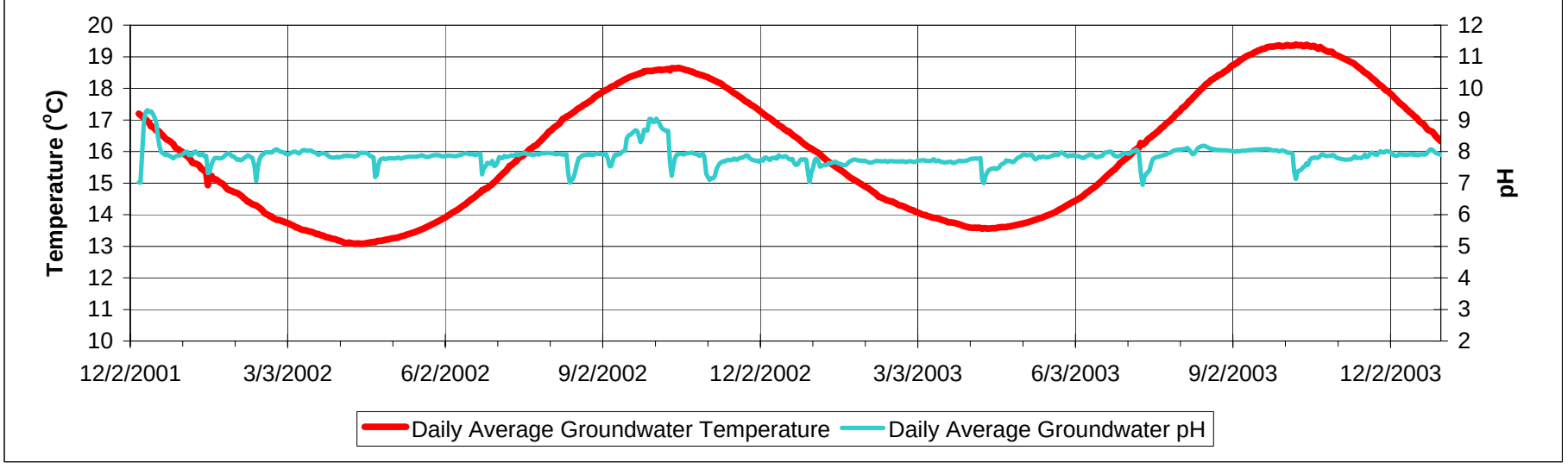
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-11
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-6

AGENCY REVIEW DRAFT



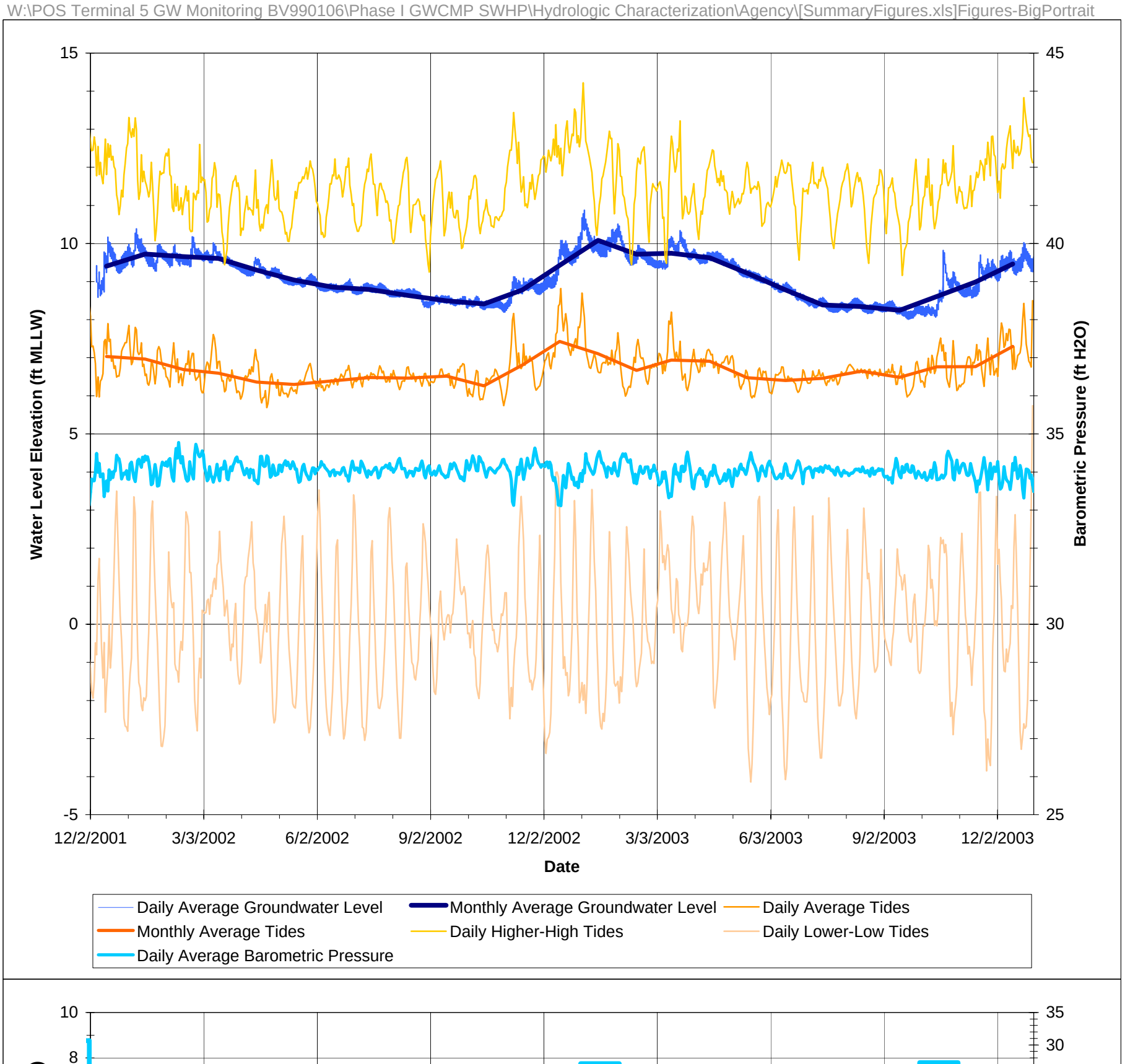


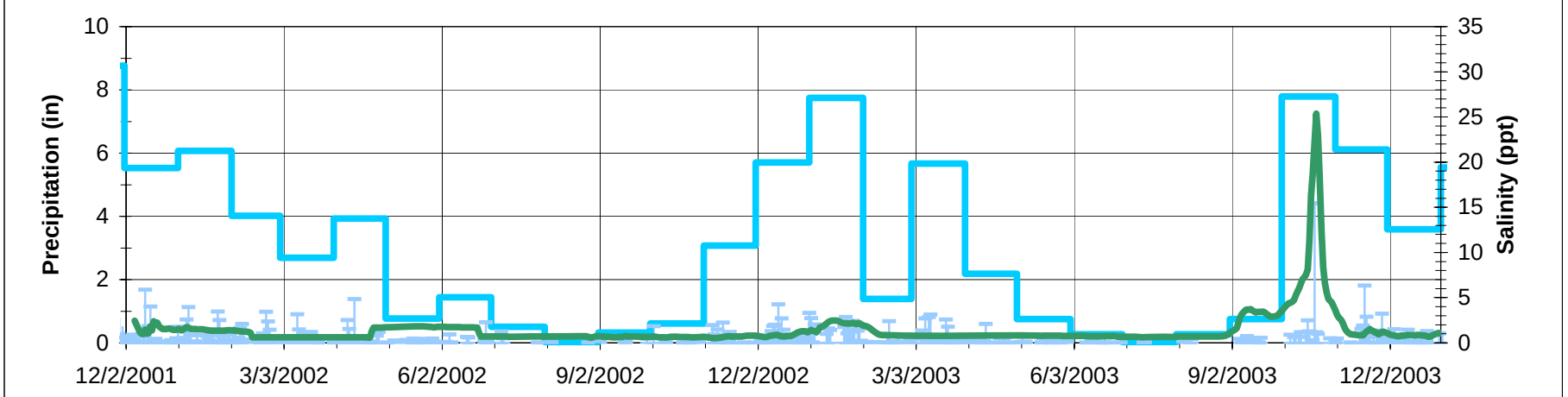


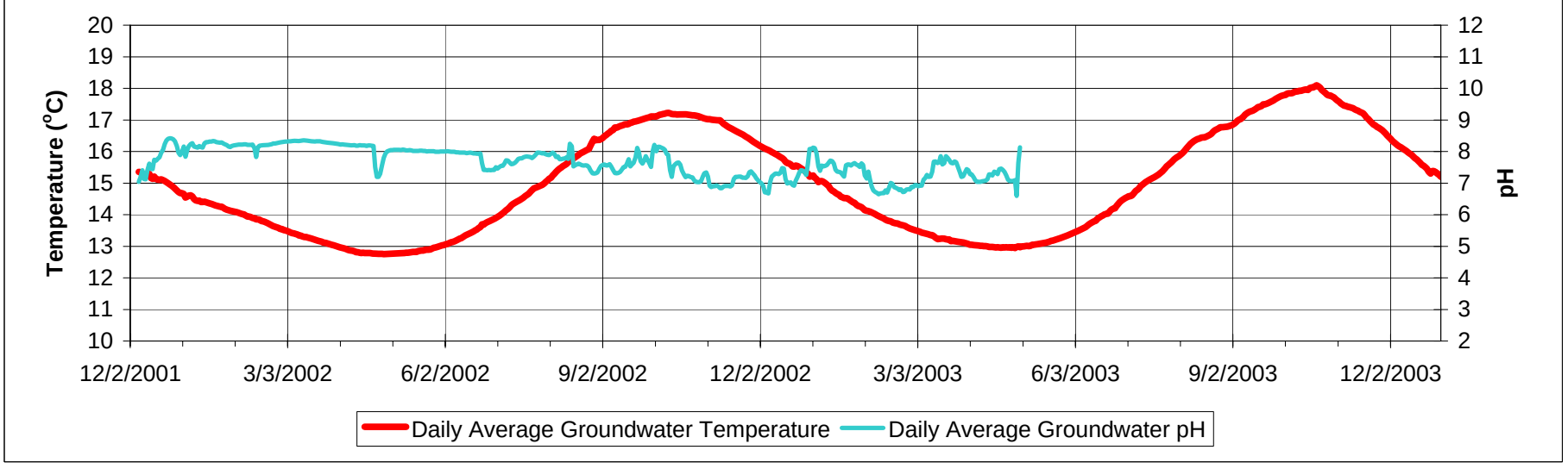
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-12
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-7

AGENCY REVIEW DRAFT



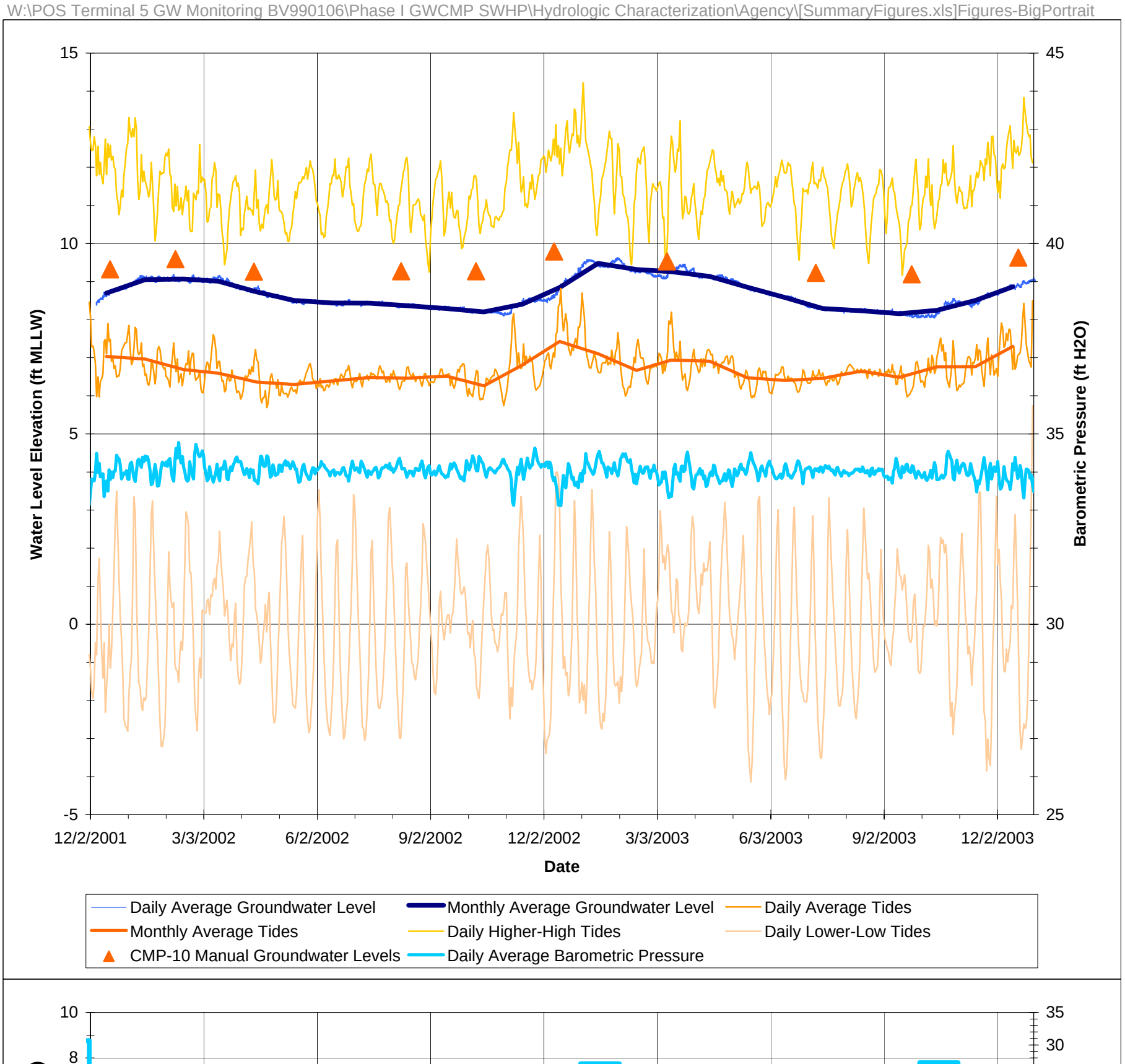


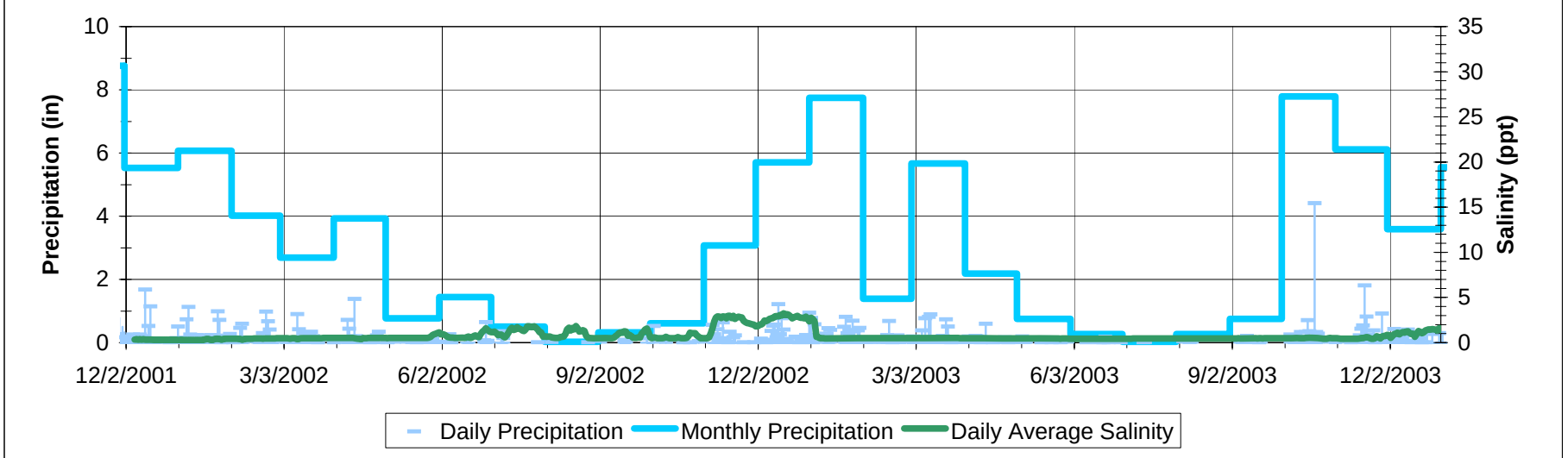


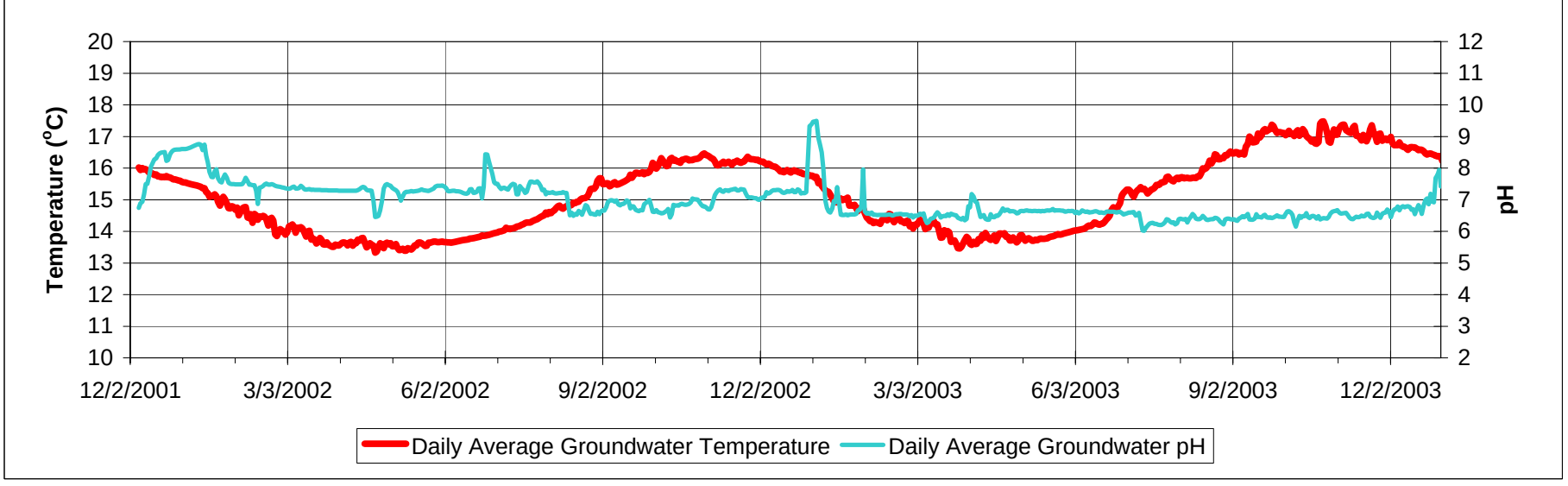
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-13
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-8

AGENCY REVIEW DRAFT



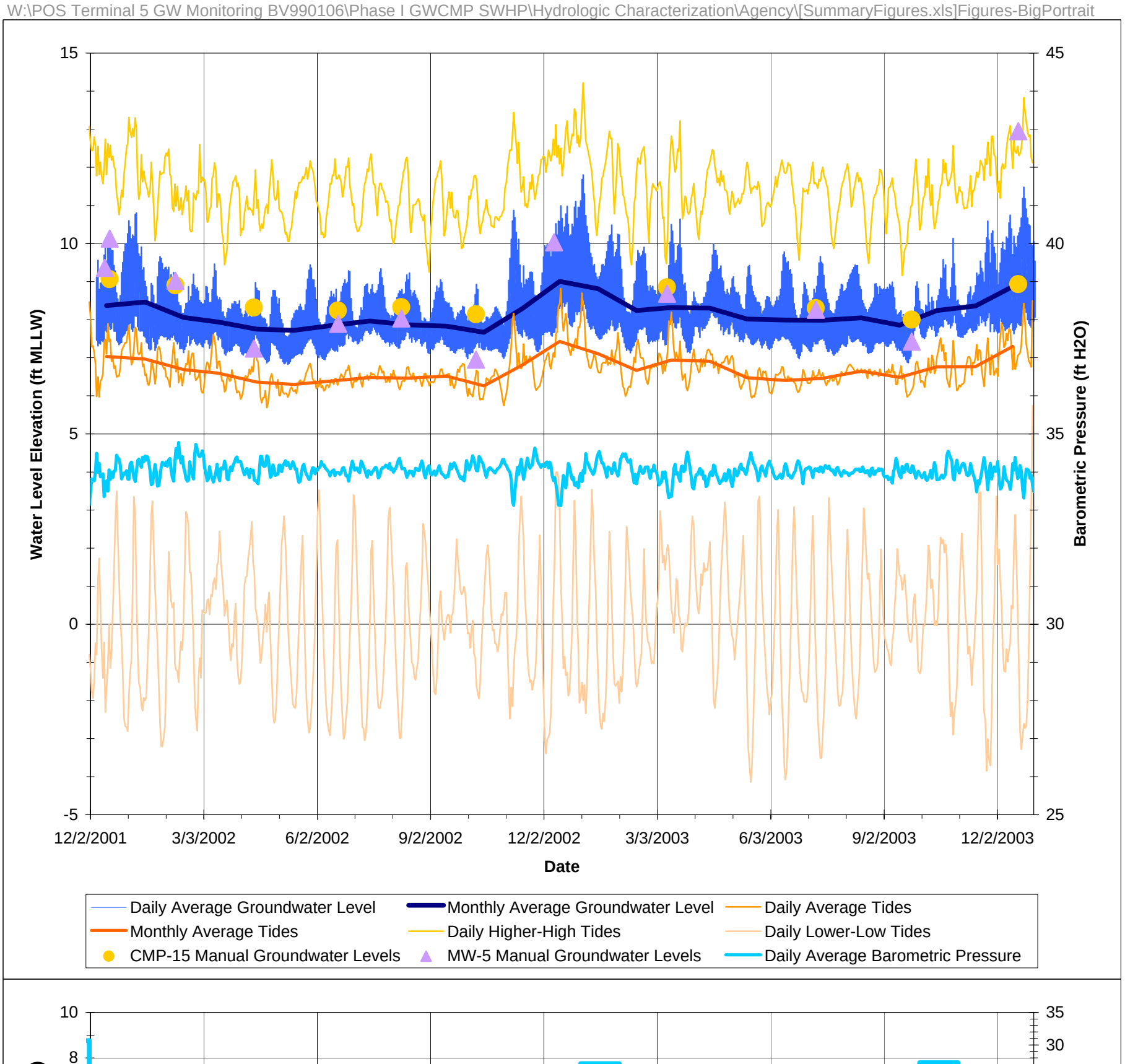


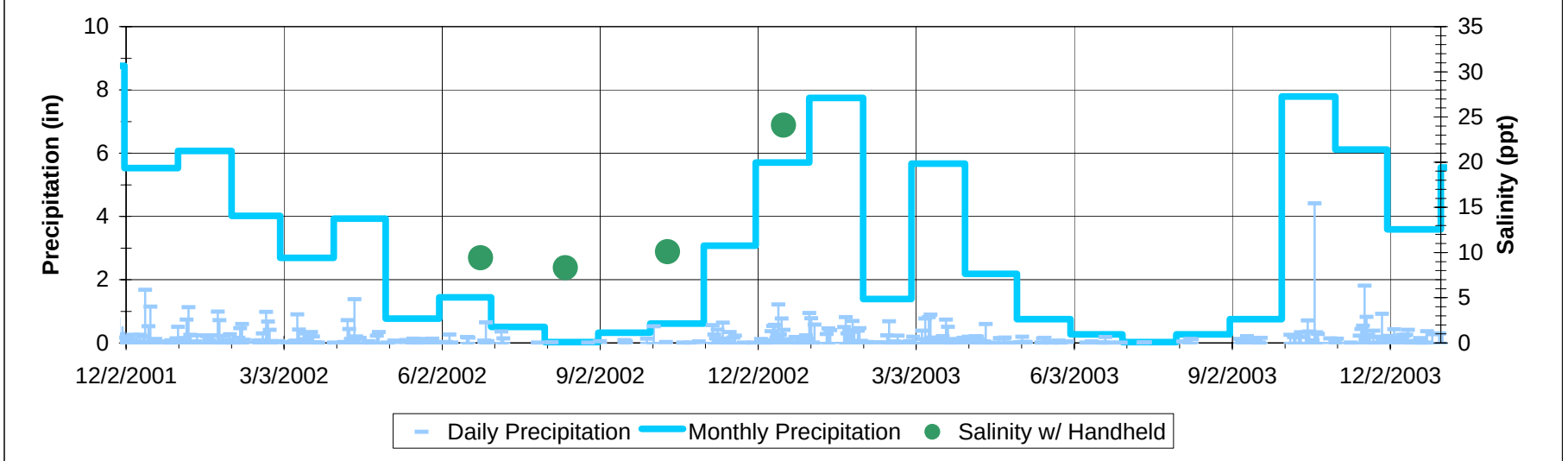


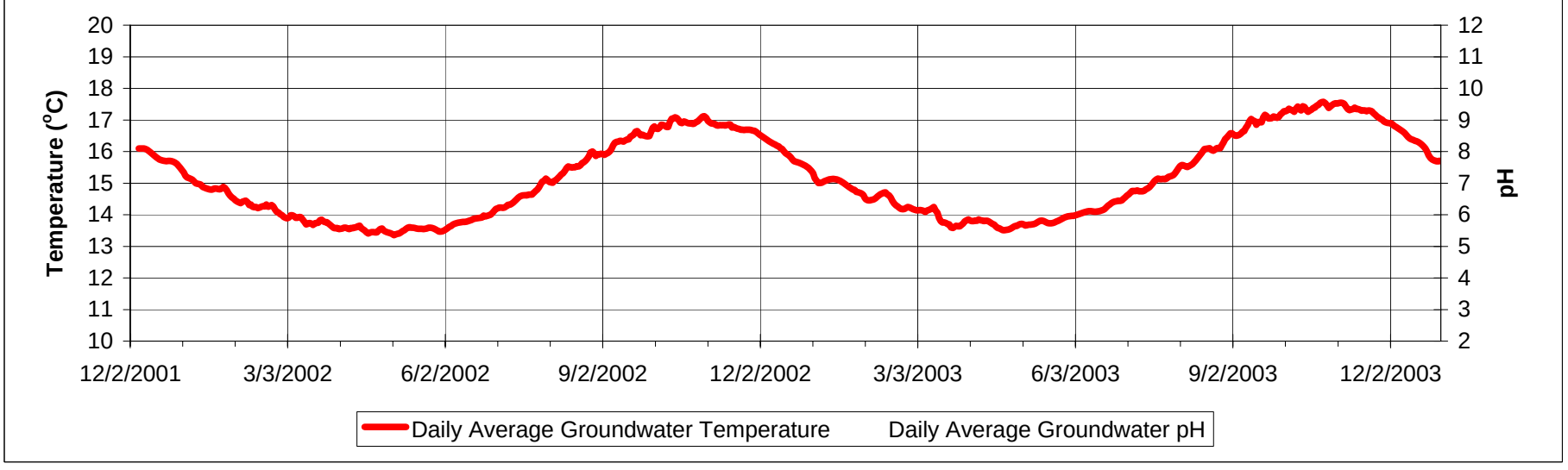
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-14
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-9

AGENCY REVIEW DRAFT







Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-16
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-10

AGENCY REVIEW DRAFT

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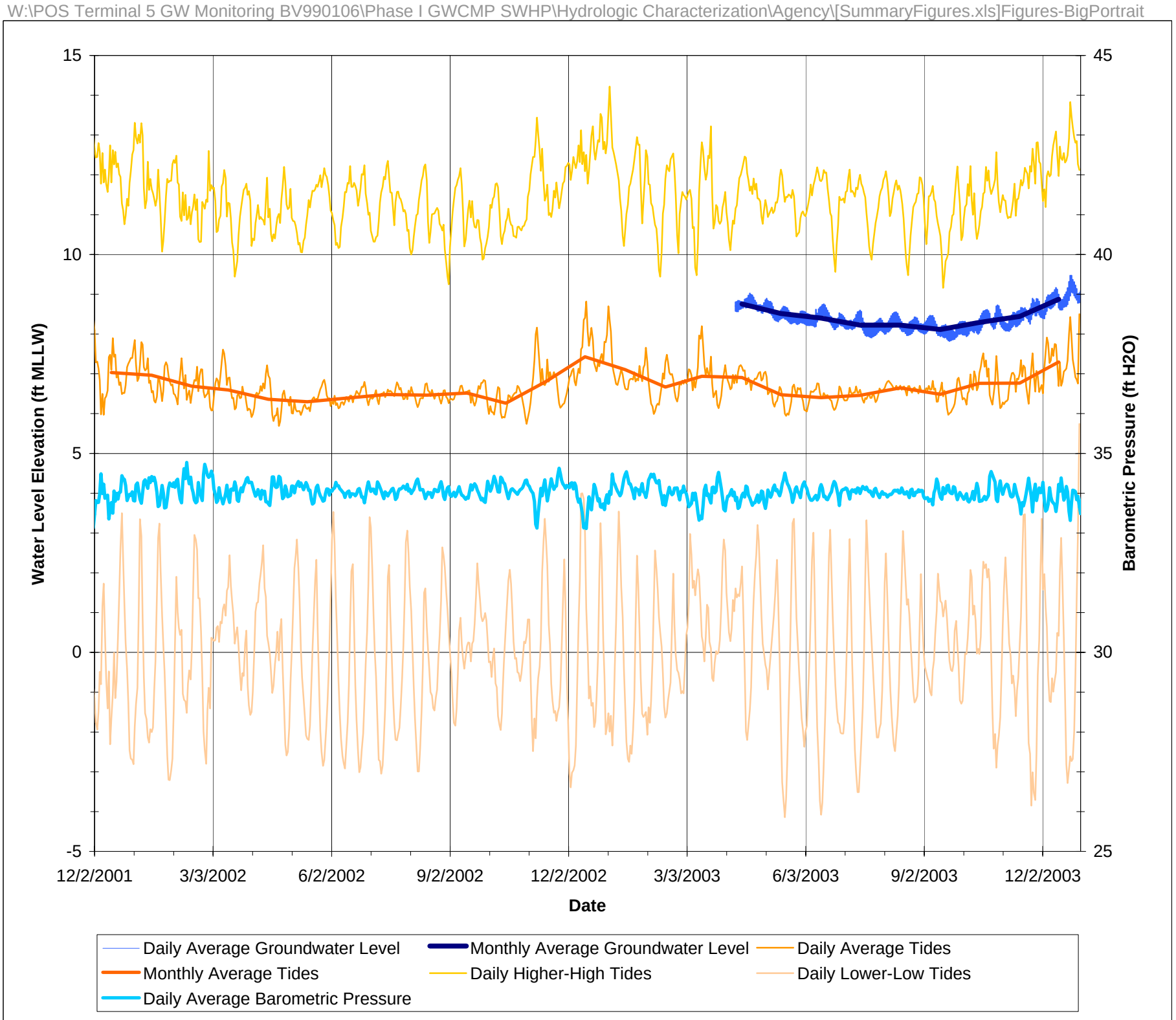
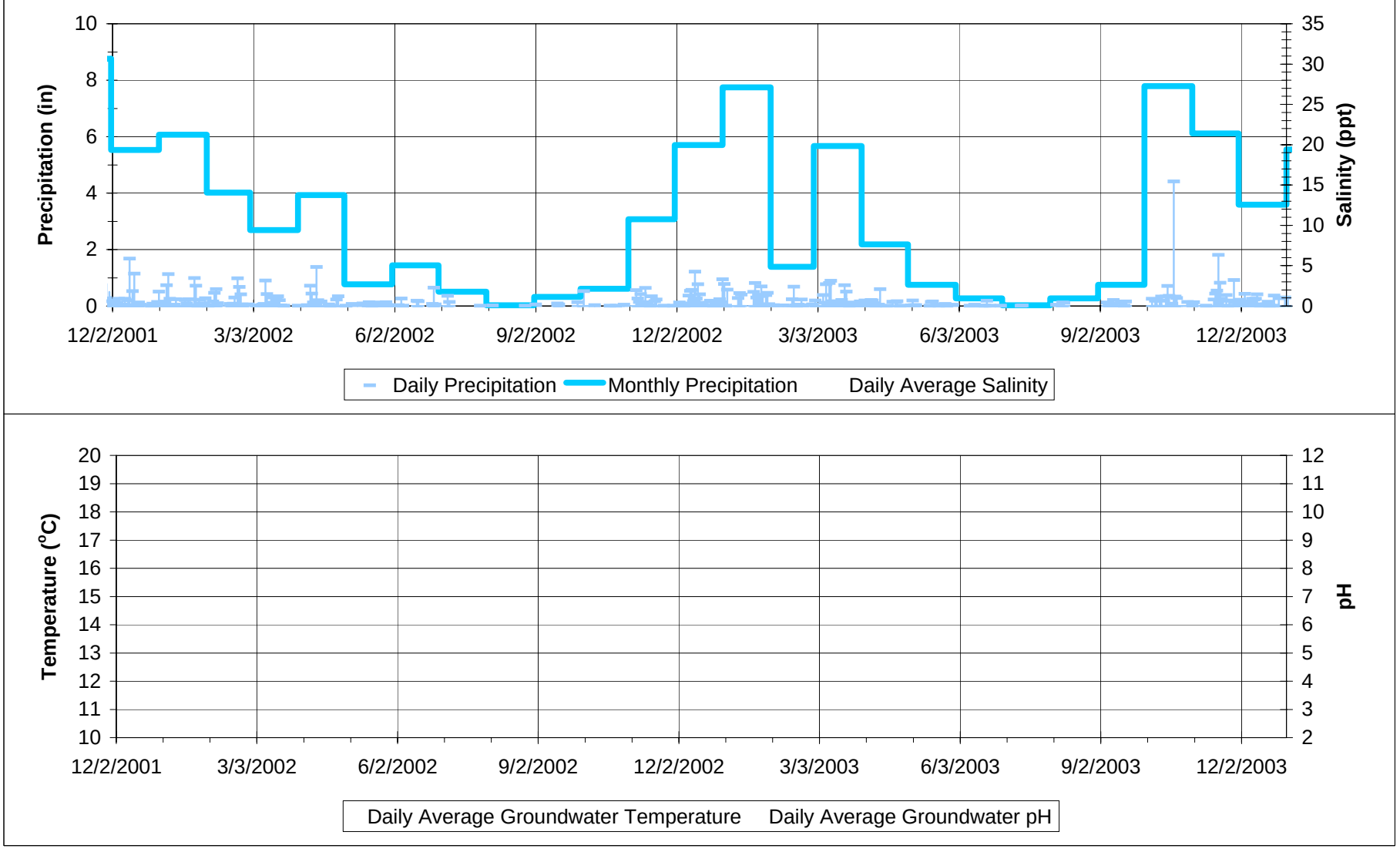
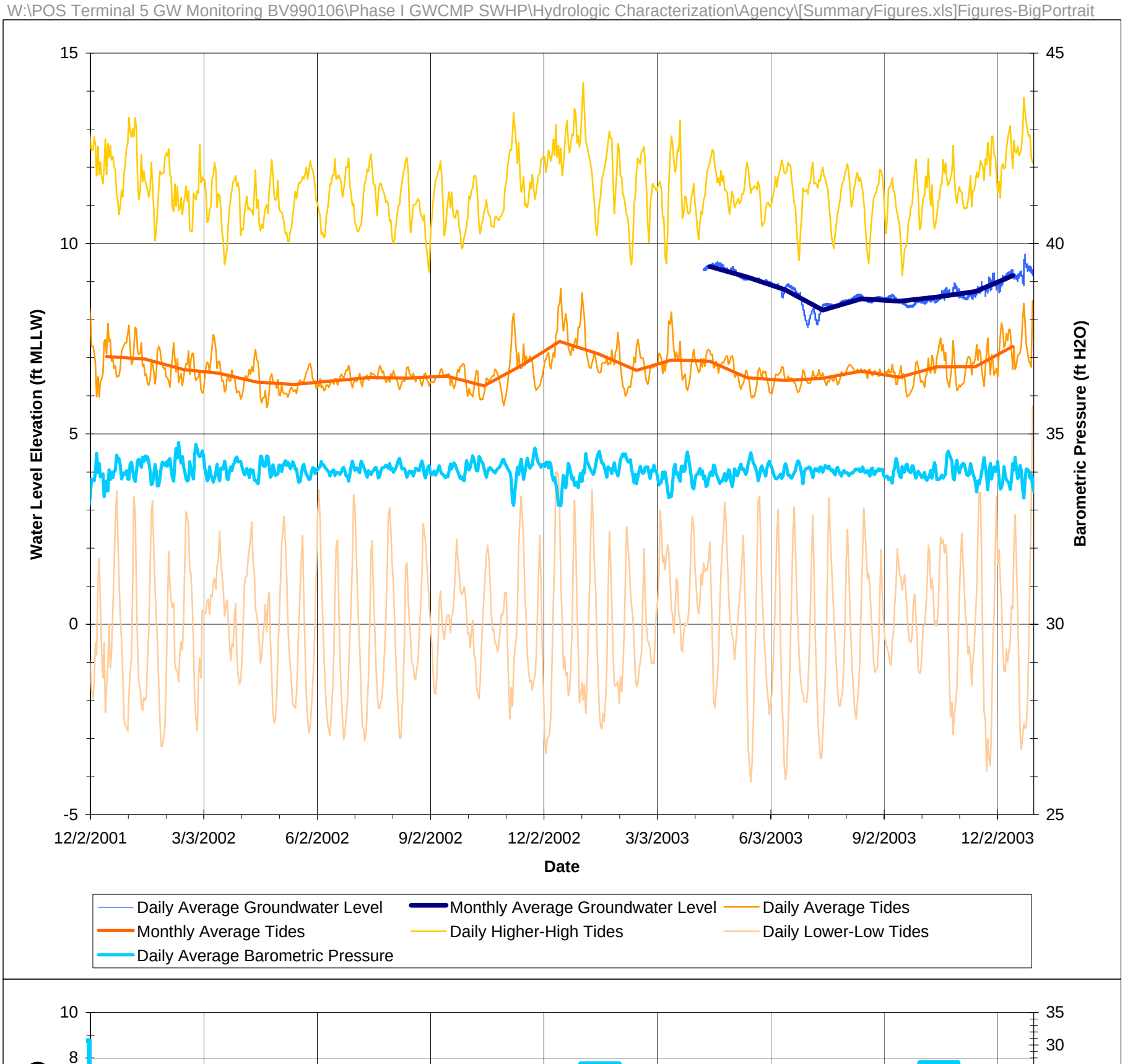


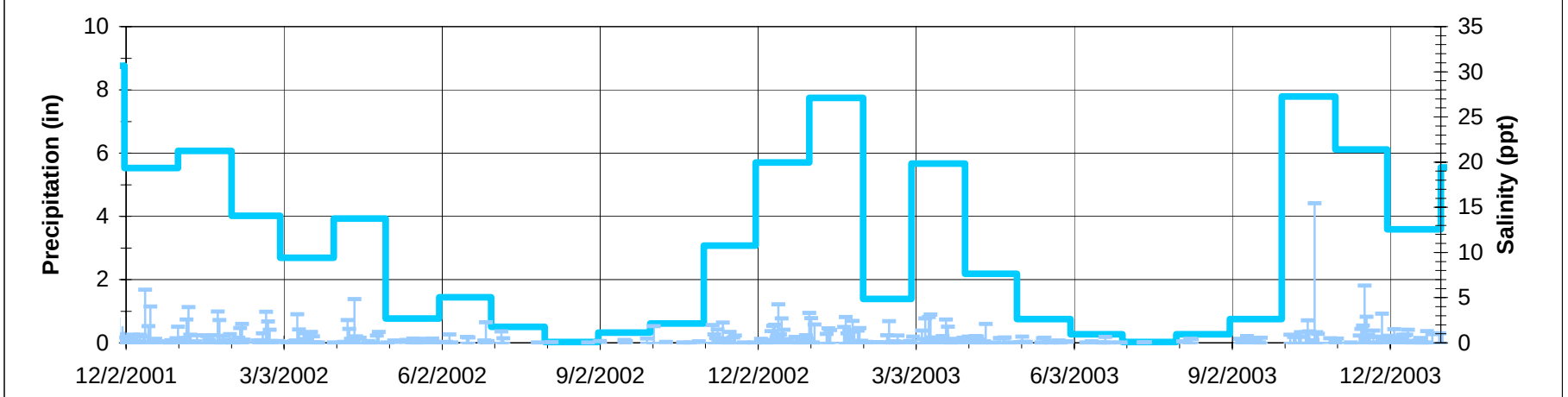


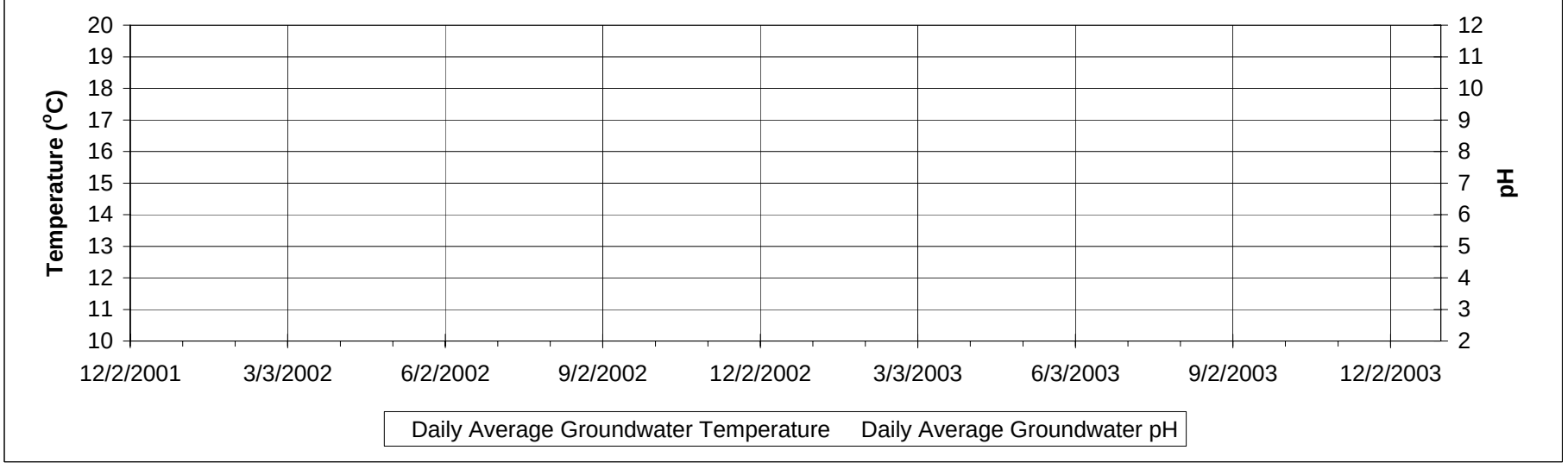
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-18
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-11

AGENCY REVIEW DRAFT



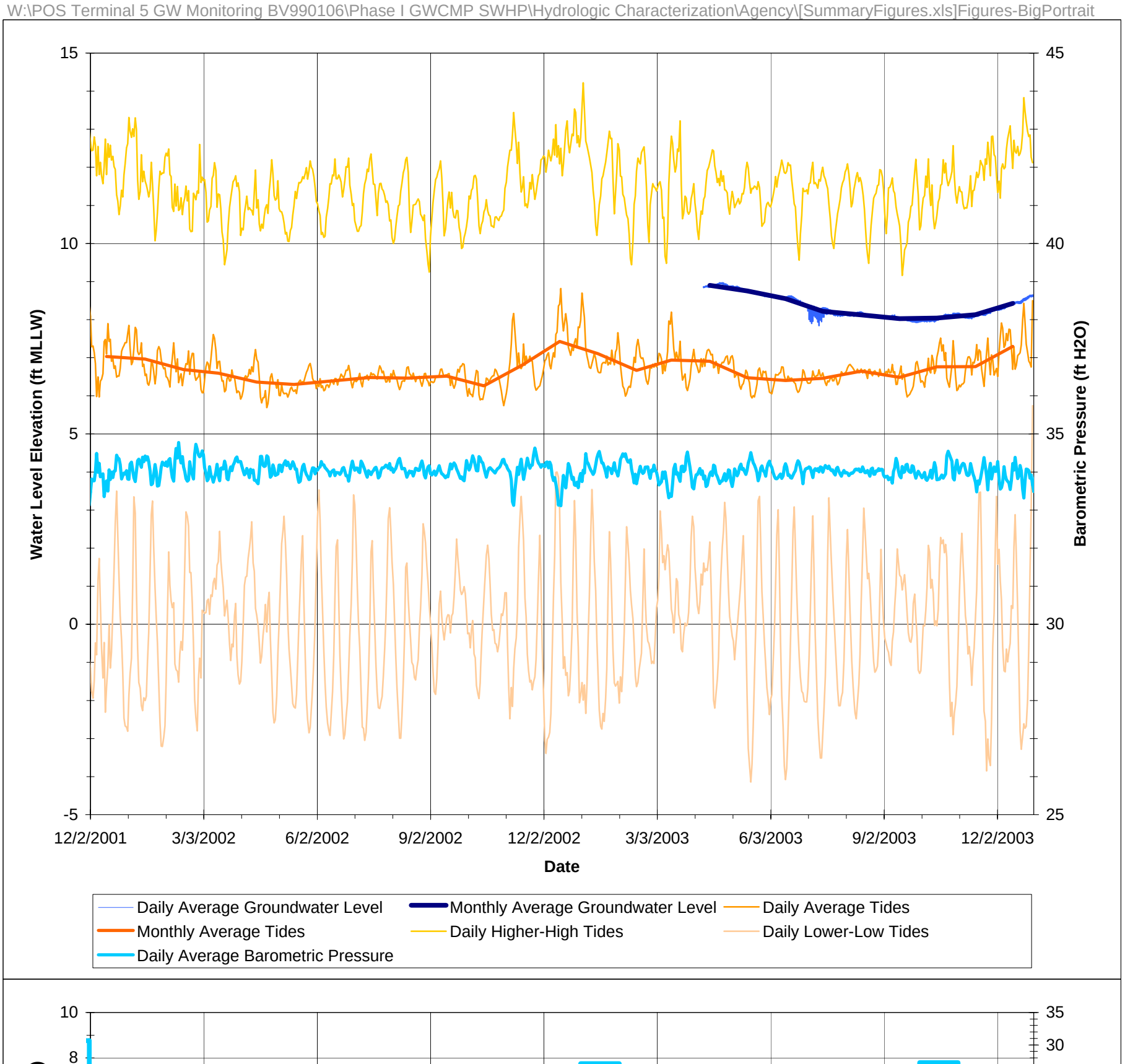


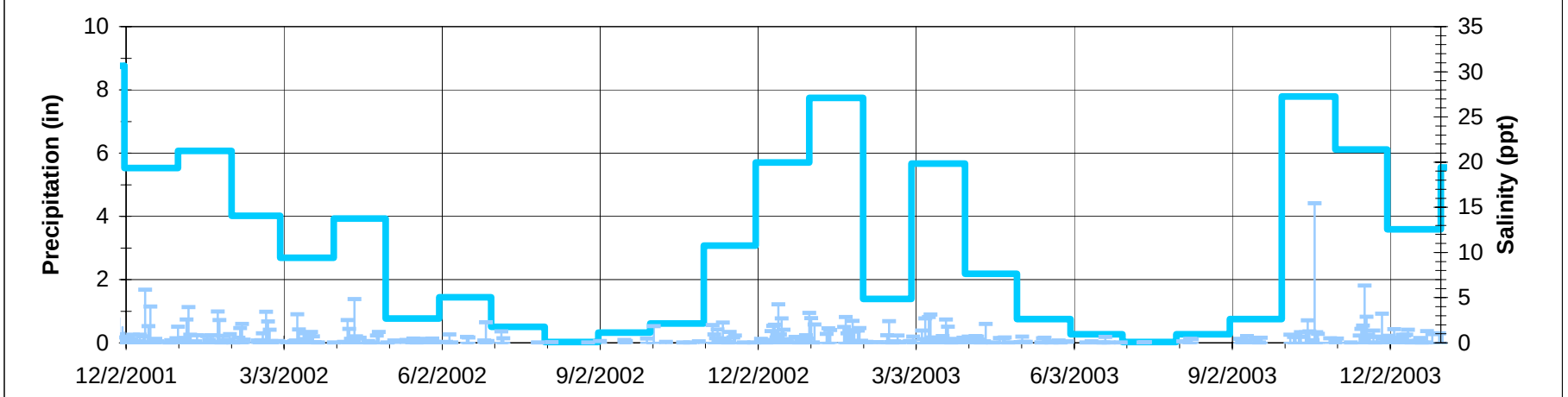


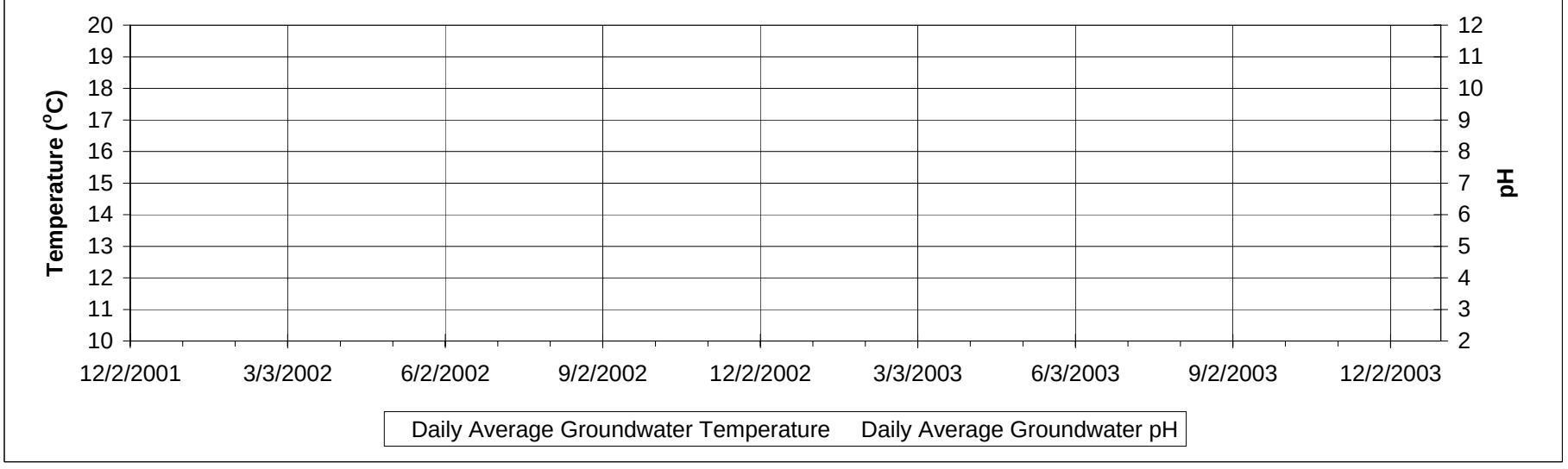
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-19
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-12

AGENCY REVIEW DRAFT



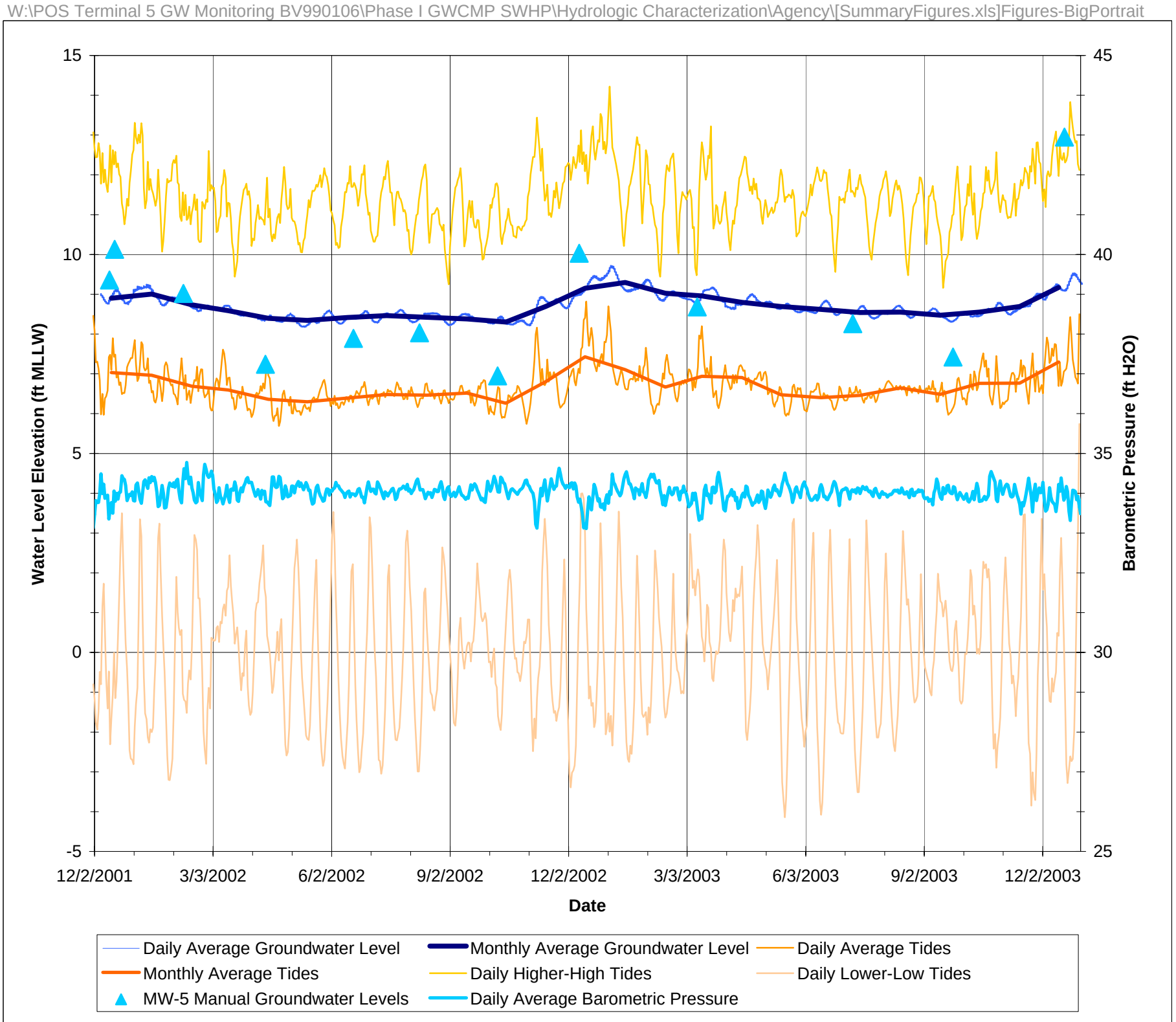


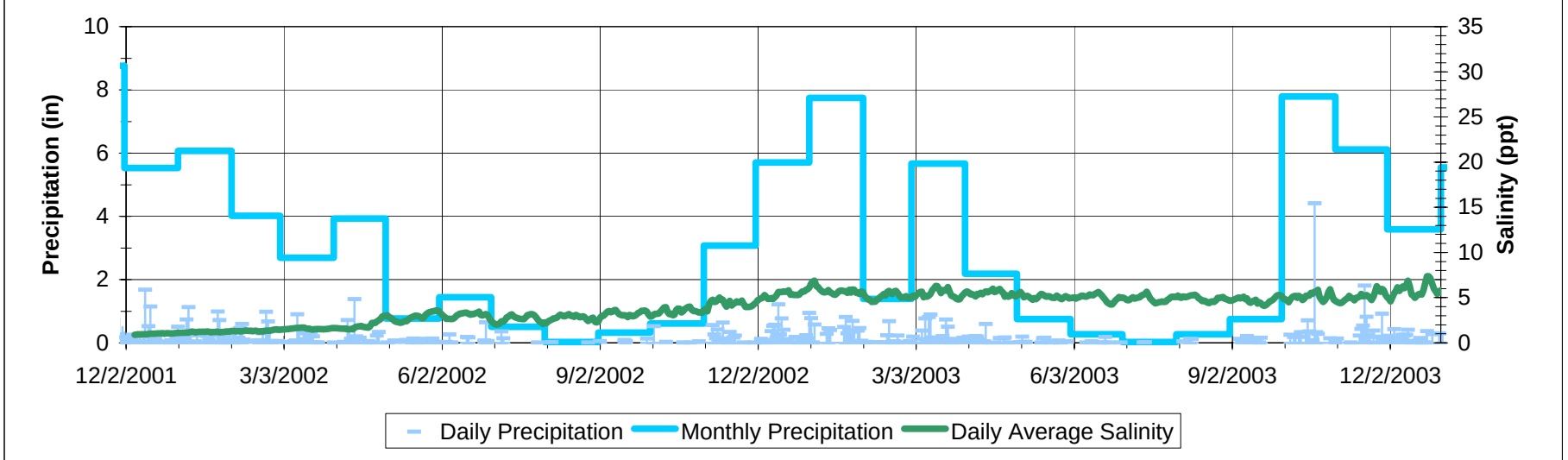


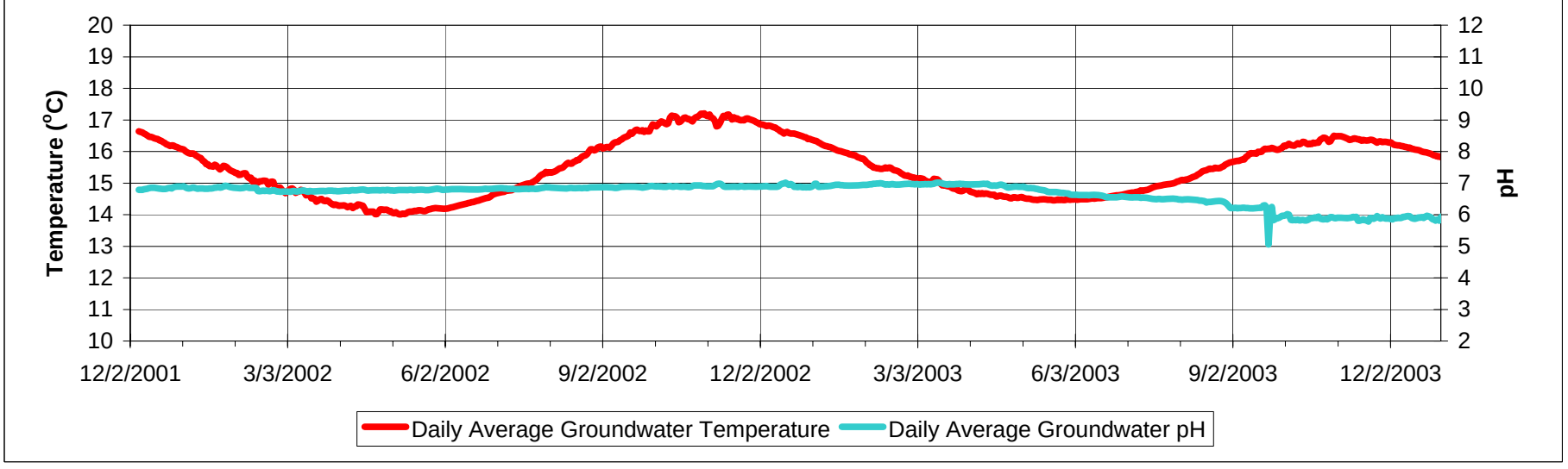
Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well CMP-20
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-13

AGENCY REVIEW DRAFT





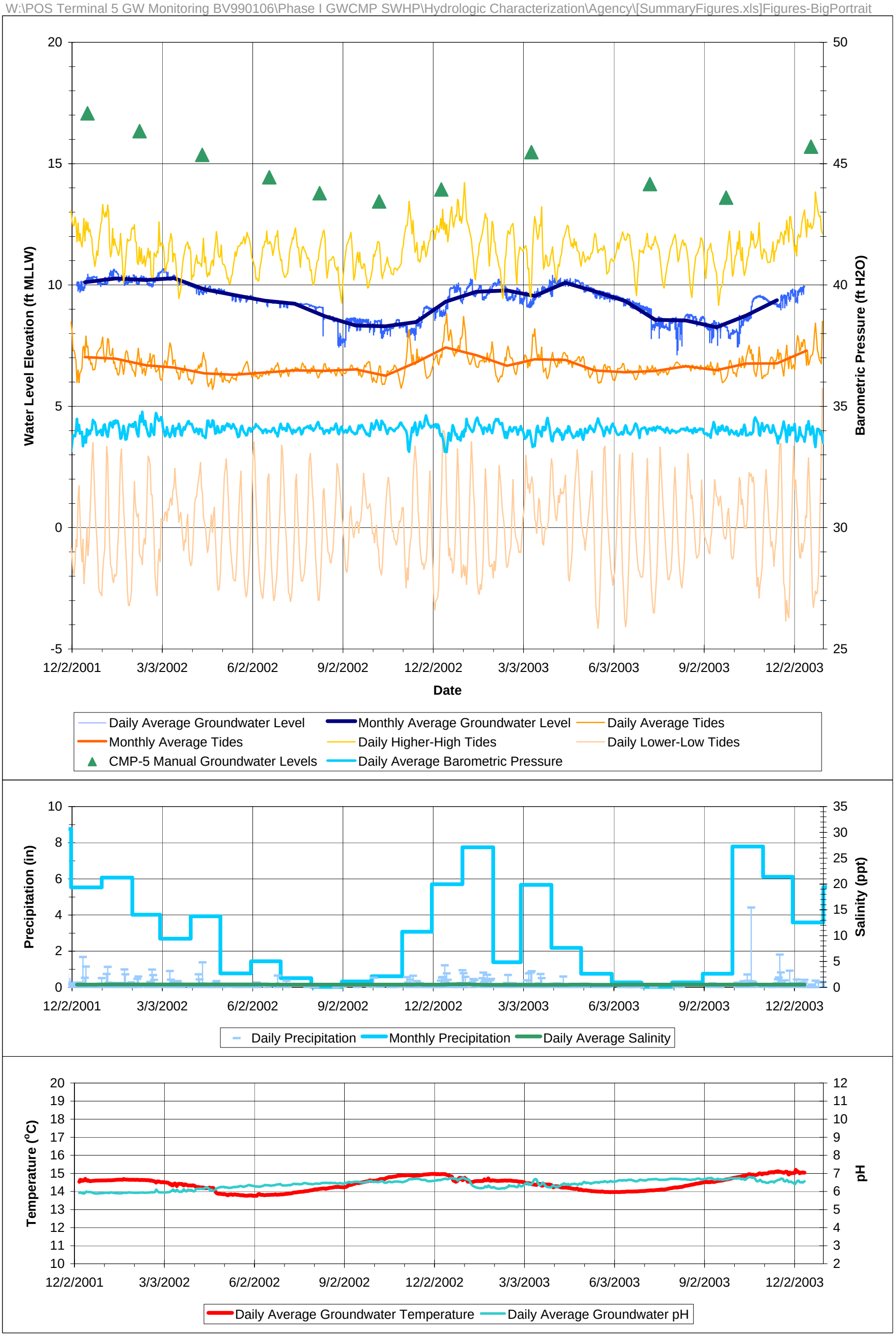


Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well MW-26R
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Aspect consulting
IN-DEPTH PERSPECTIVE

Figure F-14

AGENCY REVIEW DRAFT



Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well MW-307A
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Aspect consulting
IN-DEPTH PERSPECTIVE

Figure F-15

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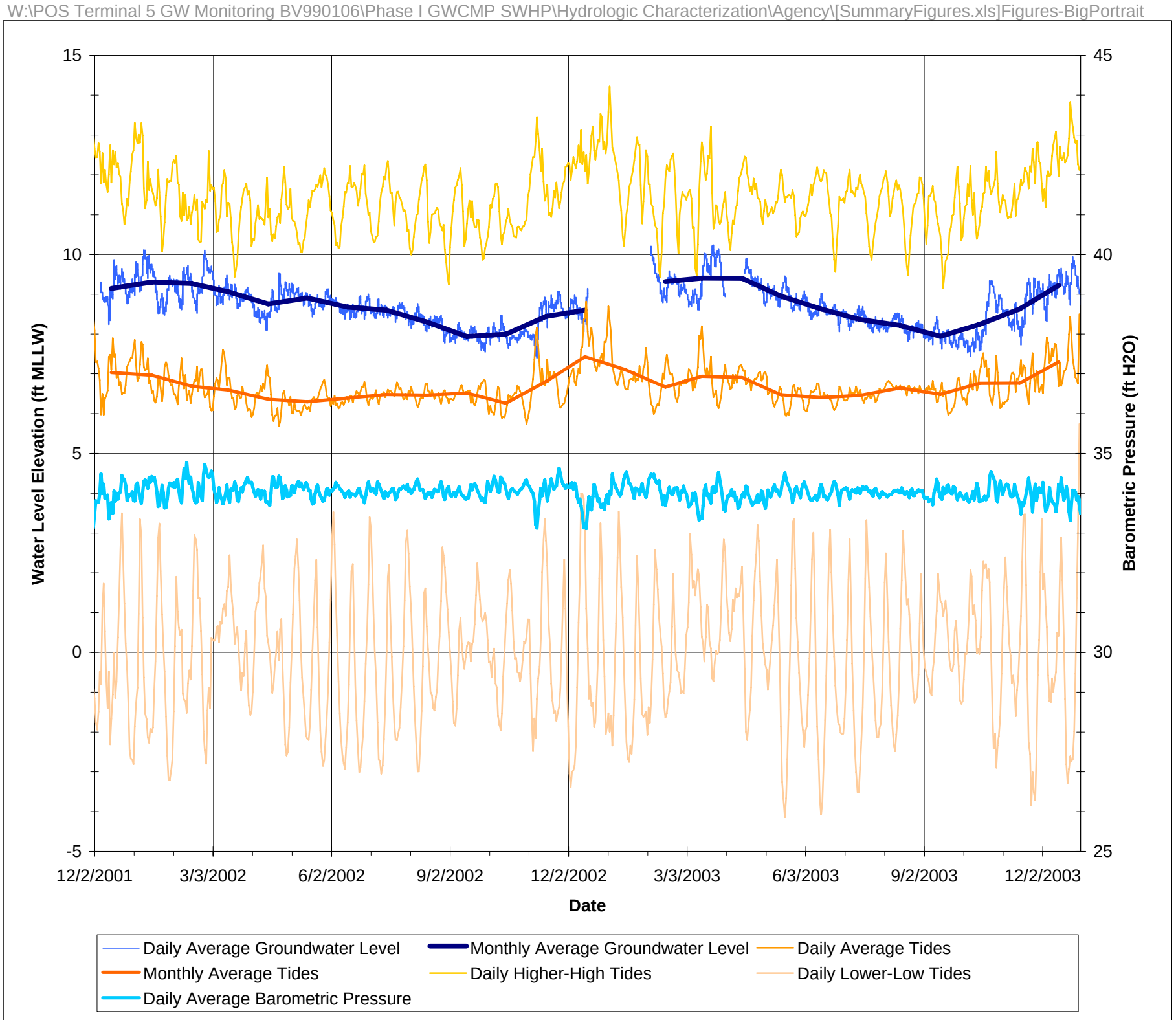

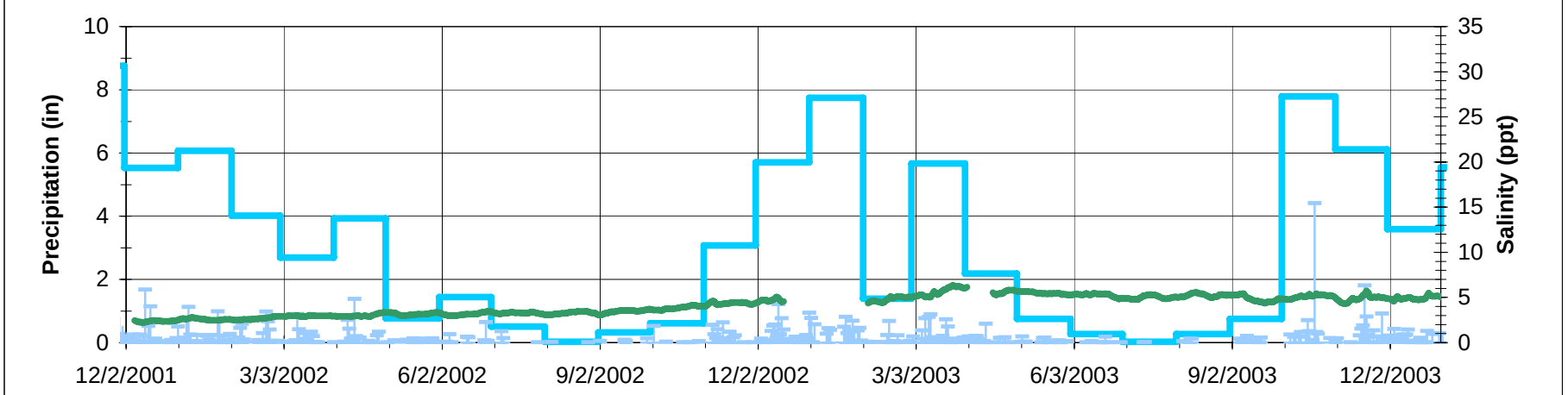

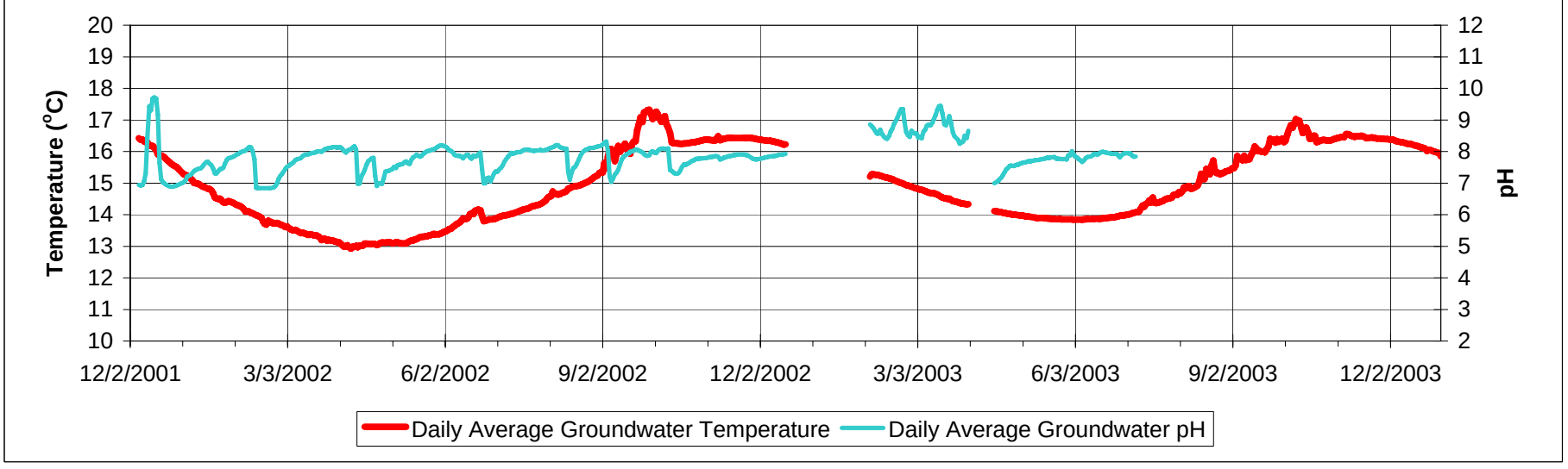

Groundwater Levels, Water Quality Parameters, and Tidal Data
Fill Aquifer Well MW-308N
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Aspect consulting
IN-DEPTH PERSPECTIVE

Figure F-16

AGENCY REVIEW DRAFT

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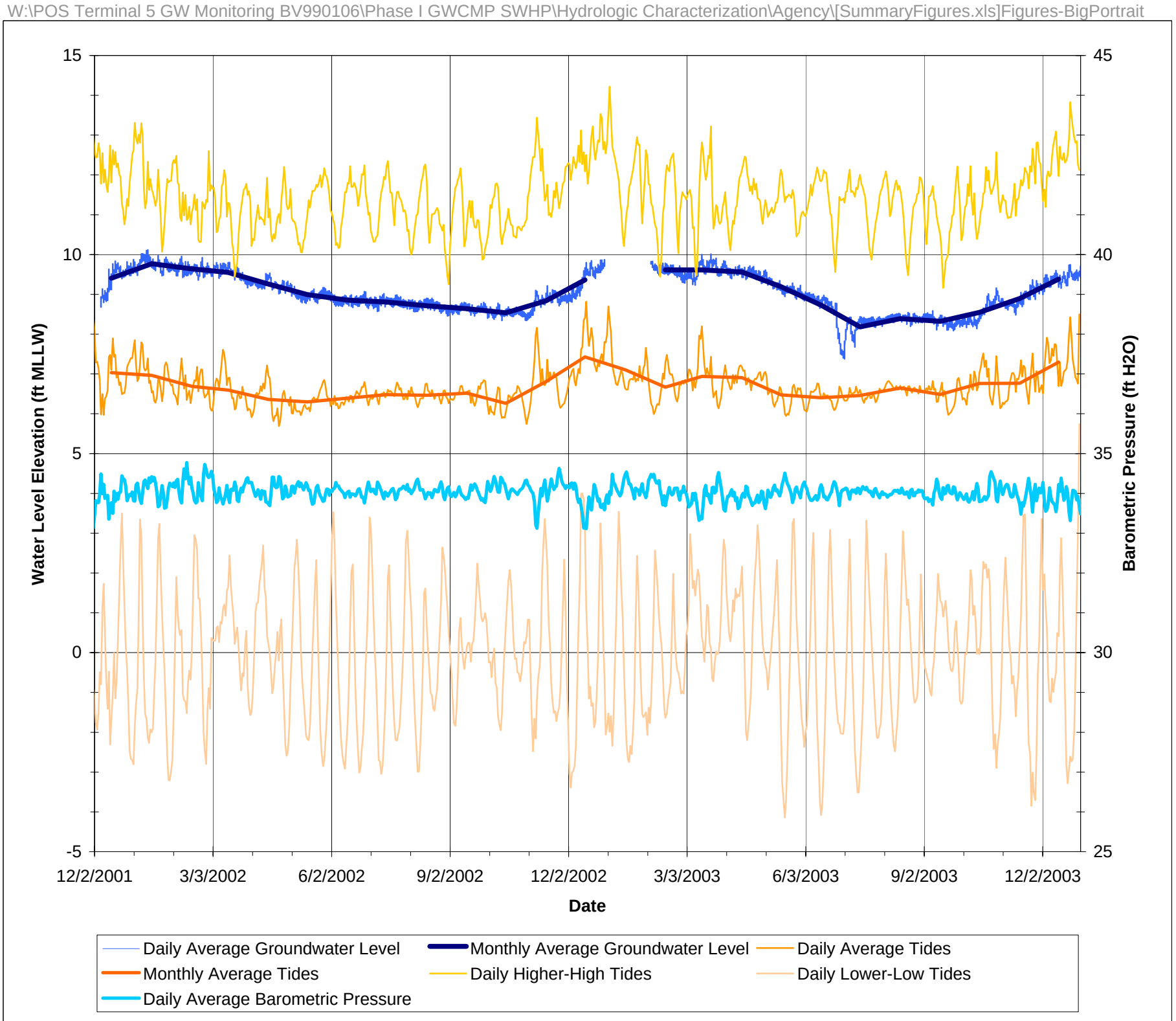

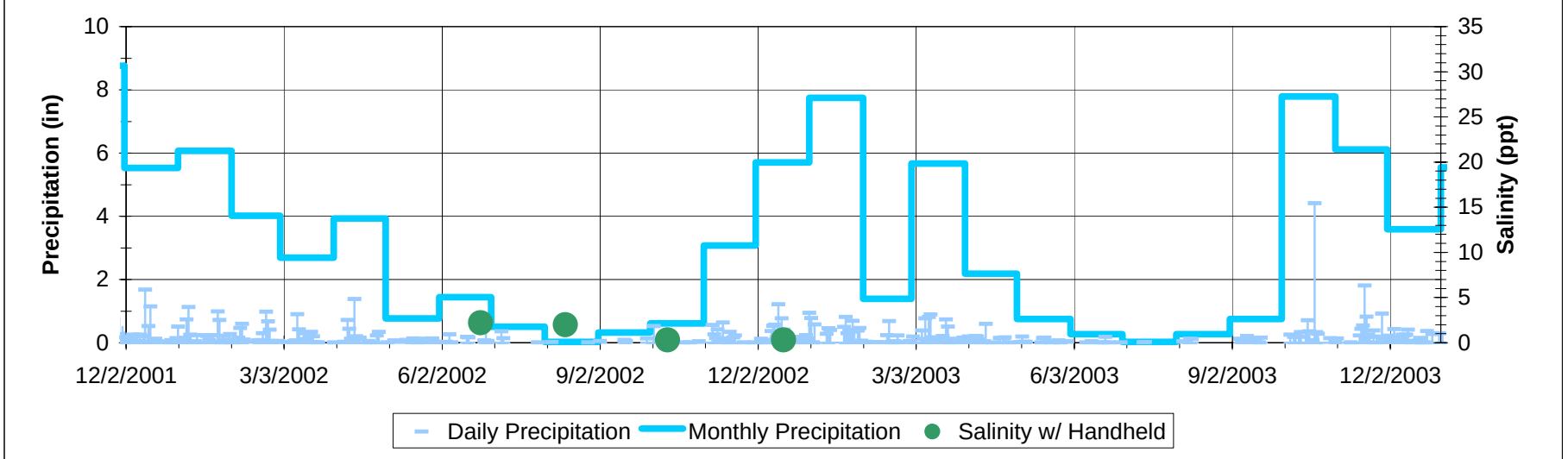

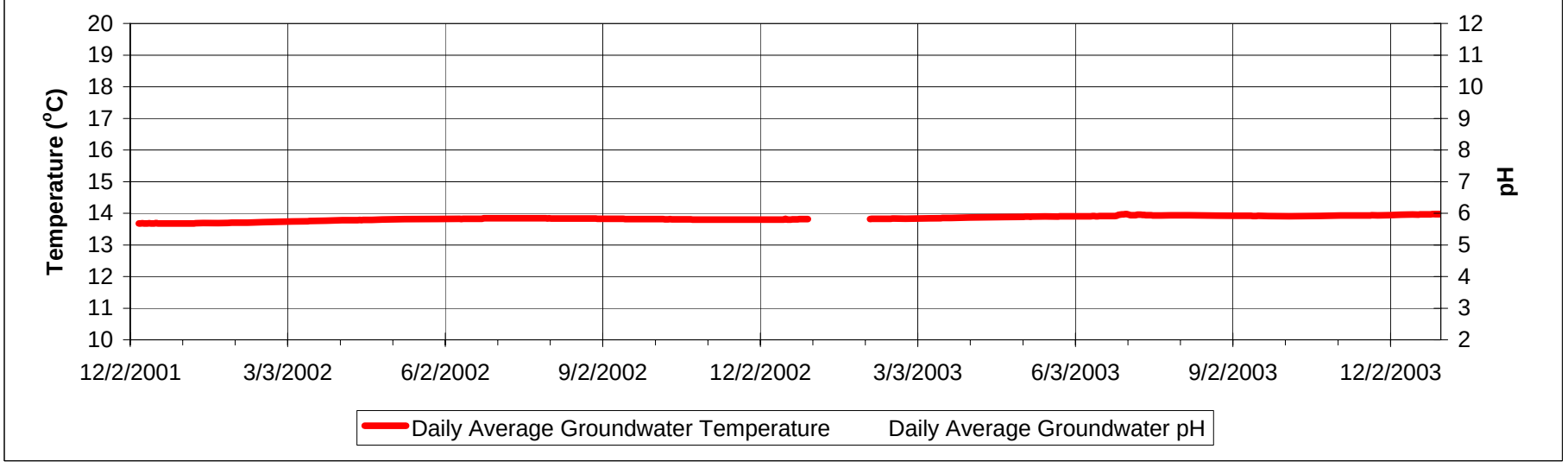

Groundwater Levels, Water Quality Parameters, and Tidal Data
Estuarine Aquifer Well CMP-7
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-17

AGENCY REVIEW DRAFT

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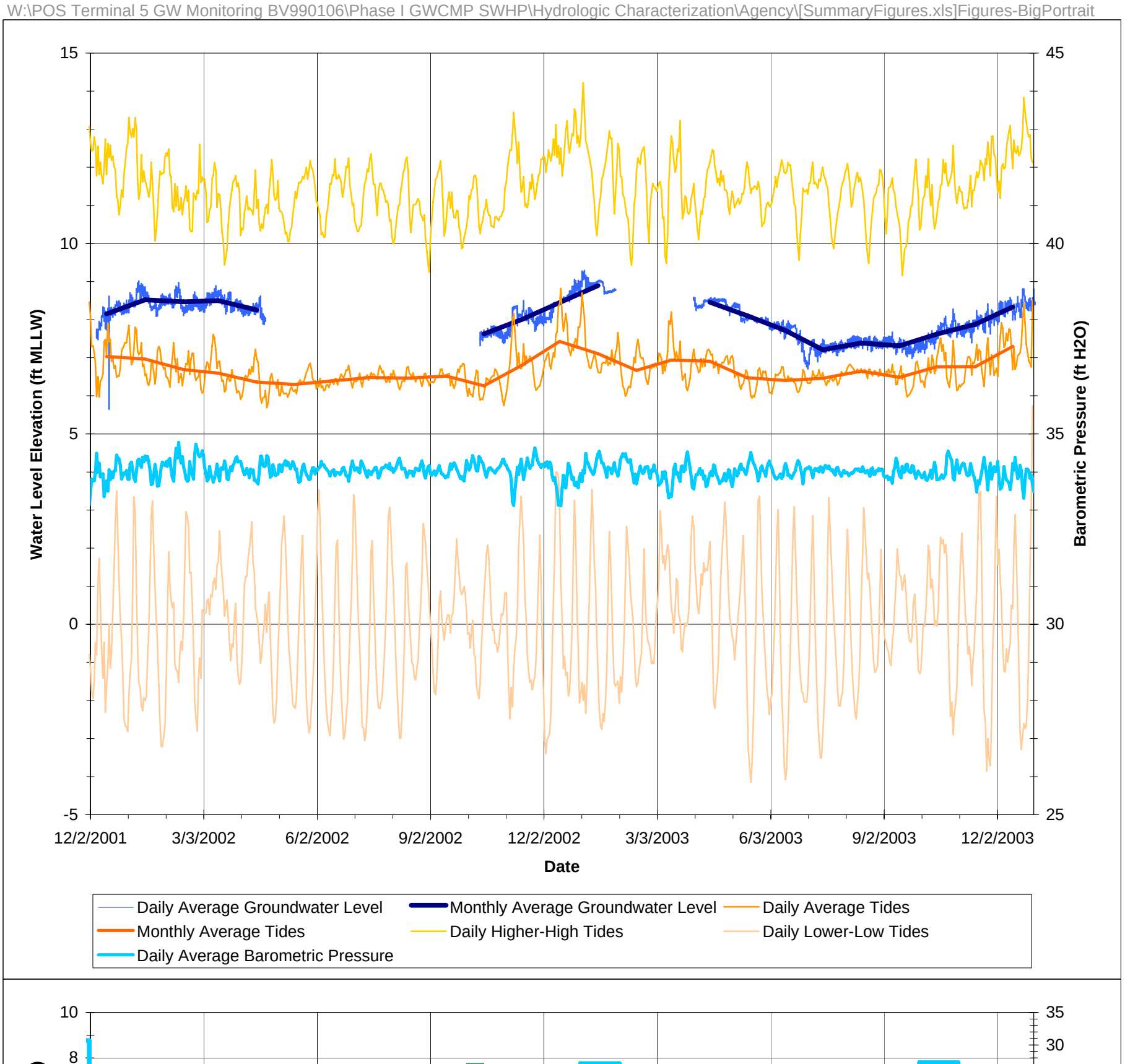
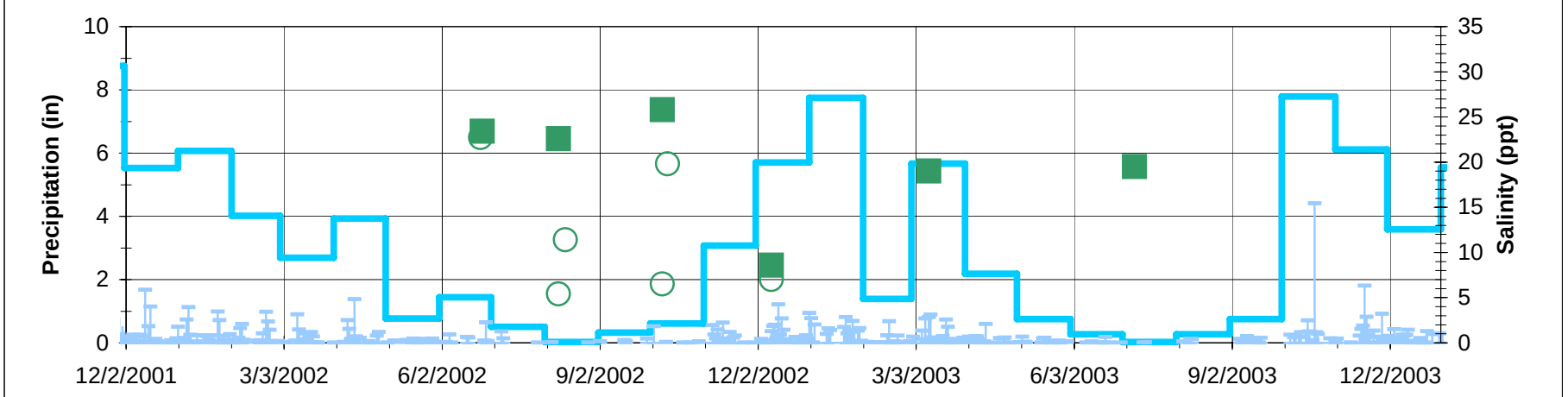
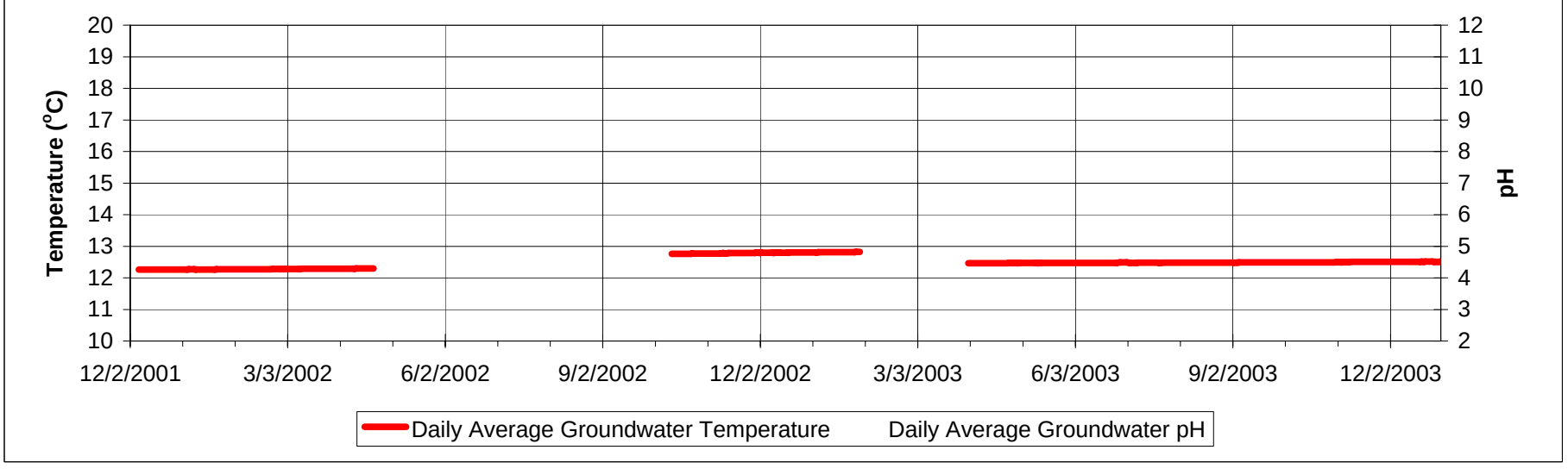


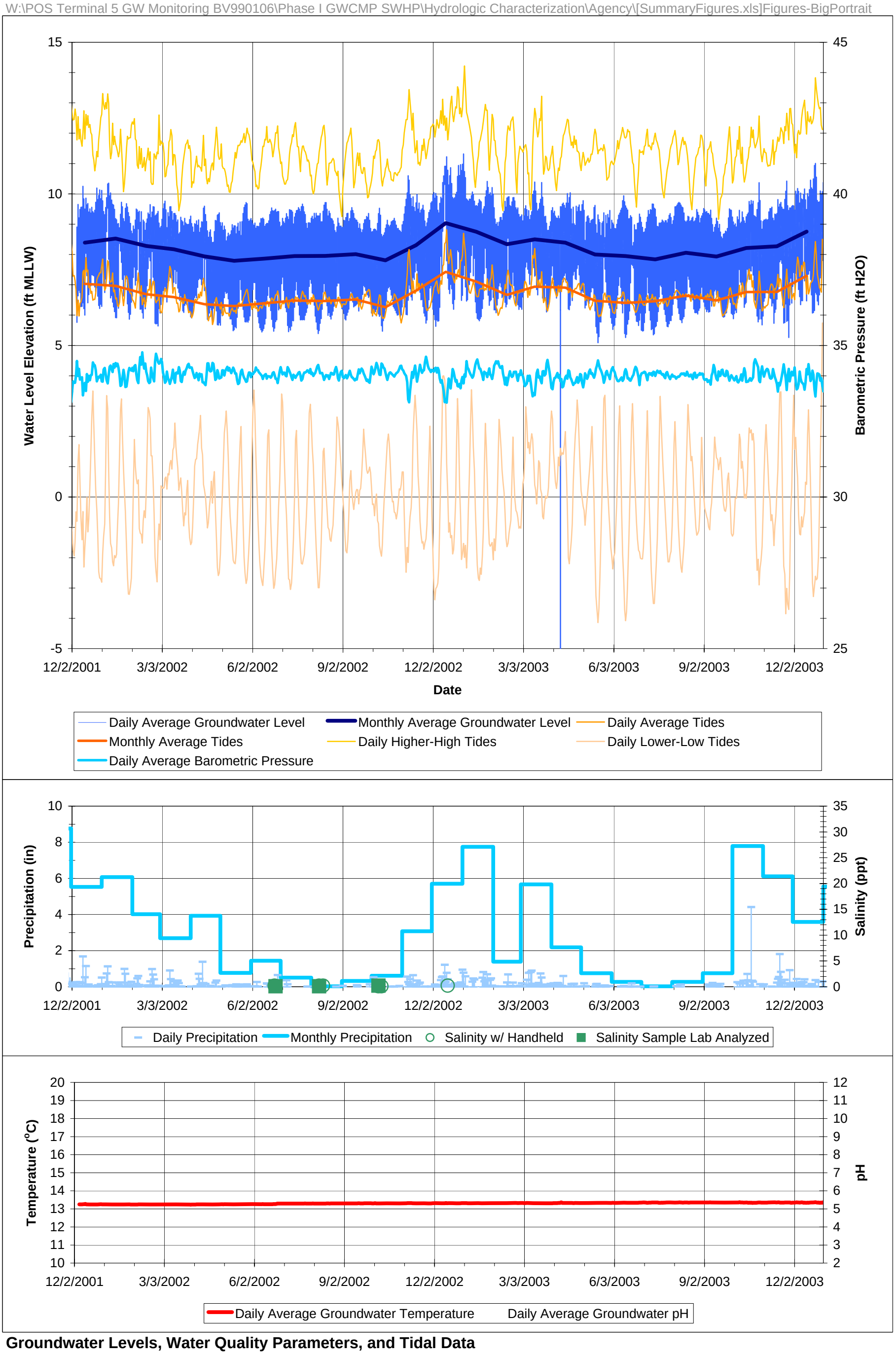




Groundwater Levels, Water Quality Parameters, and Tidal Data
Estuarine Aquifer Well MW-36
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-18

AGENCY REVIEW DRAFT

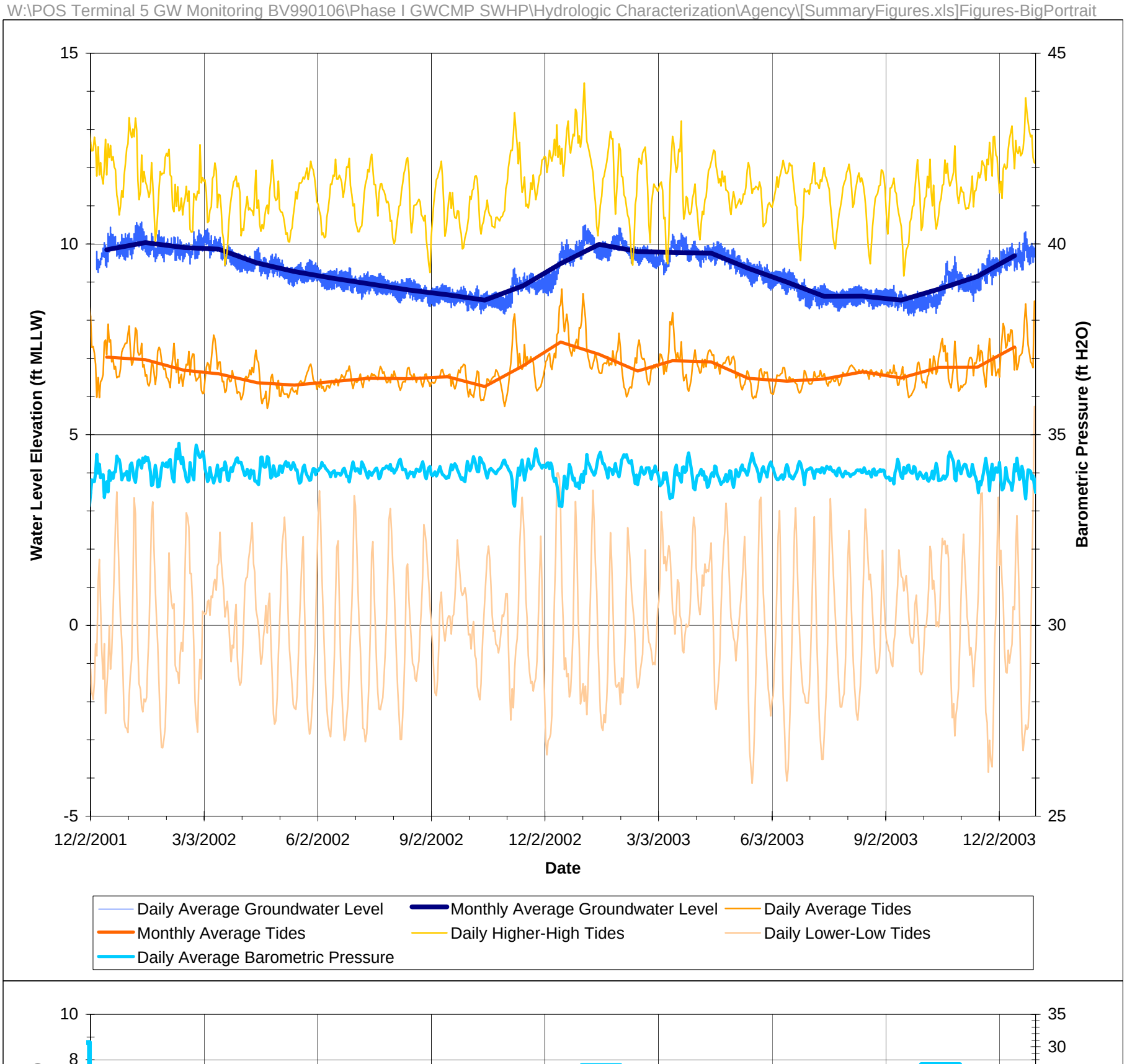


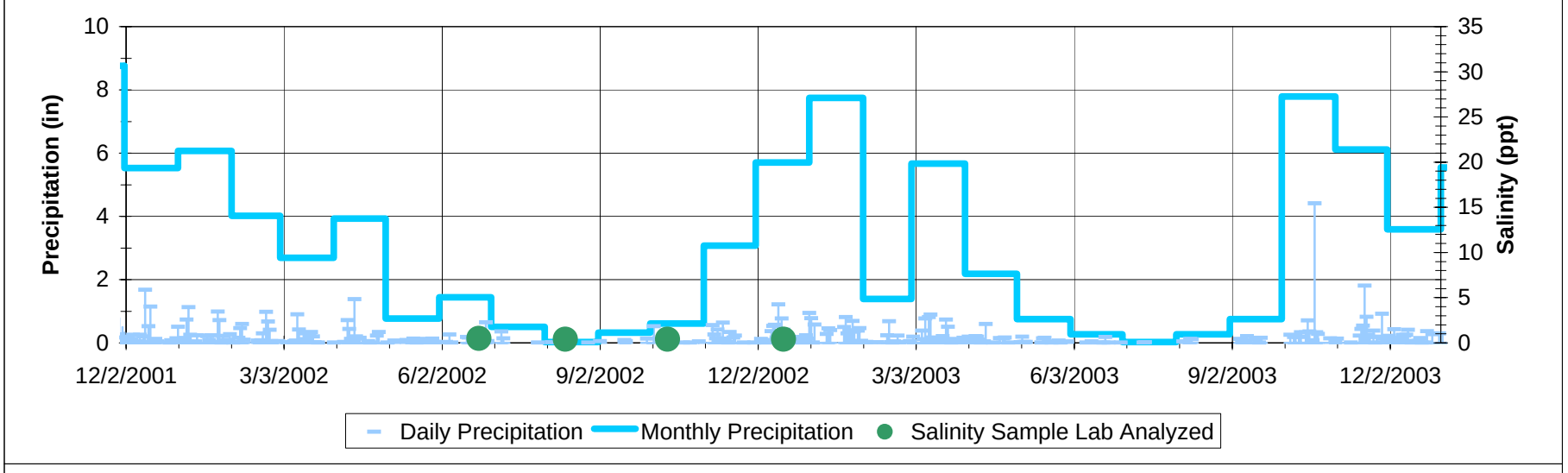
Groundwater Levels, Water Quality Parameters, and Tidal Data
Estuarine Aquifer Well MW-44
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

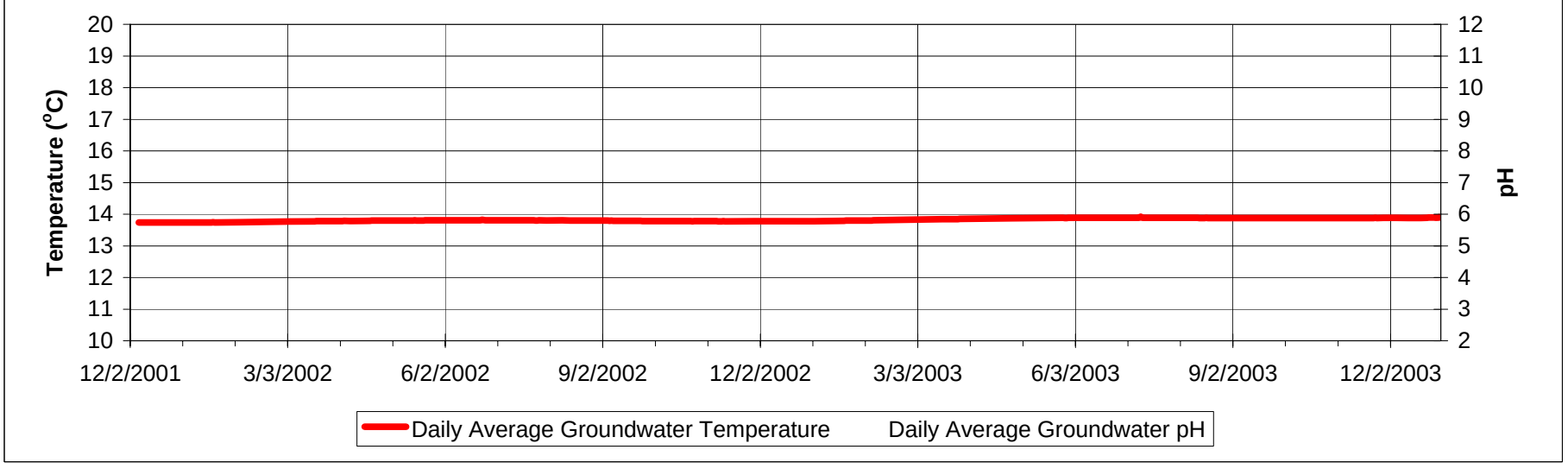
Aspect consulting
IN-DEPTH PERSPECTIVE

Figure F-19

AGENCY REVIEW DRAFT



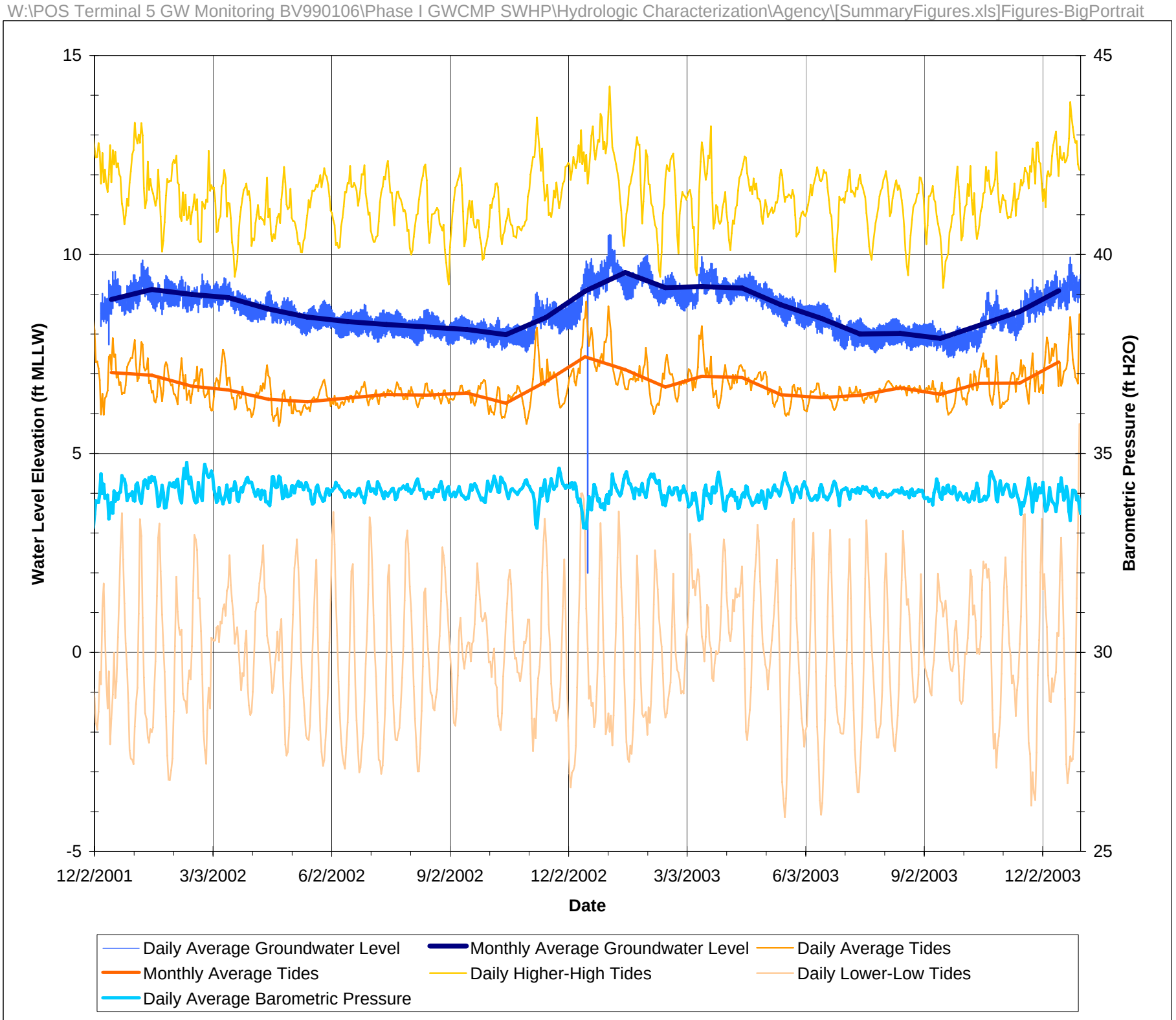


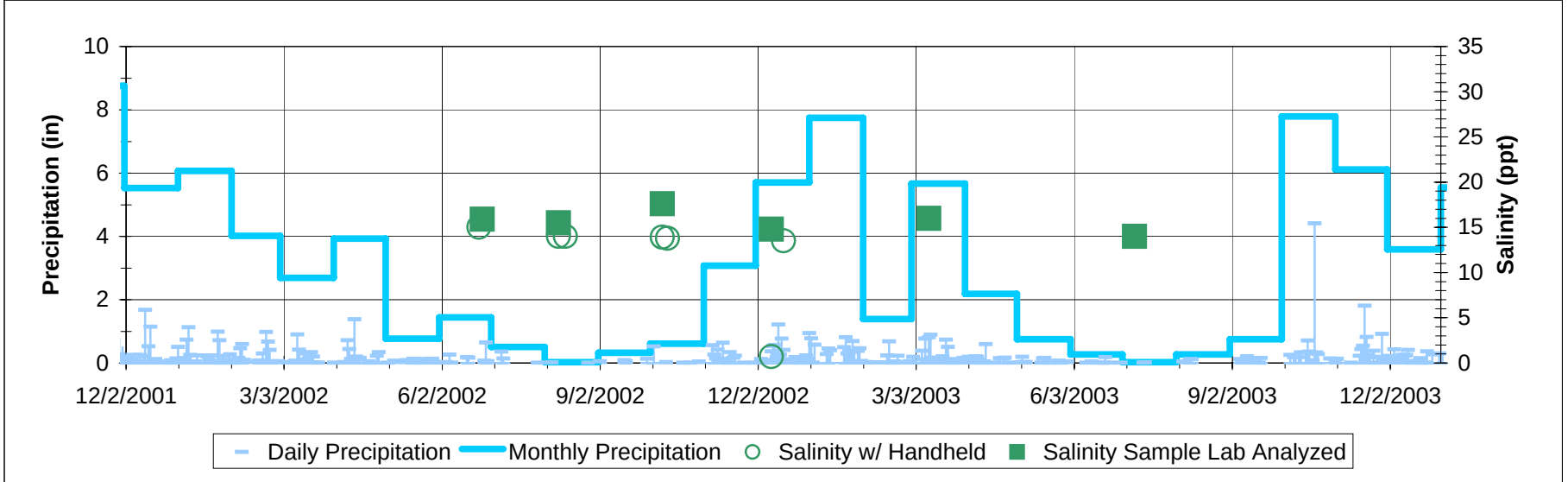


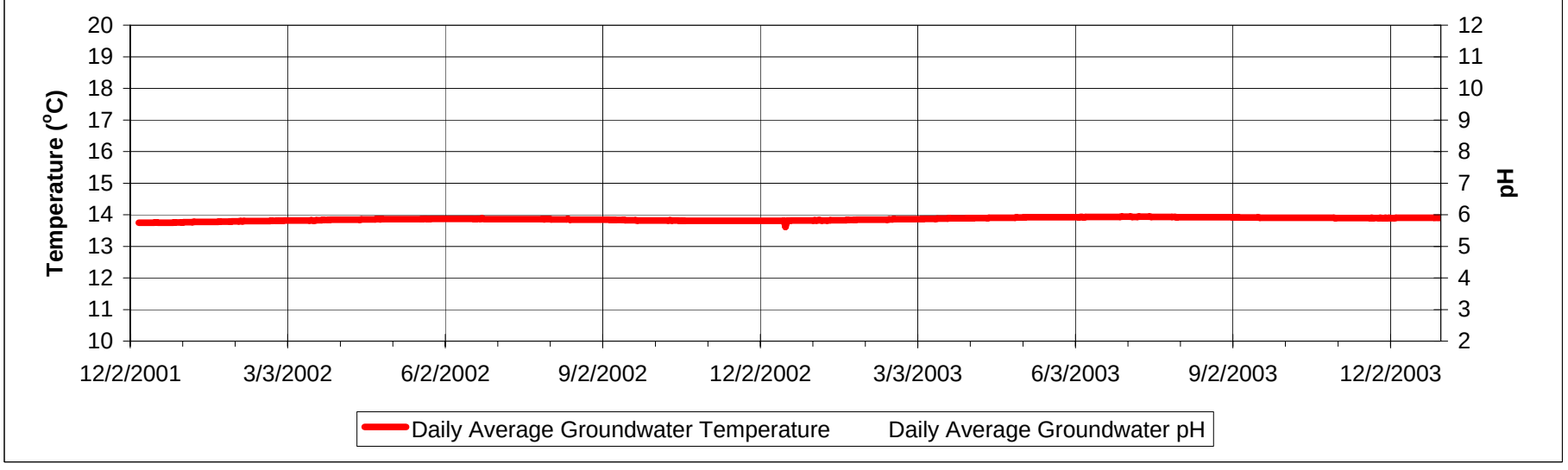
Groundwater Levels, Water Quality Parameters, and Tidal Data
Estuarine Aquifer Well MW-307BR
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-20

AGENCY REVIEW DRAFT



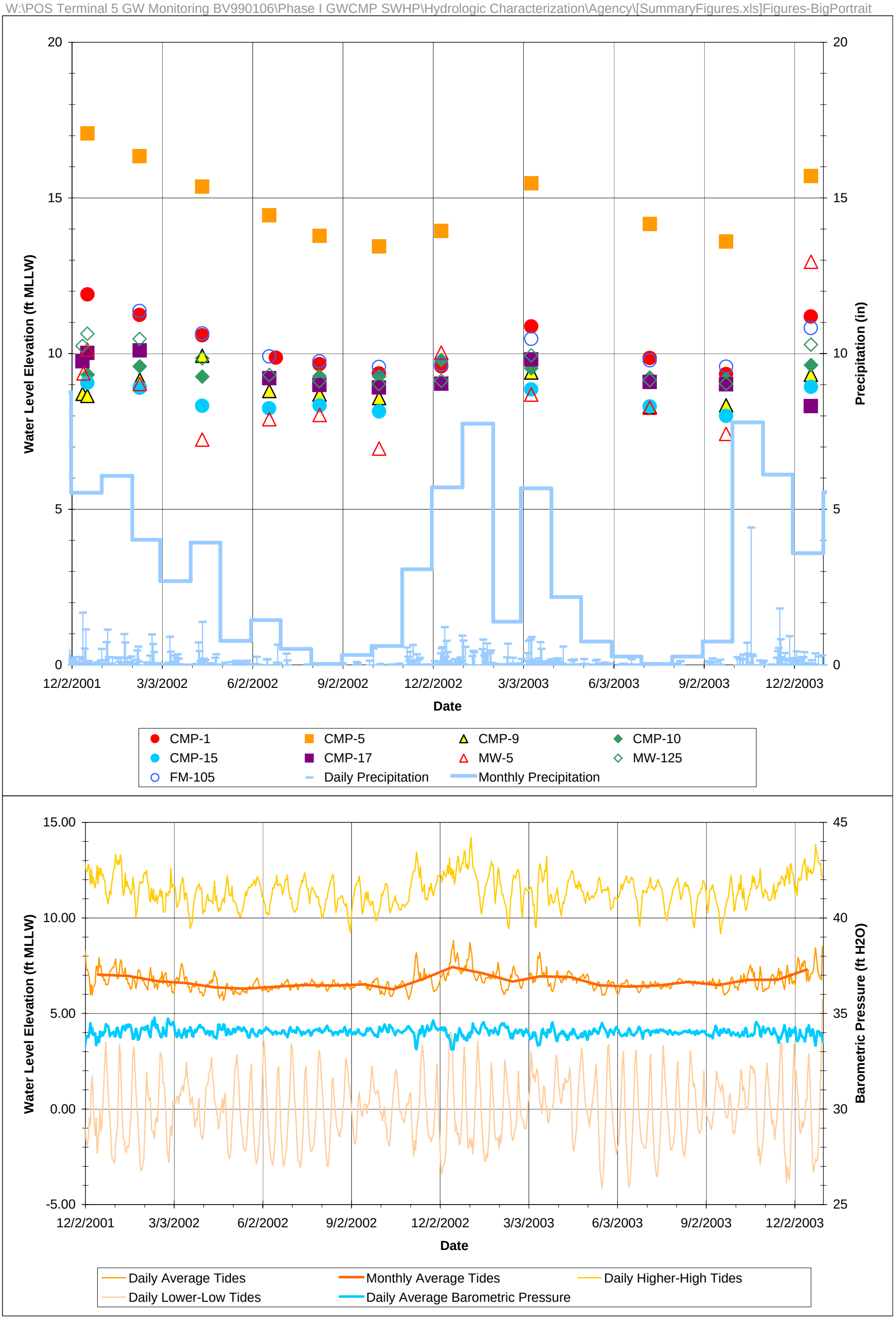




Groundwater Levels, Water Quality Parameters, and Tidal Data
Estuarine Aquifer Well MW-308S
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-21

AGENCY REVIEW DRAFT



Groundwater Levels and Tidal Data
Manual Measurements
SWHP Phase I Groundwater Confimation Monitoring Program
Hydrologic Characterization Report

Figure F-22

AGENCY REVIEW DRAFT

APPENDIX A.5

TERMINAL 5 STORM DRAIN SYSTEM HISTORY AND EXISTING CONDITIONS UPDATE

(on CD)

200 West Mercer St. • Suite 401 • Seattle, WA 98119
Phone: 206.378.1364 • Fax: 206.217.0089 • www.windwardenv.com

MEMORANDUM

To: Ms. Kathy Bahnick
Port of Seattle

From: Warren Hansen
Windward Environmental LLC

Subject: Terminal 5 – Former Lockheed Yard II (Remediation Area 5)
Storm Drain System History and Existing Conditions Update

Date: August 10, 2006

Terminal 5 – Former Lockheed Yard II (Remediation Area 5) Storm Drain System History

In response to the Port of Seattle's inquiry, I have examined the Terminal 5 Southwest Harbor Project documents and archives regarding information pertinent to the demolition, cleaning, removal, or replacement of storm drains at the Former Lockheed Yard II site in West Seattle (Terminal 5 Expansion Area). Port of Seattle drawings were also examined to identify the current surface water drainage system in the area. A site visit was also conducted on August 8, 2006 to verify existing drainage connections. The following observations are provided to help the Port in evaluating the general drainage conditions in the area.

HISTORY

According to the available information, many of the old shipyard-era storm drains were removed ("demoed") or plugged in accordance with the CP#14 project plans.[1] Drawing 5-9603-C-10 of the Southwest Harbor Project Terminal 5 Expansion Lockheed Redevelopment (CP#14) entitled Storm Drainage/Environmental Remediation Plan (included in Exhibit A) shows the former yard drains designated for removal or

[1] CP#14: Option Area. Notice-to-proceed date: September 1997. Contractor: M.A. Segale, Inc. Original Scope: Demolish foundations and existing utilities, install new drainage and utilities, grading and paving of approximately 24.5 acres and installation of container yard lighting.

plugging. Pipes to be removed are shown in heavy (bold) solid lines. Details provided on the accompanying drawing 5-9603-C-11 (Storm Drainage/Environmental Remediation Details, also in Exhibit A) indicate how certain catch basins and drain lines were to be abandoned by filling and plugging.

Note that the storm drain lines at the north side of the facility were plugged at a point some distance inboard of the shoreline, immediately downstream of the last catch basin. Structures called out on the drawing to be maintained and protected were preserved because they drain the Terminal 5 yard located immediately to the south.

Further documentation on the performance of work is contained in the letter from Andrew Gates (Retec, Inc.) to Bruce McDonald of Hartman Consulting on October 21, 1998. This letter and attachments are included as Exhibit B. The attachments include a letter from William Whitfield of M.A. Segale, Inc., dated October 13, 1998, in which he states, "I certify that all materials identified on CP#14 contract drawing # 5-9603-C-10 have been removed, capped, or abandoned in place per the notes on the drawing." A partial copy of the marked-up drawing attached to the letter indicates that the work occurred during or around the last three months of 1997.

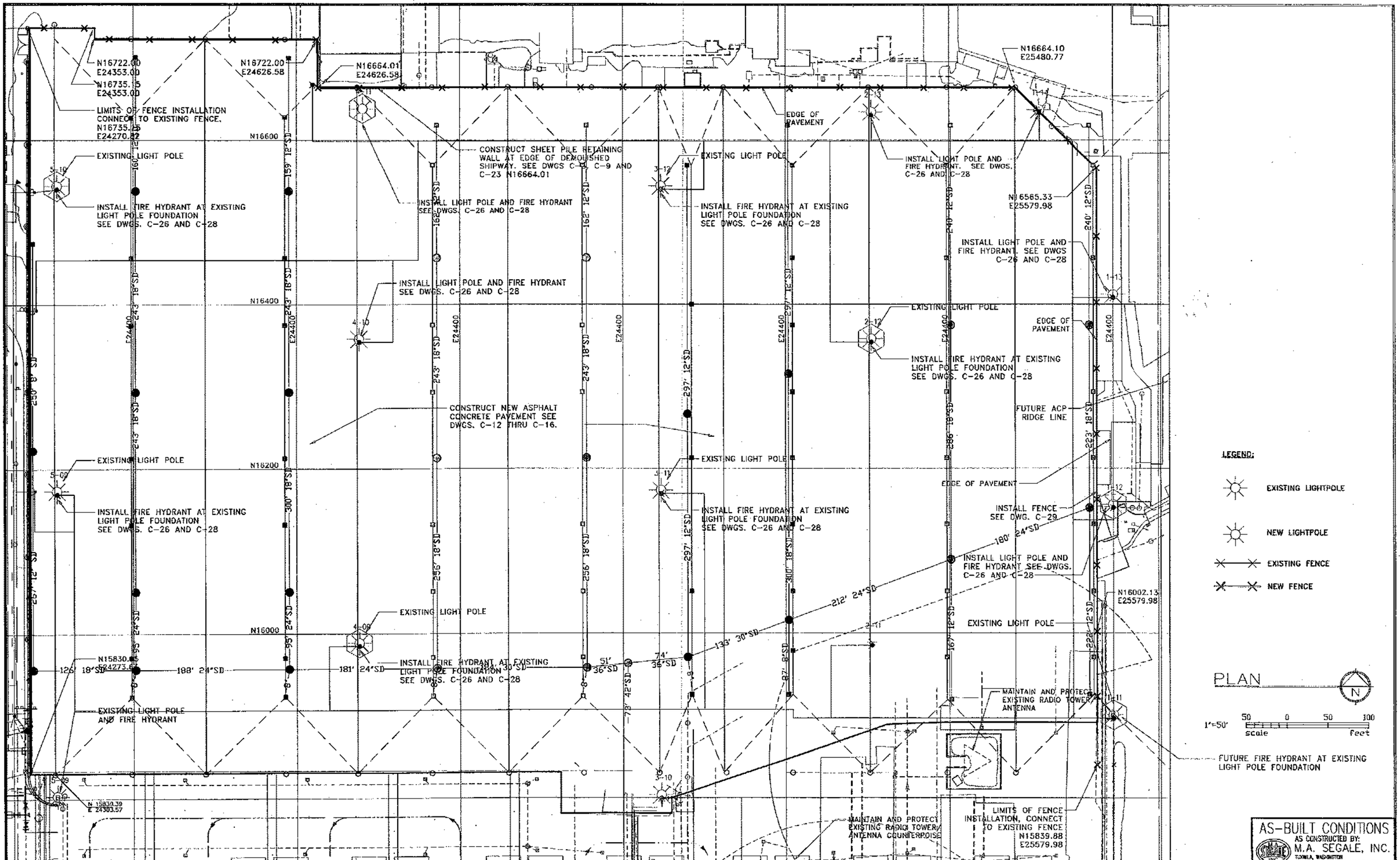
CURRENT DRAINAGE PICTURE

The current stormwater drainage system is documented in Port of Seattle drawing 5-9603-C-7 entitled Site Plan – Final Conditions (also included in Exhibit A). Rows of inter-connected catch basins running north and south at regular intervals across the site receive runoff from the asphalt-paved surface. Several of these catch basins were recently opened and observed to be equipped with down-turned (submerged) outlets. Culverts serving these catch basins discharge to the south side of the property to interceptors that flow to centrally located Manhole MH-9. Manhole MH-9 discharges 73 ft south to a manhole connected to the Florida Street drain (discharging to the Duwamish West Waterway at the Terminal 5 shoreline). This was verified in the field by opening the manhole and observing the connecting pipes. Connection to the Florida Street outfall was verified using auditory signals.

EXHIBITS

A. Drawings from Port of Seattle Marine Facilities, Southwest Harbor Project, Terminal 5 Expansion, Lockheed Redevelopment (CP#14). Drawings 5-9603-C-7, C-10, and C-11.

B. Lockheed Storm Drain Cleanout Documentation. October 21, 1998, letter (and attachments) from A. Gates, Retec, Inc., to B. McDonald, Hartman Consulting.



CALL 48 HOURS BEFORE YOU DIG
1-800-424-5555

PROJECT ENGR/ARCH
DESIGNED:
DRAWN BY:
SCALE:
DATE:
CHECKED BY:

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

DAKOTA CHAMBERLAIN
STATE OF WASHINGTON
30940
REGISTERED PROFESSIONAL ENGINEER
EXPIRES OCT 25, 1998

PORT OF SEATTLE

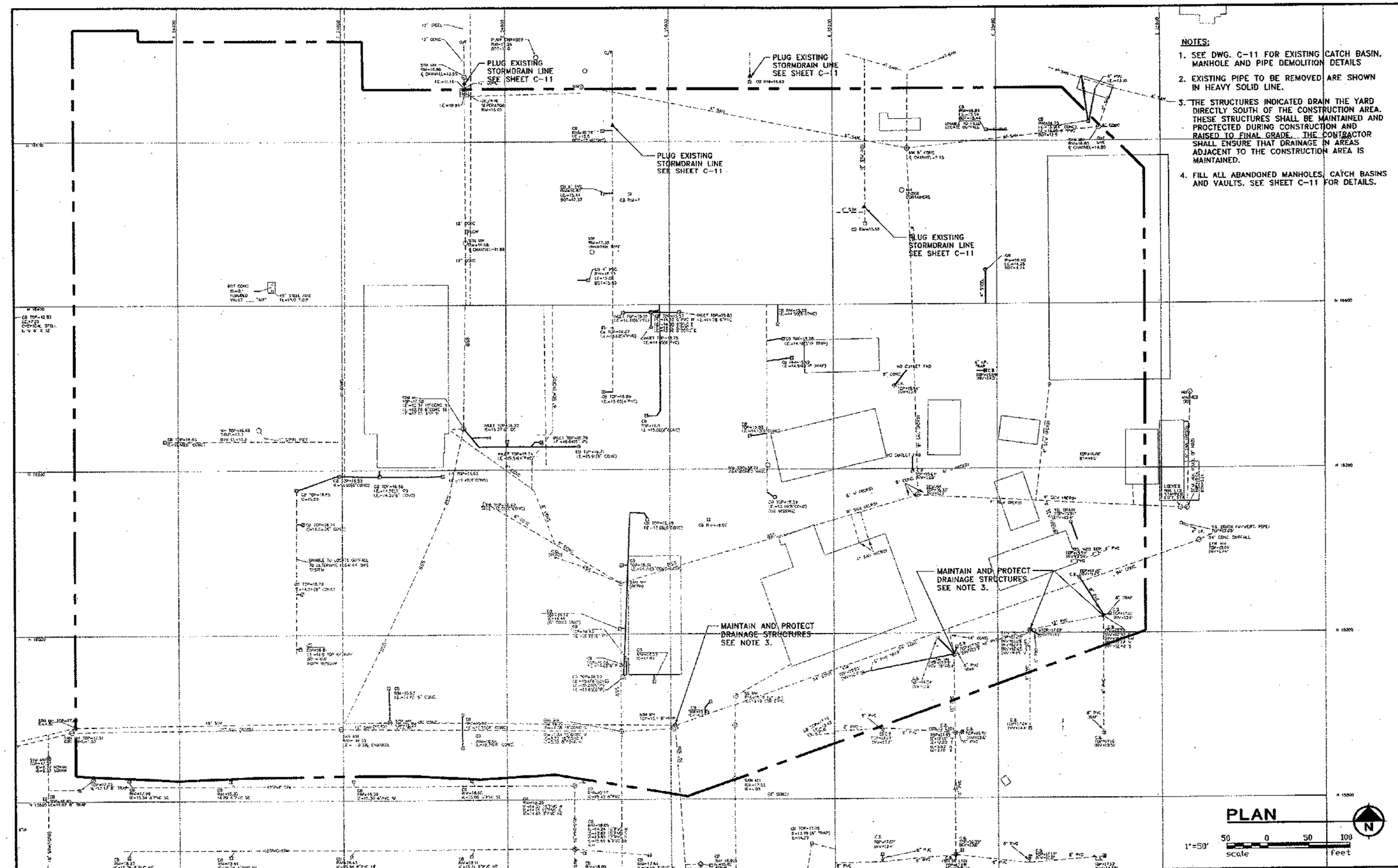
PROJECT ENGINEER: DAKOTA CHAMBERLAIN
SCALE: 1" = 50'
DESIGNED: DAKOTA CHAMBERLAIN
DATE: 12-18-96
DRAWN BY: MIKE CORPUZ
CHECKED BY: DOT
APPROVED BY:

MARINE FACILITIES
SOUTHWEST HARBOR PROJECT
TERMINAL 5 EXPANSION
LOCKHEED REDEVELOPMENT (CP-14)

SITE PLAN
FINAL CONDITIONS

WORK ORDER NO. D-4770
CONSULTANT'S NO.
PORT OF SEATTLE NO. 5-9603-C-7

Time: Tue Mar 18 1997 10:20am Filename: I:\75\1996\D-4770\C007.DWG Scale Factor: 1 Plotted by: Dakota



NOTES:

1. SEE DWG. C-11 FOR EXISTING CATCH BASIN, MANHOLE AND PIPE DEMOLITION DETAILS
2. EXISTING PIPE TO BE REMOVED ARE SHOWN IN HEAVY SOLID LINE.
3. THE STRUCTURES INDICATED DRAIN THE YARD DIRECTLY SOUTH OF THE CONSTRUCTION AREA. THESE STRUCTURES SHALL BE MAINTAINED AND PROCTECTED DURING CONSTRUCTION AND RAISED TO FINAL GRADE. THE CONTRACTOR SHALL ENSURE THAT DRAINAGE IN AREAS ADJACENT TO THE CONSTRUCTION AREA IS MAINTAINED.
4. FILL ALL ABANDONED MANHOLES, CATCH BASINS AND VAULTS. SEE SHEET C-11 FOR DETAILS.

CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555

PROJECT ENGR./ARCH
DESIGNER:
DRAWN BY:
SCALE:
DATE:
CHECKED BY:

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

DAKOTA CHAMBERLAIN 38060 REGISTERED PROFESSIONAL ENGINEER
EXPIRES OCT 25, 1998

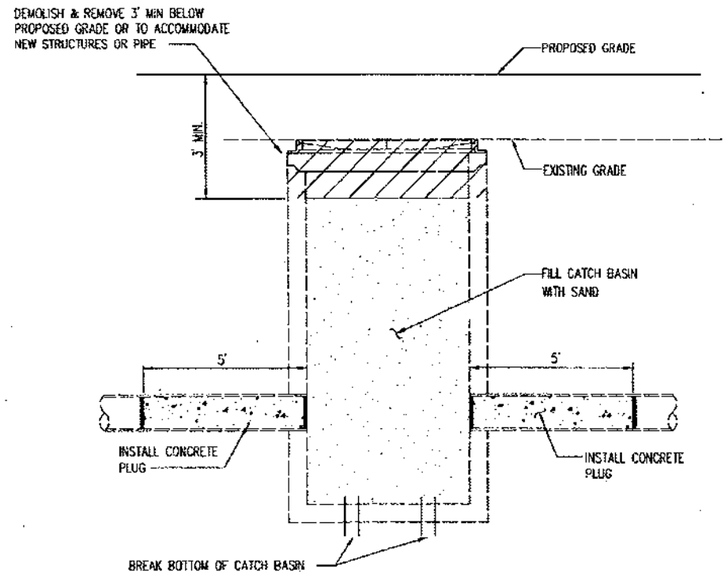
PORT OF SEATTLE

PROJECT ENGINEER: DAKOTA CHAMBERLAIN
SCALE: 1" = 50'
DESIGNER: TICSON MACH
DATE: 3/21/97
DRAWN BY: MICHAEL A. CORPUZ
CHECKED BY:
APPROVED BY:

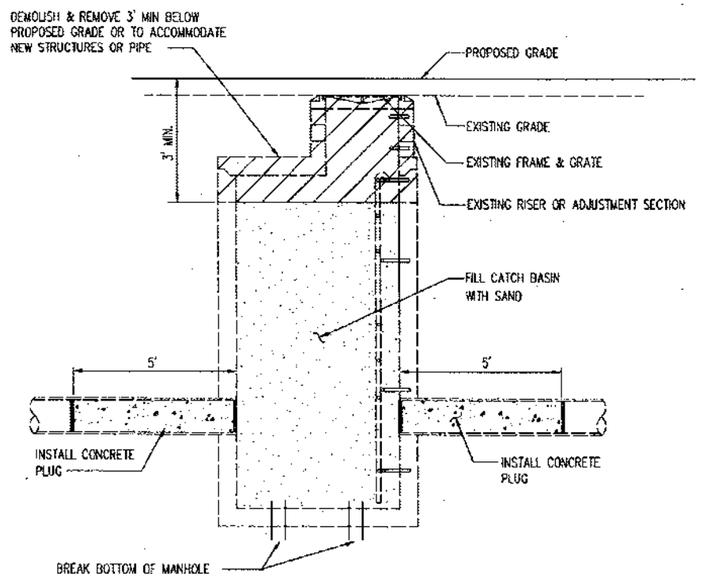
MARINE FACILITIES
SOUTHWEST HARBOR PROJECT
TERMINAL 5 EXPANSION
LOCKHEED REDEVELOPMENT (CP-14)
STORM DRAINAGE/ENVIRONMENTAL REMEDIATION PLAN

WORK ORDER NO. D-4770
CONSULTANT'S NO.
PORT OF SEATTLE NO. S-9603-C-10

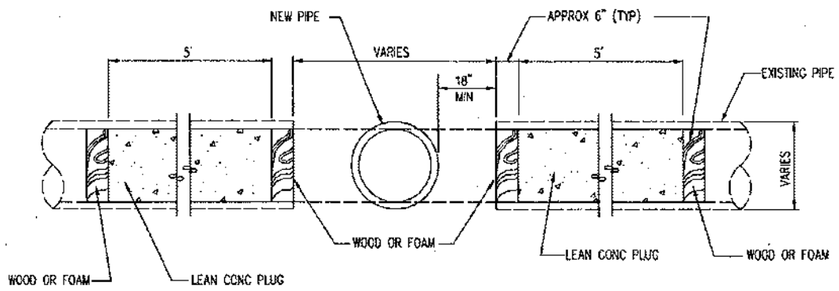
Time: Mon Dec 16 1996 9:39am Filename: I:\75\1996\D-4770\C010.DWG Scale Factor: 1 Plotted by: D. Chamberlain



DETAIL 1 C-10
DEMOLITION OF EXISTING CATCH BASIN
NO SCALE



DETAIL 2 C-10
DEMOLITION OF EXISTING MANHOLE
NO SCALE



DETAIL 3 C-10
CUT & PLUG OF EXISTING PIPE
NO SCALE

PLAN
1"=50' scale
50 0 50 100 feet
N

CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555

PROJECT ENGR./ARCH
DESIGNED BY:
DRAWN BY:
SCALE:
DATE:
CHECKED BY:

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

DAKOTA CHAMBERLAIN — STATE OF WASHINGTON — 20990 — REGISTERED PROFESSIONAL ENGINEER
EXPIRES: OCT 25, 1998

PROJECT ENGINEER: DAKOTA CHAMBERLAIN	SCALE: AS NOTED
DESIGNED: TICSON MACH	DATE: 3/21/97
DRAWN BY: MICHAEL A. CORPUZ	CHECKED BY:
APPROVED BY:	

PORT OF SEATTLE

MARINE FACILITIES
SOUTHWEST HARBOR PROJECT
TERMINAL 5 EXPANSION
LOCKHEED REDEVELOPMENT (CP-14)
STORM DRAINAGE/ENVIRONMENTAL REMEDIATION DETAILS

WORK ORDER NO.	D-4770
CONSULTANT'S NO.	
PORT OF SEATTLE NO.	5-9603-C-11

Plot time: Tue Mar 18 1997 10:25am Filename: I:\Y5\1996\C-4770\C011.DWG Scale Factor: 1 Plotted by: Dakota

REIEC

1011 S. W. Klickitat Way
Suite 207
Seattle, WA 98134-1162
(206) 624-9349
FAX (206) 624-2839

October 21, 1998

Mr. Bruce McDonald
Hartman Consulting
10900 NE 8th
Suite 1300
Bellevue, WA 98004

RE: Lockheed Storm Drain Cleanout Documentation

Dear Mr. McDonald:

Attached please find documentation provided by M.A. Segale, Inc. (Segale) for the removal of contaminated material from the storm drain system on the Lockheed property on Terminal 5. In addition to the figure and letter provided, I have attached the Contractor's field notes describing the removal and disposal work performed on the dates indicated. If you have any questions or need additional information from Segale, you should contact Bill Whitfield at (206) 938-3672.

Also attached to this letter is a copy of the original Storm Drainage / Environmental Remediation Plan, a copy of a figure marked up by field inspector Alan Hale of AAR Testing Laboratories, and copies of field inspector Bill Pittwood's field notes that describe the removal work. If you have any questions or need additional information, contact Alan at (425) 881-5812 or page Bill at (206) 994-4457.

Sincerely,

Andrew R. Gates
SWHP Assistant Construction Manager

attachments

cc: W. Hansen - OnSite Enterprises

M.A. SEGALE, INC.
GENERAL CONTRACTORS
An Oldcastle Company

October 13,1998

Mr. George England
Port of Seattle
P. O. Box 1209
Seattle, WA 98111

Reference: Terminal 5 Expansion CP6 (CP-14)
Contract No. EMC 960003/ D-4401

Subject: Documentation of Contaminated Material Handling

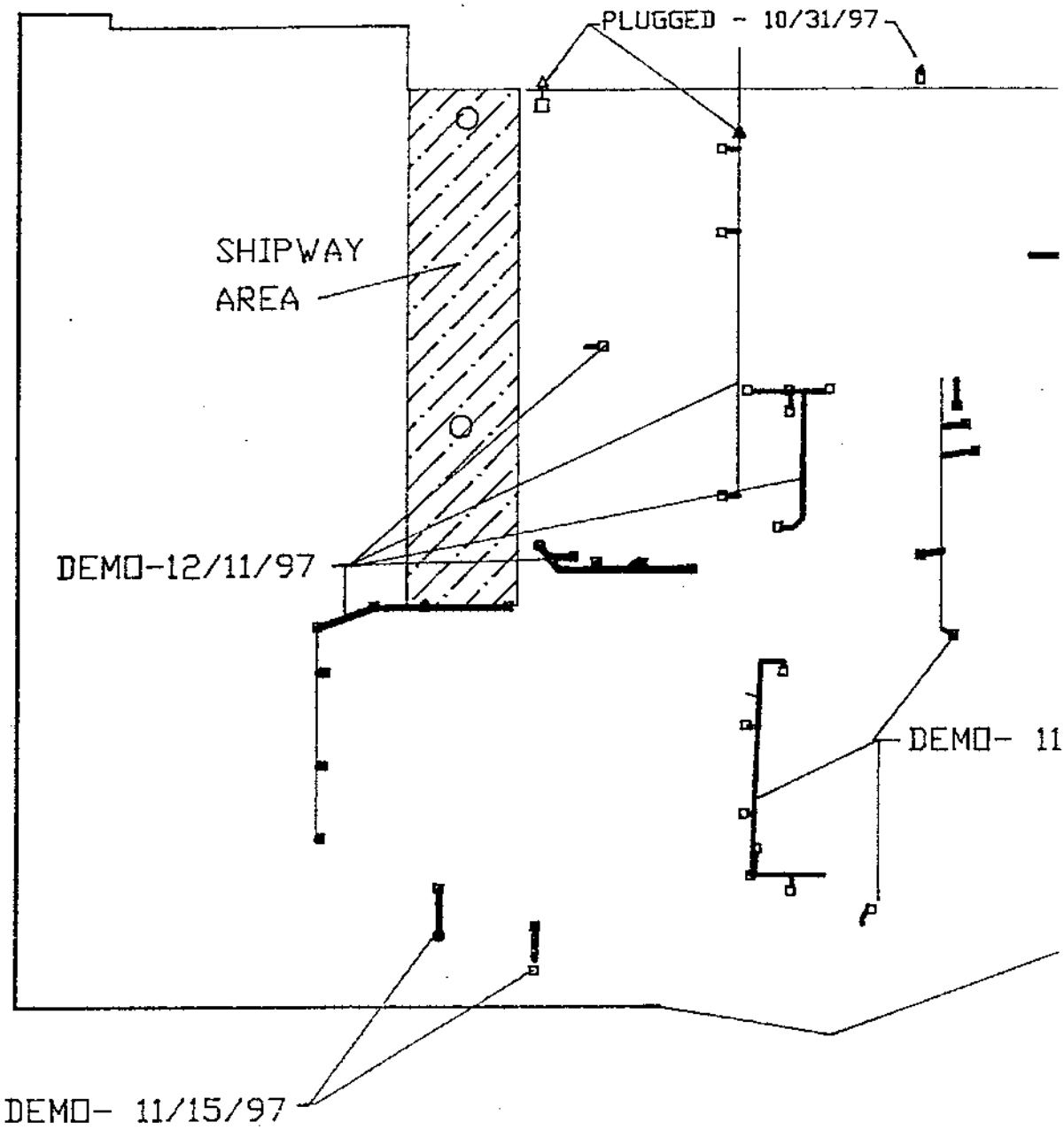
Dear George,

This letter serves as the required documentation of the contaminated material handling for the CP-14 Option Area. I certify that all materials identified on CP-14 contract drawing # 5-9603-C-10 have been removed, capped, or abandoned in place per the notes on the drawing. The attached sketch identifies the dates of the work performance. All storm drain pipe that was removed was properly disposed of as directed by the Port of Seattle in the RA-3 landfill cell and is located near the north slope of the cell. The landfill cell was completed, and the geomembrane cap was installed following the disposal of these materials.

Please feel free to contact me should you have any questions or need additional information.

Sincerely,

William P. Whitfield
M.A. Segale, Inc. CQCR



CP-14 STORM I

AS-BUILT CONDITIONS

GOLDER CONSTRUCTION
SERVICES, INC.
4104 148th Avenue NE
Redmond, Washington 98052

To: M.A. Segale

On Site : 07:00

Off Site: 17:00

DATE	PROJECT NUMBER
21 Oct 97	967-3043.200
PROJECT: M.A. Segale/Terminal 5 CP6	
LOCATION: SW Harbor, Terminal 5 Seattle, WA	
CONTRACTORS: M.A. Segale	OWNER: Port of Seattle
WEATHER: AM fog, PM clearing	TEMPERATURE: 45° 07:00 / 52° at 14:00
PRESENT AT SITE: Michael Lumpkin, David O'Malley - GCS	
GCS subcontractors listed below	

I. Construction Activities Observed

A. Segale continued grading and compacting landfill subgrade at the northwestern quadrant of the landfill. Also placed and graded up to 1½ ft. of crushed asphalt on subgrade to establish subgrade elevation at the southern portion of this area. Subgrade preparation progressed northward from work performed on Saturday. Segale also placed spoils excavated from the northern end of the geomembrane anchor trench (CP.-10) at the subgrade fill area at the northeastern quadrant of the landfill. This fill contained an high landfill rubbish content.

B. Segale completed constructing the haul road along the eastern side of the landfill from the northern end of the liner (currently installed) to the southern end of the landfill. Crushed rock base was placed and compacted on imported sand.

C. Segale continued placing and compacting imported sand along the upper portion of the western landfill slope above the anchor trench bench.

D. NW Linings was not on site today.

M&R Bldg. (5M1)

E. Skyline Steel continued welding of decking on the upper floors of the tower between Line 10 and 12 from Grid K to Q.

F. Austin and Skyline Steel performed final preparation to pour the second deck at the center of the building.

G. Installation of interior fire system piping and electrical continued.

H. Segale began grading and compacting subgrade to the west of the southern end of the western wall between the building and existing asphalt approximately 40 ft. to the west from Line K to 40 ft. south of Grid A.

RA-5 Lockheed Area

J. Kohl completed installation of manhole MH-1 and installation of 24 in. SD into the manhole from the east at the western end of the southern side of the RA-5 (southwestern corner of RA-5). Began excavation and installation of 18 in. SD to the west of the manhole. The trench was partially backfilled with excavated sandy backfill.

K. Kohl extended two CB laterals from new CB's to existing CB's south of manholes MH-7 and MH-8 at the eastern side of the southern edge of RA-5.

I. Construction Activities Observed

L. Kohl continued excavation and installation of 8 in. DI water main extensions from the new water main along the southern edge of RA-5 to two light poles at the south end of the site.

M. Rhine has continued to demolish the concrete at the northern end of the ship ways at the north side of the area.

N. Kohl began excavating and removing existing storm drain piping from the eastern end of RA-5.

II. Monitoring and Testing Activities

A. The on-site QC staff included:

• Michael Lumpkin	Golder	Lead
• David O'Malley	Golder	Soil Technician

B. Observed backfilling and compaction and performed nuclear density compaction testing at the following locations:

- Overliner sand placed at the RA-3 landfill
- 24 in. SD trench backfill in RA-5
- 8 in. water main extension in RA-5

Compaction testing of the landfill underliner sand is being performed with the understanding that, due to subgrade conditions, 95% compaction may not be achievable even after considerable compactive effort.

C. Received and distributed 60 mil HDPE liner destructive test samples DS-55, DS-56 and DS-57.

D. Performed air monitoring for methane at the northern edge of new HDPE liner installed on the landfill. Periodic elevated measurements for methane (up to 26 % LEL) were observed. The contractor was informed.

E. Performed air monitoring of storm drain excavation in the central portion of the eastern RA-5 using an OVM 580A. No elevated readings were observed. Air monitoring was performed because of a hydrocarbon like odor of the appearance of the soils in the excavation.

COPIES TO: File

FIELD REPORT

SIGNED Michael Lumpkin

Michael Lumpkin - G&S Lead

GOLDER CONSTRUCTION
SERVICES, INC.
4104 - 148th Avenue NE
Redmond, Washington 98052

DATE	PROJECT NUMBER
October 21, 1997	967-3043
PROJECT: MA Segale/Terminal 5 Expansion - CP6/WA	
LOCATION: SW Harbor, Seattle, WA	
CONTRACTORS: Kohl, Segale, Zuluaga	OWNER: Port of Seattle
WEATHER: Foggy (am)-Partly Sunny/Windy	TEMPERATURE: 44° (07:30) - 50° (15:30)
PRESENT AT SITE: Kohl, Segale	SITE CONDITIONS: Drying Out
GCS - D. O'Malley, M. Lumpkin	

To: MA Segale

ON SITE: 07:15
OFF SITE: 17:30

THE FOLLOWING WAS NOTED:

Summary of Construction Activities and Testing:

RA3 Area: - Segale placed and roller compacted over liner sand (approximately 12 inches thick) along the east side of the landfill, in an approximately 35 foot wide strip, from their previous stop point to the south end of the landfill. Performed (3) nuclear density tests (1 was a re-test) on the sand - the test locations met the compaction requirement. Segale placed and roller compacted crushed rock base course material (approximately 6 inches thick) over the sand. Segale also placed and graded under liner sand along the west crest of the landfill and down onto the anchor trench bench.

- Segale completed excavating for a liner anchor trench along the west side of the landfill. The trench was backfilled with imported sand. The excavated material was placed as fill (in an approximately 3 foot thick lift) in the northern/eastern part of the landfill, north of approximately 1350 feet north of the south end of the "E" wall. Segale continued to work late on the landfill.

RA5 Area: - Kohl installed 24 inch diameter concrete storm drain piping from their previous stop point to Manhole MH-1, excavated and placed MH-1, and installed 18 inch diameter concrete storm drain piping west of MH-1 to approximately 35 feet west of the manhole. The piping was backfilled (no backfill was placed for MH-1) with the excavated materials placed in 1 to 1.5 foot thick lifts and compacted using an excavator hoe-pack. The backfill materials consisted of brown to gray sand and silty sand with some in-place construction debris. Performed (2) nuclear density tests on the backfill - the test locations were compacted to a minimum of 95 percent of the maximum dry density value for the material.

- Performed (1) nuclear density test on backfill placed for the water line feed line to the hydrant at Light Pole LP 2-11. The test location was compacted to at least 95 percent of the maximum dry density value of the backfill. Additional backfill to be placed.

- Kohl excavated and removed (2) runs of the existing 8 inch diameter PVC storm drain piping in the southeastern part of the RA5 area (at the LP 1-11 and 2-11 locations).

FIELD REPORT

COPIES TO: File

Field Technician

GOLDER CONSTRUCTION
SERVICES, INC.
4104 - 148th Avenue NE
Redmond, Washington 98052

DATE	PROJECT NUMBER
October 21, 1997	967-3043
PROJECT: MA Segale/Terminal 5 Expansion - CP6/WA	
LOCATION: SW Harbor, Seattle, WA	

To: MA Segale

THE FOLLOWING WAS NOTED:

Summary of Construction Activities and Testing (continued):

RA5 Area (continued): - Kohl excavated and placed 8 inch diameter PVC storm drain piping from the catch box at the south end of the run south of MH-8 to an existing catch basin southwest of the catch box. No backfill was placed.

- Kohl excavated and placed 8 inch diameter PVC storm drain piping from the catch box at the south end of the run south of MH-7 to an existing catch basin southeast of the catch box. No backfill was placed.

- Kohl excavated and placed 8 inch diameter ductile iron water line piping from the 8 inch tee placed previously west of Light Pole LP 1-11 to the hydrant tee just west of the light pole, and connected the line to an existing line running south of the hydrant tee. The piping was partially backfilled. Performed (1) nuclear density test on the backfill - the test location was compacted to at least 95 percent of the maximum dry density value for the material.

- Kohl continued installing 8 inch diameter ductile iron water line piping in the northern part of the RA5 area. The piping was placed from their previous stop point west of the 8 inch tee to Light Pole LP 2-12, to approximately 195 feet west of the 8 inch tee to Light Pole LP 3-12. The piping was backfilled with the excavated sandy soils placed in 1.5 to 2 foot thick lifts and compacted using an excavator hoe-pack. The excavated material had a hydrocarbon odor (see air monitoring). Performed (4) nuclear density tests on the backfill - the test locations were

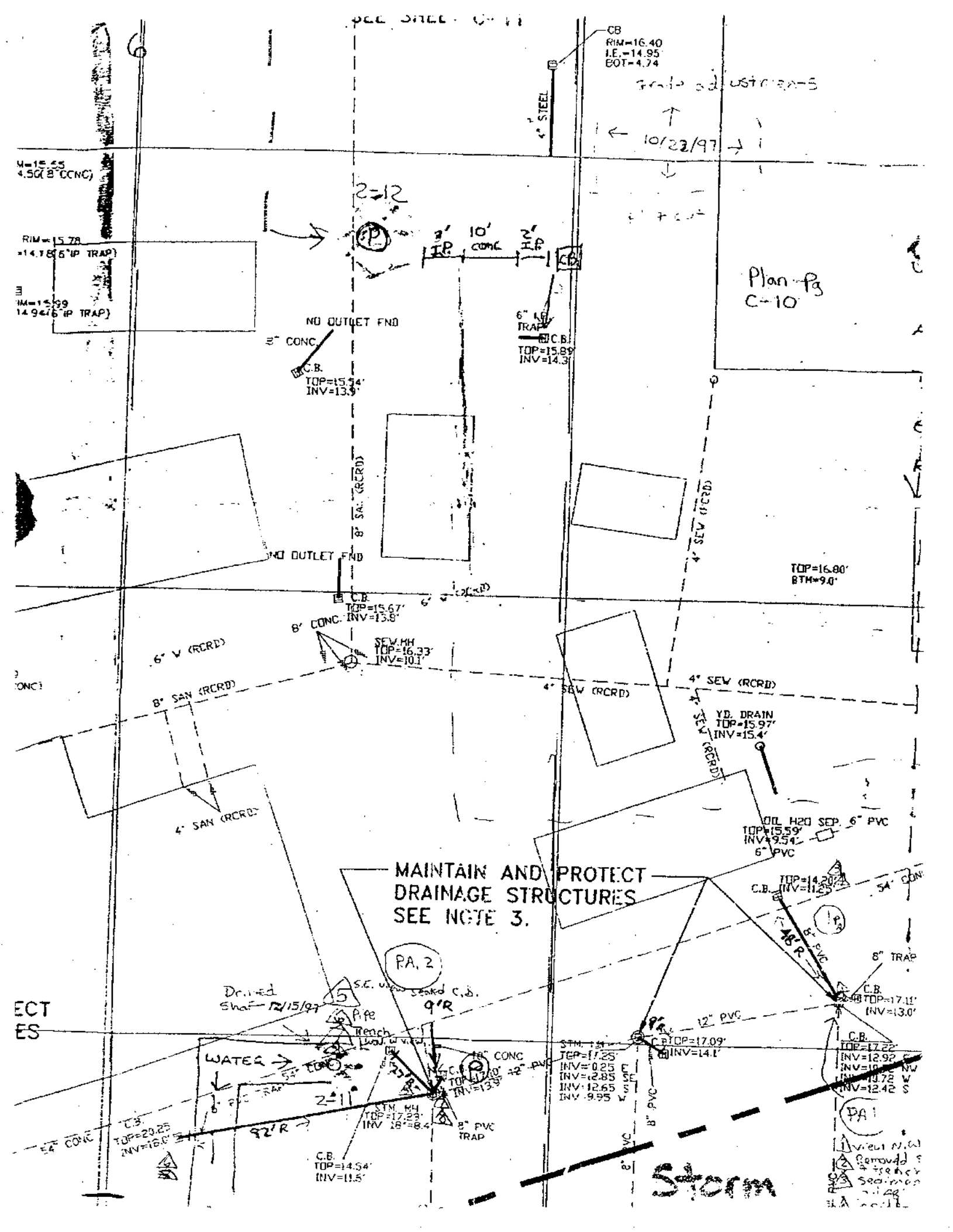
Misc.: - As requested, we performed air monitoring in the landfill area along north edge of the placed liner (including the methane collection trenches), using the MSA 361. We observed LEL (methane) readings that ranged up to 26 ppm. It appeared from the readings that the methane levels fluctuated or pulsed over time. We informed the contractor of our observations.

- Performed air monitoring in the area of the water line installation in the north-central part of the RA5 area using the OVM 580A. We observed that the soils were dark gray in color and had a hydrocarbon odor. We did not observe any readings that reached action levels.

COPIES TO: File

FIELD REPORT

David O'Malley
Field Technician



CB
RIM=16.40
I.E.=14.95
BOT=4.74
4" STEEL
10/22/97
2-12
3' I.P.
10' CONC
2' I.P.
CB
Plan Pg C-10
NO OUTLET END
8" CONC.
C.B.
TOP=15.54'
INV=13.9'
6" I.P. TRAP
C.B.
TOP=15.89'
INV=14.3'
8" SAN (RCRD)
4" SEW (RCRD)
NO OUTLET END
C.B.
TOP=15.67'
INV=13.8'
TOP=16.80'
BTM=9.0'
8" CONC.
SEW.MH
TOP=16.33'
INV=10.1'
6" W (RCRD)
8" SAN (RCRD)
4" SEW (RCRD)
4" SEW (RCRD)
YD. DRAIN
TOP=15.97'
INV=15.4'
4" SAN (RCRD)
OIL H2O SEP. 6" PVC
TOP=15.59'
INV=9.54'
6" PVC
MAINTAIN AND PROTECT
DRAINAGE STRUCTURES
SEE NOTE 3.
C.B.
TOP=14.20'
INV=11.25'
54" CONC
48' R
8" PVC
8" TRAP
C.B.
TOP=17.11'
INV=13.0'
PA. 2
Drained Shaft 12/15/97
S.E. view sealed C.B.
9' R
Pipe
Trench
12" PVC
C.B.
TOP=17.09'
INV=14.1'
C.B.
TOP=17.22'
INV=12.92
INV=10.72 W
INV=12.42 S
WATER
54" CONC
18" CONC
12" PVC
C.B.
TOP=17.10'
INV=13.9'
2-11
STM. MH
TOP=17.29'
INV 18"=8.4'
8" PVC TRAP
92' R
C.B.
TOP=20.25
INV=16.0'
54" CONC
C.B.
TOP=14.54'
INV=11.5'
8" PVC
PA 1
Storm

Port of Seattle

Southwest Harbor Project Office

Terminal Five Expansion - CP6

Contract # EMC 960003 Work Order # D 4401

INSPECTOR'S DAILY REPORT

M. A. Segale, Inc. Contractor

ROUTING	INIT.
GEORGE ENGLAND	
ED FIELD	
DOUG CARROLL	
ELIZABETH STETZ	
FILE	

Date 10-21-97

Contractor's Field Rep. Don Powell

Subcontractor Kohl Sub-Contractor's Rep S. Christensen

Demo of ex S.D.

Task Storm Drain Location CP-14 4 & 1 areas

Rain .60"

Weather OVC H-58° L-41° 6VC Shift DAY Diary ref. #

Schedule Ref. Task ID # Safety Meeting held at/on:

Description of Work and Remarks:

0730 to 0800 Office catch up paper work reports RFIs correspondence
0800 to 0930 Field CP-14 to observe contractors activities and take equip Inventory Kohl demoing existing CB's & Storm drains as shown on plans CP-14 C-10. Contractor has removed apron 46' of 8" PVC. there was no sediment in pipe only a dark film of approximate 30 to 40 mils. Went to office to get Alan Hale from AAR to cover demo of existing CB's & Stormdrains, 0930 office Alan Hale unable to get right out on site so I Bill Attwood returned at observe S.D demo. Kohl could not locate several of CB's & S.D. that were to be demoed. Kohl's S. Christensen called Bruce H. from M.A.S. to find out if MAS had demoed CB's & S.D that could not be found. Bruce found out that in fact that M.A.S. had demoed said CB's & SD Checked with office Wai Wong from P.O.S. who contacted A. Gates from P.O.S. who said we could allow this but in future M.A.S. & Kohl had to send P.O.S. inspectors a Memo of time & date of demoing future CB's & S.D.'s. Notified Brian H. as to plan also S. Christensen of Kohl as to procedures to be followed:
0930 to 1500 Field MA.S. & Magnolia working at new rest room just N. of Transit Shed N.W. corner Austin working on yard scales stripping forms (CP-14) Kohl installing 24" RCP in Area #4 + demoing existing CB's & Stormdrains area #1 (RA-1) M&T States working on RN track to pier #2 & elevator Yard also installing concrete crossing at M.A.S. trailers on pier 2 rail (RA-2) MAS working sub grade N. end and building road the length of geomembrane all ready placed E. side of land fill APL-RA-1 Work in Progress @ M&R Bldg. MAS. working sub grade S.W. ½ of M&R Bldg Cosco working on Fire controll piping Magnolia working on plumbing. Mehrer Dry wall is stalling Metal studs at N. end H. Bay interior SOF working on built up roof system East Side sealant caulking tilt up panel seams Sky Line Steel installing stairs to tower placing floor decking SDS working on roll up Doors Valley electric running conduit Austin working on forms & clean-up (RA-1 & 2) AGT working on Rail signals
1500 to 1530 Office finish reports and work on unprocessed slag issues

Bill Attwood

Kohl
Equipment Log

EQUIPMENT TYPE	EQPM'T NUMBER	LOCATION							STATUS			ACTIVITY
		RA1	RA2	RA3	RA4	RA5	APL		UP	DOWN	STDBY	
40yd Dump Truck												
Excavator PC400						X						24" RCP Area 4
Excavator PC220						X			X			Demo existing Storm Drain Conc. 2 CBS's
JD 544 E Loader						X						24" RCP Area 4
JD 544 G Loader						X			X			Demo existing Storm Drain Area #1
JD 650 Dozer						X						" " " " " "
RayGo 410 Roller												
590 Case						X						Demo existing Storm Drain Area #1
591 Case & Comp						X			X			" " " " " "
592 Case & Comp						X						24" RCP Area 4
Rhine Kobelco	687											
Kobelco MARK IV	970											
Komatsu PC 150						X			X			24" RCP Area 4

Zuluaga Equipment

EQUIPMENT TYPE	EQPM'T NUMBER	LOCATION							STATUS			ACTIVITY
		RA1	RA2	RA3	RA4	RA5	APL		UP	DOWN	STDBY	
Hitacni EX 120												
Hitachi EX 200												
950G												
Case 580K												
Fork Lift												

Port of Seattle

Southwest Harbor Project Office

Terminal Five Expansion - CP6
Contract # EMC 960003 Work Order # D 4401
INSPECTOR'S DAILY REPORT
M. A. Segale, Inc. Contractor

Date 10-28-97

Contractor's Field Rep. Don Powell

Subcontractor Kohl Sub-Contractor's Rep S. Christensen

Demo S.D

Task SD Water Line Fire Hyd Location CP-14 Area #1 + 5

RAIN .80"

Weather OVC H 58° L-48° OVC Shift DAY Diary ref. #

ROUTING	INIT.
GEORGE ENGLAND	
ED FIELD	
DOUG CARROLL	
ELIZABETH STETZ	
FILE	

Schedule Ref. Task ID #

Safety Meeting held at/on:

Description of Work and Remarks:

0600 to 0900 Office worked on filing phone messages quanity tracking

0900 to 1200 Field to observe contractors activies and take equip inventory (CP-14) Met Paul A. from M.A.S. to look at 8" PVC line installed to hook existing CBs to new SD system. 8" PVC less than 1' below paving sub grade and now broken due to equip running over it. Will have to replace 8" pvc with D.I.P. due to lack of cover. Kohl demoed CB @ N 11625 E 25520 which had 3' sediment also one 6" PVC aprox 9'6" long was 2/3 full of sediment. Kohl installing Fire Hydrant in same location Kohl also installing 12" PVC S.D. M.A.S. also installing "Krail wall N. end Area #1 MAS. working sub grade area #1 Rine demoing concrete Area #6 M.A.S. operating Asphalt Batch plant (RArea-4) Mt States installing concrete crossing just South of IYM&R Bldg Stoped at M.A.S. Trailer to go over payment for un-processed Slag came to agreement to total cost (APL) Rine Demoing old CFS Bldg (APL RA-1) Work in progress at M&R Bldg.: Valley electric running conduit Magnolia running plumbing Merhrer Dry wall installing Steel studs for walls Sky line steel working structural Steel Austin placed concrete in tower floor Cosco working of fire sprinklers (APL) MAS paving around refer stations just N&E of exuting M&R Bldg.

1200 to 1400 Office worked on field Memos for MAS Great White & Kohl checked on reports.

1400 to 1630 Field to observe contractors activies Kohl uncovered 12" DIP water line where we were going to wet tap into new port 8" Main and Kohl discovered that existing line was lead jointed so will abandon as per plan Kohls trailer to go over pay app quanities

1630 to 1700 Office Reports

Note: 10-27-97 130' 18" PCP + 2 CB's

Inspector: William P. Pittwood

Kohl
Equipment Log

Oct 28, 1997

EQUIPMENT TYPE	EQPMT NUMBER	LOCATION							STATUS			ACTIVITY
		RA1	RA2	RA3	RA4	RA5	APL		UP	DOWN	STORY	
10yd Dump Truck												
Excavator PC400						X						S.D. Area #5
Excavator PC220						X	XM		X			Fire Hydrant Area #1
JD 544 E Loader						X						S.D Area #5
JD 544 G Loader						X			X			Fire Hydrant Demo Area #1
JD 650 Dozer						X				X		
RayGo 410 Roller												
590 Case						X						Fire Hydrant Area #1
591 Case & Comp						X			/	X		
592 Case & Comp						X						
Rhine Kobelco	687											
Kobelco MARK IV	970											
Komatsu PC 150						X			X			SD Area #5

Zuluaga Equipment

EQUIPMENT TYPE	EQPMT NUMBER	LOCATION							STATUS			ACTIVITY
		RA1	RA2	RA3	RA4	RA5	APL		UP	DOWN	STORY	
Hitachi EX 120												
Hitachi EX 200												
950G												
Case 580K												
Fork Lift												

Port of Seattle

Southwest Harbor Project Office

11 00

Terminal Five Expansion - CP6
Contract # EMC 960003 Work Order # D 4401
INSPECTOR'S DAILY REPORT
M. A. Segale, Inc. Contractor

ROUTING	INIT.
GEORGE ENGLAND	
ED FIELD	
DOUG CARROLL	
ELIZABETH STETZ	
FILE	

Date 10-31-97

Contractor's Field Rep. Don Powell

Subcontractor Kohl W.L & F.H Sub-Contractor's Rep S. Christerson

Task SD Inst & Demo Location CP-14 Area 4 & 5 & 1

Weather ovc H. 64° L. 48° PC Shift DAY Diary ref. #

Schedule Ref. Task ID # Safety Meeting held at/on:

Description of Work and Remarks:

0600 to 0630 Office phone messages and continue filing from 10-30-97
0630 to 0730 Field Chelan cafe waiting for Rep from Terra to monitor sheet piles never showed up went to office
0730 to 0800 Office Met rep from terra who is to monitor driving sheet piles went over drawings
0800 to 1500 Field to observe contractors activies and take equip Inventory Took Kamer the Terra rep to area #6 where Great White to drive sheet piles in ship way (CP-14). CP-14 Kohl installing fire hydrants in Area #1 MAS working on subgrade for Ecology Rockwall Area #5 Kohl installing 24" RCP N. from MH-11 in Area #4 Kohl plugged line from MH5 to SS MH on pier just east of ship way + MAS demoing Asphalt in Area #5 along old ship way. Merit Const working on KTR Ground grid for Antenna. Talked to Mike from Merit Const and he has expressed concern that M.A. Segale is not maintaining communication with them when they are working in area of ground grid MAS starting to place Elect vaults with in bounds of ground grid M.A. Segale did not notify Merit that they were going to set the elect vaults. M.A.S. office trailer and talked to Bruce Z & Frank S. about maintaining scheduled comm with Merit Const if working with in ground plane of KTR Antenna Elevator Yard Mt Stutes working on turn out. (RA-3) M.A.S hauling in SSP Stock piling N end land fill (APL) Rine demoing existing CES Work in progress @ M & R Bldg. Austin Forming up for Bldg Apron slab Sky line steel erecting N end awning steel (Structural) Magnolia working on plumbing Valley electric running conduit CASCO installing fire protection system Mehrer Dry wall installing steel studs Vertex Fire proofing Structural steel & Sound door working on roll up doors
1300 to 1400 office
1400 to 1600 Field to observe contractors activies
1600 to 1700 Office Reports & Filing

Inspector: William P. Pittwood

Kohl
Equipment Log

EQUIPMENT TYPE	EQPM'T NUMBER	LOCATION							STATUS			ACTIVITY
		RA1	RA2	RA3	RA4	RA5	APL		UP	DOWN	STDBY	
10yd Dump Truck												
Excavator PC400						X						24" RCP N from MH1
Excavator PC220						X			X			Water line + Demo SD
JD 544 E Loader						X						24" RCP N from MH1
JD 544 G Loader						X			X			Water line + Demo SD
JD 650 Dozer						X						
RayGo 410 Roller												
590 Case						X						24" RCP N from MH1
591 Case & Comp						X			X			Water line + Demo SD
592 Case & Comp												
Rhine Kobelco	687											
Kobelco MARK IV	970											
Komatsu PC 150						X						24" RCP N from MH-1

Zuluaga Equipment

EQUIPMENT TYPE	EQPM'T NUMBER	LOCATION							STATUS			ACTIVITY
		RA1	RA2	RA3	RA4	RA5	APL		UP	DOWN	STDBY	
Hitachi EX 120												
Hitachi EX 200												
950G												
Case 580K												
Fork Lift												

Port of Seattle

Southwest Harbor Project Office

Terminal Five Expansion - CP6
Contract # EMC 960003 Work Order # D 4401
INSPECTOR'S DAILY REPORT
M. A. Segale, Inc. Contractor

Date 11-14-97

Contractor's Field Rep. Don Powell

Subcontractor Kohl Sub-Contractor's Rep S. Christensen

Task SD. Location APL

Rain .00

Weather CLR H-52° L-45° CLR Shift DAY Diary ref. #

ROUTING	INIT.
GEORGE ENGLAND	
ED FIELD	
DOUG CARROLL	
ELIZABETH STETZ	
FILE	

Schedule Ref. Task ID # Safety Meeting held at/on:

Description of Work and Remarks:

0630 to 0830 Office worked on Pay app Change Order and Phone calls
0830 to 1030 Field w/Allen Hale from AAR & Mike Wayland from Hart Crowser CP-10
1030 to 1100 Office report.
1100 to 1500 Field to observe contractors Activies and take Equip Inv. CP-14
M.A.S. Demoing Asphalt A#5 also working sub grade Area #5 Kohl demoed CB & MH in Area 1 Area #5 + 5 Pine moving in crusher to re cycle Asphalt & concrete APL Kohl installing 18" RCP Storm Drain South from MH K7A (APL + RA-1) Work in progress @ M+R Bldg.; M.A.S. working sub grade N.E Side M&R Inter State Sheet Metal working on Awning Roof. Valley elect. working on Conduits Magnolia working on plumbing Mehrer Dry Wall installing steel studs on tower Sky Line Steel installing awning N. end M+R Austin forming up for Apron (concrete) S.E. end M+R Bldg. Pacific Contractors insulating N. end M+R SDS installing roll up doors Vertex applying fire proofing to tower Structural steel RA-2 + 3 M+ States working on rail AST working on rail signals + switches
1500 to 1700 Office worked on CP-10 Memos & Faxes

Note Kohl installed 164' of 18" RCP S. from MHK7A

Inspector William P. Pittwood

Kohl
Equipment Log

Nov 14 1997

EQUIPMENT TYPE	EQPMT NUMBER	LOCATION							STATUS			ACTIVITY
		RA1	RA2	RA3	RA4	RA5	APL		UP	DOWN	STDBY	
10yd Dump Truck						X		X	X			Street Tie in S.D Harbor Ave
Excavator PC400							X		X			SD + MH
Excavator PC220						X		X	X			S.D Tie in Harbor Ave
JD 544 E Loader							X		X			SD + MH
JD 544 G Loader						X			X			Support Demo of CB + MH Area #1
JD 650 Dozer							X		X			SD + MH
RayGo 410 Roller												
590 Case						X			X			Harbor Av S.D Tie in
591 Case & Comp						X			X			Support Demo of CB + MH Area #1
592 Case & Comp							X		X			SD + MH
Rhine Kobelco	687											
Kobelco MARK IV	970											
Komatsu PC 150							X		X			SD + MH

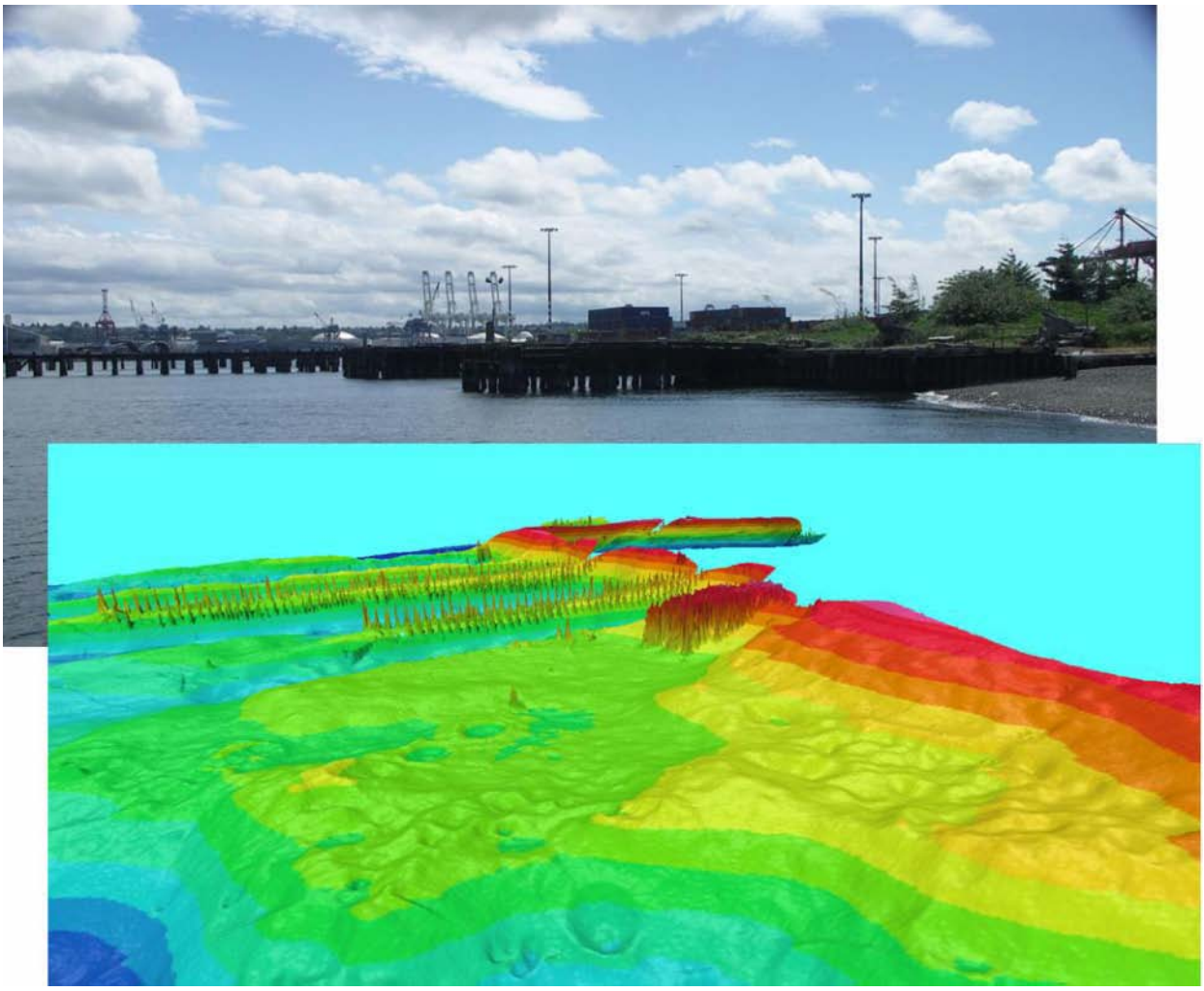
Zuluaga Equipment

EQUIPMENT TYPE	EQPMT NUMBER	LOCATION							STATUS			ACTIVITY
		RA1	RA2	RA3	RA4	RA5	APL		UP	DOWN	STDBY	
Hitachi EX 120												
Hitachi EX 200												
950G												
Case 580K												
Fork Lift												

APPENDIX B

LOCKHEED BATHYMETRY SURVEY REPORT

Lockheed
Lockheed Shipyard 2



Bathymetry Survey Report
May 2006

Prepared by:
TetraTech, Inc.
12100 NE 195th St, Suite 200
Bothell, WA 98011
(425) 482 7600

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1 Introduction

The following document describes a high resolution multibeam sonar bathymetric survey which was conducted for Lockheed, by TetraTech, Inc, on May 20, 2006. The multibeam sonar system provided a high resolution, full bottom coverage, bathymetry of the area in the vicinity of the Lockheed Shipyard 2 project site, from which contour lines and hill-shade maps (hard copy and electronic) digital terrain models where created.

The survey data was collected to chart bottom features and provide detailed bathymetric data to: 1) support future site characterization activities; 2) determine bathymetric anomalies; and 3) provide data for potential remedial designs. Additionally, the collected data may also be used to: 1) analyze bottom substrate composition; and 2) evaluate sediment transportation.

The survey was conducted in accordance with the procedures in the US Army Corps of Engineers Manual 1101-2-1003, Engineering and Design Hydrographic Surveying.

Table 1 lists the personnel and their roles in the survey.

Table 1 – Survey team

Company	Personnel
TetraTech EC, Inc.	Robert Feldpausch - Hydrographer Burton Bridge - Hydrographer
Sound Vessels, Inc.	Lou Schwartz – Vessel Captain

2 System Setup

The survey systems were installed on the R/V Brendan D, a 32 foot research vessel owned by Sound Vessels, Inc., of Port Townsend, WA The equipment used for the survey is shown in Table 2. Data sheets for the main survey systems are included in Appendix C.

Table 2 - Survey Equipment

Sensor Type	Manufacturer/Model
Multibeam Sonar	RESON SeaBat 8125
Motion Sensor	Applanix WaveMaster
Heading	Applanix WaveMaster
Position	Leica 1230 RTK GPS
Sound Speed Profiler	SeaBird SBE-19
Tide Corrections	Leica 1230 RTK GPS

Data collection and navigation software for the bathymetry survey was Hypack®/Hysweep®. The data were processed and data products generated using a combination of Hysweep, IVS 3D Fledermaus, and ESRI ArcGIS.

Software settings for bathymetry data acquisition include the serial I/O configuration and sensor offsets in Hypack, and Hypack Navigation device offsets in the Hysweep hardware configuration.



Figure 1 - R/V Brendan D

2.1 Interconnections

Figure 2 shows the data flow and communications setup for the devices which make up the survey system. Table 3 lists the settings for each of the data communication links.

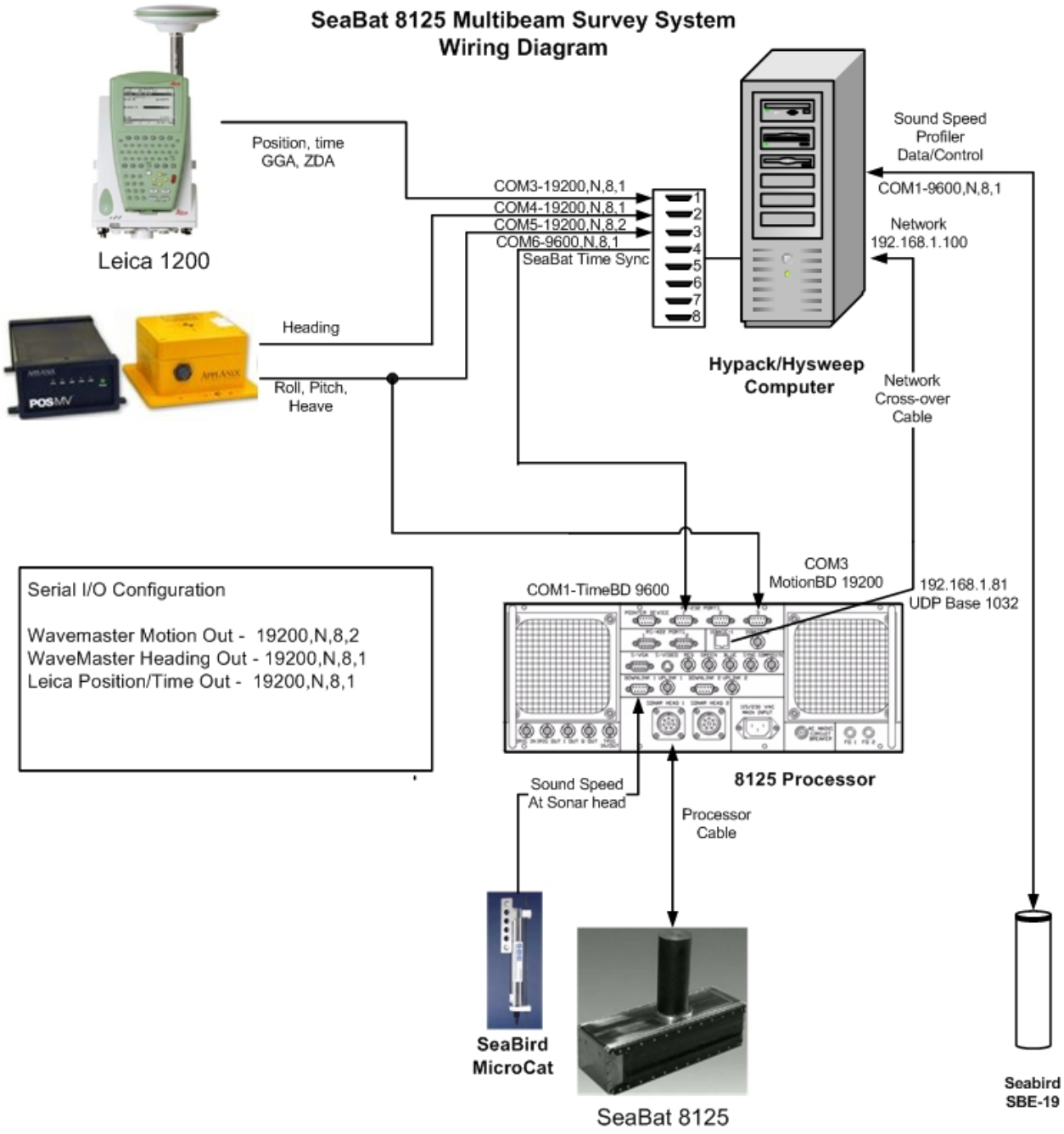


Figure 2 – 8125 Multibeam Survey System

Table 3 - Communications Settings

Device	Communications link	Settings
8125 SeaBat	Network imagery data out	Local IP 192.168.1.25 Remote IP 192.168.1.100 UDP base port 1032
8125 SeaBat	UTC time sync in	COM 1 – 9600, N, 8, 1
Applanix WaveMaster	TSS1 roll, pitch, heave out	19200, N, 8, 2, 50 Hz update
Applanix WaveMaster	NMEA HDT heading	19200, N, 8, 1, 5 Hz update
Leica position	NMEA GGA position	19200, N, 8, 1, 10 Hz update
Leica time	NMEA ZDA time	19200, N, 8, 1, 1 Hz update

2.2 Device Offsets

Device offsets are precisely defined for the multibeam sonar, attitude sensor and GPS antenna, so that the Hypack/HySweep acquisition software can accurately convert the input sonar and support sensor data into XYZ soundings on the earth.

2.2.1 Hypack/Hysweep Offsets

The following offsets, in feet, were used for the Hysweep sensors:

Table 4 - Sensor Offsets (feet)

Sensor	Across	Along	Vertical
SeaBat 8125	1.84	0.00	3.08
Motion Sensor (Applanix WaveMaster)	0.00	0.00	-4.50
Hypack Navigation (Leica RTK antenna)	1.84	0.00	-11.78

2.3 Sonar Mount

The sonar head was mounted to the vessel using a side mount pole, shown in Figure 1. The mount is rigidly attached to the side of the vessel, with the Leica GPS antenna mounted on an extension pole, directly above the sonar.

2.4 Geodesy Settings

The geodesy settings shown in Table 5 were used for the project.

Table 5 - Survey Geodesy Settings

Parameter	Setting
Grids	State Plane NAD-83
Zone	WA-4601 Washington North
Distance Unit	US Survey Feet
Depth Unit	US Survey Feet
Ellipsoid	NAD-83
Geoid	NAVD 88
Vertical Datum	Port of Seattle MLLW (geoid height – 2.59 ft)
Horizontal Control	WA DOT Duwamish SY4595 – ID 6242
Vertical Control	WA DOT Duwamish SY4595 – ID 6242

The elevations output by the Leica RTK were referenced to the NAVD88 geoid. Corrections to the Port of Seattle MLLW datum were made in the Hypack Max® sensor offsets.

2.5 GPS Reference Station

The RTK base station was set up over Washington Department of Transportation (DOT) benchmark SY4595, as shown in Figure 3. The agency provided description of the control point is shown in Appendix D.

3 Survey Procedures

This was a project condition survey to assess the bottom topography and the presence of man-made debris in the area of the shipyard. To provide the highest possible resolution, a RESON SeaBat 8125 multibeam sonar was used. This system is currently the highest resolution commercial multibeam sonar on the market. It has an along-track beamwidth of 1.0 degrees and an across-track beamwidth of 0.5 degrees normal to the array, increasing to 1.0 degrees at +/- 60 degrees. The support sensors, used to measure vessel attitude (roll, pitch, heave), position, heading, and sound speed through the water column, were selected to ensure that the associated accuracies commensurate with the accuracy and resolution of the sonar.



Figure 3 - RTK GPS Base Station - Duwamish Benchmark

3.1 Position/height

To compensate for tides, vessel squat and settlement and varying draft due to vessel loading, RTK GPS was used for both position and height. Tetra Tech staff set up a RTK base station on the WA DOT monument shown in Table 5 and Appendix D. The rover unit was then taken to monument GP17099-241 and the position compared to that of the monument. In the comparison between the position reported by the rover GPS and the published position of the monument, all X, Y and Z values matched to within 5 cm. The locations of the base station (Duwamish monument) and the monument used for QC are shown in Figure 4.

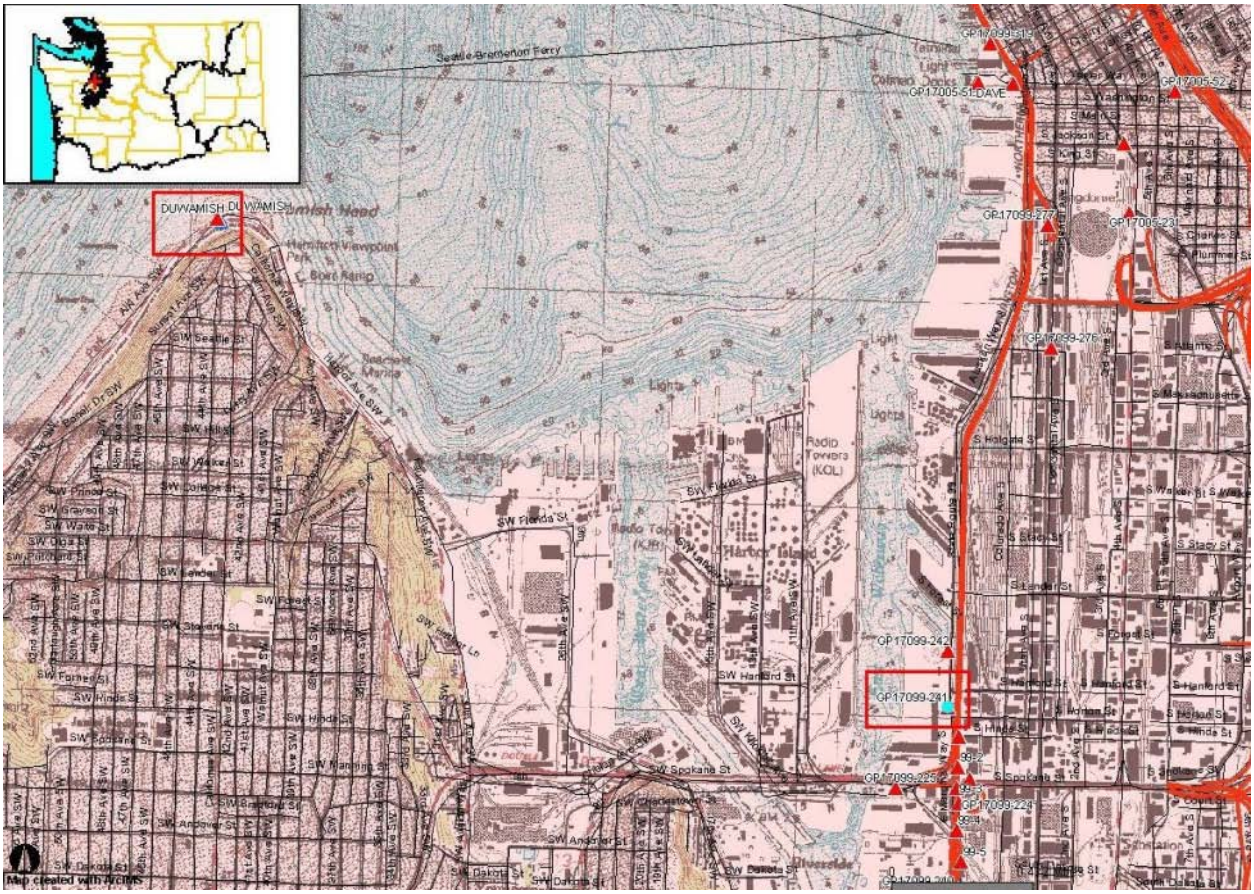


Figure 4 - Monument Locations

3.2 Sensor Offset Measurements

All sensor offsets were measured relative to the XY position of the Inertial Measurement Unit (IMU), with the waterline as the vertical reference. All measurements were done at the dock, in calm water, using a tape measure.

The measured offsets were compared to those done for the preceding survey, and matched, except for small changes in the draft of the multibeam sonar head, due using a different model sonar, with different brackets and size, and the height of the GPS antenna above the waterline. The latter is expected to change with changes in vessel loading. The vertical offset between the GPS antenna and the acoustic center of the sonar is a critical measurement, and was checked by two of the survey staff.

3.3 WaveMaster GAMS Calibration

Prior to performing the patch test, an alignment test was performed on the Applanix WaveMaster motion and heading sensor. This procedure, called a GAMS calibration by Applanix, uses software built into the WaveMaster, while the vessel is maneuvering, to calculate the offsets between the system's two GPS antennas. This allows the system to align the heading with the vessel and provide the full specification measurement accuracies (see Appendix B).

3.4 Patch Test Results

A standard patch test was carried out within the survey area to determine the calibration offsets between the multibeam echosounder and the motion reference unit. The offsets shown in Table 6 were calculated from the patch test which was conducted on 20 May 2006. These offsets were applied in the data processing software to correct residual misalignments in the mechanical installation of the sensors, and to compensate for any latency in the positioning system.

Figure 5 shows the site, the survey lines and data collected for the patch test calibration. This location provided multiple distinct features, with significant changes in depth over very short distances along track. This in turn provided very consistent results fromt eh processing.

The data collection software was time synchronized to GPS UTC time, and the time stamp from the GPS position messages was used for the position data, which should provide a latency value of zero. This had been verified with this same hardware and software configuration multiple times in the past, so a latency test was not specifically done for this survey. Review of the full survey data set showed none of the position offsets that would result from a latency error.

Table 6 - Patch Test Results

Parameter	Value (deg.)
Roll	-0.3
Pitch	0.0
Yaw	4.0
Latency	0.0 sec

The data were processed using the Patch Test toolkit in the Hypack MB Max processing software, using the procedures defined in the Hypack documentation. Collections were performed so that at least two independent data sets were used to derive each measurement. No significant differences were observed in the results for each measurement.

Figure 6 shows a check of the calculated yaw offset, with four patch test survey lines input. This a cross section taken between the two parallel pairs of lines.

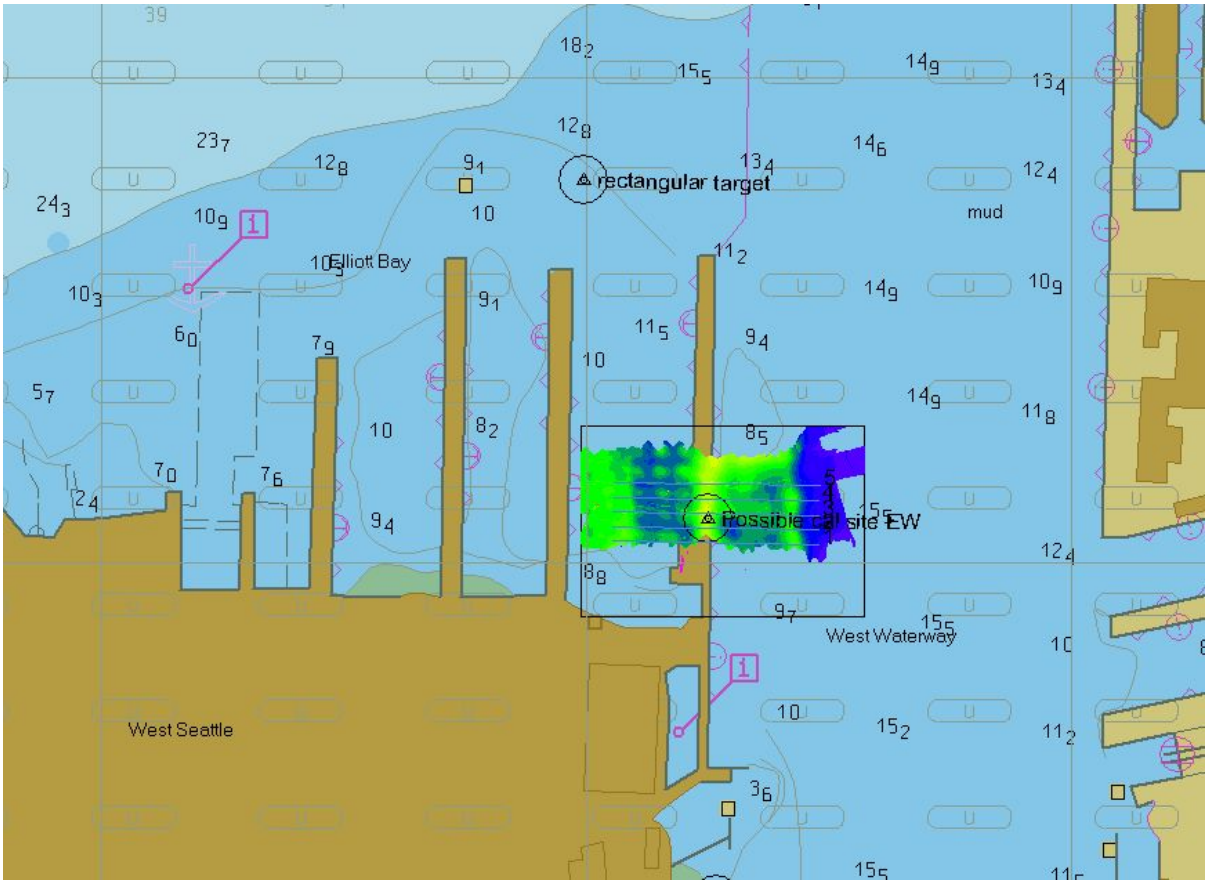


Figure 5 - Patch Test Site

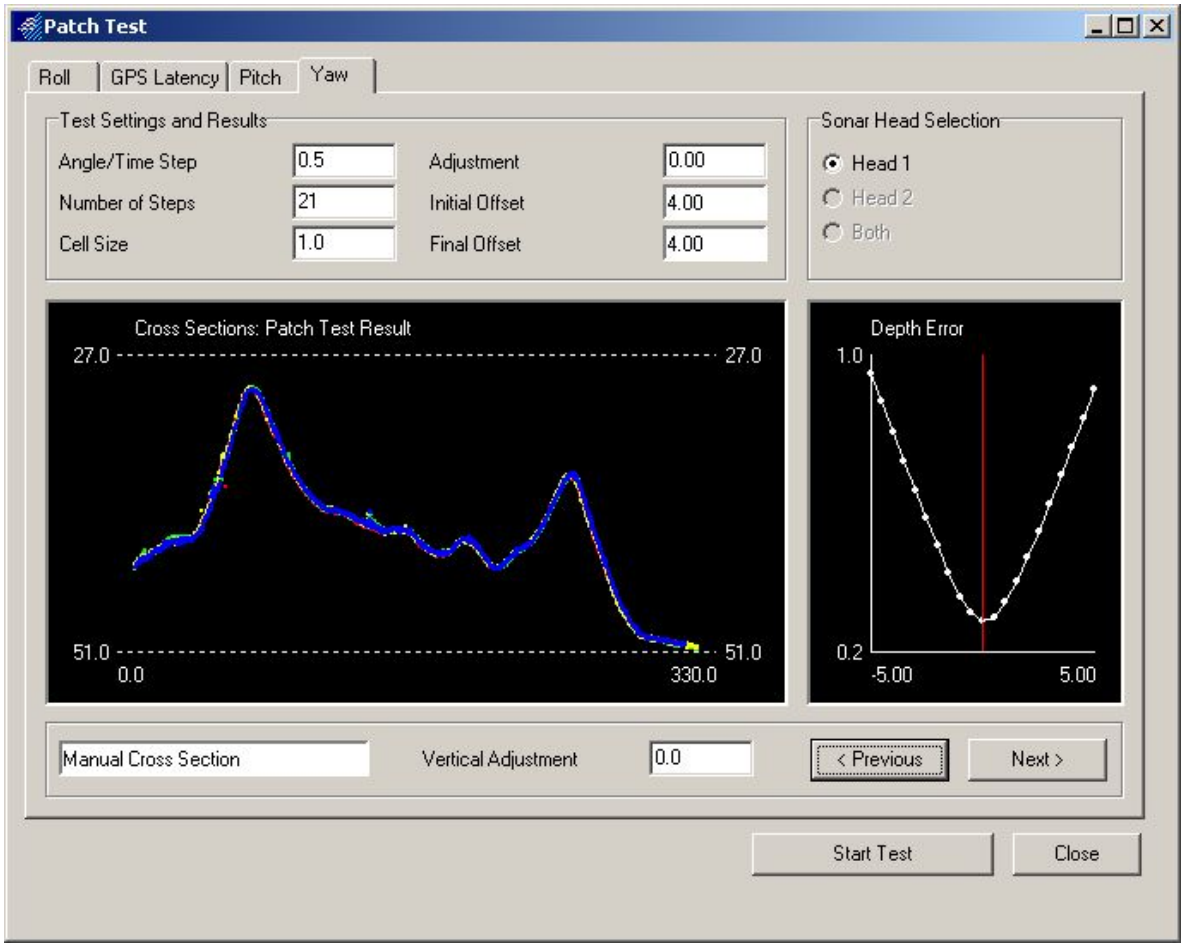


Figure 6 - Yaw Calibration Check (4 survey lines)

3.5 Sound Speed Casts

Sound speed casts were performed at the beginning and end of the survey. A comparison of the cast data showed no significant differences in the induced depth offsets out to the +/- 60 degree swath coverage of the sonar.

4 Bathymetry Results

The following is a description of the processing used to convert the raw collected data to depths and positions, and to remove invalid soundings from the processed data set.

4.1 Bathymetry Processing

The collected data were processed in Hypack MB Max to generate the XYZ soundings, in the survey coordinate system and units. The preliminary data cleaning was also done in MB Max, to eliminate any gross outliers induced by noise in the sensor systems or the acoustic environment. A subsequent area based cleaning, using the merged data from all the survey lines, was then conducted using Fledermaus, an advanced 3D editing application. The results of this processing were then exported back to the Hypack HS2 files.

As this was intended as a condition survey, and one of the objectives was to locate and identify debris in the project area, the data were binned in a one (1) foot grid, and the minimum depth value within each grid cell was used for the final data presentations.

4.2 Bathymetry Results

The results from the multibeam bathymetry survey are shown in Figure 7 and in Appendix A. Appendix C contains the survey collection logs. Bathymetry data extended from near shore to approximately 192 ft below MLLW off shore.

The high resolution bathymetry data shows extensive man-made debris in the area around the shipyard, mostly what appear to be timber pilings, lying on the seafloor. Areas previously dredged, as well as deposition under existing and former piers, are clearly visible in the data.

Figure 8 shows a set of 3D soundings from an area near the northeast corner of the shipyard, color coded for survey line. The data clearly show a set of fully submerged, but standing pilings, the tops of which are as little as 3.6 feet below MLLW. Many other pilings, some lying on the bottom and some tilted up are also visible. A review of the data in this and other areas also shows very good correlation between the data from overlapping survey lines, another QC check used in processing the data.

Figure 9 shows two 10 foot square blocks that were found near the north end of one of the former piers. The tops of the blocks are about five (southern) and 4 (northern) feet above the surrounding bottom. More piles lying on the bottom are also visible in the same area.

Figure 10 shows the Digital Terrain Model (DTM) of the data around the northeast corner of the shipyard. The objects sticking up near the center of the image are the same pilings shown in Figure 8. They appear distorted since the DTM provides a less than perfect representation of vertical features. Large numbers of piles lying on the bottom, the pattern of mounds where the former dry docks were located, and the mounds at the former pier locations are clearly visible.

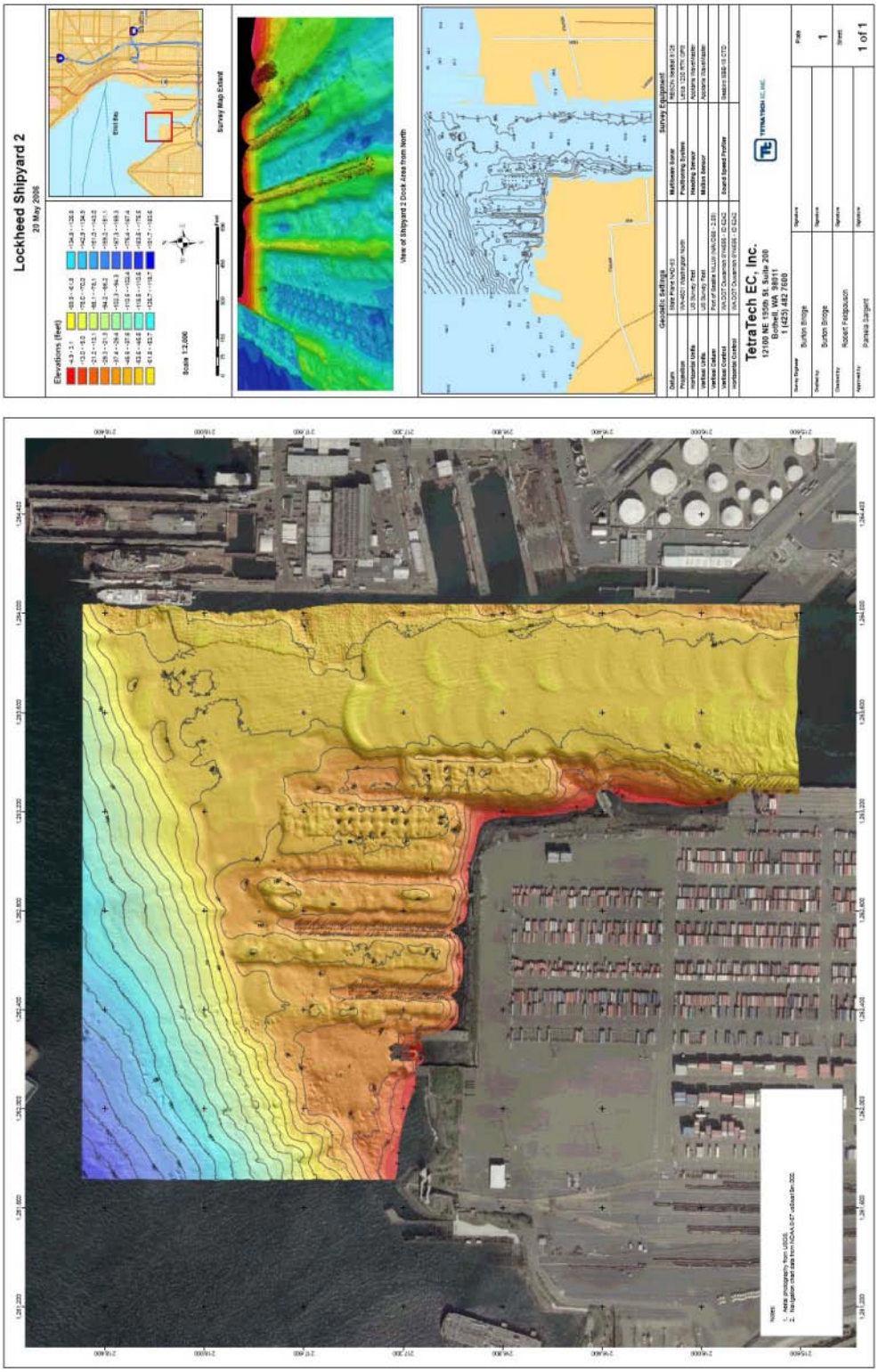


Figure 7 – Lockheed Shipyard 2 Bathymetry – May 2006

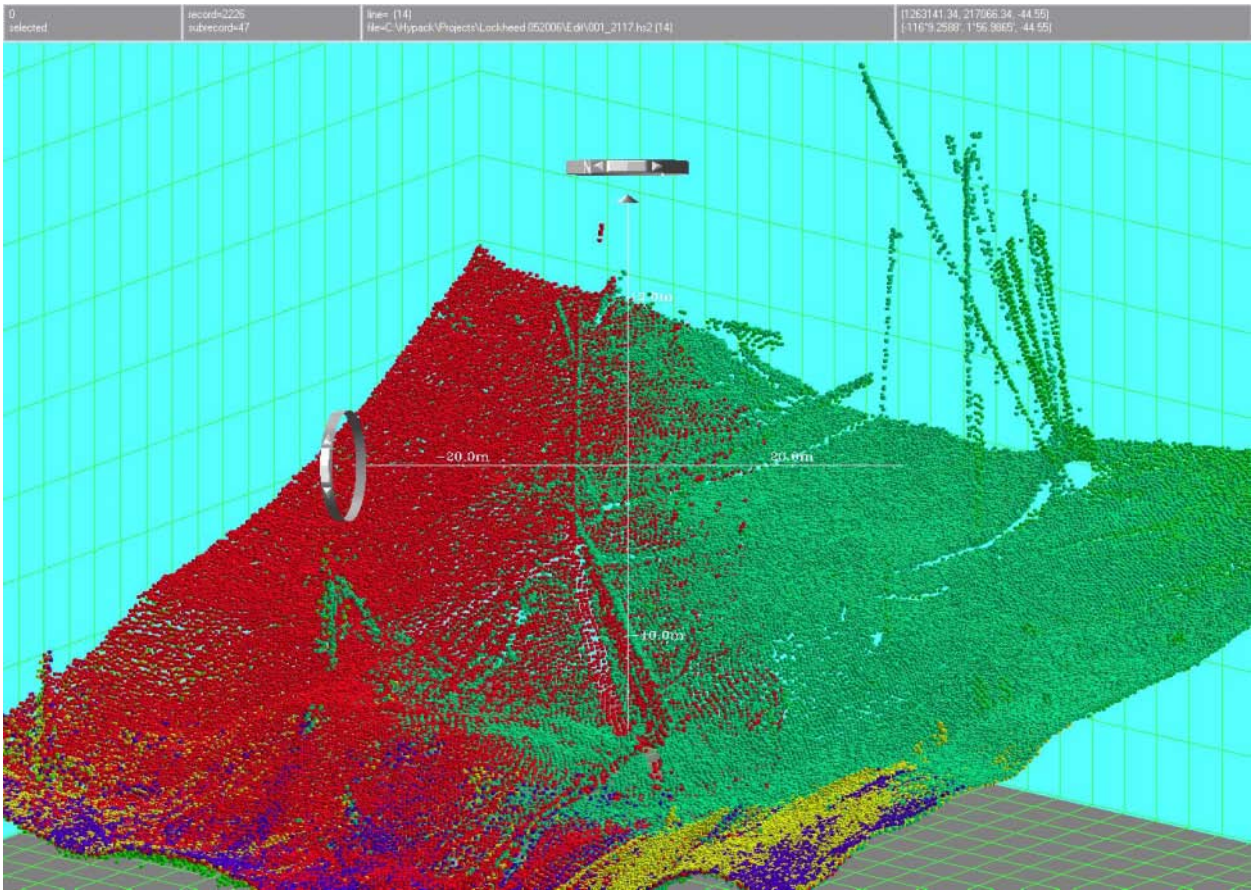


Figure 8 - 3D Sounding Display - Multiple Piles

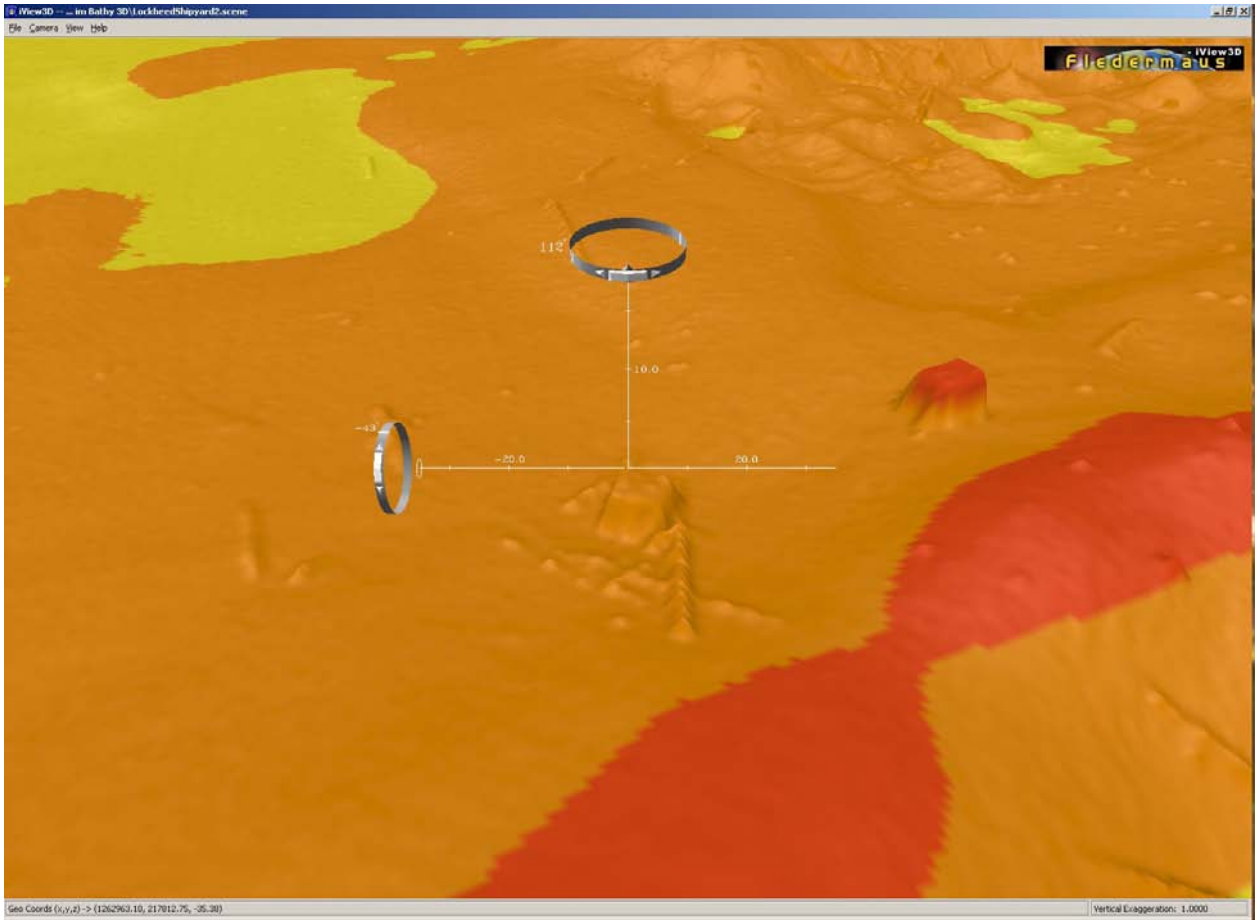


Figure 9 - DTM of Blocks and Piles

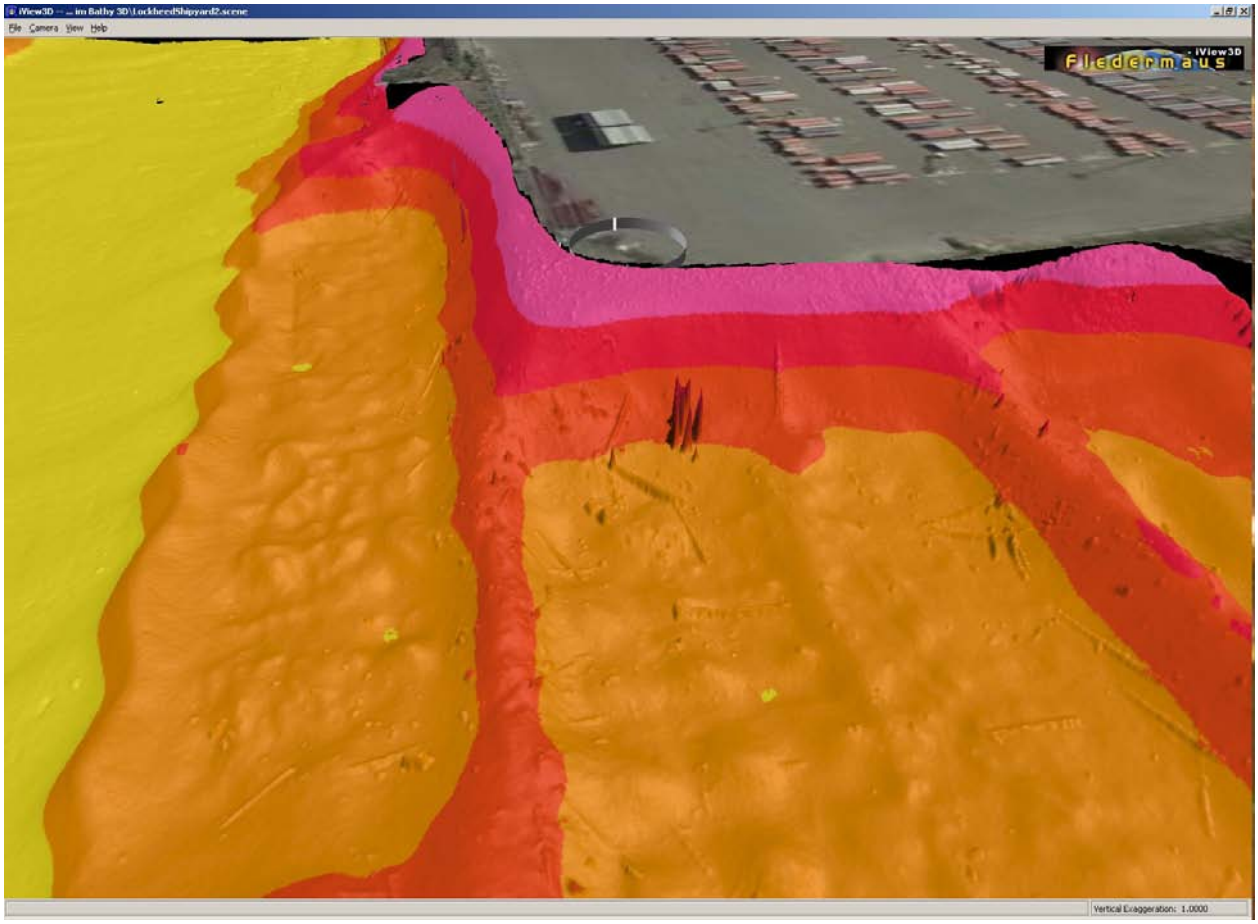


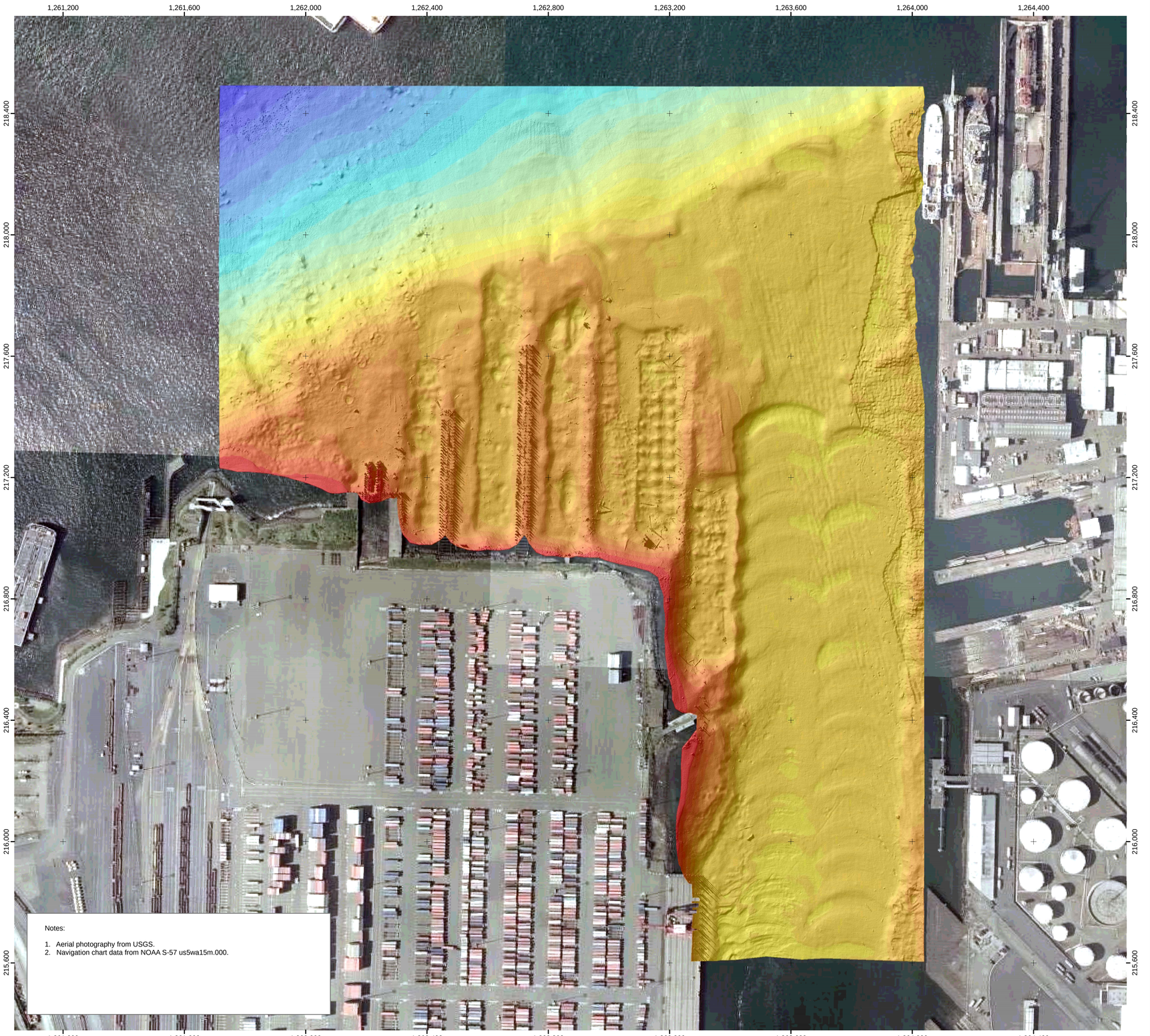
Figure 10 - DTM Around NE Corner of Shipyard

5 Summary

This data set provides a high resolution view of the topography in the vicinity of the shipyard that can be used for planning further tests, such as sediment sampling, and for locating debris.

Previously unknown features, such as the pattern of mounds in the former locations of the dry docks have been found, and can be used in planning remediation work.

The high resolution bathymetry clearly shows features 0.5 feet or less above the surrounding bottom. These data can be used to locate and identify the great majority of the man made debris that will need to be removed from the site.



Notes:

1. Aerial photography from USGS.
2. Navigation chart data from NOAA S-57 us5wa15m.000.

Lockheed Shipyard 2

20 May 2006

Elevations (feet)

-4.9 - 3.1	-69.9 - -61.9	-134.8 - -126.8
-13.0 - -5.0	-78.0 - -70.0	-142.9 - -134.9
-21.2 - -13.1	-86.1 - -78.1	-151.0 - -143.0
-29.3 - -21.3	-94.2 - -86.2	-159.2 - -151.1
-37.4 - -29.4	-102.3 - -94.3	-167.3 - -159.3
-45.5 - -37.5	-110.5 - -102.4	-175.4 - -167.4
-53.6 - -45.6	-118.6 - -110.6	-183.5 - -175.5
-61.8 - -53.7	-126.7 - -118.7	-191.7 - -183.6

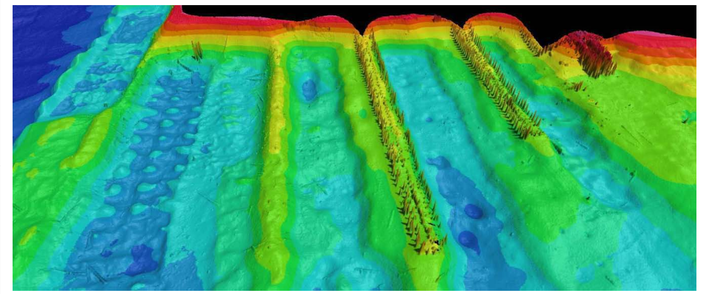
Scale 1:2,000

N W E S

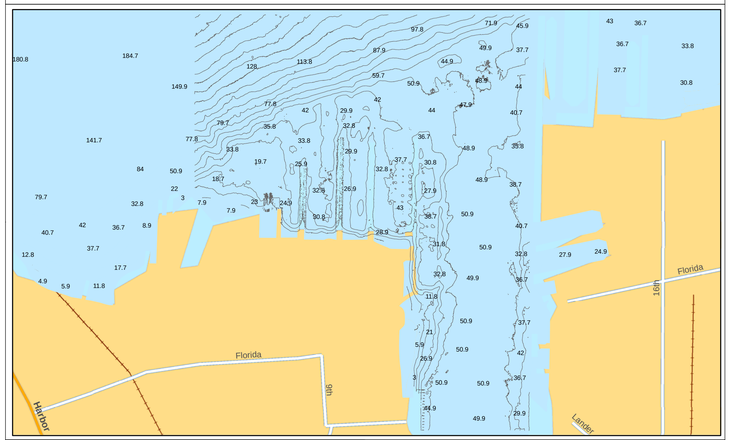
0 75 150 300 450 600 Feet



Survey Map Extent



View of Shipyard 2 Dock Area from North



Geodetic Settings		Survey Equipment	
Datum	State Plane NAD-83	**Multibeam Sonar**	RESON SeaBat 8125
Projection	WA-4601 Washington North	**Positioning System**	Leica 1230 RTK GPS
Horizontal Units	US Survey Feet	**Heading Sensor**	Applanix WaveMaster
Vertical Units	US Survey Feet	**Motion Sensor**	Applanix WaveMaster
Vertical Datum	Port of Seattle MLLW (NAVD88 - 2.59)		
Vertical Control	WA DOT Duwamish SY4595 - ID 6242	**Sound Speed Profiler**	Seabird SBE-19 CTD
Horizontal Control	WA DOT Duwamish SY4595 - ID 6242		

TetraTech EC, Inc.
12100 NE 195th St. Suite 200
Bothell, WA 98011
1 (425) 482 7600

Survey Engineer: Burton Bridge	Signature	Plate: 1
Drafted by: Burton Bridge	Signature	
Checked by: Robert Feldpausch	Signature	Sheet: 1 of 1
Approved by: Pamela Sargent	Signature	

P:\projects_2006\Lockheed_Bathymetry\maps\LockheedShipyard2.mxd

Appendix B. Equipment Data Sheets

The following are copies of the equipment data sheets provided by the manufacturers of some of the systems used in the survey.

RESON

SeaBat 8125

ULTRA HIGH RESOLUTION FOCUSED MULTIBEAM ECHOSOUNDER SYSTEM



SeaBat 8125

- **Focused 0.5° beams**
- **240 beams**
- **2.5cm near field resolution**
- **6mm depth resolution**
- **120° swath**

The SeaBat 8125 is the first wide-sector, wide-band, focused multibeam sonar ever to be deployed. Utilizing 240 dynamically focused receive beams, the system measures a 120° swath across the seafloor, detects the bottom, and delivers the measured ranges at a depth resolution of 6mm. The backscatter intensity image is displayed in real time on the sonar display.

The 8125 can be controlled through its native graphical user interface, or through an external control data collection and navigation software package.

The system can be mounted on a survey vessel or deployed on an ROV at depths down to 1500m. The high-speed data uplink is carried on a standard SeaBat copper cable for surface installation. A fiber-optical interface is available for ROV deployment.



www.reson.com

SeaBat 8125

ULTRA HIGH RESOLUTION FOCUSED MULTIBEAM ECHOSOUNDER SYSTEM

SYSTEM PERFORMANCE

Frequency:	455kHz
Depth Resolution:	6mm
Swath Coverage:	120°
Max Range:	120m
Number of Beams:	240
Along-Track Beamwidth:	1°
Across-Track Beamwidth:	0.5°
Accuracy:	• IHO Special Order • U.S. Army Corps of Engineers Special Order
Operational Speed:	Up to 12 knots
Max. Update Rate:	40
Transducer Depth Rating:	600m (Standard) 1500m (Optional)

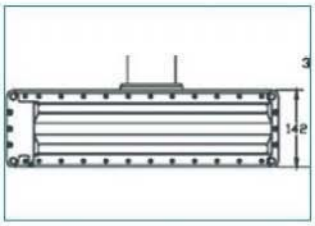
INTERFACE

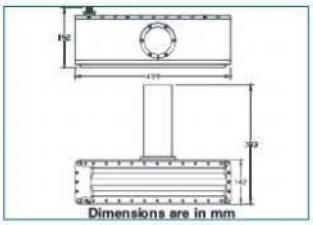
System Supply:	115V/230V 50/60Hz, 350W max	
Video Display:	SVGA, 800 x 600, 72Hz	
System Control:	Trackball	
Data Output:	10MB Ethernet or serial RS232C	
Data Uplink:	High-speed digital coax with fiber-optic option	
Sonar Head Supply:	24VDC, 5.6A Peak, 2A Average (May be supplied from sonar processor)	
Temperature:	Operating: Storage:	0° to +40°C -30° to +55°C

MECHANICAL INTERFACE

Power Requirements:	24VDC, 5.6A Peak, 2A Average (May be supplied from sonar processor)	
Operating Depth:	600m/1500m	
Dimensions:	266 x 320mm (W / D) excluding projector	
Temperature:	Operating: Storage	-5° to +40°C -30° to +55°C
Weight (aluminum):	Dry: Wet:	26.8kg (59lbs.) 4.8kg (10.6lbs.)
Weight (titanium):	Dry: Wet:	40kg (88lbs.) 18kg (39.6lbs.)







RESON reserves the right to change specifications without notice. © 2006 RESON A/S
For Acoustical Measurement Accuracy please refer to www.reson.com or contact sales.

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www.reson.com

Version: B023 051103 / US

POS MV™ WaveMaster

Providing Survey Launch Marine Industry with robust, reliable, and repeatable position and orientation solutions in all dynamics



SYSTEM COMPONENTS

POS Computer System (PCS)
A rugged, compact computer system contains the core POS processor and IMU interface electronics, plus two GPS receivers. The PCS provides all motion variables and timing data at high rate and/or provides motion compensation and georeferenceing data to all multibeam systems.

POS Inertial Measurement Unit
The system's primary sensor is a Ring Laser Gyro (RLG) manufactured by one of the world's experts in inertial technology. This high performance, low drift rate gyro ensures that the attitude data remains robust as the dynamics increase.

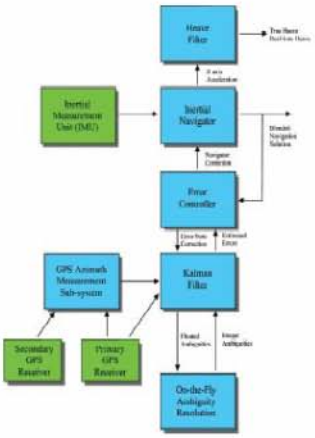
Primary and Secondary GPS Antennas
Dual frequency antennas for use with GAMS and/or RTK.

APPLANIX
A TRIMBLE COMPANY

Accurate Position and Orientation Solution
POS MV WaveMaster designed for survey launch vessels, maintains positioning accuracy under the most demanding conditions. With its high data update rate, the system delivers a full six degree-of-freedom position and orientation solution to provide the following:

- Position (latitude, longitude and elevation)
- Velocity (north, east and vertical)
- Attitude (roll, pitch and true heading)
- Heave (real-time, delayed)
- Acceleration Vectors
- Angular Rate Vectors

The new POS MV WaveMaster generates a tightly-integrated solution for smaller vessels, which means the system's Inertial Navigator will provide continuous positioning information while surveying in areas where GPS reception is compromised by multipath effect and signal loss. Raw GPS data from as few as one satellite can now be processed directly within the WaveMaster.



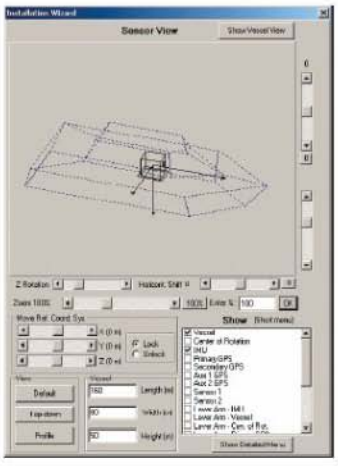
Tightly Coupled POS MV WaveMaster

Tightly-coupled integration offers the following advantages:

Advantage – Strengthens the system's ability to provide continuous, accurate data in areas with intermittent GPS reception
Advantage – Reduces position drift
Advantage – Enables almost instantaneous RTK re-acquisition (with internal RTK option)

WaveMaster Features and Benefits:

- Uses the latest GPS receiver technology from Trimble:
  - Maxwell™ chip technology
  - Everest™ multipath elimination technology
  - 10Hz raw observables for post-processing
  - Outstanding positioning performance and low elevation satellite tracking accuracy
- TrueHeave - **Applanix's ground breaking delayed time** heave processor
  - Removes processing artifacts but not real motion
  - No tuning required for varying sea conditions
  - Provides online quality measurement
- Faster CPU (700Mhz)
  - Low system loading allows for enhanced capabilities in the future
  - Runs at less than 10% of its total capacity to allow for upgrades and additional features
- TCP/IP protocol for raw data logging
  - Reliable logging of all raw data with microsecond-accurate time stamping
  - POSPac ready (for post-mission analysis)
- Firmware migration path
  - Access to new releases with new features as they become available
- New small, compact form-factor
- New Graphical User Interface
  - Makes installation and setup intuitive
  - Reduces operator error



POS MV WaveMaster Graphical User Interface

POS MV™ WaveMaster

POS MV WAVEMASTER MAIN SPECIFICATIONS (with Differential Corrections)

Roll, Pitch accuracy:	0.03° (1 sigma with GPS or DGPS) 0.02° (1 sigma with RTK)
Heave Accuracy:	5 cm or 5% (whichever is greater) for periods of 20 seconds or less
Heading Accuracy:	0.06° (1 sigma) with 1 m antenna baseline, 0.03 (1 sigma) with 2 m baseline, 0.015 (1 sigma) with 4 m baseline
Position Accuracy:	0.5 - 2 m (1 sigma) depending on quality of differential corrections 0.02 - 0.10 m (RTK) with input from auxiliary RTK or optional internal RTK receiver
Velocity Accuracy:	0.05 m/s horizontal

POS MV WAVEMASTER DURING GPS OUTAGES

Roll, Pitch accuracy:	0.04° (1 sigma)
Heave accuracy:	5 cm or 5% (whichever is greater) for wave periods of 18s or less
Heading accuracy:	Drift less than 2° per hour
Position accuracy degradation:	3 m (1 sigma) for 30 s outages <10 m (1 sigma) for 60 s outages

PHYSICAL CHARACTERISTICS

Size

IMU	160mm x 160mm x 102mm
PCS	281mm x 165mm x 90mm
GPS Antenna (2)	187mm x 53mm

Weight

IMU	3.6kg
PCS	3.0kg
GPS Antenna	<0.5kg

Power

IMU	Power provided by PCS
PCS	24vdc, 50 W (peak)
GPS Antenna	Power provided by PCS

ENVIRONMENTAL

Temperature Range (Operating)

IMU	-40 °C to +60 °C
PCS	-20 °C to +60 °C
GPS Antenna	-40 °C to +70 °C

Temperature Range (Storage)

IMU	-40 °C to +60 °C
PCS	-20 °C to +60 °C
GPS Antenna	-40 °C to +70 °C

Humidity

IMU	10-80% RH, Ingress Protection of 65
PCS	5-90% RH, non-condensing
GPS Antenna	0-100% RH

Ethernet (100 base-T)

Parameters	Time tag, status, position, attitude, heave, velocity, track and speed, dynamics, performance metrics, raw IMU data, raw GPS data
Display Port	Low rate (1 Hz) UDP protocol output
Control Port	TCP/IP input for system commands
Data Port 1	Real-time (up to 200 Hz) UDP protocol output
Data Port 2	Buffered TCP/IP protocol output for data logging to external device

Serial RS232 I/O

5 COM Ports	User assignable to: NMEA output, Binary output, Auxiliary GPS input (2), Base GPS correction input (2)

NMEA ASCII Output

Parameters	NMEA Standard ASCII messages: Position ($INGGA, $INGGK), Heading ($INHDT), Track and Speed ($INVTG), Statistics ($INGST), Attitude ($PASHR, $PRDID), Time and Date ($INZDA, $UTC).
Rate	Up to 50 Hz (user selectable)

High Rate Attitude Output

Parameters	User selectable binary messages: attitude, heading, speed
Rate	Up to 100 Hz (user selectable)

Auxiliary GPS Inputs

Parameter	NMEA Standard ASCII messages: $GPGGA, $GPGST, $GPGSA, $GPGSV. Uses Aux input with best quality.
Rate	1 Hz

Base GPS Correction Inputs

Parameter	RTCM 1, 9, 18, 19, CMR and CMR+ input formats accepted. Combined with raw GPS observables in tightly-coupled navigation solution.
Rate	1 Hz

Digital I/O

1PPS Output	1 pulse-per-second Time Sync output, normally high, active low pulse
Event Input (2)	Time mark of external events. TTL pulses > 1 msec width, rising or falling edge, max rate 200 Hz.

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APPLANIX®
A TRIMBLE COMPANY

TETRA TECH, INC.

LOCKHEED MARTIN
We never forget who we're working for™

Leica GPS1200
Technical specifications and system features



GPS1200 receivers	GX1230 GG/ATX1230 GG	GX1230/ATX1230	GX1220	GX1210
GNSS technology	SmartTrack+	SmartTrack	SmartTrack	SmartTrack
Type	Dual frequency	Dual frequency	Dual frequency	Single frequency
Channels	14 L1 + 14 L2 GPS 2 SBAS 12 L1 + 12 L2 GLONASS 72 Channels	12 L1 + 12 L2 GPS 2 SBAS	12 L1 + 12 L2 GPS 2 SBAS (with DGPS option)	12 L1 2 SBAS (with DGPS option)
RTK	SmartCheck+	SmartCheck	No	No
Status indicators	3 LED indicators: for power, tracking, memory			

GPS1200 receivers	GX1230 GG/GX1230/GX1220	GX1210	ATX1230 GG/ATX1230
Ports	1 power port, 3 serial ports, 1 controller port, 1 antenna port		1 power/controller port, Bluetooth® port
Supply voltage,	Nominal 12 VDC		Nominal 12 VDC
Consumption	4.6 W receiver + controller + antenna		1.8 W
Event input and PPS	Optional:	Optional:	
	1 PPS output port	1 PPS output port	
	2 event input ports	2 event input ports	
Standard antenna	SmartTrack+ AX1202 GG	SmartTrack AX1201	SmartTrack+ ATX1230 GG
Built-in groundplane	Built-in groundplane	Built-in groundplane	Built-in groundplane

The following apply to all receivers except where stated.

Power supply	Two Li-Ion 3.8 Ah/7.2 V plug into receiver. One Li-Ion 1.9 Ah/7.2 V plugs into ATX1230 and RX1250.
Plug-in Li-Ion batteries Same for GPS and TPS	Power receiver + controller + SmartTrack antenna for about 15 hours (for data logging).
	Power receiver + controller + SmartTrack antenna + low power radio modem or phone for about 10 hours (for RTK/DGPS). Power SmartAntenna + RX1250 controller for about 5 hours (for RTK/DGPS)
External power	External power input 10.5 V to 28 V.
Weights	Receiver 1.20 kg. Controller 0.48 kg (RX1210) and 0.75 kg (RX1250). SmartTrack antenna 0.44 kg. SmartAntenna 1.12 kg. Plug-in Li-Ion battery 0.09 kg (1.9 Ah) and 0.19 kg (1.9 Ah).
	Carbon fiber pole with SmartTrack antenna and RX1210 controller: 1.80 kg.
	All on pole: carbon fiber pole with SmartAntenna, RX1250 controller and plug-in batteries: 2.84 kg.

Temperature ISO9022 MIL-STD-810F	Operation:	Receiver	−40° C to +65° C
	Antennas		−40° C to +70° C
	Controllers		−30° C to +65° C
	Storage:	Receiver	−40° C to +80° C
	Antennas		−55° C to +85° C
	Controllers		−40° C to +80° C
Humidity ISO9022, MIL-STD-810F	Receiver, antennas and controllers Up to 100 % humidity.		
Protection against water, dust and sand IP67, MIL-STD-810F	Receiver, antennas and controllers: Waterpoof to 1 m temporary submersion. Dust tight		
Shock/drop onto hard surface	Receiver: withstands 1 m drop onto hard surface. Antennas: withstand 1.5 m drop onto hard surface.		
Topple over on pole	Receiver, antennas and controllers: withstand fall if pole topples over.		
Vibrations ISO9022 MIL-STD-810F	Receiver, antennas and controllers: withstand vibrations on large construction machines. No loss of lock.		

MicroCAT C-T Recorder (Serial interface & Memory)

SBE 37-SM



The SBE 37-SM MicroCAT is a high-accuracy conductivity and temperature (pressure optional) recorder with internal battery and memory. Designed for moorings or other long duration, fixed-site deployments, the MicroCAT includes a standard serial interface and non-volatile FLASH memory. Construction is of titanium and other non-corroding materials to ensure long life with minimum maintenance, and depth capability is 7000 meters (23,000 feet).

Calibration coefficients are stored in EEPROM, and uploaded data is presented in ASCII engineering units. The data always includes Conductivity, Temperature, and Pressure (if optional pressure sensor is installed). If desired, time can be added to each scan, and the MicroCAT can calculate and output salinity and sound velocity (Chen-Millero). The MicroCAT retains the temperature and conductivity sensors used in our time-proven SEACAT products; however, new acquisition techniques provide increased accuracy and resolution while reducing power consumption. Electrical isolation of the conductivity electronics eliminates any possibility of ground-loop noise.

The MicroCAT's unique internal-field conductivity cell permits the use of expendable anti-foulant devices. The aged and pressure-protected thermistor has a long history of exceptional accuracy and stability.

The MicroCAT's optional pressure sensor, developed by Druck, Inc., has a superior new design that is entirely different from conventional 'silicon' types in which the deflection of a metallic diaphragm is detected by epoxy-bonded silicon strain gauges. The Druck sensor employs a micro-machined *silicon diaphragm* into which the strain elements are implanted using semiconductor fabrication techniques. Unlike metal diaphragms, silicon's crystal structure is perfectly elastic, so the sensor is essentially free of pressure hysteresis. Compensation of the temperature influence on pressure offset and scale is performed by the MicroCAT's CPU.

SENSOR INTERFACE ELECTRONICS

Temperature is acquired by applying an AC excitation to a hermetically-sealed VISHAY reference resistor and an ultra-stable aged thermistor (drift rate typically less than 0.002 °C per year). The ratio of thermistor resistance to reference resistance is determined by a 24-bit A/D converter; this A/D also processes the pressure sensor signal. Conductivity is acquired using an ultra-precision Wien-Bridge oscillator. A high-stability reference crystal with a drift rate of less than 2 ppm/year is used to count the frequency from the oscillator.

COMMUNICATIONS AND INTERFACING

The MicroCAT communicates directly with a computer via standard RS-232 interface. Data can be uploaded at up to 38.4K baud. Real-time data can be transmitted at distances of up to 1600 meters (5200 feet) at 600 baud, simultaneously with recording. An optional RS-485 interface allows multiple MicroCATs to share a common 2-wire cable, minimizing cable complexity for C-T chains.

User-selectable operating modes include:

- **Autonomous Sampling** – At pre-programmed intervals of 5 seconds to 9.1 hours, the MicroCAT wakes up, samples, stores the data in its FLASH memory, and goes to sleep.
- **Polled Sampling** – On command from a computer or satellite, radio, or wire telemetry equipment, the MicroCAT takes a sample and transmits the data.
- **Serial Line Sync** – In response to a pulse on the serial line, the MicroCAT wakes up, samples, stores the data in its FLASH memory, transmits real-time data, and goes to sleep.

SOFTWARE

The MicroCAT is supplied with a powerful Windows 95/98/NT/2000/XP software package, SEASOFT®-Win32, which includes:

- SEATERM® – terminal program for easy communication and data retrieval.
- SBE Data Processing® – programs for calculation, display, and plotting of conductivity, temperature, pressure (optional), and derived variables such as salinity and sound velocity.

SBE **Sea-Bird Electronics, Inc.**
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com
E-mail: seabird@seabird.com
Telephone: (425) 643-9866
Fax: (425) 643-9954

MicroCAT C-T Recorder (Serial interface and Memory) SBE 37-SM

DATA STORAGE AND BATTERY ENDURANCE

Converted temperature and conductivity are stored 5 bytes per sample, time 4 bytes per sample, and optional pressure 2 bytes per sample; memory capacity is in excess of 185,000 samples. The MicroCAT is powered by a 7.2 Ampere-Hour (nominal) battery pack consisting of six 9-volt lithium batteries which, when removed from the MicroCAT, can be shipped without hazardous material restrictions. The pack provides sufficient internal battery capacity for more than 300,000 samples. *

SPECIFICATIONS

Measurement Range
Conductivity: 0 - 7 S/m (0 - 70 mS/cm)
Temperature: -5 to 35 °C
Optional Pressure: 20/100/350/600/1000/2000/3500/7000 (meters of deployment depth capability)

Initial Accuracy
Conductivity: 0.0003 S/m (0.003 mS/cm)
Temperature: 0.002 °C
Optional Pressure: 0.1% of full scale range

Typical Stability *(per month)*
Conductivity: 0.0003 S/m (0.003 mS/cm)
Temperature: 0.0002 °C
Optional Pressure: 0.004% of full scale range

Resolution
Conductivity: 0.00001 S/m (0.0001 mS/cm)
Temperature: 0.0001 °C
Optional Pressure: 0.002% of full scale range

Time Resolution 1 second

Clock Accuracy 13 seconds/month

Quiescent Current * 10 microamps

Sampling and Communication Current *
Without external power option
Communication 38 milliamps
Sampling 20 milliamps for autonomous or serial line sync sampling; 39 milliamps for polled sampling
With external power option
Communication 35 milliamps
Sampling 35 milliamps

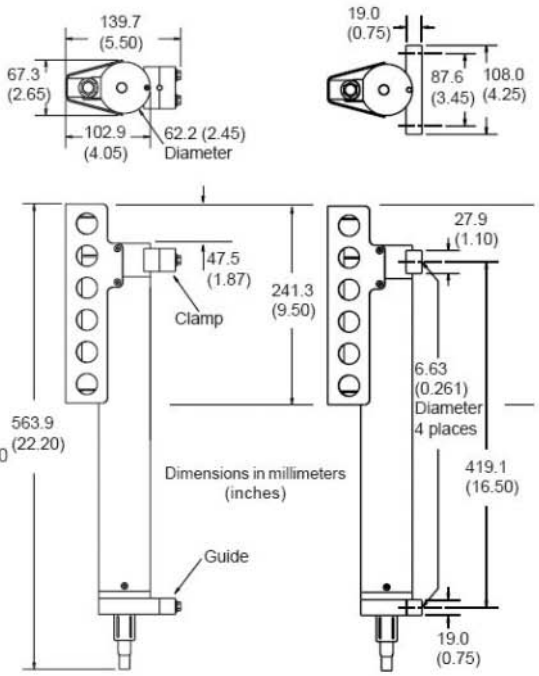
Acquisition Time 1 - 3 seconds/sample (for 1 measurement/sample), *dependent on sampling mode and inclusion of pressure sensor*

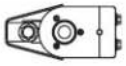
Optional External Input Power 0.5 Amps at 9-24 VDC

Housing Titanium

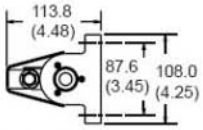
Depth Capability 7000 m (23,000 feet)

Weight
in air: 3.8 kg (8.3 lbs)
in water: 2.3 kg (5.1 lbs)

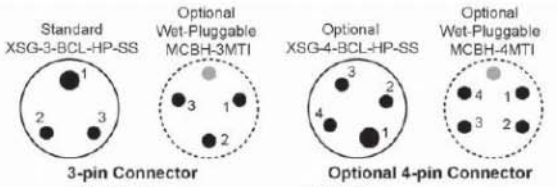




Standard Wire Mounting Clamp and Guide



Alternate Flat Surface Mounting Brackets



3-pin Connector

Pin	Signal
1	Common
2	RS-232 data receive
3	RS-232 data transmit

Optional 4-pin Connector

Pin	Signal
1	Common
2	RS-232 data receive
3	RS-232 data transmit
4	9-24 VDC (optional external power)

* Power consumption / battery endurance values are for standard RS-232 interface; for optional RS-485 interface, see RS-485 manual

05/05

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Website: http://www.seabird.com
E-mail: seabird@seabird.com
Telephone: (425) 643-9866
Fax: (425) 643-9954

Appendix C. Survey Log Sheets

TetraTech EC

Date:	5/20/2006	**Survey Area:**	Lockheed	**Page 1 / Pages:**	
Survey Name:	Thea Foss	**Surveyors:**	Bridge, Feldpausch	**TimeZone:**	GMT
Survey Vessel:	R/V Brendan D	**Client:**	Tetra Tech EC		

Offset Information

	X	Y	Z	Latency	Roll	Pitch	Yaw
Sounder	1.84	0.00	3.08	0.00	-0.30	0.00	4.00
RTK GPS	1.84	0.00	-11.78	0.00			
Motion Sensor	0.00	0.00	-4.50				
Other							

SVP File:
Tide File:

Date of Patch Test 5/10/2006

Total Pole	14.86
minus Dry Pole	11.78
Draft (Z)	3.08

Start	Stop	Line (.raw)	Dir.	Speed	COMMENTS
1748	1810	001_1748	108	2	Bad sound speed at head - don't use
1829	1857	001_1829	86	2	1480 m/sec from cast - check headings (possible C1911
1904	1911	001_1904	345	2.5	
1911	1933	001_1911	28	2	
1934	1941	001_1934	95	2	
1942	1949	001_1942	124	2	
1950	2008	001_1950	115	2	
2011	2017	001_2011	348	3	
2018	2028	001_2018	192	2	still seeing CMG in heading
2033	2039	001_2033	340	4	changed setup to put gyro in Hysweep
2040	2048	001_2040	173	2.7	
2117	2033	001_2117	285	2	
2134	2046	001_2134	85	2.5	chk headings for variations
2147	2157	001_2147	300	2.5	
2158	2208	001_2158	40	2	
2208	2218	001_2208	310	3	
2222	2233	001_2222	80	3.6	
2233	2237	001_2233	352	3.8	
2237	2241	001_2237	140	3	

Survey Manager: _____ Client Representative: _____
Signature: _____ Signature: _____

TetraTech EC

Date:	5/20/2006	**Survey Area:**	Lockheed	**Page 1 / Pages:**	
Survey Name:	Thea Foss	**Surveyors:**	Bridge, Feldpausch	**TimeZone:**	GMT
Survey Vessel:	R/V Brendan D	**Client:**	Tetra Tech EC		

Offset Information

	X	Y	Z	Latency	Roll	Pitch	Yaw
Sounder	1.84	0.00	3.08	0.00	-0.30	0.00	4.00
RTK GPS	1.84	0.00	-11.78	0.00			
Motion Sensor	0.00	0.00	-4.50				
Other							

SVP File: Lockheed 052006 16
Tide File: RTK GPS

Date of Patch Test: 5/20/2006

Total Pole	14.86
minus Dry Pole	11.78
Draft (Z)	3.08

Start	Stop	Line (.raw)	Dir.	Speed	COMMENTS
2254	2256	003_2254	250	3.8	pitch/yaw cal
2257	2259	003_2257	86	3.5	
2300	2301	005_2300	252	4.3	
2302	2304	005_2302	88	3.6	end cal
2327	2341	001_2327	73	3.5	re-start survey data collection
2341	2349	001_2341	249	3.1	
2350	2352	003_2350	29	2.7	

Survey Manager: _____ Client Representative: _____
Signature: _____ Signature: _____

Appendix D. Base Station Benchmark Description

WSDOT Survey Mark Report http://www.wsdot.wa.gov/monument/report.cfm?monumentid=6242

Washington State Department of Transportation **Geographic Services**

SURVEY INFORMATION SYSTEM Report of Survey Mark

GENERAL MONUMENT INFORMATION

Designation:	DUWAMISH	**T.R.S:**	24N, 3E , 2	
Monument ID:	6242	**Corner Code:**		
Ngs Pid:	SY4595	**State Route:**		
State:	WASHINGTON	**Mile Post:**		
County:	KING	**Station:**		
Region:	NW	**Offset:**		
Nearest Town:	SEATTLE	**Owner:**	GS	
Usgs Quad:	DUWAMISH HEAD	**Bearing:**	M	

ACCOUNTS INFORMATION

BOOK	PROJECT	INVOICE
253	MS4466	23-04006
264	XL2219	23-04021
296	XL2219	23-06020

Description

TO REACH THE STATION FROM THE JUNCTION OF SR 005 AND SPOKANE STREET IN SEATTLE, GO WEST 2.3 MILES ALONG SPOKANE STREET TO THE HARBOR AVENUE EXIT. BEAR RIGHT AND FOLLOW THE EXIT RAMP 0.2 MILES TO A 'T' INTERSECTION. TURN RIGHT AND GO NORTHWEST 2.0 MILES ALONG HARBOR AVENUE TO MARK ON RIGHT. IT IS LOCATED IN AN OLD CONCRETE SEA WALL SOUTH OF A SIDEWALK AND A SMALL PARK, 5.8 METERS EASTERLY OF TOP OF STAIRS, 4.9 METERS NORTH OF THE NORTH EDGE OF A SIDEWALK ADJACENT TO ALKI AVE, 15.2 METERS NORTHWEST OF THE CENTER OF HARBOR AVE SW, 9.1 METERS NORTHWEST OF A LIGHT POLE AND 7.0 METERS EAST OF A 1.5-INCH IRON PIPE. THE MARK IS A USC&GS TRIANGULATION STATION DISK SET IN A DRILL HOLE AND LEVEL WITH THE CONCRETE SEA WALL SURFACE.



CURRENT SURVEY CONTROL

DATUM	LATITUDE	UNIT	LONGTITUDE	UNIT	NETWORK	METHOD	ACCURACY
NAD 83/91	47 35 42.537420	N	122 23 14.845970	W	PRIMARY	GPS	2 CM
	ELLIP HGT						
NAD 83	-18.180	M				GPS	5 CM
	ORTHO HGT						
NAVD 88	5.244	M			PRIMARY	DIFF LEVELS	1 CM
SPC ZONE	NORTHING	UNIT	EASTING	UNIT	SCALE	CONV.ANGLE	COMB.FACTOR
N	67350.036	M	383128.343	M	0.99998361	-1 09 25.5	

MONUMENTATION HISTORY

DATE	RECOVERED BY	CONDITION

01/01/1933	USC&GS	MONUMENTED
01/01/1955	USC&GS	GOOD
01/01/1973	NGS	GOOD
05/17/1994	NOS	GOOD
02/26/2004	GEOGRAPHIC SERVICES	GOOD
08/06/2004	GEOGRAPHIC SERVICES	UPDATED
07/10/2006	GEOGRAPHIC SERVICES	GOOD

SUPERSEDED CONTROL

DATUM	LATITUDE	UNIT	LONGTITUDE	UNIT	NETWORK	METHOD	ACCURACY
	ORTHO HGT						
NAVD 88	5.2	M			PRIMARY	GPS	5 CM

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Washington State Department of Transportation **Geographic Services**

SURVEY INFORMATION SYSTEM **Report of Survey Mark**

GENERAL MONUMENT INFORMATION

Designation:	GP17099-241	**T.R.S:**	24N, 4E , 18		
Monument ID:	3296	**Corner Code:**			
State:	WASHINGTON	**State Route:**	099	**ACCOUNTS INFORMATION**	
County:	KING	**Mile Post:**	29.070	**BOOK**	**PROJECT** **INVOICE**
Region:	NW	**Station:**		152	0L3414 23-98015
Nearest Town:	SEATTLE	**Offset:**			
Usgs Quad:	SEATTLE SOUTH	**Owner:**	GS		
		Bearing:	M		

Description

TO REACH THE STATION FROM THE JUNCTION OF SR 099 AND SR 509 IN SOUTH SEATTLE, GO NORTHERLY 2.10 MILES ALONG SR 099 TO THE EAST MARGINAL WAY OFF-RAMP, TAKE THE OFF-RAMP AND GO NORTHERLY 0.53 MILES ALONG EAST MARGINAL WAY TO MARK ON LEFT. IT IS LOCATED IN THE WESTERLY SIDEWALK OF EAST MARGINAL WAY, APPROXIMATELY 60 METERS NORTH OF THE 'T' INTERSECTION WITH HORTON STREET, 6.3 METERS @ 55 DEGREES FROM A ELECTRICAL RISER BOX, 6.5 METERS @ 160 DEGREES FROM A MANHOLE COVER IN SIDEWALK, 2.1 METERS @ 240 DEGREES FROM THE EAST FACE OF THE WEST SIDEWALK AND 12.9 METERS @ 335 DEGREES FROM THE SOUTHEAST CORNER OF THE SIDEWALK. MARK IS A WSDOT BRASS DISK CEMENTED INTO A DRILL HOLE AND SET LEVEL WITH THE CONCRETE SURFACE. NOTE: THIS STATION SIGHTS GP17099-242.



CURRENT SURVEY CONTROL

DATUM	LATITUDE	UNIT	LONGTITUDE	UNIT	NETWORK	METHOD	ACCURACY
NAD 83/91	47 34 29.040571	N	122 20 24.431981	W	PRIMARY	GPS	2 CM
	ELLIP HGT						
NAD 83	-18.657	M				GPS	5 CM
	ORTHO HGT						
NAVD 88	4.669	M			PRIMARY	DIFF LEVELS	1 CM
SPC ZONE	NORTHING	UNIT	EASTING	UNIT	SCALE	CONV.ANGLE	COMB.FACTOR
N	65009.837	M	386643.247	M	0.99998690	-1 07 18.6	

MONUMENTATION HISTORY

DATE	RECOVERED BY	CONDITION

03/03/1998	GEOGRAPHIC SERVICES	MONUMENTED

SUPERSEDED CONTROL

DATUM	LATITUDE	UNIT	LONGTITUDE	UNIT	NETWORK	METHOD	ACCURACY
	ORTHO HGT						
NAVD 88	4.708	M			PRIMARY	DIFF LEVELS	1 CM

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APPENDIX C

SAMPLING AND ANALYSIS PLAN

LOCKHEED

WEST SEATTLE SUPERFUND SITE

SITE CHARACTERIZATION SAMPLING AND ANALYSIS PLAN

Revised Draft

Prepared for

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Prepared by

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December 2007

GREEN DOVE AWARD ISO 14001 SGS

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1. INTRODUCTION

This Site Characterization Sampling and Analysis Plan (SC SAP) is a component of the Remedial Investigation/Feasibility Study Work Plan for the Lockheed West Seattle Superfund Site. This SC SAP is submitted on behalf of Lockheed Martin Corporation (LMC). This SC SAP describes a sampling and analysis plan approach for the Lockheed West Site and has been prepared as a stand-alone document to expedite collection of site data. EPA comments on the draft site investigation approach have been incorporated in to the study design in this SC SAP. As agreed with EPA, collection of additional site data early in the site cleanup process will better inform decision making and determination of appropriate cleanup measures.

Risk assessments underway on the Lower Duwamish River Superfund Site have concluded that the cleanup levels mandated under the Washington State Sediment Management Standards (SMS;WAC 173-204) may not meet EPA risk tolerances for certain contaminants when site-specific input assumptions are used. Given this finding, no-action and natural recovery remediation alternatives are infeasible for meeting risk-based cleanup levels and that more active remediation alternatives would be required throughout the extent of contaminated sediments on the Lockheed West site. At the minimum, remediation of the site would consist of placing caps over all contaminated sediments. Other remediation approaches, such as dredging, may also be implemented if site conditions warrant their use. The purpose of performing the site characterization sampling is to support the streamlined RI/FS in light of remedial plans for the site. Specifically, the purpose of the investigation is to:

- Collect a comprehensive sediment quality data set to determine the nature and extent of sediment contamination resulting from historical releases at the Former Lockheed Shipyard No. 2 (Lockheed West) in support of developing risk-based cleanup goals and determining an appropriate remediation alternative for the site.
- Collect data representative of both the surface and subsurface sediment quality condition.
- Refine site conceptual model based on new sampling and analysis results,
- Identify and characterize (based on sampling and analysis of sediment quality samples) representative Range Finding for Background locations in and about the Elliott Bay system in support of developing appropriate potential cleanup goals for the site,

- Delineate cleanup boundary for the site,
- Identify areas within the cleanup boundary that are suitable for sediment capping and or dredging considering chemical concentrations, physical environment and future site use considerations, and
- Perform supplemental tests and analyses where appropriate to determine effectiveness of capping and dredging using collected data.

The focus of this SC field sampling is the field data collection that will be used to characterize the nature and extent of potential sediment contamination during Winter 2007. The field data collection for the intertidal areas will be conducted during daylight low tides (Spring 2007). In addition, the spring sampling effort may be used to fulfill data gaps identified during the initial data collection.

2. SAMPLING AND ANALYSIS

2.1 OVERVIEW OF SEDIMENT SAMPLING AND ANALYSIS

The rationale for the proposed sampling approach is based on the assessment of existing data and identification of data gaps (see Section 4.7 of the Work Plan). EPA's seven step Data Quality Objectives (DQOs) process was followed to develop all the data collection efforts (e.g., Guidance on Systematic Planning using the Data Quality Objectives Process (QA/G-4), EPA 240/B-06/001 Feb 2006), and provides the technical and decision-making basis for the collection of all proposed data.

Field data collection will be to characterize the nature and extent of the contamination. The sampling effort includes collection and analysis of subtidal subsurface samples, subtidal subsurface samples, intertidal surface samples, range finding for background samples, and a topographic survey to tie the banks in with the multibeam bathymetry data. Field samples collected will be analyzed for contaminants of interest (COIs) listed in Table 2-1. As part of the subtidal subsurface sampling, duplicate cores will be collected for potential contaminant mobility testing and duplicate cores for evaluation of disposal options for dredged material. The analysis of contaminant mobility samples will follow the receipt and evaluation of the data from the initial sampling.

A synopsis of the SC field program is provided below. Samples are located beyond the property boundary to assess the extent of the nature and extent of the contamination from the former shipyard to support the proposed remedial alternatives. Samples are not located beyond the adjacent Puget Sound Resources (PSR) Superfund site boundary (Figure 2-1) because remedial actions (sediment capping) have been recently completed in this area of the site. The PSR site boundary presented is based on the cap boundary shown in the Final Design Submittal, Pacific Sound Resources Superfund Site Marine Sediment Unit, Seattle, Washington dated 2/3/2003. The boundary of the PSR cap (as depicted in the drawings) is evident in the recent hydrographic survey of the LW site. Surface data collected for the SC will be used to define remediation areas. Subsurface data will be used to define the maximum potential dredging depth.

2.2 IDENTIFY EXTENT OF SEDIMENT CONTAMINATION EXCEEDING PRGS

Sediment sampling and analysis will be performed in accordance with the SOW for the purpose of identifying the nature and extent of chemical contamination in sediment at the site.

Sediment sampling will be performed in the general vicinity of the Lockheed West property boundaries. Sample locations are extended beyond the property boundary to assess the nature and extent of contamination from the former shipyard.

Sediment samples will include surface (0 to 10 cm) grab samples and subsurface core samples. All sampling, handling, and analyses will be performed in general accordance with EPA-recommended methodology and PSEP protocols as outlined in the standard operating procedures included in Attachment 1. The proposed sampling program includes evaluation of intertidal and subtidal surface and subsurface samples for the COPCs. Sediment sampling will be performed at 51 locations throughout the Site as shown on Figure 2-1. Subsurface and co-located surface sediment sampling will be performed at 35 locations, surface sediment sampling only will be performed at 7 locations, and up to nine discrete intertidal bank surface samples will be collected along the shoreline. The sample locations and rationale are included in Table 2-1.

2.2.1 Surface Sediment Samples

Sample locations have been selected to be representative of the range of surface sediment conditions at the Site and to provide adequate spatial coverage based on the historical site uses. Surface samples will be used for bulk chemical analysis and to assist in evaluation of remedial alternatives.

Surface sediment samples will be collected to determine the horizontal extent of COIs. COIs consist of the parameters listed in Table 2-1, including bulk sediment TBT and supporting conventional parameters.

The proposed surface sediment samples are comprised of the top 0 to 10 cm at two types of locations:

- Forty-two surface samples collected from the subtidal areas of Lockheed West; and
- Up to nine representative samples will be collected from the intertidal bank areas of Lockheed West and analyzed for COIs.

Background samples (locations were determined in conjunction with EPA) will be collected in and around Elliot Bay.

Subtidal Sediment Samples. A total of 42 surface samples, representative of the upper 10 cm of sediment, will be collected at 42 locations in the subtidal area for the purposes of determining surface sediment quality and establishing the locations of chemical “hot spots.”

Table 2-1. Sample Locations, Analysis, and Rationale

Location	Type	Proposed Easting[1]	Proposed Northing[1]	Mudline Elevation (MLLW)	Sample Depth (Feet)[2]	Target Elevation (MLLW)	Conventionals[3]	metals	SVOC	PCB	Pesticides	TBT bulk	Archive for PCB/Dioxin	Porewater[4]	Geotechnical[5]	Contaminant Mobility[6]	PSDDA Cores	Work Area	Rationale
1	Core and Grab	1263235.3	216012.3	-8.3	16	-24.3	x	x	x	x	x	x	x		x		1	Future POS Terminal (1a)	On slope to assess the area south of the CSO. Expected future POS slope is 1:1.75 side cut on slopes. Collect duplicate core to evaluate for PSDDA suitability.
2	Core and Grab	1263355.3	216056.9	-40.4	12.6	-53.0	x	x	x	x	x	x	x				1	Future POS Terminal (1a)	Off shore to assess the outer limits of CSO and surface sediment quality. Collect duplicate core to evaluate for PSDDA suitability.
3	Core and Grab	1263351.9	216274.6	-24.8	28.2	-53.0	x	x	x	x	x	x	x	x	x		1	Future POS Terminal (1a)	Off shore to assess the outer limits of CSO and surface sediment quality. Collect duplicate core to evaluate for PSDDA suitability.
4	Core and Grab	1263249.0	216267.8	0.0	20	-20.0	x	x	x	x	x	x	x		x		1	Future POS Terminal (1a)	On slope to assess the CSO and surface sediment quality. Expected future POS slope is 1:1.75 side cut on slopes. Collect duplicate core to evaluate for PSDDA suitability.
27	Core and Grab	1263334.8	216515.7	-14.9	38.1	-53.0	x						x		x		1	Future POS Terminal (1a)	On slope to assess the surface sediment quality. Collect duplicate core to evaluate for PSDDA suitability.
28	Grab	1263421.0	215964.3	-51.9	10 cm grab	--	x	x	x	x	x	x	x					Future POS Terminal (1a)	Surface grabs added to bound surface contamination in West Waterway.
29	Core and Grab	1263446.7	216397.7	-41.4	11.6	-53.0	x	x	x	x	x	x	x		x			Future POS Terminal (1a)	Added to bound extent of contamination in West Waterway.
5	Core and Grab	1263211.3	216573.8	-3.3	6.1	-9.4	x	x	x	x	x	x	x		x		1	Eastern Drydock; Future POS Terminal (1b)	On slope to assess the surface sediment quality. Expected future POS slope is 1:1.75 side cut on slopes. Collect sediment to evaluate for PSDDA suitability
6	Core and Grab	1263339.9	216644.1	-41.5	11.5	-53.0	x	x	x	x	x	x	x		x	1		Eastern Drydock; Future POS Terminal (1b)	Assess Eastern Drydock area
7	Core and Grab	1263202.7	216848.1	-6.4	5	NA	x	x	x	x	x	x	x					Eastern Drydock; Future POS Terminal (1b)	On slope to assess the surface sediment quality. Expected future POS slope is 1:1.75 side cut on slopes.
8	Core and Grab	1263398.2	216875.6	-40.1	12.9	-53.0	x	x	x	x	x	x	x		x	1		Eastern Drydock; Future POS Terminal (1b)	Assess Eastern Drydock area
30	Core and Grab	1263479.5	216815.7	-51.4	1.6	-53.0	x	x	x	x	x	x	x					Eastern Drydock; Future POS Terminal (1b)	Added to bound spatial contamination in West Waterway.
9	Core and Grab	1263319.7	217126.0	-41.1	11.9	-53.0	x	x	x	x	x	x	x	x	x	1		Eastern Drydock; Future POS Terminal (2a)	Near the 3 cores SB-1, D5, and M1 because of the inconsistencies of previous sample results.
31	Core and Grab	1263489.1	217144.2	-50.4	2.6	-53.0	x	x	x	x	x	x	x		x			Eastern Drydock; Future POS Terminal (2a)	Added to bound extent of contamination in West Waterway.
10	Core and Grab	1263358.7	217312.7	-28.7	24.3	-53.0	x	x	x	x	x	x	x		x	1		North of Eastern Drydock (2b)	Assess the mound north of the former drydock location.
11	Core and Grab	1263355.3	217629.9	-40.0	13.0	-53.0	x	x	x	x	x	x	x			1		North of Eastern Drydock (2b)	collected previously in this vicinity).
42	Core and Grab	1263524.1	217658.5	-49.9	3.1	-53.0	x	x	x	x	x	x	x	x				North of Eastern Drydock (2b)	Cores added to bound surface contamination in West Waterway.
32	Core and Grab	1263476.2	217485.2	-42.2	10.8	-53.0	x	x	x	x	x	x	x					North of Eastern Drydock (2b)	Cores added to bound surface contamination in West Waterway.
33	Core and Grab	1263473.0	217836.1	-46.7	6.3	-53.0	x	x	x	x	x	x	x					North of Eastern Drydock (2b)	Cores added to bound surface contamination in West Waterway.
12	Core and Grab	1263045.0	217804.8	-41.9	11.1	-53.0	x	x	x	x	x	x	x			1		Western Former dry dock (3)	Beyond the dredge cut on the north end has uncharacterized surface sediments. Cores (12 and 13) added at north end to assess surface sediment quality and vertical contamination
13	Core and Grab	1263226.7	217789.3	-45.2	7.8	-53.0	x	x	x	x	x	x	x	x		1		Western Former dry dock (3)	Beyond the dredge cut on the north end is a deep collection area (deposition/sink). Cores (12 and 13) added at north end to assess surface and vertical contamination
15	Core and Grab	1263190.7	217485.9	-45.3	7.7	-53.0	x	x	x	x	x	x	x	x	x	1		Western Former dry dock (3)	Assess drydock area and uneven bathymetry looking at an elevation lower than Location 17
16	Core and Grab	1262974.0	217215.4	-35.7	17.3	-53.0	x	x	x	x	x	x	x			1		Western Former dry dock (3)	Assess drydock area along western border
17	Core and Grab	1263173.6	217124.1	-43.8	9.2	-53.0	x	x	x	x	x	x	x		x	1		Western Former dry dock (3)	Assess drydock area and uneven bathymetry looking at an elevation higher than Location 15
18	Core and Grab	1263065.6	216957.8	-17.7	10	NA	x	x	x	x	x	x	x					Western Former dry dock (3)	Close to shore to assess slope
40	Grab	1263275.8	217499.2	-29.2	10 cm grab	--	x	x	x	x	x	x	x					Western Former dry dock (3)	Two additional surface grabs are proposed along historic pier location; no other grabs proposed, as area is well characterized on the surface by the co-located grab/cores.
41	Grab	1263254.0	217086.8	-31.8	10 cm grab	--	x	x	x	x	x	x	x					Western Former dry dock (3)	Two additional surface grabs are proposed along historic pier location; no other grabs proposed, as area is well characterized on the surface by the co-located grab/cores.
14	Core and Grab	1262951.6	217517.9	-25.0	28.0	-53.0	x	x	x	x	x	x	x					Former Mooring Area (4)	Assess historic pier location
19	Core and Grab	1262835.8	216971.6	-17.1	10	NA	x	x	x	x	x	x	x					Former Mooring Area (4)	Close to shore to assess slope
20	Grab	1262787.8	217299.0	-27.3	10 cm grab	--	x	x	x	x	x	x	x	x				Former Mooring Area (4)	Confirm results from SA6 core, G8 core, and HC-03-06 surface sample area with metals and PCBs on surface.
21	Grab	1262535.8	217309.3	-33.6	10 cm grab	--	x	x	x	x	x	x	x					Former Mooring Area (4)	Assess surface sediment
22	Core and Grab	1262909.5	217693.3	-42.2	10.8	-53.0	x	x	x	x	x	x	x					Former Mooring Area (4)	Located in deeper hole near G9 surface sample, cores HC-03-17 and 30-1-197 to assess vertical and spatial contamination
23	Core and Grab	1262647.2	217737.9	-45.4	7.6	-53.0	x	x	x	x	x	x	x					Former Mooring Area (4)	Assess vertical contamination. Located in an area without historical sample data.
24	Core and Grab	1262314.6	217455.0	-26.3	10	NA	x	x	x	x	x	x	x					Shipway (5)	Determine spatial and vertical boundary of PAH and SVOCs
25	Core and Grab	1262285.5	217268.2	-25.9	10	NA	x	x	x	x	x	x	x	x				Shipway (5)	Assess area in between pier and shipway pilings
26	Core and Grab	1262410.5	217033.0	-28.7	10	NA	x	x	x	x	x	x	x					Former Mooring Area (5)	Close to shore to assess slope adjacent to pier
34	Core and Grab	1263466.5	218102.6	-51.1	1.9	-53.0	x	x	x	x	x	x	x					North Boundary (6)	No exceedances at depth. Samples added to bound spatial contamination.
35	Core and Grab	1263141.5	218021.3	-47.7	5.3	-53.0	x	x	x	x	x	x	x					North Boundary (6)	No exceedances at depth. Samples added to bound spatial contamination.
36	Grab	1262978.6	218051.8	-53.9	10 cm grab	--	x	x	x	x	x	x	x					North Boundary (6)	No exceedances at depth. Samples added to bound spatial contamination.
37	Core and Grab	1262771.1	217930.3	-39.4	13.6	-53.0	x	x	x	x	x	x	x					North Boundary (6)	No exceedances at depth. Samples added to bound spatial contamination.
38	Grab	1262637.1	217984.6	-66.9	10 cm grab	--	x	x	x	x	x	x	x					North Boundary (6)	No exceedances at depth. Samples added to bound spatial contamination.
39	Core and Grab	1262481.9	217819.9	-43.6	9.4	-53.0	x	x	x	x	x	x	x					North Boundary (6)	No exceedances at depth. Samples added to bound spatial contamination.
IT-1	Intertidal Grab[7]	1263183.4	216096.7	NA	10 cm grab	--	x	x	x	x	x	x	x					Future POS Terminal	Sandy Seep Area
IT-2	Intertidal Grab[7]	1263188.2	216179.1	NA	10 cm grab	--	x	x	x	x	x	x	x					Future POS Terminal	Sandy Seep Area
IT-3	Intertidal Grab[7]	1263242.0	216345.1	NA	10 cm grab	--	x	x	x	x	x	x	x					Future POS Terminal	Sandy area near Florida Street Outfall
IT-4	Intertidal Grab[7]	1263166.8	216686.4	NA	10 cm grab	--	x	x	x	x	x	x	x					Eastern Drydock; Future POS Terminal	Seep area
IT-5	Intertidal Grab[7]	1262714.3	216934.3	NA	10 cm grab	--	x	x	x	x	x	x	x					Former Mooring Area	Sandy area under pier (Pier 23)
IT-6	Intertidal Grab[7]	1262330.4	216973.0	NA	10 cm grab	--	x	x	x	x	x	x	x					Former Mooring Area	Sandy area near pier (pier adjacent to shipway)
IT-7	Intertidal Grab[7]	1262269.1	217020.6	NA	10 cm grab	--	x	x	x	x	x	x	x					Shipway	Sandy area within shipway
IT-8	Intertidal Grab[7]	1262188.8	217026.5	NA	10 cm grab	--	x	x	x	x	x	x	x					Shipway	Sandy area within shipway
IT-9	Intertidal Grab[7]	1262149.9	217106.8	NA	10 cm grab	--	x	x	x	x	x	x	x					PSR interface	Sample to assess surface sediments at edge of PSR capping area

Notes:

1 Target locations, actual location will be determined in the field.

2 Most cores will be pushed to approximately -53 MLLW or to a maximum of 20 feet. Cores along POS Terminal slope will be pushed to slope cut. Cores located in probable cap area will be pushed to 10 ft.

3 Conventional analysis includes total solids, grain size, and TOC.

4 Analysis of porewater will be conducted on the surface grab sample.

5 Atterberg Limits will be analyzed on samples within the potential dredge prism and should primarily consist of clays, therefore to be determined in the field. Specific gravity will be analyzed on each startigraphy layer of cores located within the dredge prism.

6 Contaminant mobility samples will be a composite sample of core increments located within the dredge prism as well as a surface water sample.

7 Intertidal Bank Samples (IT-1 though IT-9) will be collected during a daylight low tide in the second phase of field work.

Legend

1998 and Earlier Sampling Locations

- Surface Grab
- Subsurface Core
- PSR RI STNS Points

2003 Sampling Locations

- Surface Grab

2006 Sampling Locations

- Proposed Surface Grabs
- Proposed Subsurface Cores and Co-located Surface Grabs
- Proposed Intertidal Sampling Location

Upland MW Locations

- Existing Well Location
- Historical Well Location
- Property Boundary
- 10 Foot Contours
- Pacific Sound Resources Superfund Site (approx)
- Western Waterway OU (approx)

N

0 125 250 500 Feet

P:\projects 2006\Lockheed\maps\Figure1_GB.mxd

1. 1998 and earlier sampling locations from SEDQUAL or transposed from plan sheet.
2. Multibeam Bathymetry Survey conducted by TtEC on May 20, 2006 using a RESON SeaBat 8125 system. Datum: State Plane NAD 83, Projection: WA-4601 Washington North, Units: US Survey Feet
3. Vertical Datum: Port of Seattle, MLLW= NAVD88 - 2.59
4. Approximate intertidal sampling locations considering sediment availability and seeps areas. Exact locations to be determined in the field.

TETRA TECH

Lockheed West Shipyard No. 2 Seattle, WA

Figure 2-1 Existing and Proposed Sediment Sampling Locations

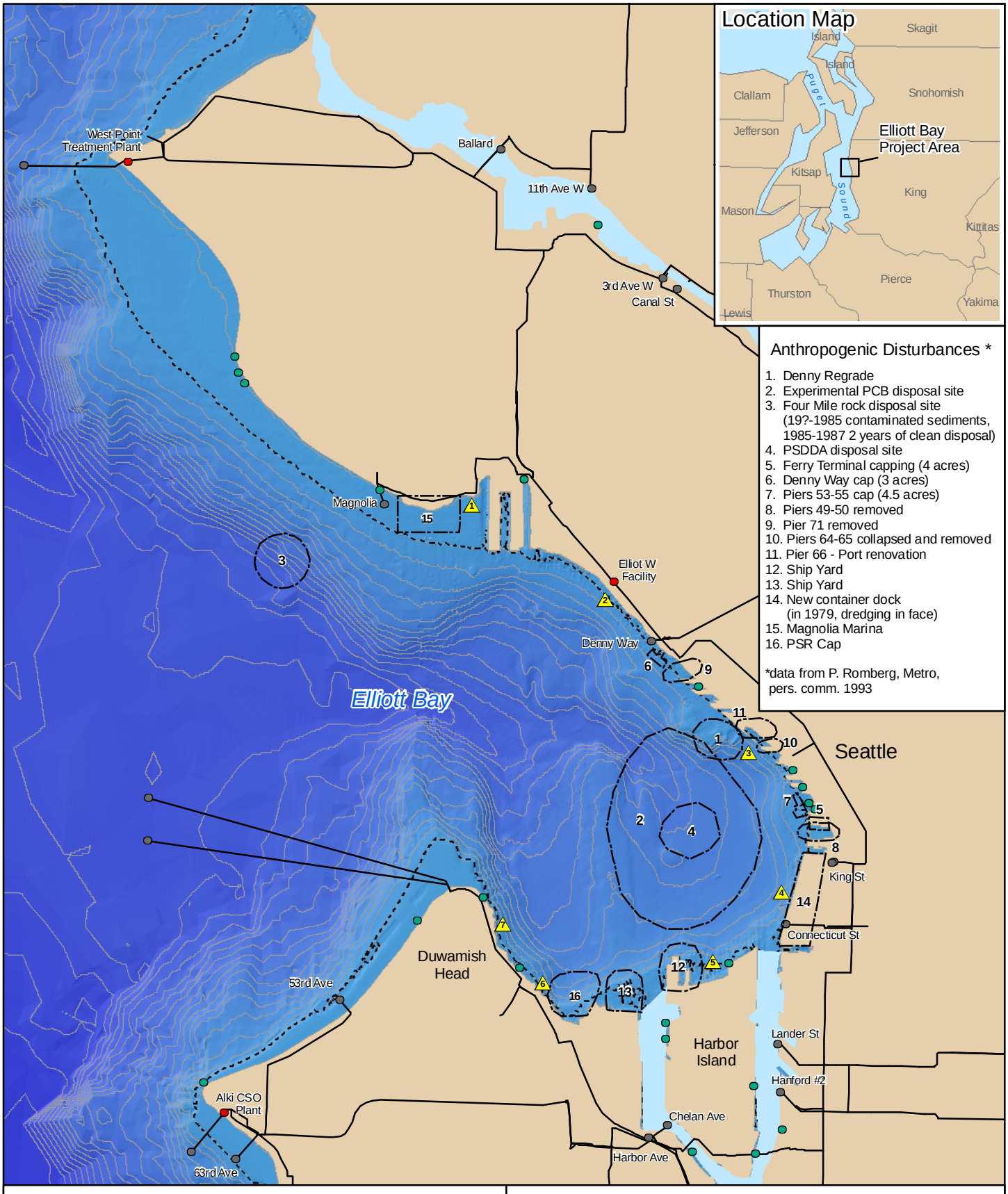

Figure 2-2
Range Finding Background Locations

Samples collected from the subtidal portion of the Site will be collected using a van Veen grab sampler deployed from a work vessel.

Surface samples have been placed outside of the property boundary to the north and east to evaluate and bound the spatial extent of contamination.

Surface sampling will be conducted during the early part of the field effort to ensure that the surface sediments are undisturbed and not impacted by the other RI field activities.

Intertidal Bank Samples. Waterway bank areas are representative of nearshore surface sediments that may be impacted by eroding banks, historical and current outfalls, seeps, or surface runoff. These areas are also subject to deposition of suspended particulate material that may be resuspended during storm events, from vessel wakes, or during dredging within the waterway. No data exist on the condition of the banks. Intertidal samples will be collected for the purpose of determining the sediment chemical concentrations and extent of sandblast grit, defining the location of chemical "hot spots," and determining the intertidal sediment physical characteristics. These data will also provide data that will define the upper (shoreward) boundary of the sediments in Lockheed West.

Based on a visual survey of the Lockheed West bank areas, several sampling areas have been identified where discrete intertidal bank samples will be collected (Figure 2-1). Intertidal bank samples will be collected with bowls and spoons during a daytime low tide to allow field personnel to assess the slope and substrate for optimal sampling locations.

To characterize the upper portion of the slope (intertidal zone), up to nine discrete samples are proposed along the Site shoreline bank (locations IT-1 though IT-9). Each sample will be analyzed for COIs. The samples will be collected from the top 10 cm of silt and/or sand, either at the sediment/riprap interface at the top of the slope or along the exposed bank slope if no riprap is present. The proposed bank locations are shown on Figure 2-1. The rationale for each location is included in Table 2-1. The actual sampling locations will be determined in the field, based on the results of the low tide habitat and structure survey. Areas that will be avoided are rip rap and areas with little sediments. In the event that a suspected source material is identified, the location will be documented, a discrete sample will be collected, and EPA will be notified. A sufficient volume of sediment will be collected for the COIs. The location of each discrete sample, tidal elevation, material description, and identification of suspected source material will be documented and presented in the RI Data Collection Report.

2.2.2 Subsurface Sediment Sampling and Analysis

Subsurface Sampling. Subsurface sampling will be performed primarily using a vibracore system. The coring system will be operated from a work vessel

Data gathered from the subsurface cores will be used for characterization of the subsurface material, sediment chemical characterization, and optional dredgability and contaminant mobility testing. Sample locations have been selected systematically to provide adequate spatial coverage of the Site based on historical site uses and previous sediment core results.

Most subsurface cores will be advanced beyond the deepest extent of PRG exceedances indicated by the existing data or to native material, expected to be an approximate elevation of -45 feet MLLW, which is the historical dredging depth to a maximum of 20 feet in length. Several cores will be advanced to -53 MLLW, the maximum depth potentially required for navigation. The primary objective will be to determine the vertical extent of sediment potentially requiring remediation. No cores will be longer than 20 feet, as the depth of contamination from shipyard activities is not expected to be buried 20 feet below the existing surface.

Collection of duplicate cores in the area south of the property boundary along the West Waterway may also be used to support a preliminary evaluation to assess potential Port of Seattle development options. These locations include Stations 1 through 5 and 27 (Table 1). The Port of Seattle may expand Terminal 5 into this area. The duplicate cores can provide information about preliminary disposal options. If this preliminary evaluation indicates that the potential dredge material may be disposed of at an open water disposal site, LMC will discuss the need for a full PSDDA characterization with EPA.

Collection of duplicate cores in areas where removal may be a feasible remedial option will allow for the formation of a sediment composite representative of the potential dredge prism to be analyzed for contaminant mobility.

Chemistry Sample Collection. Subsurface sediment cores will be collected at 37 co-located surface sample locations to determine the vertical extent of chemical concentrations in subsurface sediment exceeding the SQS or CSL chemical criteria and to determine volumes of sediment that may require remediation (Table 2-1). The primary objective will be to determine the vertical extent of sediment requiring remediation down to native material or a maximum elevation of -53 MLLW. This is the deepest elevation that would be required for navigation. Therefore, based on site bathymetry and proposed locations, cores will range from approximately 7.5 to 20 feet in length. Each subsurface core will be logged and subsampled in the field. A certified geologist will conduct the visual classification of the

sediment cores. The core logging will include the description of grain size, sediment consistency, and location of native sediments (if possible) to aid in the evaluation of dredging suitability.

Sample intervals will be identified first based on sediment stratigraphy then by 1-foot intervals with consideration of required volumes for chemical analyses. Therefore, a 20-ft long core may be divided up into 20 samples. A minimum of two sample intervals will be analyzed from each core with the remaining samples archived. Selection of samples to be submitted for chemical analyses will be representative of the various subsurface sediment types observed based on the visual observations and core logs. A relatively uniform subsurface sediment stratigraphy is expected within the Lockheed West site; therefore, an estimated two to three sediment sample intervals from each core will likely be submitted for chemical analysis. As co-located surface sediment samples (0 to 10 cm) will be collected at each core location, an estimate of four samples (three core intervals and one surface) may be submitted for analysis at each location. The remaining core intervals will be collected and archived and held under chain of custody for determination as to which additional samples may need to be submitted for analysis.

Contaminant Mobility Sample Collection. Duplicate subtidal cores from the potential dredge area will be archived pending review of sediment chemistry results (Table 2-1). One to two sediment composite samples representative of the potential dredge prism will be created from the duplicate archived cores to support sediment contaminant mobility testing. Based on a review of sediment stratigraphy, sediment chemistry results, and dredging plan specifics, a volume weighted sediment composite sample (e.g., equal volume of sediment for each depth interval that may require removal) will be created that is representative of sediments that may require removal from the subtidal area. Multiple cores may be necessary at any one location to collect adequate volumes for the planned analyses. The sediment composite sample will be submitted for analysis. Contaminant mobility testing performed on the sediment composite includes a Column Settling Test (CST) and a Dredging Elutriate Test (DRET) to provide an assessment of contaminant mobility testing during dredging and aquatic confinement and disposal (i.e., thick capping, capped aquatic disposal, or upland disposal).

2.2.3 Background

Proposed cleanup actions at the Lockheed West site requires characterization of background sediment quality conditions. Background sediment quality concentrations for the Lockheed West chemicals of concern will be used as site cleanup objectives if risk-based cleanup

numbers derived from the site-specific human health and ecological risk assessments are calculated to be below the background. Sampling and analysis of the proposed locations will be performed in conjunction with the surface sediment sampling effort.

Objective for selection of urban background sediment quality sampling locations:

- Sample areas that are representative of the overall ambient sediment quality condition
- Sample in areas that do not have a potential to be biased by known or suspected contaminant sources
- Sample at depth ranges comparable to those of Lockheed West Site (i.e., < 45 feet MLLW)
- Sample sediments that are comparable to those of Lockheed West Site (e.g., %TOC, grain size)

Locations and Rationale:

Proposed Elliott Bay background sediment concentration sampling locations are presented on Figure 2-2. Rationale for selection of the proposed locations is presented below.

- Sampling Location 1 is representative of northern Elliott Bay and is the same as the LDW background site 2. This site is situated near the Magnolia marina and Terminals 90 and 91 and will be located at depths that are comparable to those of Lockheed West. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination.
- Sampling Location 2 is representative of northern Elliott Bay and is the same as the PSR background location "BK02". This location is situated along a municipal park and is at depths that are comparable to those at Lockheed West. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. The location is not situated within an area to have been subject to anthropogenic disturbances. The nearest industrial use is the Port of Seattle bulk grain loading facility.
- Sampling Location 3 is representative of the eastern portion of Elliott Bay. This location is situated along the central waterfront of Downtown Seattle. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. The location is not situated within an area to have been subject to anthropogenic disturbances. Uses of areas near the sampling location are primarily commercial and maritime transportation.

- Sampling Location 4 is representative of the southeastern portion of Elliott Bay. This location is situated along the large container dock south of the central waterfront of Downtown Seattle. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. The location is situated within an area that was last dredged in 1979. Uses of areas near the sampling location are primarily commercial and maritime transportation.
- Sampling location 5 is representative of the southern portion of Elliott Bay. This location is situated along the north shore of Harbor Island. The location is not in the immediate vicinity of known outfalls. The nearshore and onshore areas located near the site are used for maritime commerce purposes such as tug boat storage and shipbuilding. The location is not situated within an area to have been subject to anthropogenic disturbances. Sediment cleanup has been completed at the shipyard facility to the west of the proposed sampling location.
- Sampling location 6 is representative of southwestern Elliott Bay. This location is situated along the west shore Harbor Avenue. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. Uses of areas near the sampling location are primarily public access, municipal parks, and commercial businesses. The location is not situated within an area to have been subject to anthropogenic disturbances. Sediment cleanup has been completed at the PSR facility to the east of the proposed sampling location.
- Sampling Location 7 is representative of western Elliott Bay. This location is situated along the west shore Harbor Avenue. This location is not in the immediate vicinity of known outfalls or industrial use areas that may provide point sources of contamination. Uses of areas near the sampling location are primarily public access, municipal parks, and commercial businesses. The location is not situated within an area to have been subject to anthropogenic disturbances.

Sampling Approach

Surface sediment samples (0 to 10 cm) will be collected from the proposed locations using a grab- type sampling device deployed from a work vessel. On collection, sediment samples will be observed to ensure that the sampling objectives (described above) are met. Acceptable samples will be submitted to the analytical laboratory for chemical analysis. In the event a given sample location does not yield a sample meeting the above objectives, a second attempt will be made at an alternative location in the vicinity of the proposed location. In the event the second sample location does not yield a sample meeting the above objectives,

a third attempt will be made at an alternative location in the vicinity of the proposed location. In the event the third offset sample is found to be unacceptable then the proposed location will not be sampled.

2.2.4 Physical Testing

Characterization of the physical properties of the Lockheed West sediments will be accomplished to provide the information necessary for an evaluation of remedial options. Physical properties analysis of the sediments will be conducted on selected samples to identify and estimate the dredge and disposal characteristics of sediments likely requiring removal and confinement. Physical characterization testing will include the following:

- PSEP grain size, percent solids, and TOC will be determined at all surface and subsurface locations (conventional analyses).
- In addition, selected samples from the subsurface cores will be submitted for:
  - Atterberg limit determinations by American Society for Testing and Materials (ASTM) Method D4318-84; and
  - Sediment specific gravity determination by ASTM Method D854.

Test results will be used to characterize the sediments and assess the feasibility of removing and/or capping impacted sediments. Specifically, these tests will be used to estimate the dredgability, water generation during dredging, and bulking of sediments subjected to different types of removal techniques.

2.2.5 Water Quality

Surface water samples will be collected from representative locations as supply water for the column settling and elutriate tests. The water will be collected below the water surface but above the bottom using a peristaltic pump with weighted Teflon-lined tubing. Water for the column settling test will be stored in pre-cleaned polyethylene containers. Water for chemical and elutriate testing will be collected and stored in 1-liter amber glass bottles. The bottles will be shipped to the lab and analyzed for the chemical parameters (elutriate tests and baseline chemical testing of surface water). Representative surface water collected and used in the elutriate testing will be analyzed in duplicate for both dissolved and total contaminants of concern.

2.2.6 Topographic Survey

The purpose of the topographic survey is to document the current upland elevations to tie in the current bathymetry survey. This survey will provide additional data that will be used during the FS and design. A survey firm licensed in Washington will conduct a full-coverage topographic survey of the upland area adjacent to Lockheed West site. The survey area will extend from the shoreline bank (to the water's edge) up to 200 feet away on Port of Seattle property. Horizontal positioning will be based on North American Datum (NAD) 1983 and vertical positioning will be tied in to the bathymetry survey which is based on the Port of Seattle MLLW datum for Elliott Bay.

3. LABORATORY ANALYSIS

A detailed description of the laboratory analyses to be conducted is presented in the Quality Assurance Project Plan (QAPP), Appendix D of the Work Plan). This section includes an overview.

3.1 SEDIMENT CHEMISTRY

Sediment samples will be analyzed for COPCs listed in Table 3-1. Analytical methods are listed below for each parameter. Consistent with risk-based low-level detection limits of the Lower Duwamish project, the preferred methods and low-level detection limits are provided in Table 3-2. Additionally, sediment porewater will be analyzed at selected stations for analysis of the COIs in Table 3-1.

Table 3-1. COIs for the Site Characterization

Parameters	Analysis	Sediment Target Detection Limit[a]
Grain Size	PSEP 1986	0.1 % retained
Total Organic Carbon	ASTM 4129/Plumb 19819060	500 mg/kg
TBT	Krone et al. 1989	1-5 µg/kg
Metals	SW846 6020, 6010B	0.03 – 1 mg/kg
Mercury	SW846 7471A	0.003 µg/kg
PCB Aroclors[b]	SW846 8082	0.4 µg/kg
Pesticides	SW846 8081A	0.024- 3 µg/kg
Semivolatiles	SW846 8270C-low level	0.006 – 0.1 mg/kg
PAHs	SW846 8270C-low level	0.001 – 0.05 µg/kg
PCB Congeners[c]	SW846 1668A	0.35 – 0.95 ng/kg
Dioxin/Furans[c]	Method 1613B	0.059 – 0.518 ng/kg

(a) Detection limits are on wet weight basis. Detection limits on dry weight basis are dependent on total solids content.
(b) PCB Aroclors to be analyzed include 1016, 1221, 1232, 1242, 1248, 1254, 1260. Detected Aroclors will be summed to find total PCBs.
(c) Sediment will be archived for potential analysis of PCB Congerners and Dioxin/Furans.
Notes: Samples with high moisture contents or matrix interference may have detection limits higher than those listed.
EPA test methods are found in SW-846. Test methods for the evaluation of solid waste physical/chemical methods.

Table 3-2. Laboratory Method Detection Limits and Reporting Limits

METHOD AND ANALYTE	RL[a] (mg/kg dw)	MDL[a] (mg/kg dw)	SEDIMENT ACG[b] (mg/kg dw)
EPA Method 8270C -low level			
PAHs			
Acenaphthylene	0.02	0.00909	0.33
Benzo(a)anthracene	**0.02**	**0.00834**	0.0052
Benzo(a)pyrene	**0.02**	**0.00731**	0.00076
Benzo(b)fluoranthene	**0.02**	**0.00734**	0.0047
Benzo(k)fluoranthene	0.02	0.0104	0.047
Total benzofluoranthenes [c]	0.02	0.0104	1.2
Benzo(g,h,i)perylene	0.02	0.00804	0.16
Chrysene	0.02	0.00809	0.48
Dibenzo(a,h)anthracene	0.02	0.00835	0.06
Fluoranthene	0.02	0.00849	0.80
Indeno(1,2,3-cd)pyrene	**0.02**	**0.00854**	0.0029
Phenanthrene	0.02	0.00863	0.50
Pyrene	0.02	0.00872	5.0
Acenaphthene	0.02	0.00936	0.08
Anthracene	0.02	0.00869	1.1
Fluorene	0.02	0.00917	0.12
Naphthalene	0.02	0.00753	0.50
2-Methylnaphthalene	0.02	0.00721	0.19
Dibenzofuran	0.02	0.00795	0.075
Total LPAHs [d]	0.02	0.00936	1.9
Total HPAHs [e]	0.02	0.0104	4.8
Total PAHs [f]	0.02	0.0104	1,410
Other SVOCs			
1-Methylnaphthalene[l]	0.02	0.00691	na
1,2,4-Trichlorobenzene	**0.02**	**0.00588**	0.0041
1,2-Dichlorobenzene	**0.02**	0.00876	0.012
1,3-Dichlorobenzene	0.02	0.00755	0.17
1,4-Dichlorobenzene	**0.02**	0.00816	0.016
2-Methylnaphthalene[l]	0.02	0.0183	na
2-Methyl-4,6-dinitrophenol (4,6-dinitro-o-cresol)[l]	0.2	0.11	na
2-Nitroaniline[l]	0.1	0.0542	na
2-Nitrophenol[l]	0.1	0.00878	na
2,4,5-Trichlorophenol	0.10	0.00834	610
2,4,6-Trichlorophenol	0.10	0.010	0.61
2,4-Dichlorophenol	0.10	0.00773	18
2,4-Dimethylphenol	0.02	0.01052	0.029
2,4-Dinitrophenol	0.20	0.1042	12
2,4-Dinitrotoluene	0.10	0.00897	12
2,6-Dinitrotoluene	0.10	0.01073	6.1
2-Chloronaphthalene	0.02	0.00832	490
2-Chlorophenol	0.20	0.00948	6.3
2-Methylphenol	0.02	0.0138	0.063
3,3'-Dichlorobenzidine	0.10	0.0617	1.1
3-Nitroaniline[l]	0.1	0.0532	na
4-Bromophenyl phenyl ether[l]	0.02	0.0129	na
4-Chloro-3-methylphenol[l]	0.1	0.0101	na
4-Chlorophenyl phenyl ether[l]	0.02	0.012	na

Table 3-2. Laboratory Method Detection Limits and Reporting Limits

METHOD AND ANALYTE	RL[a] (mg/kg dw)	MDL[a] (mg/kg dw)	SEDIMENT ACG[b] (mg/kg dw)
4-Nitroaniline[l]	0.1	0.0255	na
4-Nitrophenol[l]	0.1	0.037	na
4-Chloroaniline	0.10	0.0257	24
4-Methylphenol	0.10	0.0135	0.67
Aniline	0.02	0.00912	85
Benzoic acid	0.20	0.105	0.65
Benzyl alcohol	0.40	0.041	0.057
Bis(2-chloroethoxy)methane[l]	0.02	0.0123	na
Bis(2-chloroethyl)ether	0.02	0.00993	0.21
Bis(2-ethylhexyl)phthalate	0.02	0.0108	0.24
Bis-chloroisopropyl ether	0.02	0.00996	2.9
Butyl benzyl phthalate	0.02	0.0103	0.025
Di-ethyl phthalate	0.02	0.135	0.31
Dimethyl phthalate	0.02	0.0120	0.27
Di-n-butyl phthalate	0.02	0.0135	1.1
Di-n-octyl phthalate	0.02	0.0113	0.29
Hexachlorobenzene[i]	**0.02**	**0.00928**	0.0019
Hexachlorobutadiene[i]	0.02	0.00828	0.02
Hexachlorocyclopentadiene[l]	0.10	0.0445	na
Hexachloroethane	0.02	0.00798	0.12
Isophorone	0.02	0.00738	510
Nitrobenzene	0.02	0.0159	2.0
N-Nitrosodimethylamine	**0.10**	**0.00912**	0.0095
N-Nitrosodi-n-propylamine	**0.10**	0.0102	0.069
N-Nitrosodiphenylamine	0.02	0.0107	0.055
Pentachlorophenol	0.10	0.0371	0.36
Phenol	0.02	0.00947	0.42
EPA Method 8082			
Aroclor 1016	**0.02**	0.00098	0.0061
Aroclor 1221	**0.02**	**0.00098**	0.00021
Aroclor 1232	**0.02**	**0.00098**	0.00021
Aroclor 1242	**0.02**	**0.00098**	0.00021
Aroclor 1248	**0.02**	**0.00098**	0.00021
Aroclor 1254	**0.02**	**0.00098**	0.00021
Aroclor 1260	**0.02**	**0.00098**	0.00021
Total PCBs [g]	**0.02**	**0.00098**	0.00021
EPA Method 6020 (except as noted)			
Antimony	0.20	0.005	3.1
Arsenic	**0.20**	**0.02**	0.006
Cadmium	**0.20**	**0.02**	0.003
Chromium (EPA 6010B)	0.50	0.09	100
Cobalt	0.30	0.03	900
Copper (EPA 6010B)	0.20	0.04	1.3
Lead	2.00	0.12	40
Molybdenum	0.50	0.06	39
Nickel	1.00	0.38	140
Selenium	5.00	0.3	14.9
Silver	0.30	0.03	6.1
Thallium	0.20	0.003	0.52
Vanadium (EPA 6010B)	0.30	0.03	55
Zinc (EPA 6010B)	0.60	0.29	16

Table 3-2. Laboratory Method Detection Limits and Reporting Limits

METHOD AND ANALYTE	RL[a] (mg/kg dw)	MDL[a] (mg/kg dw)	SEDIMENT ACG[b] (mg/kg dw)
EPA Method 7471A			
Mercury	**0.05**	0.003	0.016
TBT Method - Krone 1989			
Di-n-butyltin[l]	0.006	0. 00479	na
n-Butyltin[l]	0.006	0.00451	na
Tri-n-butyltin	**0.006**	0.00284	0.00028
EPA Method 8081A			
4,4'-DDD	0.002	0.000320	0.0083
4,4'-DDE	0.002	0.000166	0.0026
4,4'-DDT	**0.001**	0.000284	0.00092
2,4'-DDD	0.002	0.0011	0.0083
2,4'-DDE	0.002	0.000894	0.0026
2,4'-DDT	0.002	0.000870	0.00092
Total DDT[j]	**0.002**	**0.0011**	0.00092
Aldrin	**0.001**	0.000054	0.000063
alpha-BHC	**0.001**	0.000214	0.09
beta-BHC	0.001	0.000045	0.00063
delta-BHC[l]	0.001	0.00002	na
alpha-Chlordane	0.001	0.000144	0.01
gamma-Chlordane[l]	0.001	0.00012	na
Total chlordane[k]	0.001	0.000964	0.0017
Dieldrin	**0.001**	**0.000049**	0.000033
Endosulfan	0.001	0.000129	0.50
Endrin	0.002	0.00024	0.027
gamma-BHC (Lindane)	**0.001**	0.000141	0.00083
Heptachlor	**0.001**	0.000027	0.00025
Heptachlor epoxide	0.001	0.000122	0.053
Hexachlorobenzene	0.001	0.000034	0.0019
Oxy-chlordane[l]	0.002	0.00012	na
trans-Nonachlor[l]	0.002	0.000024	na
cis-Nonachlor[l]	0.002	0.000055	na
Methoxychlor	0.010	0.000402	0.44
Mirex	0.002	0.00122	0.27
Toxaphene	0.100	0.0297	0.44
EPA Method 1668			
PCB-77 [h]	2.0E-6	3.9E-7	3.5E-3
PCB-81 [h]	2.0E-6	3.9E-7	3.5E-3
PCB-105 [h]	2.0E-6	4.4E-7	3.5E-3
PCB-114 [h]	2.0E-6	4.6E-7	7.0E-4
PCB-118 [h]	2.0E-6	3.7E-7	3.5E-3
PCB-123 [h]	2.0E-6	9.5E-7	3.5E-3
PCB-126 [h]	2.0E-6	2.1E-7	3.5E-6
PCB-156 [h]	2.0E-6	6.6E-7	7.0E-4
PCB-157 [h]	2.0E-6	6.6E-7	7.0E-4
PCB-167 [h]	2.0E-6	3.5E-7	3.5E-2
PCB-169 [h]	2.0E-6	4.4E-7	3.5E-2
PCB-189 [h]	2.0E-6	3.4E-7	3.5E-3

Table 3-2. Laboratory Method Detection Limits and Reporting Limits

METHOD AND ANALYTE	RL[a] (mg/kg dw)	MDL[a] (mg/kg dw)	SEDIMENT ACG[b] (mg/kg dw)
EPA Method 1613B			
2,3,7,8-TCDD	**1.0E-6**	5.9E-8	3.5E-07
1,2,3,7,8-PeCDD[h]	**5.0E-6**	1.53E-7	3.5E-07
1,2,3,4,7,8-HxCDD[h]	**5.0E-6**	1.72E-7	7.0E-07
1,2,3,6,7,8-HxCDD[h]	**5.0E-6**	1.18E-7	3.5E-06
1,2,3,7,8,9-HxCDD[h]	**5.0E-6**	1.72E-7	3.5E-06
1,2,3,4,6,7,8-HpCDD[h]	**5.0E-6**	1.69E-7	3.5E-06
OCDD[h]	**1.0E-5**	5.18E-7	3.5E-06
2,3,7,8-TCDF[h]	1.0E-6	7.7E-8	3.5E-06
1,2,3,7,8-PeCDF[h]	**5.0E-6**	1.32E-7	3.5E-06
2,3,4,7,8-PeCDF[h]	**5.0E-6**	1.43E-7	3.5E-06
1,2,3,4,7,8-HxCDF[h]	5.0E-6	1.48E-7	3.5E-06
1,2,3,6,7,8-HxCDF[h]	5.0E-6	1.54E-7	7.0E-06
1,2,3,7,8,9-HxCDF[h]	5.0E-6	1.48E-7	3.5E-05
2,3,4,6,7,8-HxCDF[h]	5.0E-6	9E-8	3.5E-05
1,2,3,4,6,7,8-HpCDF[h]	5.0E-6	1.83E-7	3.5E-05
1,2,3,4,7,8,9-HpCDF[h]	5.0E-6	8.1E-8	0.0035
OCDF[h]	1.0E-5	3.81E-7	0.0035

Footnotes

RL reporting limit
MDL method detection limit
ACG analytical concentration goal
mg/kg dw milligrams per kilogram dry weight
na not available

RLs or MDLs in BOLD are greater than at least one of their respective ACGs. All of the ACGs that are lower than RLs or MDLs are based on human health RBCs, with the exception of the following four chemicals, which are based on benthic invertebrate RBCs: 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and hexachlorobenzene.

[a] RLs, MDLs, and ACGs from LDWG Surface QAPP (LDWG 2005)
[b] ACG for sediment is the lowest of the RBCs for benthic invertebrates, spotted sandpipers, and humans.
[c] Total benzofluoranthenes is the sum of benzo(b)fluoranthene and benzo(k)fluoranthene. RL and MDL are the highest of the RLs and MDLs for benzo(b)fluoranthene or benzo(k)fluoranthene.
[d] Total LPAHs is the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. RL and MDL are the highest RL and MDL for the LPAHs. 2-methyl naphthalene is not included in the LPAH definition under the SMS and under the DMMP.
[e] Total HPAHs is the sum of fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. RL and MDL are the highest RL and MDL for the HPAHs.
[f] Total PAHs is the sum of the LPAHs and the HPAHs. RL and MDL are the highest RL and MDL for either the LPAHs or HPAHs.
[g] Total PCBs is the sum of the Aroclors. RL and MDL are the highest RL and MDL for the individual Aroclors.
[h] Dioxin-like PCB and dioxin/furan congeners will be evaluated as toxic equivalents (TEQs) in the risk assessments, rather than as individual congeners. However, because TEQs are calculated, rather than measured by the laboratory, RBCs for individual congeners are presented to facilitate comparison with RLs for those congeners. In reality, risks will be assessed based on sums of these congeners (normalized per their relative toxicity to TCDD), and thus comparison to RLs on a congener-specific basis is somewhat uncertain.
[i] Hexochlorobenzene and Hexachlorobutadiene are also analyzed with 8081A to obtain lower DLs
[j] Total DDT is the sum of 4,4'-DDD, 4,4-DDE, 4,4'-DDT, 2,4'-DDD, 2,4-DDE, and 2,4'-DDT. RL and MDL are the highest RL and MDL for the DDT isomers.
[k] Total chlordane is the sum of oxychlordane, alpha- and gamma-chlordane, and cis- and trans-nonachlor. RL and MDL are the highest RL and MDL for the chlordane-related compounds.
[l] RLs and MDLs from LDWG Subsurface QAPP (LDWG 2006)

3.2 GEOTECHNICAL AND CONTAMINANT MOBILITY TESTING

A suite of physical tests are used to evaluate dredging and capping methods, dredged material transport and placement, dredge material behavior in the disposal site, potential short-term impacts at the dredge and disposal sites, and capacity of existing sediments to provide foundation support for capping material. The following tests will be completed for selected samples collected in the cores (Table 3-3).

Table 3-3. Geotechnical and Contaminant Mobility Methodology

Parameters	Method
Grain Size	PSEP 1986
Atterburg Limits	ASTM D 4318-95
Specific Gravity	ASTM D 854-92
Column Settling Test	EPA/USACE 1998
Dredge Elutriate Test	DiGiano et al. 1995

ASTM = American Society for Testing and Materials
PSEP = Puget Sound Estuary Program

Grain size will be analyzed by the pipette and sieve method following PSEP and will provide information on site geologic character and engineering properties of sediment proposed for remediation.

Atterberg Limit analysis will be analyzed on selected samples of fine-grained sediment in accordance with ASTM D-4318-95 (includes organic determination). Atterberg limits, which include the liquid limit, plastic limit, and the plasticity index, are used to define plasticity characteristics of clays and other cohesive sediments.

Specific gravity will be measured on selected samples analyzed for engineering properties in accordance with ASTM D-854-92. The specific gravity of sediment samples is used to determine sediment dredgeability, the dispersal and settling characteristics of the dredged material after placement, and the bed consolidation after capping.

The dredging elutriate test (DRET) will be performed on a composite of representative material to be dredged to provide an assessment of contaminant mobility. The DRET method is particularly effective for examining the short-term contaminant release at the point of dredging. The test will be performed in accordance with WES-recommended procedures (DiGiano, et al., 1995) using a solids concentration of 10 g/L and a settling time of one hour. Representative sediment from areas yet undetermined for dredging in the Site will be collected for elutriate testing. Approximately 4 liters of sediment representative of the dredge prism are required. In addition, approximately 10 to 15 liters of site water will be collected

from the waterway for the testing. The elutriate will be analyzed for those constituents that have marine acute and chronic water quality criteria.

The CST is used to model the settling behavior of sediments that may be dredged (EPA/USACE 1998). The objective is to predict the gravity settling rate and behavior of dredged material discharged as a slurry of water and sediment into a containment area. Results of the testing identify the characteristics of the sediment settling and consolidation which are used to select an appropriate dredging/placement method, predict potential water quality effects, and to design the disposal site/containment area. The test is conducted by placing a known quantity of sediment slurry in a settling column and observing the amount of time necessary to settle different size fractions of the sample. The CST will be conducted in general accordance with WES-recommended procedures (USACE 1993) using a solids concentration of 150 g/L. Approximately 40 liters of sediment representing a composite sample and 60 liters of site water are required for the test.

4. REPORTING AND SCHEDULE

4.1 REPORTING

Reporting for this project includes laboratory reports, quality assurance reports, and the final report.

4.1.1 Laboratory Reports

Final written laboratory reports will be required for both chemical and physical analyses. Key elements of these reports are described below. It is expected that these reports, or summaries of these reports (as appropriate), will be appended to the final report.

4.1.2 Chemistry Reports

Final written laboratory reports and data deliverables will contain the following:

- Case narrative
- Identification of all protocols
- Summary results of initial and continuing calibrations
- Method and instrument blanks
- All field sample and field QA/QC sample results
- Surrogate recoveries (organic analyses)
- Matrix spikes (organics, batch specific)
- Matrix spike duplicates (organics only, batch specific)
- Supporting raw data and spectra
- Supporting sample tracking information (e.g. shipping forms, chain-of-custody forms)
- Supporting documentation on any corrective actions

Initial calibration information must include concentrations of each standard analyzed, response factors for each analyte at each standard concentration, relative standard deviation (RSD) (or correlation coefficient for metals analytes) over all standards for individual analytes. The RSD control limit range must also be indicated in the initial calibration summary data.

Continuing calibration information must include the response factor (organic analytes) for each analyte, and the calculated percent difference as compared to initial calibration (organic analytes). Control limits for each analyte must also be indicated on each continuing calibration summary data sheet.

Method blank and field sample data pages must indicate the method reporting limit and the dilution factor. Surrogate reporting forms must list control limits for surrogate recovery. Spike reporting forms (blank and matrix spikes) must indicate spike percent recovery and relative percent difference control limits (if spikes are analyzed in duplicate).

Documentation of detection limits (detection limit studies) and results of performance evaluation samples (supplied by regulatory agencies or purchased from certified vendors) are not required for the data deliverable. However, these records must be supplied upon request. Total measurement error determination for field duplicate samples will be calculated.

Electronic data deliverables will also be required.

4.1.3 Geotechnical Testing and Contaminant Mobility Laboratory Report

Final written laboratory reports and data deliverables will include the following:

- A short write-up on laboratory methods, sample identifications, and problems encountered during testing
- A full data report of all chemistry data for elutriate testing
- Graphs and tables for the column settling test including total suspended solids (TSS) and turbidity versus time, interface height versus time, TSS versus turbidity, percent initial concentration (TSS versus time versus height), average TSS versus time, and initial test parameters with associated test description
- Grainsize data and Atterberg limits presented on graphs
- Volumes and weights of sample used in column settling and elutriate tests
- A copy of the chain-of-custody forms

4.1.4 Data Validation Report

The project QA representative will prepare a report based upon a review of the laboratory analytical data. An internal data validation or third party data validation will be completed. The laboratory quality assurance/quality control (QA/QC) reports and any data package validation reports will be incorporated by reference. This report will identify any laboratory

activities that deviated from the approved referenced protocols and will make a statement regarding the overall validity of the data collected. The data validation report will be incorporated into the final report.

4.1.5 Final Data Report

A final written report will be prepared documenting all activities associated with collection, compositing, and transportation of samples. At a minimum, the following will be included in the data report:

- Brief description of the project and its objectives
- Type of sampling equipment used
- Identification and description of protocols used during sampling and testing and an explanation of any deviations from the sampling plan protocols
- Description or summary of sampling and compositing procedures
- Descriptions of each sample and the sediments (i.e., core logs and sample logs)
- Summary of methods used to locate the sampling positions, and a discussion of the position accuracy
- Locations where the sediment samples were collected. Locations will be reported in NAD 83 State Plane Coordinates
- A plan view of the project showing the actual sampling locations
- Sample results

In addition to the items listed above, the final report will include an electronic file of sample location information (i.e., sample ID, sample type, coordinates, sample data, water depth, and sample depth) and sample results.

Data will be reported according to the data management discussed in the QAPP. Only appropriate laboratory replicates will be reported to two significant figures, both original and field duplicate results will be reported, only the appropriate result for one analyte by two different methods will be reported, and totals will be calculated according to Sediment Management Standards Chapter 173-204 WAC.

4.2 SCHEDULE

The overall schedule for the field effort is shown in Table 4-1. This schedule will be revised, as appropriate, as details of the program are developed.

Table 4-1. Project Schedule

Milestone	Target Timeline/Date
EPA-approval of Site Characterization SAP	November 22, 2006
Project planning, scheduling, and mobilization	30 days
Subtidal field collection effort	January 2007
Draft Data Report	May 2007
EPA Review	45 days
Intertidal field collection effort	April 2007
Addenda to Draft Data Report	July 2007
Final Data Report	January 2008

5. REFERENCES

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LDWG. 2006. Quality Assurance Project Plan: Surface Sediment Sampling for Chemical Analyses. Prepared for EPA and Ecology dated February 3, 2006. Prepared by Windward Environmental for Lower Duwamish Work Group, Seattle, WA.

ATTACHMENT 1

STANDARD OPERATING PROCEDURES

SOP 1: Sampling Equipment Decontamination

SOP 2: Decontamination of Hand Sampling Equipment

SOP 3: Sample Packing and Shipment

SOP 4: Vibracore Sampling

SOP 5: Documentation

STANDARD OPERATING PROCEDURE 1
SAMPLING EQUIPMENT DECONTAMINATION

Required Equipment

Source-approved potable tap water

ASTM Type II, or equivalent, reagent deionized (DI) water

Laboratory-grade detergent (i.e., Alconox® or equivalent)

5-gallon buckets

Scrub brushes

Plastic garbage can

Plastic sheeting

Sprayers (i.e., garden or hand)

Pressure washer (provided by subcontractors).

Typical Procedures

Preparation:

1. Set up decontamination area on plastic sheeting.
2. Set up "clean" area upwind of decontamination area for air drying of equipment.
3. Fill one 5-gallon "wash" bucket with detergent and potable tap water.
4. Fill spray bottles with DI water and methanol.

Decontamination of Sampling Equipment:

1. Clean all sampling equipment to remove gross contamination.
2. Wash equipment in detergent.
3. Rinse with potable tap water (bucket).
4. Rinse with DI water (sprayer).
5. Air dry.
6. Place disposable items (sampling gloves, paper towels, etc.) in garbage can.
7. Document activities in the field and site logbooks.

Note: In adverse weather conditions, air drying may not be possible. In this case, a methanol rinse will be added.

STANDARD OPERATING PROCEDURE 2
DECONTAMINATION OF HAND SAMPLING EQUIPMENT

Required Equipment

Source approved potable tap water

ASTM Type II, or equivalent, reagent deionized (DI) water

Laboratory-grade detergent (i.e., Liquinox, Alconox, or equivalent)

5-gallon buckets

Scrub brushes

Plastic sheeting

Garden and hand sprayers (plastic).

Typical Procedures

Preparation:
Set up decontamination area—buckets, plastic sheeting, scrub brushes, sprayers.

Set up "clean" area upwind of decontamination area for air drying of equipment.

Fill one 5-gallon bucket with detergent and potable tap water.

Fill a second 5-gallon bucket with potable tap water only.

Fill new/clean spray bottles with DI water (garden sprayer).

Decontamination of Sampling Equipment:

Scrub all sampling equipment to remove gross contamination.

Wash equipment in detergent.

Rinse with potable tap water.

Rinse with DI water.

Note: If sticky or oily residues are observed during sampling, an acid/solvent rinse sequence (i.e., nitric acid [0.1 percent] and isopropanol) will be added prior to the final DI water rinse.

Air dry.

Cover sampling surfaces with aluminum foil.

Place disposable items (sampling gloves, paper towels, etc.) in garbage can, garbage bag, or 5-gallon bucket with lid.

Document activities in the field and site logbooks.

Note: All decontamination fluids will be contained in a tub or bucket for proper disposal.

STANDARD OPERATING PROCEDURE 3
SAMPLE PACKING AND SHIPMENT

Required Equipment

Sampling and Analysis Plan

Indelible, black ink pens

Field logbook

Ziploc® bags

Coolers

Blue Ice®

Strapping tape or duct tape

Vermiculite

Sample logs

Sample labels

Chain of custody forms

Custody seals.

Typical Procedures

Before packing, all samples will be individually labeled and noted in the field logbook by the Sample Coordinator or designee. Labels will be completed with all required information. The samples will be assigned individual numbers. The sample numbers will be used to complete the chain of custody forms.

Samples to be hand-delivered to the laboratory:

1. Attach sampling label and custody seals (if necessary) on each sample jar.
2. Place each sample in a plastic Ziploc® bag and align the label so it can be easily read. Seal the bag.
3. Place individual samples into the cooler so that each container is safely secured.
4. Include sufficient ice or Blue Ice® packs to cool samples to 4°C.

5. Complete a chain of custody form for the containers and seal in a Ziploc® bag. Place the chain of custody form in the cooler. Always transport the cooler together with its accompanying chain of custody form.

Samples to be shipped to the laboratory:

1. Attach custody seal on each sample jar.
2. Place each sample in a plastic Ziploc® bag and align the label so it can be easily read. Seal the bag.
3. Spread a layer of vermiculite or foam peanuts at least 1-inch deep in the bottom of a cooler.
4. Place individual samples into the cooler so each container has at least 1 inch of clearance on all sides.
5. Fill the void spaces with vermiculite, foam peanuts, or other cushioning material. When the level of the cushioning material is even with the jar tops, jiggle the cooler vigorously to settle the cushioning material, then add enough additional material to cover the containers with at least 2 inches.
6. Cover the head space inside the cooler with frozen Blue Ice® packs and cover with more packing material.
7. Place the chain of custody form in a sealed Ziploc® bag and attach to inside cover of the cooler.
8. Close and latch the cooler. Wrap the cooler and lid with at least two turns of strapping or duct tape. Affix signed custody seals over the edge of the lid and the top of the cooler body at front and rear.
9. Label coolers with up arrows and information to comply with U.S. Department of Transportation requirements.

The Lead Sampler will notify the laboratory approximately when and how many samples will arrive. The samples must be kept refrigerated (or packed with Blue Ice®) between sampling and analysis processing. The sample containers will be checked on arrival at the laboratory for breakage.

STANDARD OPERATING PROCEDURE 4
VIBRACORE SAMPLING

Required Equipment

Sampling and Analysis Plan (SAP), Site logbook, Sample logs, Sample labels

Indelible black ink pens

Camera

End caps for Vibracore sleeves

Electrical tape, duct tape, aluminum foil

Vibracore apparatus

Sample shipping containers

Ice

H_2S monitor

Tape measure

Operating Procedures

1. The support frame is maneuvered over the approximate position for the core and the water depth and bottom slope determined. The Vibracore Sampler (VCS) base will be adjusted to the bottom slope, if required.

2. The corer is suspended from the support frame and lowered to the bottom.

3. After successful deployment, the penetration recording system and vibratory head are engaged and the desired penetration is obtained. Penetration versus time is recorded.

4. The core is extracted from the sediment and the VCS is recovered and stowed.

5. The core, with contained sediment, is removed from the driving head and transferred to a processing rack. (Note: Check H_2S in the work space prior to proceeding)

6. Core Measuring: The distance from the top of the core to the end of the core tube is physically measured and the top of the core is marked on the outside of the tube using black indelible ink (large Sharpie®, etc.).

7. The tube is positioned in the rack to allow cutting at/near the top of the core and the tube is securely clamped to the rack.

8. The excess core tube is cut off using a tube cutter. Two personnel are required—one to operate the tube cutter and a second to hold onto the segment being removed.

9. The core is marked for cutting into desired segments, positioned in the core rack, and cut. As segments are removed, they are sealed, labeled, and stowed in a core storage box. This box is insulated and can be covered if segment length is less than 4 feet. Ice may be used for cooling.

10. The core holding area is then washed down using the deck pump/hose system.

11. Equipment is secured and the support frame is moved to the next sampling site.

Core Acceptance Criteria

A continuous core sample will be collected to the designated coring depth or until refusal.

The depth of core penetration will be measured and recorded.

The core sample will be evaluated at the visible ends of the core tube to ensure that retrieved sediment core reached the required penetration depth. Sample recovery will be inspected relative to the following acceptance criteria:

1. Overlying water is present and the surface is intact;

2. Calculated compaction is not greater than 25 percent; and

3. The core tube appears intact without obstruction or blocking.

STANDARD OPERATING PROCEDURE 5
DOCUMENTATION

Required Equipment

Sampling and Analysis Plan
Indelible black-ink pens
Site logbook (bound and ruled)
Camera

Typical Procedures

Photo Documentation:

1. Record sample location in site logbook.
2. Obtain a sufficient amount of photographs of all material before sampling to ensure accurate documentation of the site and sampled materials

Site Logbook:

Note: One site logbook will be used for all tasks. The sampling coordinator is responsible for documenting all site activities.

1. Label front cover of site logbook in indelible black ink with project name and number, client name, contact number, and start and end dates of field investigation. If multiple logbooks are used, they must be numbered sequentially.
2. Enter the date and page number on the top of each page.
3. Enter the day; date; time of arrival on site; weather conditions; and names, titles, and organizations of personnel present on site.
4. List instrument calibration information including serial number, model number, calibration fluid, readings, adjustments, red line (if applicable), battery level, and person performing the calibration.
5. Record name, title, and organization of all visitors to the site.
6. Describe all site activities performed for each day.
7. Describe any field tests that were performed.
8. Describe any samples collected, their sample numbers, and whether splits, duplicates, or blanks were prepared.
9. List all chain of custody details, including air bills, sample identification numbers, and analytical laboratory.
10. If applicable, list any equipment failures encountered during the day, and how repairs were made.
11. Describe any field changes that occur which deviate from the Sampling and Analysis Plan.
12. Record all telephone calls relating to the field activities.

13. The sampling coordinator or designee must sign the bottom of each page.
14. Label front cover of site logbook in indelible black ink with project name and number, client name, contact number, and start and end dates of field investigation. If multiple logbooks are used, they must be numbered sequentially.
15. Enter the date and page number on the top of each page.
16. Enter the day; date; time of arrival on site; weather conditions; and names, titles, and organizations of personnel present on site.
17. List instrument calibration information including serial number, model number, calibration fluid, readings, adjustments, red line (if applicable), battery level, and person performing the calibration.
18. Record name, title, and organization of all visitors to the site.
19. Describe all site activities performed for each day.
20. Describe any field tests that were performed.
21. Describe any samples collected, their sample numbers, and whether splits, duplicates, or blanks were prepared.
22. List all chain of custody details, including air bills, sample identification numbers, and analytical laboratory.
23. If applicable, list any equipment failures encountered during the day, and how repairs were made.
24. Describe any field changes that occur which deviate from the Sampling and Analysis Plan.
25. Record all telephone calls relating to the field activities.
26. The sampling coordinator or designee must sign the bottom of each page.

APPENDIX D

QUALITY ASSURANCE PROJECT PLAN

(Attachments on CD)

LOCKHEED
WEST SEATTLE SUPERFUND SITE

QUALITY ASSURANCE PROJECT PLAN

Revised Draft

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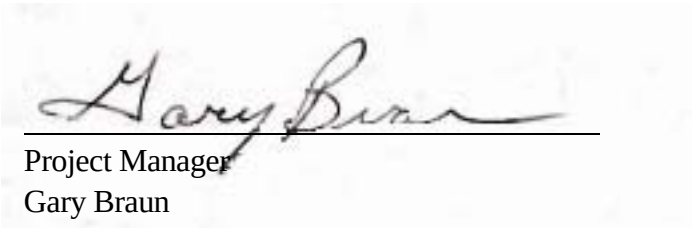
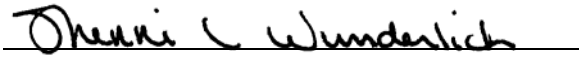
December 2007
Revision 2

APPROVALS



Project Manager — Date
Gary Braun



Project Chemist — Date
Sherri Wunderlich

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ACRONYMS AND ABBREVIATIONS

%R	percent recovery
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ASTM	American Society for Testing and Materials
CCV	continuing calibration verification
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Program
DI	deionized water
DOC	dissolved organic carbon
DQO	Data Quality Objective
dw	dry weight
EPA	U.S. Environmental Protection Agency
FCR	Field Change Request
FOL	Field Operations Lead
HSP	Health and Safety Plan
ICV	initial calibration verification
LCS	laboratory control sample
LMC	Lockheed Martin Corporation
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MS	matrix spike
MSB	matrix spike blank
MSD	matrix spike duplicate
PARCC	precision, accuracy, representativeness, completeness, comparability

ACRONYMS AND ABBREVIATIONS (continued)

PCB	polychlorinated biphenyl
PESM	Project Environmental and Safety Officer
PM	Project Manager
PSEP	Puget Sound Estuary Program
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
RSD	relative standard deviation
SAP	Sampling and Analysis Plan
SD	standard deviation
SMS	Washington Sediment Management Standards
SOP	Standard Operating Procedure
SOW	Statement of Work
SQS	sediment quality standard
SPCC	system performance check compounds
SVOC	semivolatile organic compound
TBD	to be determined
Tetra Tech EC, Inc.	TtEC Corporation
TOC	total organic carbon
TSS	total suspended solids

1. PROJECT MANAGEMENT

1.1 PROJECT ORGANIZATION

This Quality Assurance Project Plan (QAPP) provides the quality assurance/quality control (QA/QC) requirements for sediment sampling activities to be conducted at the Lockheed West Seattle Superfund Site (Site) by Tetra Tech EC, Inc. (TtEC) under the direction of Lockheed Martin Corporation (LMC). The objective of this QAPP is to ensure that data quality requirements are established and fulfilled pertaining to collecting and evaluating site data. This QAPP has been prepared to define the QA and QC activities to be implemented, to ensure the integrity of the work to be performed at the site, and to ensure that the data collected will be of the appropriate type and quality needed for the intended use following *EPA Guidance for Quality Assurance Project Plans* (EPA 1998).

TtEC-Related documents referenced in this QAPP include the Field Sampling and Analysis Plan (SAP), which describes field sampling activities, and the Environmental Health and Safety (HSP) Plan. All field activities will be performed in compliance with the SAP. All parties generating data under this program are responsible for implementing the requirements presented in this QAPP.

Although QA/QC responsibilities lie principally with the TtEC Project Manager (PM) and QA Manager, proper implementation of QA/QC requirements necessitate that the entire project staff be cognizant of all procedures and goals. A field program organization chart is presented as Figure 2-1.

Mr. Gary Braun will be the PM for the Site investigation. He will be responsible for implementing and executing the technical, QA, and administrative aspects of the investigation, including the overall management of the project team. The PM is also accountable for ensuring that the investigation is conducted in accordance with applicable plans and guidelines, including the SAP, the QAPP, and the HSP Plan. In addition, the PM will communicate all technical, QA and administrative matters to the LMC Project Manager. He will ensure that any deviations from the approved SAP, QAPP, and/or HSP Plan are documented in Field Change Request (FCR) forms, communicated to LMC, and approved before implementation. The PM is responsible for overseeing the preparation of project deliverables to be submitted by TtEC.

The overall management of the project-specific QA activities is the responsibility of the QA Manager, Ms. Jennifer Hawkins. The QA Manager, or designee, is responsible for implementation of site-specific QA activities, including field and laboratory quality control. In

addition, the QA Manager or her designee will coordinate with the PM and other project staff, as applicable, during the reduction, review and reporting of analytical data.

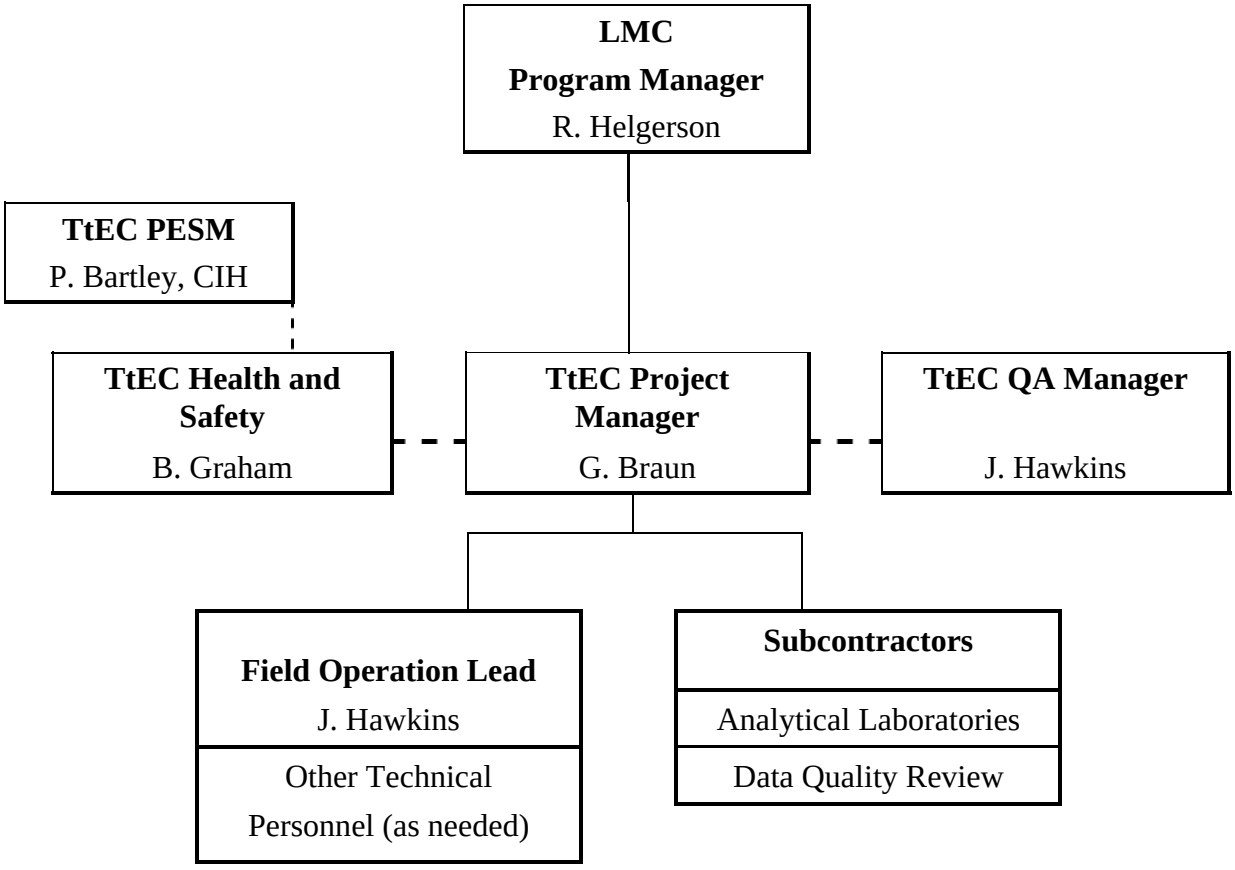
The Field Operations Lead (FOL), Ms. Jennifer Hawkins, is responsible for managing and supervising the field investigation program and providing consultation and decision-making on day-to-day issues relating to the sampling activities. The FOL shall monitor the sampling to ensure that operations are consistent with plans and procedures, and that the data acquired meets the analytical and data quality needs. When necessary, the FOL will document any deviations from the plans and procedures for approval.

The TtEC Health and Safety Manager, Mr. Bryan Graham, is responsible for the implementation of the site-specific HSP Plan. The Health and Safety Manager, through the cross-trained FOL, shall advise the project staff on health and safety issues, conduct health and safety training sessions, and monitor the effectiveness of the health and safety program conducted in the field.

The services of several subcontractors (e.g., laboratory services, data validation) will also be necessary for the performance of the field investigation and implementation of project objectives. The PM, with assistance from the FOL as necessary and appropriate, will be the primary liaison between TtEC, the LMC Project Manager, and each of the subcontractors. Subcontractors are responsible for performing work according to the requirements in this QAPP.

Chemical and physical analysis on the sediment samples and biological testing on the bioassay samples collected for this project will be analyzed by accredited analytical laboratories. The project manager at each laboratory will be responsible for coordination with TtEC, QAPP implementation, and analytical data quality.

Figure 1-1. Program Organization Structure



1.2 PROBLEM DEFINITION/BACKGROUND

This QAPP has been prepared by TtEC in accordance with the requirements of Section II Task 1 of the Statement of Work (SOW), Appendix A to the Administrative Settlement Agreement and Order on Consent (ASAOC) (U.S. Environmental Protection Agency [USEPA] Docket No. CERCLA-10-2006-0321/Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]) for the Site. The QAPP was prepared for LMC as a project planning document for the implementation of the chemical, physical, and biological/toxicological characterization of the Site.

The purposes of the ASAOC that pertain to this QAPP are to (a) to determine the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants or contaminants at or from the Site, by conducting a Remedial Investigation (RI); and (b) to identify and evaluate remedial alternatives to prevent, mitigate or otherwise respond to or remedy any release or threatened release of hazardous substances, pollutants, or contaminants at or from the Site, by conducting a Feasibility Study (FS). The RI/FS will be conducted in accordance with the provisions of the ASAOC, the SOW, CERCLA, the National Contingency Plan (NCP) and EPA guidance, including, but not limited to the "Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (Office of Solid Waste and Emergency Response [OSWER] Directive #9355.3-01, October 1988 or subsequently issued guidance), "Guidance for Data Usability in Risk Assessment" (OSWER Directive #9285.7-05, October 1990 or subsequently issued guidance), and guidance referenced therein, and guidance referenced in the SOW, as may be amended or modified by EPA.

The Site is located in the southwest corner of Elliott Bay, and consists of the area covered by the extent of sediment contamination and sources thereto from the former shipyard facility also known as Lockheed Shipyard Number 2 which was located at 2330 Southwest Florida Street in West Seattle, Washington.

The Site is bounded by Elliott Bay on the north, and the Harbor Island West Waterway on the east, and the Pacific Sound Resources Superfund Site on the west. It includes approximately seven acres of aquatic land now owned by the Port of Seattle (formerly owned by LMC), and approximately 20 acres owned by the State of Washington Department of Natural Resources (DNR) and leased to LMC.

LMC discontinued operations at Lockheed Shipyard Number 2 in 1987 after approximately 41 years of continuous operations, primarily shipbuilding, ship repair and maintenance. Past industrial practices at or adjacent to the facility have resulted in contamination of upland soils

and adjacent aquatic sediments. The contaminants found in the aquatic area include hazardous substances commonly associated with shipbuilding, repair and maintenance activities, consistent with the historical uses of the facility.

Contaminants of concern in the Site include, but are not limited to, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), mercury, other metals and organic compounds.

Associated sediments are habitat to numerous fish and other aquatic species, and are within a migratory corridor for endangered, threatened, and other anadromous fish.

Pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, EPA plans to propose the Site for inclusion on the National Priorities List.

Details of the project history, available data, and data gaps are included in the Work Plan.

1.3 PROJECT DESCRIPTION

The objective of this project is to characterize the sediments at the Site. Surface and subsurface samples will be collected to evaluate the chemical and physical characteristics of the sediment. Surface water samples will also be collected. These samples will be analyzed for chemicals of concern and physical characteristics and will also be used for the elutriate and column settling tests. Biological testing data will be collected to confirm sediment quality in surface sediments. This biological testing will include two acute laboratory bioassay tests and a chronic laboratory bioassay. Confirmatory biological effects testing will be performed at selected locations to address the spatial resolution of chemical contaminant distribution. Chemical concentration distribution and the results of the biological testing will support an evaluation of sediments that may require remediation and support an evaluation of remedial options, including natural recovery.

The primary tasks that will be completed for this project include sediment and water sample collection within the Site. Sediment samples will be collected using a Vibracore technique. Water samples will be collected using a grab technique. Samples will be analyzed for project-specific parameters to evaluate the chemical and physical characteristics of the site. The chemical parameters of interest for sediment samples include PCB Aroclors, pesticides, semivolatile organic compounds (SVOCs), metals, total organic carbon (TOC), and Tributyltin (TBT). Physical parameters of interest include Atterberg Limits, specific gravity, and grain size. Biological testing will include acute and chronic laboratory bioassay tests. Confirmatory biological effects testing will be performed at selected locations to address the spatial resolution of chemical contaminant distribution.

Rational and procedures describing these activities are presented in the SAP. In addition, decontamination procedures for sampling equipment are also provided in the SAP.

1.4 DATA QUALITY OBJECTIVES

This section of the QAPP documents the project data quality objectives (DQOs) and establishes the performance criteria for the planning and measurement system that will be used to generate data. DQOs apply to field and analytical data, as well as data verification, reduction, and evaluation activities. The QC requirements for this project include procedures to promote data quality and collect QC samples that provide data of a measurable quality.

1.4.1 Project Quality Objectives

DQOs provide criteria against which project performance can be evaluated to determine whether the overall project QA objectives are met. The objectives will be met by collecting data of sufficient quality and quantity that can be used for the intended purposes. DQOs can be defined as what the end user expects to obtain from the analysis results. DQOs are developed through a seven-step process. The DQOs for this project are defined below using the seven-step process described in EPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006).

State the Problem. Sediment and water samples must be collected within the Site to characterize the nature and extent of contamination in support of restoration alternatives development and evaluation.

Identify the Decision. A decision must be made from the data collected to determine whether target analytes are present in sediments at levels exceeding the project-specific action levels as defined by LMC.

Identify Inputs to the Decision. Inputs to the decision include the following:

- Analytical data resulting from sediment and water samples collected within the Site
- Project-specific action levels
- Analytical method reporting limits
- Existing data from previous site investigations (if needed)

Define the Study Boundaries. Data collected in this study will focus on the target analytes known to exist at the site. The geographic boundaries of this study include the sediment and surface water at the sediment sample locations.

Develop a Decision Rule. The decision rules are defined as follows:

- If target analytes are not detected at concentrations above the Contract Required Quantitation Limit (CRQLs), no further action is required.
- If target analytes are detected above CRQLs, the data will be used to evaluate the nature and extent of contamination for the purpose of evaluating the need for remediation and/or restoration of the river sediments.

Specify Limits on Decision Errors. The decision rules will be applied using valid analytical data derived from the samples. Sample locations have been selected to be representative of site conditions. Method data quality requirements for precision and accuracy will be used to determine the validity or usability of the data. The analytical method precision and accuracy requirements are defined in the individual laboratory procedures and laboratory quality assurance plans.

Optimize the Design for Obtaining Data. Historical information related to the source(s), the locations of the source(s), patterns of contaminant deposition, and the technical characteristics of the contaminants and the media have been utilized to determine the most cost-effective design for sample collection. This study will be performed to allow for minimization of the number and types of samples collected while supplying sufficient data upon which to apply the decision rules.

The DQOs for the Lockheed West project are included in Table 1-1.

1.4.2 Measurement Performance Criteria

The DQO process provides a logical basis for linking the QA/QC procedures to the intended use of the data, primarily through the decision maker's acceptable limits on decision error. The overall QA/QC objective for the field investigation is to develop and implement procedures that will provide data of known and documented quality. QA/QC characteristics for data include precision, accuracy, representativeness, completeness, and comparability (PARCC). This section provides a description of specific routine procedures to assess PARCC parameters. The QA objectives for analytical data for the field samples include the following, where appropriate.

Table 1-1 Data Quality Objectives

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
Confirmation of existing sediment quality condition and Increase Data Density	Additional data are required to determine the nature and extent of contamination and evaluate risks.	Collect additional sediment quality samples in the vicinity of existing sampling locations to confirm previous results and potential changes in sediment quality that may have occurred between sampling events. Supplement existing sediment quality data by collecting additional subsurface and surface samples	Current property boundary reflects the historical ownership and lease areas; it is not intended to imply a nature and extent boundary, additional sampling is planned beyond the former property boundaries	Collected sediment data will be compared to Elliot Bay samples and PRGs	To ensure proper decisions are made, samples will be analyzed using approved EPA methods and definitive quality levels. Sediment data will be screened against HHRA and ERAs PRGs and Elliot Bay samples. Percent completeness will be evaluated for data collected in support of the work effort.	The additional sampling has been optimized based on the knowledge of the site history and previous site characterization work.

Table 1-1. Data Quality Objectives (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
Based on evaluation of existing data, there is uncertainty about the Sediment Stability in the project area.	Additional information is needed to determine if site sediments, in particular subsurface sediments, are stable. Determine if sediments are contaminated will they be disturbed or re-exposed due to sediment instability.	A tiered approach to evaluating sediment stability is proposed: • Compile and review existing sediment transport data for the lower Duwamish River, West Waterway and Elliott Bay • Evaluate high resolution bathymetry for geomorphic features indicative of sediment erosion and accretion • Collect subsurface sediment quality data • Perform numerical modeling (if necessary) of wind, wave, current and propeller scour conditions	Sediment stability concerns apply to the entire Site. Samples representative of the Site will be collected.	Evaluation of stability will utilize the multiple tiers to make a stability determination. If necessary, results of the additional modeling (e.g., prop scour, wave and wind generated disturbance) will be used in combination to further evaluate the stability determination.	The collection and analysis of subsurface cores will utilize EPA-approved methods and definitive quality levels. Only valid data will be used to assess sediment stability.	The additional sampling has been optimized based on the knowledge of the site history and previous site characterization work. A registered geologist will be assessing the stratigraphy of the subsurface cores with geotechnical analyses of pertinent sample increments..

Table 1-1. Data Quality Objectives (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
Conditions along the Site shoreline have not been characterized and there is uncertainty about the status of current physical conditions (e.g., substrate type, slope, debris, structures, seeps, outfalls) along the shoreline at the Site.	Additional information is required to determine the current status of shoreline conditions. This data will help refine the bank sampling approach and assist in the evaluation of potential remedial actions.	Conduct a preliminary shoreline structure survey to document the location, type, and condition of existing shoreline and over water structures (scheduled for August 2006 low tide period). Conduct a topographic survey of the banks to mesh with the site bathymetry.	The boundaries of this survey will be in the intertidal area from the lowest tide mark to the top of bank along the Site.	Information gathered during the survey will help define similar bank areas for composite sampling; document the conditions of shoreline structures (e.g., bulkheads) for remedial option evaluations, and provide documentation of existing intertidal habitat conditions.	This is a preliminary qualitative survey.	The survey has been designed to gather the maximum amount of information during the low tide survey event.
Current habitat conditions along the Site shoreline have not been characterized	Documentation of existing intertidal habitat conditions is needed to assess the impacts and benefits of future remedial actions.	Conduct a low-tide video survey of the Site to document habitat conditions for the intertidal area of the Site (scheduled for August 2006 low tide period)	The boundaries of this survey will be in the intertidal area from the lowest tide mark to the top of bank along the Site.	The low tide video survey will be used to document existing site conditions and may be used to evaluate the impacts and benefits of remedial options.	This is a qualitative survey. If additional site-specific habitat quantity and quality are determined to be needed based on this reconnaissance survey, a formal quantitative survey will be performed.	A video survey that documents current intertidal habitat conditions is adequate for the intended purposes. It will be used in conjunction with the other qualitative data collected as part of the shoreline conditions survey.

Table 1-1. Data Quality Objectives (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
An assessment of the potential for sediment recontamination is necessary to support the remedial design.	Documentation of upland source control is needed to determine the potential for sediment recontamination from upland sources. Determination of ongoing contaminant sources from the West Waterway/ Lower Duwamish Waterway.	Review and evaluation of available groundwater and cleanup action data provided by the Port of Seattle for the site uplands and from EPA on the PSR cleanup.	Former shipyard and PSR uplands boundaries. Inputs from West Waterway/Lower Duwamish Waterway at the project's eastern boundary.	If review of existing upland data shows that the upland sources have been controlled, then no additional data collection will be required. If ongoing upland sources are suspected or found, then a request that further evaluation, design, and control of potentially significant sources identified on upland properties not controlled by LMC be addressed by EPA and Ecology	If additional groundwater or discrete outfall or sediment samples are collected, they will be analyzed by EPA approved methods and protocols.	The existing data from EPA and the Port of Seattle will be used to compare groundwater contaminant concentrations with water quality criteria and evaluate the potential to impact sediment. If existing data show no impacts then no additional data will be collected and analyzed.

Table 1-1. Data Quality Objectives (continued)

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Units on Decision Errors**	**Optimize the Sampling Design**
Existing baseline HHRAs and ERAs are inadequate.	Site-specific baseline HHRAs and ERAs will be used as part of the RI/FS to assist in the evaluation of potential remedial alternatives for the Site.	Complete Baseline Human Health and Ecological Risk Assessments Work Plan and determine what assumptions are to be used and to determine if site-specific data are needed.	Baseline risk assessments apply to the entire Site.	Sediment data from the Site will be used as inputs to the baseline RAs to calculate risks and to assist in establishing PRGs.	Any data collected as part of the RI that is used for the Risk assessments will have been analyzed following EPA-approved methods and QC protocols and the uncertainties associated with the data identified. All data will have been validated prior to its use.	The additional sampling has been optimized based on the knowledge of the site history and previous site characterization work.

1.4.2.1 Precision

Precision is the measurement of agreement in repeated tests of the same or identical samples, under prescribed conditions. Analytical precision can be expressed in terms of standard deviation (SD), relative standard deviation (RSD) and/or relative percent difference (RPD). The precision of analytical environmental samples has two components: laboratory precision and sampling precision. Laboratory precision is determined by replicate measurements of laboratory duplicates. Generally, results from the matrix spike (MS)/matrix spike duplicate (MSD) samples and laboratory duplicate samples are used to measure laboratory precision. The precision requirements for the laboratory analyses are specified in the appropriate laboratory Standard Operating Procedures (SOPs) and analytical methodologies. Overall precision of the field sampling and analysis effort is determined by an evaluation of field duplicate samples. Field duplicate analysis will be performed at a rate of 5 percent (i.e., one duplicate collected for every 20 samples).

1.4.3 Accuracy

Accuracy is the degree of agreement of a measured sample result or average of results with an accepted reference or true value. It is the quantitative measurement of the bias of a system, and it is usually expressed in terms of percent recovery (%R). The accuracy of the sample analyses will be determined in accordance with the specifications contained in the laboratory SOPs established through the evaluation of surrogate spike, laboratory control samples, and MS and/or MSD samples.

1.4.4 Representativeness

Representativeness expresses the degree to which the results of the analyses accurately and precisely represent a characteristic of a population, a process condition, or an environmental condition. In this case, representativeness is the degree to which the data reflect the contaminants present and their concentration magnitudes in the sampled site areas. Representativeness of data will be ensured through the selection of proper sampling locations and implementation of approved sampling procedures. Results from environmental field duplicate sample analyses can be used to assess representativeness, in addition to precision.

1.4.5 Comparability

Comparability represents the degree of confidence with which results from two or more data sets, or two or more laboratories, may be compared. To achieve comparability, standard

environmental methodologies (as prescribed in the procedures outlined in the SAP, the QAPP, and the laboratory SOPs) will be employed in the field and in the laboratory.

1.4.6 Completeness

Completeness is defined as the percentage of samples that meet or exceed the criteria objective levels for accuracy, precision and reporting limits within a defined time period or event. It is the measure of the number of data "points" that are judged as valid, usable results. Completeness can be ensured by collecting an adequate number of samples to accomplish project objectives.

1.5 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

TtEC will establish requirements for training and qualification of project personnel to ensure that they are capable of performing investigation activities. The TtEC QA Manager, in consultation with the TtEC PM, will establish and implement a program for the TtEC staff involved in the project, to ensure compliance with the SAP, the QAPP, and the HSP Plan.

Performance-based testing will be provided to all appropriate personnel performing project activities. TtEC's performance-based testing involves the review of the personnel's work products by the TtEC PM, FOL, and/or QA Manager, until the monitored individual reaches the desired level of competence in performing his work tasks. Once a person exhibits the required degree of competence, unannounced periodic monitoring is performed to ensure this level is maintained.

1.5.1 Project-Specific Personnel Training

Project staff shall receive general training on the project objectives, the DQOs for the site, the SAP, the QAPP, and the HSP Plan.

Quality assurance training will cover, but not be solely limited to, the following:

- QAPP elements, including project-specific QA requirements
- Need for proper documentation and records maintenance
- Responsibilities of project personnel
- Handling and review of field, laboratory, and non-direct measurement data

TtEC will assure that all personnel performing site activities shall receive training on their respective tasks. In general, training shall be provided to accomplish the following:

- Initial proficiency

- Maintain proficiency
- Adapt to changes in technology, methods, or job responsibilities

The extent of training will be commensurate with the following objectives:

- Scope, complexity, and nature of the activity to be performed
- Prior education, experience, and proficiency of personnel

1.5.2 Training Records

TtEC will complete and maintain all training records in the project files. They will include the following, as appropriate:

- Attendance sheets
- Records of course content, including dates of training and the instructor name
- Training logs and curricula
- Personnel training record

Formal qualification/certification records (as applicable)

1.6 DOCUMENTATION AND RECORDS

As discussed in Section 4.1 of the SAP, reporting for this project includes laboratory reports, quality assurance reports, and the final report.

1.6.1 Laboratory Reports

Final written laboratory reports will be required for both chemical and physical analyses. Key elements of these reports are described below. It is expected that these reports, or summaries of these reports (as appropriate), will be appended to the final report.

1.6.2 Chemistry Reports

Final written laboratory reports and data deliverables will contain the following:

- Case narrative
- Identification of all protocols
- Summary results of initial and continuing calibrations
- Method and instrument blanks
- All field sample and field QA/QC sample results

- Surrogate recoveries (organic analyses)
- Matrix spikes (organics, batch specific)
- Matrix spike duplicates (organics only, batch specific)
- Supporting raw data and spectra
- Supporting sample tracking information (e.g. shipping forms, chain-of-custody forms)
- Supporting documentation on any corrective actions

Initial calibration information must include concentrations of each standard analyzed, response factors for each analyte at each standard concentration, relative standard deviation (RSD) (or correlation coefficient for metals analytes) over all standards for individual analytes. The RSD control limit range must also be indicated in the initial calibration summary data.

Continuing calibration information must include the response factor (organic analytes) for each analyte, and the calculated percent difference as compared to initial calibration (organic analytes). Control limits for each analyte must also be indicated on each continuing calibration summary data sheet.

Method blank and field sample data pages must indicate the method reporting limit and the dilution factor. Surrogate reporting forms must list control limits for surrogate recovery. Spike reporting forms (blank and matrix spikes) must indicate spike percent recovery and relative percent difference control limits (if spikes are analyzed in duplicate).

Documentation of detection limits (detection limit studies) and results of performance evaluation samples (supplied by regulatory agencies or purchased from certified vendors) are not required for the data deliverable. However, these records must be supplied upon request. Total measurement error determination for field duplicate samples will be calculated.

Electronic data deliverables will also be required.

1.6.3 Geotechnical and Contaminant Mobility Laboratory Report

Final written laboratory reports and data deliverables will include the following:

- A short write-up on laboratory methods, sample identifications, and problems encountered during testing
- A full data report of all chemistry data for elutriate testing
- Graphs and tables for the column settling test including total suspended solids (TSS) and turbidity versus time, interface height versus time, TSS versus turbidity, percent initial

concentration (TSS versus time versus height), average TSS versus time, and initial test parameters with associated test description

- Grainsize data and Atterberg limits presented on graphs
- Volumes and weights of sample used in column settling and elutriate tests
- A copy of the chain-of-custody forms

1.6.4 Data Validation Report

The project QA representative will prepare a report based upon a review of the laboratory analytical data. An internal data validation or third party data validation will be completed. The laboratory quality assurance/quality control (QA/QC) reports and any data package validation reports will be incorporated by reference. This report will identify any laboratory activities that deviated from the approved referenced protocols and will make a statement regarding the overall validity of the data collected. The data validation report will be incorporated into the final report.

1.6.5 Final Field Sampling Report

A final written report will be prepared documenting all activities associated with collection, compositing, and transportation of samples. At a minimum, the following will be included in the field sampling report:

- Brief description of the project and its objectives
- Type of sampling equipment used
- Identification and description of protocols used during sampling and testing and an explanation of any deviations from the sampling plan protocols
- Description or summary of sampling and compositing procedures
- Descriptions of each sample and the sediments (i.e., core logs and sample logs)
- Summary of methods used to locate the sampling positions, and a discussion of the position accuracy
- Locations where the sediment samples were collected. Locations will be reported in NAD 83 State Plane Coordinates
- A plan view of the project showing the actual sampling locations

In addition to the items listed above, the final report will include an electronic file of sample location information (i.e., sample ID, sample type, coordinates, sample data, water depth, and sample depth).

2. MEASUREMENT DATA ACQUISITION

2.1 SAMPLING PROCESS DESIGN

The rationale for the proposed sampling approach is based on the assessment of existing data and identification of data gaps (see Section 4.9 of the Work Plan). The primary objectives of sediment sampling and analysis are the support of the spatial resolution of chemical contaminant distribution, assessment of sediment toxicity with respect to potential biological effects, and identification of potential natural recovery areas. Together, these data will be used to identify areas and volumes of sediment that may require active remediation, potential natural recovery areas, and areas that require no further action. Data collected as part of these activities will also support the assessment of sediment contaminant mobility, the potential for sediment recontamination, and physical characterization of the site.

The consulting team will be responsible for the tasks associated with the collection of sediment and site characterization data for Lockheed West. The proposed scope of work includes:

- Collection and analysis of samples for:
    - Chemical, conventional, and physical testing, and
    - Site characterization for remedial design planning; and
- Data analysis, interpretation, and reporting.

2.2 SAMPLING METHODS REQUIREMENTS

A synopsis of the RI field program is provided below. Surface data will be used to define potential remediation areas. Subsurface data will be used to define the maximum dredging depth and will indicate whether the sediments may be suitable for disposal under the PSDDA program. A full PSDDA characterization is not being performed during the RI sampling activities.

Surface Sampling. Surface sampling locations have been selected to be representative of the surface sediment conditions and to provide adequate spatial coverage of the site. Surface samples will be used for bulk chemical analysis and porewater analysis.

Subtidal surface samples will be collected using standard van Veen grab methods deployed from a work vessel. Intertidal bank samples will be collected with bowls and spoons at low tide to allow field personnel to assess the slope and substrate for optimal sampling locations.

Subsurface Sampling. Subsurface sampling will be performed using a vibracore system. Data gathered from the subsurface cores will be used for characterization of the subsurface material, sediment chemical characterization, and optional dredgability and contaminant mobility testing. Sample locations have been selected to provide adequate spatial coverage of the site. The coring system will be operated from a work vessel. Hand auger/explorations may be performed in the nearshore areas of the shipway where exposed sediment is present.

Most subsurface cores will be advanced beyond the deepest extent of PRG exceedances indicated by the existing data or to native material, expected to be an approximate elevation of -45 feet MLLW; the historical dredging depth. Several cores will be penetrated to -53 MLLW, the maximum depth required for navigation. The primary objective will be to determine the vertical extent of sediment potentially requiring remediation. Subsurface sediment intervals may also be used to support a preliminary PSDDA evaluation in the area south of the property boundary along the West Waterway. The Port of Seattle may expand Terminal 5 into this area. If this preliminary evaluation indicates that PSDDA requirements have a reasonable probability of being achieved, LMC will discuss the need for a full PSDDA characterization with EPA.

Proposed sample locations are included in Table 2-1.

Table 2-1. Proposed Sediment Samples

Location	Type	Proposed Easting[1]	Proposed Northing[1]	Mudline Elevation (MLLW)	Sample Depth (Feet)[2]	Target Elevation (MLLW)	Conventionals[3]	metals	SVOC	PCB	Pesticides	TBT bulk	Archive for PCB/Dioxin	Porewater[4]	Geotechnical[5]	Contaminant Mobility[6]	PSDDA Cores
1	Core and Grab	1263235.3	216012.3	-8.3	16	-24.3	x	x	x	x	x	x	x		x		1
2	Core and Grab	1263355.3	216056.9	-40.4	12.6	-53.0	x	x	x	x	x	x	x				1
3	Core and Grab	1263351.9	216274.6	-24.8	28.2	-53.0	x	x	x	x	x	x	x	x	x		1
4	Core and Grab	1263249.0	216267.8	0.0	20	-20.0	x	x	x	x	x	x	x		x		1
27	Core and Grab	1263334.8	216515.7	-14.9	38.1	-53.0	x						x		x		1
28	Grab	1263421.0	215964.3	-51.9	10 cm grab	--	x	x	x	x	x	x	x				
29	Core and Grab	1263446.7	216397.7	-41.4	11.6	-53.0	x	x	x	x	x	x	x		x		
5	Core and Grab	1263211.3	216573.8	-3.3	6.1	-9.4	x	x	x	x	x	x	x		x		1
6	Core and Grab	1263339.9	216644.1	-41.5	11.5	-53.0	x	x	x	x	x	x	x		x	1	
7	Core and Grab	1263202.7	216848.1	-6.4	5	NA	x	x	x	x	x	x	x				
8	Core and Grab	1263398.2	216875.6	-40.1	12.9	-53.0	x	x	x	x	x	x	x		x	1	
30	Core and Grab	1263479.5	216815.7	-51.4	1.6	-53.0	x	x	x	x	x	x	x				
9	Core and Grab	1263319.7	217126.0	-41.1	11.9	-53.0	x	x	x	x	x	x	x	x	x	1	
31	Core and Grab	1263489.1	217144.2	-50.4	2.6	-53.0	x	x	x	x	x	x	x		x		
10	Core and Grab	1263358.7	217312.7	-28.7	24.3	-53.0	x	x	x	x	x	x	x		x	1	
11	Core and Grab	1263355.3	217629.9	-40.0	13.0	-53.0	x	x	x	x	x	x	x			1	
42	Core and Grab	1263524.1	217658.5	-49.9	3.1	-53.0	x	x	x	x	x	x	x	x			
32	Core and Grab	1263476.2	217485.2	-42.2	10.8	-53.0	x	x	x	x	x	x	x				
33	Core and Grab	1263473.0	217836.1	-46.7	6.3	-53.0	x	x	x	x	x	x	x				
12	Core and Grab	1263045.0	217804.8	-41.9	11.1	-53.0	x	x	x	x	x	x	x			1	
13	Core and Grab	1263226.7	217789.3	-45.2	7.8	-53.0	x	x	x	x	x	x	x	x		1	
15	Core and Grab	1263190.7	217485.9	-45.3	7.7	-53.0	x	x	x	x	x	x	x	x	x	1	
16	Core and Grab	1262974.0	217215.4	-35.7	17.3	-53.0	x	x	x	x	x	x	x			1	
17	Core and Grab	1263173.6	217124.1	-43.8	9.2	-53.0	x	x	x	x	x	x	x		x	1	
18	Core and Grab	1263065.6	216957.8	-17.7	10	NA	x	x	x	x	x	x	x				
40	Grab	1263275.8	217499.2	-29.2	10 cm grab	--	x	x	x	x	x	x	x				
41	Grab	1263254.0	217086.8	-31.8	10 cm grab	--	x	x	x	x	x	x	x				
14	Core and Grab	1262951.6	217517.9	-25.0	28.0	-53.0	x	x	x	x	x	x	x				
19	Core and Grab	1262835.8	216971.6	-17.1	10	NA	x	x	x	x	x	x	x				
20	Grab	1262787.8	217299.0	-27.3	10 cm grab	--	x	x	x	x	x	x	x	x			
21	Grab	1262535.8	217309.3	-33.6	10 cm grab	--	x	x	x	x	x	x	x				
22	Core and Grab	1262909.5	217693.3	-42.2	10.8	-53.0	x	x	x	x	x	x	x				
23	Core and Grab	1262647.2	217737.9	-45.4	7.6	-53.0	x	x	x	x	x	x	x				
24	Core and Grab	1262314.6	217455.0	-26.3	10	NA	x	x	x	x	x	x	x				
25	Core and Grab	1262285.5	217268.2	-25.9	10	NA	x	x	x	x	x	x	x	x			
26	Core and Grab	1262410.5	217033.0	-28.7	10	NA	x	x	x	x	x	x	x				

Table 2-1. Proposed Sediment Samples (continued)

Location	Type	Proposed Easting[1]	Proposed Northing[1]	Mudline Elevation (MLLW)	Sample Depth (Feet)[2]	Target Elevation (MLLW)	Conventionals[3]	metals	SVOC	PCB	Pesticides	TBT bulk	Archive for PCB/Dioxin	Porewater[4]	Geotechnical[5]	Contaminant Mobility[6]	PSDDA Cores
34	Core and Grab	1263466.5	218102.6	-51.1	1.9	-53.0	x	x	x	x	x	x	x				
35	Core and Grab	1263141.5	218021.3	-47.7	5.3	-53.0	x	x	x	x	x	x	x				
36	Grab	1262978.6	218051.8	-53.9	10 cm grab	--	x	x	x	x	x	x	x				
37	Core and Grab	1262771.1	217930.3	-39.4	13.6	-53.0	x	x	x	x	x	x	x				
38	Grab	1262637.1	217984.6	-66.9	10 cm grab	--	x	x	x	x	x	x	x				
39	Core and Grab	1262481.9	217819.9	-43.6	9.4	-53.0	x	x	x	x	x	x	x				
IT-1	Intertidal Grab[7]	1263183.4	216096.7	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-2	Intertidal Grab[7]	1263188.2	216179.1	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-3	Intertidal Grab[7]	1263242.0	216345.1	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-4	Intertidal Grab[7]	1263166.8	216686.4	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-5	Intertidal Grab[7]	1262714.3	216934.3	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-6	Intertidal Grab[7]	1262330.4	216973.0	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-7	Intertidal Grab[7]	1262269.1	217020.6	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-8	Intertidal Grab[7]	1262188.8	217026.5	NA	10 cm grab	--	x	x	x	x	x	x	x				
IT-9	Intertidal Grab[7]	1262149.9	217106.8	NA	10 cm grab	--	x	x	x	x	x	x	x				

Notes:

1 Target locations actual location will be determined in the field.

2 Most cores will be pushed to approximately -53 MLLW or to a maximum of 20 feet. Cores along POS Terminal slope will be pushed to slope cut. Cores located in probable cap area will be pushed to 10 ft.

3 Conventional analysis includes total solids, grain size, and TOC.

4 Analysis of porewater will be conducted on the surface grab sample.

5 Atterberg Limits will be analyzed on samples within the potential dredge prism and should primarily consist of clays, therefore to be determined in the field. Specific gravity will be analyzed on each stratigraphy layer of cores located within the dredge prism.

6 Contaminant mobility samples will be a composite sample of core increments located within the dredge prism as well as a surface water sample.

7 Intertidal Bank Samples (IT-1 though IT-9) will be collected during a daylight low tide in the second phase of field work.

2.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Identification and documentation of samples are important in maintaining data quality. Strict custody procedures are necessary to ensure the integrity of the environmental samples. Sample custody must be strictly maintained and carefully documented each time the sample material is collected, transported, received, prepared, and analyzed. The history of each sample and its handling must be documented from its collection through all transfers of custody to ensure the integrity of the sample. A "sample" shall be defined as a piece of physical evidence collected from a facility or the environment. The control of the sample is essential to this evidentiary information. The subsections below address sample identification, custody, and documentation.

2.3.1 Sample Identification

The method of identification of a sample depends on the type of measurement or analysis performed. When field in situ measurements (e.g., water temperature or conductivity) are made, data are recorded directly in logbooks or on field investigation forms. Identifying information such as project name, station number, station location, date and time, name of sampler, field observations and remarks, etc., shall be recorded.

Samples that cannot be analyzed in place must be removed and transported from the sample location to a laboratory or other location for analysis. Each sample collected for off-site laboratory analysis during the field investigation will be specifically designated by TtEC for unique identification. Information to be recorded on the sample label includes the project name, sample identification number (assigned by TtEC), sample location, date and time of sample acquisition, type and matrix of sample (including designation of grab or composite), analysis required, preservation (as necessary), and name of sampler.

Sample identification numbers shall be assigned using a data set identifier code (e.g., "TT" for Tetra Tech), a letter code designating the type of sample (e.g., "CS" for chemistry core sample, etc.), and a number designating the sample location (e.g., "01" for sample location 1). .

2.3.2 Sample Custody

Sample custody must be strictly maintained and carefully documented each time the sample material is collected, transported, received, prepared, and analyzed. Custody procedures are necessary to ensure the integrity of the samples. Samples collected during the field investigation must be traceable from the time the samples are collected until they are disposed of and/or stored at the laboratory.

2.3.2.1 Field Custody Procedures

The field custody procedures are outlined below. These procedures shall be implemented for each sample collected. The field sampler shall be responsible for the care and custody of the samples until they are properly transferred or dispatched. To assure the integrity of the samples, the samples are to be maintained in a designated, secure area and/or be custody sealed in the appropriate containers prior to shipment. The following procedures should be followed to ensure the integrity of all samples collected.

- All samples should be collected as described in the SAP.
- Sample information should be documented in the field logbook(s) and on field investigation forms (as necessary).
- Sample labels should be completed for each sample using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label because a ballpoint pen would not function in freezing weather) with the information outlined in Section 2.3.2. The sample label should be securely attached to the sample container.
- A chain-of-custody form should be completed, listing all appropriate samples.

2.3.2.2 Transfer of Custody and Shipment

The procedures for transfer of sample custody and shipment of samples to the laboratory are outlined below. All samples collected for off-site analysis must follow these procedures.

- Samples shall be accompanied by a completed chain-of-custody record during transport, either supplied by the laboratory or by TtEC. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This form documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. However, when the chain-of-custody record is sealed inside a cooler and delivered by overnight delivery service (e.g., FedEx), the delivery service will not sign the chain-of-custody record. Evidentiary custody will be demonstrated by the signatures of the sampler and receiving laboratory, along with separate tracking documentation from the overnight delivery service.
- Samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate chain-of-custody record accompanying each shipment of coolers. To ensure the integrity of the samples, the samples are to be maintained in a designated, secure area and/or be custody sealed in the appropriate containers prior to shipment. The samples shall be placed in a metal or hard plastic

cooler, filled with adequate cushioning material to minimize the possibility of container breakage. Samples are to be packed with sufficient ice to cool the samples to 4°C ± 2°C. Shipping containers will be custody sealed for shipment to the laboratory (as appropriate).

When a courier service is collecting the samples directly from the Site, the chain of custody form shall not be placed inside the cooler. The sample coolers shall be secured with custody seals affixed over the lid opening in at least two locations and the cooler wrapped with strapping tape (without obscuring the custody seals). Orientation "This End Up" arrows shall be drawn or attached on two sides of the cooler. The chain of custody form must be signed by the courier as receiving possession of the samples. Samples shall be transported to the laboratory within 48 hours of sample collection.

When the samples are being shipped by an overnight delivery service to the laboratory, the chain of custody form and any other paperwork shall be placed in a waterproof sealable plastic bag and taped securely to the inside lid of the cooler. The cooler must then be secured, with custody seals affixed over the lid opening in at least two locations, and the cooler wrapped with strapping tape (without obscuring the custody seals). Orientation "This End Up" arrows shall be drawn or attached on two sides of the cooler, and a completed overnight delivery service shipping label shall be attached to the top of the cooler. Wide, clear tape should be used to secure the label to the cooler to prevent the shipping address label from being accidentally peeled off the cooler top. Samples to be shipped by an overnight delivery service shall be shipped within 24 hours of sample collection and arrive at the laboratory within 24 hours of sample shipment. A member of the field team will contact the laboratory to notify them of the sample shipment.

A copy of the chain-of-custody form will be retained by TtEC in the project files.

2.3.2.3 Laboratory Custody Procedures

The following list summarizes laboratory custody procedures. More detailed protocols are presented in the specific SOPs.

- A designated sample custodian will accept custody of the shipped samples and will verify that the information on the sample labels matches that on the chain of custody record(s).
- The laboratory custodian will use the sample label number or assign a unique laboratory number to each sample label. The laboratory custodian will also assure that all samples are transferred to the proper analyst or stored in the appropriate secure area.

- Laboratory personnel are responsible for the care and custody of samples from the time they are received until the sample is exhausted or returned to the custodian or sample storage area. The laboratory shall maintain internal chain of custody records.

The laboratory shall communicate with TtEC personnel by telephone or electronic mail (email), as necessary, throughout the process of sample scheduling, shipment, analysis, and data reporting, to ensure that samples are properly processed. If a problem occurs during sample shipment or receipt (i.e., a sample container arrives broken or with insufficient sample volume, a sample was not preserved correctly, a sample was not listed on the chain of custody, etc.), the laboratory shall immediately notify the TtEC designee by telephone or email for resolution. Corrective actions shall be documented and approved before implementation.

When sample analyses and necessary QA checks have been completed in the laboratory, the unused portion of the sample and the sample container must be disposed of properly. All identifying tags, data sheets, and laboratory records shall be retained as part of the permanent documentation. Samples received by the laboratory will be retained until analyses and QA checks are completed.

2.3.3 Sample Documentation

Sampling information will be documented in field logbooks and on field forms. The sampling team or any individual performing a particular field investigation activity shall be required to maintain a field logbook. The field logbook shall be a bound weatherproof notebook, and entries to the logbook must be filled out legibly in ink. Pertinent information that will be recorded in field logbooks includes all information that is necessary to reconstruct the investigative/sampling operations. Documentation of sample activities in the field logbook shall be completed immediately after sampling at the location of sample collection. Logbook entries shall contain all sample information, including sample number (and duplicate sample number as applicable), collection time, location, descriptions, field measurements, and other site- or sample-specific observations. Difficulties with sample recovery and field observations (e.g., staining, visible contamination, etc.) must be noted if encountered.

Logbook pages shall be consecutively numbered, and upon entry of data, the logbook pages require the date and the signature of the responsible project team member at the bottom of each page. Corrections to the logbooks shall consist of a single strike line through the incorrect entry, the new accurate information, the initials of the corrector, and the date of amendment. Any blank spaces/pages in the logbooks shall be crossed out with a single strike mark and signed by the person making the notation.

If photographs are taken as part of the documentation procedure, the name of the photographer, the date, the time, the site name, the site location, and a description of the photo shall be entered sequentially in the field logbook as the photographs are taken. Once developed, the photographic prints shall be numbered in correspondence to the logbook numbers, and the above information shall be placed on the back of the photograph.

In addition to field logbooks, field team members will use appropriate forms applicable to the field activities (as necessary). Investigation forms may include boring logs, vessel logs, rig shift reports, or calibration/maintenance records. Chain of custody forms shall be used for all sample shipments.

2.4 ANALYTICAL REQUIREMENTS

This section describes the analytical methods that will be used by the laboratory and the method requirements. A sampling and analysis summary is provided in Table 2-2. Specific details for the analytical methods are contained in the laboratory SOPs. Typical laboratory reporting limits for target analytes are specified in Tables 2-3 and 2-4. Only methods listed in this QAPP will be used to analyze project samples, unless prior written approval is obtained from the TtEC PM (in conjunction with LMC).

2.4.1 Analytical Methods for Chemical and Physical Testing

Analytical testing of the project samples, as summarized in Table 2-2, will be performed by an analytical laboratory that will be selected prior to sample collection activities. The samples will be analyzed in accordance with the EPA method requirements as defined in the laboratory-specific SOPs. Laboratories will follow their SOPs for sample preparation, instrument maintenance, instrument calibration, and sample handling.

The project-specific chemical and physical analytical parameters and associated methods to be used by the laboratory are as follows:

- PCB Aroclors — SW846 8082
- Pesticides — SW846 8081A
- SVOCs — SW846 8270C-low level
- Total Metals — SW846 6010B, 7471A
- Total and Dissolved Metals in water — EPA 200 Series (e.g., 200.10, 200.12, 200.13, 245.2)
- TOC — EPA 415.1/9060/ASTM D4129

- Dissolved Organic Carbon (DOC) EPA 415.1
- Total Suspended Solids (TSS) EPA 160.2
- Tributyltin Krone et al. 1989
- Grain size PSEP/ASTM D 422 with pipette
- Atterberg Limits ASTM D 4318-95
- Specific Gravity ASTM D 854-92
- Dredge Elutriate Test DiGiano et al., 1995
- Column Settling USEPA/USACE 1998
- PCB Congners SW846-1668A
- Dioxin/Furans EPA 1613B, EPA 1994

2.4.2 Analytical Method Limits of Detection for Chemical and Physical Testing

Laboratory reporting limits will be similar to the reporting limits listed in Tables 2-3 and 2-4. Sediment analytical data results shall be presented either in units of micrograms per kilogram (µg/kg) dry weight (dw) or milligrams per kilogram (mg/kg) dw. Water analytical data will be reported in units of micrograms per liter (µg/L) or milligrams per liter (mg/L). The project goal for sensitivity is to achieve reporting limits that are less than or equal to the Washington Sediment Management Standards (SMS) sediment quality standard (SQS) identified in the Sediment Sampling and Analysis Plan Appendix (SAPA) (2003). Per the SMS SQS, results for nonionizable organic compounds will be organic carbon-normalized in order to compare to the sediment criteria listed in the SAPA.

2.4.3 Sample Preservation

Samples for the analytical laboratory are to be preserved (which includes ice to 4°C) prior to transportation and storage to prevent or retard degradation or modification of chemicals in the samples. Specified holding times should also be met to maintain the integrity of the sample.

Requirements for the sample containers, preservatives, and holding times to be used during the investigation are provided in Table 2-5. The procedures for the cleanliness of the containers are given in the SOPs of the analytical laboratory.

Table 2-2. Sampling and Analysis Summary for Lockheed West Seattle

Sample Matrix	Laboratory Analysis	No. of Samples*	Field QA Samples		Lab QA Samples	Total
			Environmental Duplicates	Equipment Blanks	MS/MSD Samples	
Sediment						
	SVOCs	150	8	NA	8/8	176
	Pesticides	150	8	NA	8/8	176
	PCB Aroclors	150	8	NA	8/8	176
	Total Metals	150	8	NA	8/8	176
	Tributyltin	150	8	2	8/8	176
	TOC	150	8	NA	8/8	176
	Grain Size	150	8	NA	NA	176
	Atterburg Limits	10	NA	NA	NA	10
	Specific Gravity	10	NA	NA	NA	10
	PCB Congeners	NA	NA	NA	NA	NA
	Dioxin/Furans	NA	NA	NA	NA	NA
	Dredge Elutriate Test	2	NA	NA	NA	2
	Column Settling	2	NA	NA	NA	2
Water						
	SVOCs	11	NA	2	1/1	15
	Pesticides	11	NA	2	1/1	15
	PCB Aroclors	11	NA	2	1/1	15
	Total Metals	11	NA	2	1/1	15
	Tributyltin	11	NA	2	1/1	15
	DOC	2	NA	NA	1/1	4
	TOC	11	NA	2	1/1	15
	Total Suspended Solids	2	NA	NA	NA	2

* Estimated number of samples. Actual number will change during field activities. Additional sediment samples may be archived. Anaylsis for PCB Congeners and Dioxin/Furans will be determined following the initial results of the primary analytes.
The number of environmental duplicates and MS/MSD samples will be dependent on the number of field samples collected, and shall be analyzed at a rate of 5 percent (1 per 20).

Table 2-3. Laboratory Reporting Limits, Method Detection Limits, and Analytical Concentration Goals

METHOD AND ANALYTE	RL[a] (mg/kg dw)	MDL[a] (mg/kg dw)	SEDIMENT ACG[b] (mg/kg dw)
EPA Method 8270C -low level			
PAHs			
Acenaphthylene	0.02	0.00909	0.33
Benzo(a)anthracene	**0.02**	**0.00834**	0.0052
Benzo(a)pyrene	**0.02**	**0.00731**	0.00076
Benzo(b)fluoranthene	**0.02**	**0.00734**	0.0047
Benzo(k)fluoranthene	0.02	0.0104	0.047
Total benzofluoranthenes [c]	0.02	0.0104	1.2
Benzo(g,h,i)perylene	0.02	0.00804	0.16
Chrysene	0.02	0.00809	0.48
Dibenzo(a,h)anthracene	0.02	0.00835	0.06
Fluoranthene	0.02	0.00849	0.80
Indeno(1,2,3-cd)pyrene	**0.02**	**0.00854**	0.0029
Phenanthrene	0.02	0.00863	0.50
Pyrene	0.02	0.00872	5.0
Acenaphthene	0.02	0.00936	0.08
Anthracene	0.02	0.00869	1.1
Fluorene	0.02	0.00917	0.12
Naphthalene	0.02	0.00753	0.50
2-Methylnaphthalene	0.02	0.00721	0.19
Dibenzofuran	0.02	0.00795	0.075
Total LPAHs [d]	0.02	0.00936	1.9
Total HPAHs [e]	0.02	0.0104	4.8
Total PAHs [f]	0.02	0.0104	1,410
Other SVOCs			
1-Methylnaphthalene[l]	0.02	0.00691	na
1,2,4-Trichlorobenzene	**0.02**	**0.00588**	0.0041
1,2-Dichlorobenzene	**0.02**	0.00876	0.012
1,3-Dichlorobenzene	0.02	0.00755	0.17
1,4-Dichlorobenzene	**0.02**	0.00816	0.016
2-Methylnaphthalene[l]	0.02	0.0183	na
2-Methyl-4,6-dinitrophenol (4,6-dinitro-o-cresol)[l]	0.2	0.11	na
2-Nitroaniline[l]	0.1	0.0542	na
2-Nitrophenol[l]	0.1	0.00878	na
2,4,5-Trichlorophenol	0.10	0.00834	610
2,4,6-Trichlorophenol	0.10	0.010	0.61
2,4-Dichlorophenol	0.10	0.00773	18
2,4-Dimethylphenol	0.02	0.01052	0.029
2,4-Dinitrophenol	0.20	0.1042	12
2,4-Dinitrotoluene	0.10	0.00897	12
2,6-Dinitrotoluene	0.10	0.01073	6.1
2-Chloronaphthalene	0.02	0.00832	490
2-Chlorophenol	0.20	0.00948	6.3
2-Methylphenol	0.02	0.0138	0.063
3,3'-Dichlorobenzidine	0.10	0.0617	1.1
3-Nitroaniline[l]	0.1	0.0532	na
4-Bromophenyl phenyl ether[l]	0.02	0.0129	na
4-Chloro-3-methylphenol[l]	0.1	0.0101	na
4-Chlorophenyl phenyl ether[l]	0.02	0.012	na

Table 2-3. Laboratory Reporting Limits, Method Detection Limits, and Analytical Concentration Goals

METHOD AND ANALYTE	RL[a] (mg/kg dw)	MDL[a] (mg/kg dw)	SEDIMENT ACG[b] (mg/kg dw)
4-Nitroaniline[l]	0.1	0.0255	na
4-Nitrophenol[l]	0.1	0.037	na
4-Chloroaniline	0.10	0.0257	24
4-Methylphenol	0.10	0.0135	0.67
Aniline	0.02	0.00912	85
Benzoic acid	0.20	0.105	0.65
Benzyl alcohol	0.40	0.041	0.057
Bis(2-chloroethoxy)methane[l]	0.02	0.0123	na
Bis(2-chloroethyl)ether	0.02	0.00993	0.21
Bis(2-ethylhexyl)phthalate	0.02	0.0108	0.24
Bis-chloroisopropyl ether	0.02	0.00996	2.9
Butyl benzyl phthalate	0.02	0.0103	0.025
Di-ethyl phthalate	0.02	0.135	0.31
Dimethyl phthalate	0.02	0.0120	0.27
Di-n-butyl phthalate	0.02	0.0135	1.1
Di-n-octyl phthalate	0.02	0.0113	0.29
Hexachlorobenzene[i]	**0.02**	**0.00928**	0.0019
Hexachlorobutadiene[i]	0.02	0.00828	0.02
Hexachlorocyclopentadiene[l]	0.10	0.0445	na
Hexachloroethane	0.02	0.00798	0.12
Isophorone	0.02	0.00738	510
Nitrobenzene	0.02	0.0159	2.0
N-Nitrosodimethylamine	**0.10**	**0.00912**	0.0095
N-Nitrosodi-n-propylamine	**0.10**	0.0102	0.069
N-Nitrosodiphenylamine	0.02	0.0107	0.055
Pentachlorophenol	0.10	0.0371	0.36
Phenol	0.02	0.00947	0.42
EPA Method 8082			
Aroclor 1016	**0.02**	0.00098	0.0061
Aroclor 1221	**0.02**	**0.00098**	0.00021
Aroclor 1232	**0.02**	**0.00098**	0.00021
Aroclor 1242	**0.02**	**0.00098**	0.00021
Aroclor 1248	**0.02**	**0.00098**	0.00021
Aroclor 1254	**0.02**	**0.00098**	0.00021
Aroclor 1260	**0.02**	**0.00098**	0.00021
Total PCBs [g]	**0.02**	**0.00098**	0.00021
EPA Method 6020 (except as noted)			
Antimony	0.20	0.005	3.1
Arsenic	**0.20**	**0.02**	0.006
Cadmium	**0.20**	**0.02**	0.003
Chromium (EPA 6010B)	0.50	0.09	100
Cobalt	0.30	0.03	900
Copper (EPA 6010B)	0.20	0.04	1.3
Lead	2.00	0.12	40
Molybdenum	0.50	0.06	39
Nickel	1.00	0.38	140
Selenium	5.00	0.3	14.9
Silver	0.30	0.03	6.1
Thallium	0.20	0.003	0.52
Vanadium (EPA 6010B)	0.30	0.03	55
Zinc (EPA 6010B)	0.60	0.29	16

Table 2-3. Laboratory Reporting Limits, Method Detection Limits, and Analytical Concentration Goals

METHOD AND ANALYTE	RL[a] (mg/kg dw)	MDL[a] (mg/kg dw)	SEDIMENT ACG[b] (mg/kg dw)
EPA Method 7471A			
Mercury	**0.05**	0.003	0.016
TBT Method - Krone 1989			
Di-n-butyltin[l]	0.006	0. 00479	na
n-Butyltin[l]	0.006	0.00451	na
Tri-n-butyltin	**0.006**	0.00284	0.00028
EPA Method 8081A			
4,4'-DDD	0.002	0.000320	0.0083
4,4'-DDE	0.002	0.000166	0.0026
4,4'-DDT	**0.001**	0.000284	0.00092
2,4'-DDD	0.002	0.0011	0.0083
2,4'-DDE	0.002	0.000894	0.0026
2,4'-DDT	0.002	0.000870	0.00092
Total DDT[j]	**0.002**	**0.0011**	0.00092
Aldrin	**0.001**	0.000054	0.000063
alpha-BHC	**0.001**	0.000214	0.09
beta-BHC	0.001	0.000045	0.00063
delta-BHC[l]	0.001	0.00002	na
alpha-Chlordane	0.001	0.000144	0.01
gamma-Chlordane[l]	0.001	0.00012	na
Total chlordane[k]	0.001	0.000964	0.0017
Dieldrin	**0.001**	**0.000049**	0.000033
Endosulfan	0.001	0.000129	0.50
Endrin	0.002	0.00024	0.027
gamma-BHC (Lindane)	**0.001**	0.000141	0.00083
Heptachlor	**0.001**	0.000027	0.00025
Heptachlor epoxide	0.001	0.000122	0.053
Hexachlorobenzene	0.001	0.000034	0.0019
Oxy-chlordane[l]	0.002	0.00012	na
trans-Nonachlor[l]	0.002	0.000024	na
cis-Nonachlor[l]	0.002	0.000055	na
Methoxychlor	0.010	0.000402	0.44
Mirex	0.002	0.00122	0.27
Toxaphene	0.100	0.0297	0.44
EPA Method 1668A			
PCB-77 [h]	2.0E-6	3.9E-7	3.5E-3
PCB-81 [h]	2.0E-6	3.9E-7	3.5E-3
PCB-105 [h]	2.0E-6	4.4E-7	3.5E-3
PCB-114 [h]	2.0E-6	4.6E-7	7.0E-4
PCB-118 [h]	2.0E-6	3.7E-7	3.5E-3
PCB-123 [h]	2.0E-6	9.5E-7	3.5E-3
PCB-126 [h]	2.0E-6	2.1E-7	3.5E-6
PCB-156 [h]	2.0E-6	6.6E-7	7.0E-4
PCB-157 [h]	2.0E-6	6.6E-7	7.0E-4
PCB-167 [h]	2.0E-6	3.5E-7	3.5E-2
PCB-169 [h]	2.0E-6	4.4E-7	3.5E-2
PCB-189 [h]	2.0E-6	3.4E-7	3.5E-3

Table 2-3. Laboratory Reporting Limits, Method Detection Limits, and Analytical Concentration Goals

METHOD AND ANALYTE	RL[a] (mg/kg dw)	MDL[a] (mg/kg dw)	SEDIMENT ACG[b] (mg/kg dw)
EPA Method 1613B			
2,3,7,8-TCDD	**1.0E-6**	5.9E-8	3.5E-07
1,2,3,7,8-PeCDD[h]	**5.0E-6**	1.53E-7	3.5E-07
1,2,3,4,7,8-HxCDD[h]	**5.0E-6**	1.72E-7	7.0E-07
1,2,3,6,7,8-HxCDD[h]	**5.0E-6**	1.18E-7	3.5E-06
1,2,3,7,8,9-HxCDD[h]	**5.0E-6**	1.72E-7	3.5E-06
1,2,3,4,6,7,8-HpCDD[h]	**5.0E-6**	1.69E-7	3.5E-06
OCDD[h]	**1.0E-5**	5.18E-7	3.5E-06
2,3,7,8-TCDF[h]	1.0E-6	7.7E-8	3.5E-06
1,2,3,7,8-PeCDF[h]	**5.0E-6**	1.32E-7	3.5E-06
2,3,4,7,8-PeCDF[h]	**5.0E-6**	1.43E-7	3.5E-06
1,2,3,4,7,8-HxCDF[h]	**5.0E-6**	1.48E-7	3.5E-06
1,2,3,6,7,8-HxCDF[h]	5.0E-6	1.54E-7	7.0E-06
1,2,3,7,8,9-HxCDF[h]	5.0E-6	1.48E-7	3.5E-05
2,3,4,6,7,8-HxCDF[h]	5.0E-6	9E-8	3.5E-05
1,2,3,4,6,7,8-HpCDF[h]	5.0E-6	1.83E-7	3.5E-05
1,2,3,4,7,8,9-HpCDF[h]	5.0E-6	8.1E-8	0.0035
OCDF[h]	1.0E-5	3.81E-7	0.0035

Footnotes

RL reporting limit
MDL method detection limit
ACG analytical concentration goal
mg/kg dw milligrams per kilogram dry weight
na not available

RLs or MDLs in BOLD are greater than at least one of their respective ACGs. All of the ACGs that are lower than RLs or MDLs are based on human health RBCs, with the exception of the following four chemicals, which are based on benthic invertebrate RBCs: 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and hexachlorobenzene.

[a] RLs, MDLs, and ACGs from LDWG Surface QAPP (LDWG 2005)
[b] ACG for sediment is the lowest of the RBCs for benthic invertebrates, spotted sandpipers, and humans.
[c] Total benzofluoranthenes is the sum of benzo(b)fluoranthene and benzo(k)fluoranthene. RL and MDL are the highest of the RLs and MDLs for benzo(b)fluoranthene or benzo(k)fluoranthene.
[d] Total LPAHs is the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. RL and MDL are the highest RL and MDL for the LPAHs. 2-methyl naphthalene is not included in the LPAH definition under the SMS and under the DMMP.
[e] Total HPAHs is the sum of fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. RL and MDL are the highest RL and MDL for the HPAHs.
[f] Total PAHs is the sum of the LPAHs and the HPAHs. RL and MDL are the highest RL and MDL for either the LPAHs or HPAHs.
[g] Total PCBs is the sum of the Aroclors. RL and MDL are the highest RL and MDL for the individual Aroclors.
[h] Dioxin-like PCB and dioxin/furan congeners will be evaluated as toxic equivalents (TEQs) in the risk assessments, rather than as individual congeners. However, because TEQs are calculated, rather than measured by the laboratory, RBCs for individual congeners are presented to facilitate comparison with RLs for those congeners. In reality, risks will be assessed based on sums of these congeners (normalized per their relative toxicity to TCDD), and thus comparison to RLs on a congener-specific basis is somewhat uncertain.
[i] Hexochlorobenzene and Hexachlorobutadiene are also analyzed with 8081A to obtain lower DLs
[j] Total DDT is the sum of 4,4'-DDD, 4,4-DDE, 4,4'-DDT, 2,4'-DDD, 2,4-DDE, and 2,4'-DDT. RL and MDL are the highest RL and MDL for the DDT isomers.
[k] Total chlordane is the sum of oxychlordane, alpha- and gamma-chlordane, and cis- and trans-nonachlor. RL and MDL are the highest RL and MDL for the chlordane-related compounds.
[l] RLs and MDLs from LDWG Subsurface QAPP (LDWG 2006)

Table 2-4. Target Analytes and Estimated Reporting Limits for Water Samples

Parameter (Method)	Target Analytes	Estimated Reporting Limits	Units
PCBs	Aroclor-1016	0.010	µg/L
(SW846 8082)	Aroclor-1221	0.010	µg/L
	Aroclor-1232	0.010	µg/L
	Aroclor-1242	0.010	µg/L
	Aroclor-1248	0.010	µg/L
	Aroclor-1254	0.010	µg/L
	Aroclor-1260	0.010	µg/L
Pesticides	Aldrin	0.050	µg/L
(SW846 8081A)	gamma-BHC (Lindane)	0.050	µg/L
	alpha-Chlordane	0.004*	µg/L
	gamma-Chlordane	0.050	µg/L
	4,4'-DDD	0.001*	µg/L
	4,4'-DDE	0.001*	µg/L
	4,4'-DDT	0.001*	µg/L
	Dieldrin	0.050	µg/L
	Heptachlor	0.0030*	µg/L
SVOCs	Acenaphthene	10	µg/L
(SW846 8270C)	Acenaphthalene	10	µg/L
	Anthracene	10	µg/L
	Benzo(a)anthracene	10	µg/L
	Benzo(a)pyrene	10	µg/L
	Benzo(b)fluoranthene	10	µg/L
	Benzo(g,h,i)perylene	10	µg/L
	Benzo(k)fluoranthene	10	µg/L
	Benzoic Acid	50	µg/L
	Benzyl Alcohol	20	µg/L
	Bis(2-ethylhexyl)phthalate	10	µg/L
	Butylbenzyl phthalate	10	µg/L
	Chrysene	10	µg/L
	Di-n-butyl phthalate	10	µg/L
	Di-n-octyl phthalate	10	µg/L
	Dibenzo(a,h)anthracene	10	µg/L
	Dibenzofuran	10	µg/L
	1,2-Dichlorobenzene	10	µg/L
	1,3-Dichlorobenzene	10	µg/L
	1,4-Dichlorobenzene	10	µg/L
	Diethyl phthalate	10	µg/L
	Dimethyl phthalate	10	µg/L
	2,4-Dimethyl phenol	10	µg/L
	Fluoranthene	10	µg/L

Table 2-4. Target Analytes and Estimated Reporting Limits for Water Samples (continued)

Parameter (Method)	Target Analytes	Estimated Reporting Limits	Units
	Fluorene	10	µg/L
	Hexachlorobenzene	10	µg/L
	Hexachlorobutadiene	10	µg/L
	Hexachloroethane	10	µg/L
	Indeno(1,2,3-cd)pyrene	10	µg/L
	2-Methylnaphthalene	10	µg/L
	2-Methylphenol	10	µg/L
	4-Methylphenol	10	µg/L
	Naphthalene	10	µg/L
	N-Nitrosodiphenylamine	10	µg/L
	Pentachlorophenol	50	µg/L
	Phenanthrene	10	µg/L
	Phenol	10	µg/L
	Pyrene	10	µg/L
	1,2,4-Trichlorobenzene	10	µg/L
Total or Dissolved Metals	Antimony	50	µg/L
	Arsenic	50	µg/L
	Cadmium	5	µg/L
	Chromium	5	µg/L
	Copper	5	µg/L
	Lead	5	µg/L
	Mercury	0.5	µg/L
	Nickel	5	µg/L
	Silver	5	µg/L
	Zinc	5	µg/L
TOC/DOC (EPA 415.1)	Total Organic Carbon/Dissolved Organic Carbon	0.5	mg/L
TSS (EPA 160.2)	Total Suspended Solids	5	5

Notes:
* = Actual laboratory reporting limits may be slightly different than those listed here. Laboratory will report to the method detection limits with results between the reporting limit and method detection limit qualified as estimated.
mg/L = milligrams per liter
µg/L = micrograms per liter

Table 2-5. Required Containers, Preservatives, and Holding Times

Analysis Type	Matrix	Container Size	Holding Time[1]	Preservation
SVOCs	Sediment	8 oz glass	14 days extraction/40 days analysis	Ice (4+/- 2°C)
				Frozen (-18°C)
PCBs	Sediment	8 oz glass	14 days extraction/40 days analysis	Ice (4+/- 2°C)
				Frozen (-18°C)
Pesticides	Sediment	8 oz glass	14 days extraction/40 days analysis	Ice (4+/- 2°C)
			1 year until analysis	Frozen (-18°C)
Metals	Sediment	4 oz glass	6 months/28 days*	Ice (4+/- 2°C)
				Frozen (-18°C)
			14 days extraction/40 days analysis	Ice (4+/- 2°C)
Tributyltin	Sediment	8 oz glass	1 year until analysis	Frozen (-18°C)
TOC	Sediment	4 oz glass	28 days	Ice (4+/- 2°C)
Grain size	Sediment	16 oz glass	6 months	Ice (4+/- 2°C)
Atterberg Limits	Sediment	Inc.	NA	Ice (4+/- 2°C)
Specific Gravity	Sediment	Inc.	NA	Ice (4+/- 2°C)
PCB Congener	Sediment	8 oz glass	1 year	Frozen (-18°C)
Dioxin/Furans	Sediment	8 oz glass	1 year	Frozen (-18°C)
Dredge Elutriate Test	Sediment	1 liter	NA	Ice (4+/- 2°C)
Column Settling	Sediment	40 liters	NA	Ice (4+/- 2°C)
SVOCs	Water	One 1-liter amber glass	7 days extraction/40 days analysis	Ice (4+/- 2°C)
PCBs	Water	One 1-liter amber glass	7 days extraction/40 days analysis	Ice (4+/- 2°C)
Pesticides	Water	One 1-liter amber glass	7 days extraction/40 days analysis	Ice (4+/- 2°C)
Metals	Water	One 500-mL HDPE	6 months/28 days*	Ice (4+/- 2°C), HNO_3 pH<2
				Ice (4+/- 2°C), H_2SO_4
DOC	Water	One 250-mL HDPE	28 days	pH<2**
TOC	Water	One 250-mL HDPE	28 days	Ice (4°C), H_2SO_4 pH<2
TSS	Water	One 1-liter HDPE	7 days	Ice (4+/- 2°C)

* Holding time for mercury is 28 days. Holding time for the other metals is 6 months.
Note: All holding times are from the date of sampling. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis without being qualified.
** DOC is filtered at the laboratory.

2.5 QUALITY CONTROL REQUIREMENTS

This section discusses the types and quantities of QA/QC samples to be collected during implementation of the field programs.

2.5.1 Field Quality Control Samples

The subsections below present general information and guidance on field QC samples, including definition and frequency of QC blanks.

2.5.1.1 Field Sample Duplicates

Field sample duplicates will be analyzed by the analytical laboratory to evaluate the precision and reproducibility of the sampling procedures. Field duplicate samples will be collected at a rate of five percent of the total samples for each specific matrix for each type of analysis (i.e., one duplicate for up to every 20 samples). The duplicate samples will be collected from the same location and at the same time as the original environmental sample; however, the duplicate samples will be "coded" in such a manner that the laboratory will not be able to determine that the samples are field QC (i.e., "blind" duplicates). An explanation of the duplicate "coding" must be written in the field logbook. Preservation and analysis of duplicate samples will be identical to those for the environmental samples. Precision of field data will be evaluated based on the calculation of RPD between the original and duplicate samples.

2.5.1.2 Equipment Rinse Blanks

A rinse blank (rinsate) will be collected to evaluate the potential for contamination of environmental samples from inadequate decontamination of field equipment. Rinse blanks shall be collected by pouring contaminant-free deionized (DI) water over and/or through either decontaminated equipment (e.g., compositing equipment for sediment sampling) or disposable equipment (e.g., sampling utensils), and collecting the rinsate. One rinse blank will be collected for each type of sampling (i.e., one field blank for surface sampling, one field blank for coring). Preservation and analysis of rinse blanks will be identical to analysis of the associated environmental samples and will follow the guidelines specified in Table 2-5.

2.5.2 Laboratory Quality Control Samples for Chemical Testing

General information and guidance on laboratory QC samples is presented below. A summary of QC procedures, frequencies, criteria, and corrective actions for the samples, as determined by the

laboratory SOPs, is provided in Table 2-6. Laboratory internal QC checks will, at a minimum, conform to EPA method-specific QC requirements.

2.5.2.1 Method Blanks

A method blank will be analyzed with every batch of samples to ensure that contamination has not occurred during the analytical process. These blank samples will consist of a portion of analyte-free solid that is processed through the entire sample procedure the same as an environmental sample. For this project, the laboratory must use either clean sand or sodium sulfate as the matrix for nonaqueous method blanks. These matrices will be subjected to all reagents, surrogates, internal standards, and method protocols to which the environmental samples are subjected.

2.5.2.2 Matrix Spikes/Matrix Spike Duplicates

Matrix spike/matrix spike duplicate (MS/MSD) samples will be used to assess precision and accuracy of the analytical methods. In this procedure, two aliquots of an actual field sample are "spiked" by the addition of a known amount of analyte(s) and these samples are then analyzed identically to the field samples. A comparison of the resulting concentration to the original sample concentration and among the two "spiked" sample concentrations provides information on the ability of the analytical procedure to generate an accurate and precise result from the sample. Samples will contain sufficient volume for MS/MSD sample analysis and will be analyzed at a frequency of 5 percent of the total samples. For inorganic analyses, a matrix spike/matrix duplicate may be analyzed in lieu of an MS/MSD set.

2.5.2.3 Surrogate Compounds

Surrogates (also known as System Monitoring Compounds) are compounds of known concentrations added to every organic analysis sample for analytical chromatography methods at the beginning of the sample preparation to monitor the recovery in regard to sample preparation and analysis. Surrogate recoveries will be used to assess potential matrix interferences and potential problems resulting from sample extraction.

2.5.2.4 Internal Standards

Internal standards are used to provide instrument correction for variation in instrument performance and injection volumes for some analytical chromatography methods. Internal standards also establish relative response factors for the analytes.

Table 2-6. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
Pesticides, PCB Aroclors, and PCB Congeners	SW846 8082 and SW846 8081A	ICV/CCV	ICV – following initial calibration CCV – every 20 samples	ICV - %RSD ≤ 20% CCV - ±15% from value average response factors	ICV - Generate new calibration curve for that analyte CCV – Reanalyze CCV. If CCV fails again, generate a new calibration curve.
		Method Blank	1 per batch	no constituent > RL	Correct problem before resuming sample analysis
		MS/MSD	1 per ≤ 20 samples	0 - 30 RPD	Follow method specifications
		MSB	1 per MS/MSD (≤ 20 samples), immediately following the MS/MSD	Compound and matrix specific	Follow method specifications
		QC check sample	At the end of each batch, or 1 per 20 samples, whichever is more frequent	Compound and matrix specific	Correct problem before resuming sample analysis
		LCS	1 per batch	50 – 150 % R	Correct problem before resuming sample analysis
		Surrogate Compounds	all samples	compound and matrix specific*	Check calculations and instruments, re-extract and reanalyze affected samples. Allows 1 surrogate out.
SVOCs	SW846 8270C	ICV/CCV	ICV – following initial calibration CCV – every 12 hours	ICV - %RSD ≤ 30% CCV – per method SPCC/CCC requirements	ICV - Generate new calibration curve for that analyte CCV - Reanalyze CCV. If CCV fails again, generate a new calibration curve
		Method Blank	1 per ≤ 20 samples	No constituent > RL	Follow method specifications
		MS/MSD	1 per ≤ 20 samples	0 – 30 RPD	Follow method specifications
		MSB	1 per MS/MSD (≤ 20 samples), immediately following the MS/MSD	compound and matrix specific	Follow method specifications

Table 2-6. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses (continued)

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
		LCS	1 per batch	50 – 150 % R	Correct problem before resuming sample analysis
		QC check sample	At the end of each batch, or 1 per 20 samples, whichever is more frequent	compound and matrix specific	Correct problem before resuming sample analysis; reanalyze all samples preceding the failed QC check sample and following the last valid CCV
		Surrogate Compounds	all samples	compound and matrix specific	Check calculations and instruments, re-extract and reanalyze affected samples if more than one surrogate is out of limits
Metals	SW846 6010B, SW846 7471A	ICV/CCV	ICV – following initial calibration CCV – every 10 samples	80 – 120 % R	ICV - Generate new calibration curve for that analyte CCV - Reanalyze CCV. If CCV fails again, generate a new calibration curve
		ICB/CCB	Immediately following the ICV/CCV	no constituent > RL	If the sample concentration of the analyte is < 10 times the blank concentration and above the CRQL, the sample must be redigested and reanalyzed for that analyte
		Preparation Blank	1 per batch (≤ 20 samples)	no constituent > RL	Follow method specifications
		MS/Dup	1 per batch (≤ 20 samples)	< 20% RPD	Follow method specifications
		LCS	1 per batch (≤ 20 samples), immediately following the MS/MSD	75 – 125 %R	Correct the problem and reanalyze all samples prior to the failing LCS
		ICP Interference Check Sample (does not apply to method SW846 7471A)	Beginning and end of each analytical run	+/- 20% of true value	Correct the problem, recalibrate the instrument, reanalyze all samples following the last compliant ICP Interference Check Sample

Table 2-6. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses (continued)

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
		Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"
TOC/DOC	EPA 415.1	Initial and continuing calibration	Follow method specifications	Follow method specifications	Follow method specifications
		Method Blank	Every 10 samples	No constituent > method MDL	Follow method specifications
		MS/MSD	1 per batch (≤ 20 samples)	< 20% RPD	Follow method specifications
		LCS	1 per batch (≤ 20 samples), immediately following the MS/MSD	80 – 120 %R	Follow method specifications
TSS	EPA 160.2	Initial and continuing calibration	Follow method specifications	Follow method specifications	Follow method specifications
		Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"

Table 2-6. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses (continued)

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
Grain Size	ASTM D 422 with hydrometer	Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"
Atterberg Limits	ASTM D 4318-95	Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"
Specific Gravity	ASTM D 854-92	Laboratory Duplicate Sample	1 per batch	< 20% RPD for analyte concentrations ≥ 5 times the CRQL; +/- CRQL for analyte concentrations less than 5 times the CRQL	Flag all the data for the samples received associated with that duplicate sample with an "*"
Dredge Elutriate Test	DiGiano et al. 1995	NA	NA	NA	NA
Column Settling	USEPA/USACE 1998	NA	NA	NA	NA
Dioxin/Furans	EPA 1613	ICV/CCV	ICV – following initial calibration CCV – every 20 samples	ICV - %RSD ≤ 20% CCV - ±15% from value average response factors	ICV - Generate new calibration curve for that analyte CCV – Reanalyze CCV. If CCV fails again, generate a new calibration curve.
		Method Blank	1 per batch	no constituent > RL	Correct problem before resuming sample analysis
		MS/MSD	1 per ≤ 20 samples	0 - 30 RPD	Follow method specifications

Table 2-6. Summary of Analytical QC Procedure Checks, Frequencies, Acceptance Criteria, and Corrective Actions for Laboratory Sample Analyses (continued)

Parameter	Method	QC Procedure	Frequency	Acceptance Criteria	Lab Corrective Action
		MSB	1 per MS/MSD (≤ 20 samples), immediately following the MS/MSD	Compound and matrix specific	Follow method specifications
		QC check sample	At the end of each batch, or 1 per 20 samples, whichever is more frequent	Compound and matrix specific	Correct problem before resuming sample analysis
		LCS	1 per batch	50 – 150 % R	Correct problem before resuming sample analysis
		Surrogate Compounds	all samples	compound and matrix specific	Check calculations and instruments, re-extract and reanalyze affected samples. Allows 1 surrogate out.

ASTM = American Society for Testing and Materials
ICV = Initial Calibration Verification
CCV = Continuing Calibration Verification
MS/MSD = matrix spike/matrix spike duplicate
MSB = matrix spike blank
QC = Quality Control
LCS = Laboratory Control Sample
CRQL = Contract Required Quantitation Limit
RPD = relative percent difference
CCC = calibration check compound
SPCC = system performance check compounds
MDL = method detection limit

2.5.2.5 Laboratory Control Sample

Data from the laboratory control sample (LCS) are used to monitor laboratory accuracy of a particular analytical method and to monitor laboratory performance. Generally, one LCS is analyzed per analytical batch. The LCS is an aliquot of reagent water or clean solid material (e.g., sand or sodium sulfate) spiked with the analytes as determined by the method. The LCS percent recoveries are used to evaluate the accuracy of the extraction and analysis procedures.

2.6 INSTRUMENT CALIBRATION AND FREQUENCY

This section describes the requirements for control, calibration, adjustment (if necessary) and preventive maintenance of instrumentation. Instruments shall be calibrated and adjusted (if warranted) at specified, predetermined intervals using known, recognized standards. All instruments shall be calibrated and maintained in accordance with manufacturer's instructions.

2.6.1 Field Instrumentation

2.6.1.1 Calibration

The FOL or his designee will be responsible for ensuring that instrumentation is of the proper range, type, and accuracy for the test being performed. The FOL should also verify that all of the equipment is calibrated at their required frequencies, according to their specific calibration protocols/procedures.

All field measurement instruments must be calibrated according to the manufacturer's instructions prior to the commencement of the day's activities. Exceptions to this requirement shall be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer. Calibration information shall be documented on instrument calibration and maintenance log sheets or in a designated field logbook. Information to be recorded includes the date, the operator, and the calibration standards (concentration, manufacturer, lot number, expiration date, etc.). All project personnel using measuring equipment or instruments in the field shall be trained in the calibration and usage of the equipment, and are personally responsible for ensuring that the equipment has been properly calibrated prior to its use.

In addition, all field instruments must undergo response verification checks at the end of the day's activities and at any other time that the user suspects or detects anomalies in the data being generated. The checks consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying a response. If an unacceptable instrument response is

obtained during the check (i.e., not within specifications), the data shall be labeled suspect, the problem documented in the site logbook, and appropriate corrective action taken.

Any equipment found to be out of calibration, shall be re-calibrated. When instrumentation is found to be out of calibration or damaged, an evaluation shall be made to ascertain the validity of previous test results since the last calibration check. If it is necessary to ensure the acceptability of suspect items, the originally required tests shall be repeated (if possible) using properly calibrated equipment. Any instrument consistently found to be out of calibration shall be repaired or replaced.

2.6.1.2 Maintenance

Field equipment shall be maintained at its proper functional status in accordance to manufacturer manual specifications. A check of the equipment shall be performed before field activities begin, and any potential spare parts (e.g., batteries, connectors, etc.) and maintenance tools will be brought on site to minimize equipment downtime during the field activities. Visual checks of the equipment will be conducted on a daily basis. Routine preventive maintenance shall be performed to assure proper operation of the equipment. Any maintenance performed on field equipment will be documented on instrument calibration and maintenance sheets or in the designated field logbook, and shall be undertaken only by personnel who have the appropriate skills and/or training in the type of maintenance required.

2.6.2 Laboratory Instrumentation

2.6.2.1 Calibration

Personnel at the laboratory will be responsible for ensuring that analytical instrumentation are of the proper range, type, and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to specific laboratory SOPs.

Laboratory equipment shall be calibrated using certified/nationally recognized standards and according to the laboratory SOPs. In addition, these methods/procedures specify the appropriate operations to follow during calibration or when any instrument is found to be out of calibration.

2.6.2.2 Maintenance

The laboratory is responsible for the maintenance of their analytical equipment, in accordance with manufacturers' specifications. Analytical personnel will be responsible for ensuring that instrumentation is functioning properly and within specific guidelines/specifications prior to

starting any analysis. Maintenance, performed by either laboratory personnel or the manufacturer's service personnel, will be conducted according to the manufacturer's recommendations and procedures.

2.7 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Supplies and consumables necessary for the field investigation will be obtained through appropriate commercial markets and shall meet any supply-specific requirements outlined in this QAPP. All supplies and consumables will be inspected by TtEC personnel (e.g., the FOL or the QA Manager) prior to use. Any supplies/consumables that do not meet requirements will be discarded or returned to the supplier.

Supply-specific requirements include the following:

- Sampling equipment shall be manufactured from the procedural-specific material
- Sample bottle containers will be provided by the subcontractor laboratory
- Certifications from the supplier of the "cleanliness" of the bottles must be provided to TtEC by the laboratory and retained in the project files

Supplies and consumables will be stored, as necessary, in a designated area on the site. The storage area shall be protected from adverse conditions (e.g., weather, heat, etc.) to protect the supplies/consumables from possible outside contamination and breakage.

2.8 DATA MANAGEMENT

Standard methods and references will be used as guidelines for data handling, reduction, validation, and reporting. All data for the project will be compiled and summarized with an independent verification at each step in the process to prevent transcription/typographical errors. Any computerized entry of data will also undergo verification review.

2.8.1 Field Data

Field instrumentation data will be reported by site personnel in field logbooks and/or on field investigation forms associated with the sampling event.

2.8.2 Laboratory Data

The analytical laboratory will tabulate and compile analytical results and associated QA/QC information according to method procedures. All data generated by the laboratory will be reported in appropriate formats and concentration units consistent with standard EPA procedures and this project QAPP. Laboratory QA/QC information required by the method protocols will be compiled, including the application of data QA/QC qualifiers as appropriate. In addition, laboratory worksheets, laboratory notebooks, sample tracking system forms, chains-of-custody forms, instrument logs, and calibration records, as applicable, will be provided in the laboratory data packages to determine the validity of data. Specifics on internal laboratory data reduction protocols are identified in the laboratory's quality assurance plan or SOPs.

2.8.3 Project Data Reduction

Following receipt of the laboratory analytical results by TtEC, the data will be validated. The results will be compiled in a relational database for evaluation and presentation in an appropriate tabular form. Where appropriate, the impacts of QA/QC qualifiers resulting from laboratory or external validation reviews will be assessed in terms of data usability. At this time, the QA/QC qualifiers will be added to the project database. Data will be reported to two significant figures.

2.8.3.1 Replicates and Mulitple Results

Samples in which multiple results for a target analyte are reported by the laboratory may be due to dilution, analysis of a target analyte performed by two analytical methods (e.g., 8081A and 8270C for hexachlorobenzene and hexachlorobutadiene), or when a sample is reanalyzed due to QC sample results not within acceptance criteria. In these cases, the laboratory may report all results. After the data qualifiers are applied during the data validation process, Tetra Tech will review the results to select the appropriate result and assign one valid result per target analyte per sample. Following are the guiding principles that will be applied when selecting the result that will be used when multiple results were reported:

1. When multiple results indicated the analyte was not detected, the lowest reporting limit for a non-detect analyte will be selected.
2. When one result is rejected (R) during validation, the remaining result will be selected.
3. When one result indicates a detection and the other result is not detected, the detected value will be selected.

Field split samples will be reported as individual samples in the data report tables. Laboratory QC samples such as duplicates will not be reported as a sample result but treated as a QC sample only.

2.8.3.2 Calculating Totals

Total PCBs, Total DDT, Total HPAH, Total LPAH, Total Benzofluoranthenes, Total PAH, and Total Chlordanes will be calculated using Sediment Management Standards Chapter 173-204 WAC.

Total PCBs will be calculated using only detected values for seven Aroclor mixtures. For individual samples in which none of the seven Aroclor mixtures are detected, total PCBs will be given a value equal to the highest reporting limit of the seven Aroclors and assigned a "U" qualifier indicating the lack of detected concentrations.

Total LPAHs are the sum of detected concentrations for naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. Total HPAHs are the sum of detected concentrations for fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. Total benzofluoranthenes are the sum of the b (i.e., benzo(b)fluoranthene), j, and k isomers. Because the j isomer is rarely quantitated, this sum is typically calculated with only the b and k isomers. For samples in which all individual compounds within any of the three groups described above are undetected, the single highest reporting limit for that sample represents the sum.

Total DDTs are calculated using only detected values for the six DDT isomers: 2,4'-DDD, 4,4'-DDD, 2,4'-DDE, 4,4'-DDE, 4,4'-DDT, and 4,4'-DDT. For individual samples in which none of the isomers are detected, total DDTs are given a value equal to the highest reporting limit of the six isomers and assigned a "U" qualifier, indicating the lack of detected concentrations.

Total chlordane is calculated using only detected values for the following compounds: alpha-chlordane, gamma-chlordane, oxychlordane, cisnonachlor, and trans-nonachlor. For individual samples in which none of these compounds is detected, total chlordane will be given a value equal to the highest reporting limit of the five compounds listed above and assigned a "U"qualifier, indicating the lack of detected concentrations.

2.8.3.3 Calculation of Toxic Equivalents for PCB Congners

PCB congener toxic equivalents (TEQs) will be calculated using the World Health Organization consensus toxic equivalence factors (TEFs) (Van den Berg et al. 1998) for mammals presented in

Table 2-7. The TEQ is calculated as the sum of each congener concentration multiplied by the corresponding TEF value. When the congener concentration is reported as non-detected, then the TEF is multiplied by zero, half the RL, or the full RL, depending on the calculation method specified.

Table 2-7. Mammalian TEF values for PCB Congeners

PCB Congener Number	TEF Value (unitless)
77	0.0001
81	0.0001
105	0.0001
114	0.0005
118	0.0001
123	0.0001
126	0.1
156	0.0005
157	0.0005
167	0.00001
169	0.01
189	0.0001

2.8.3.4 Calculation of Toxic Equivalents for Dioxin/Furan Congeners

Dioxin/furan congener TEQs will be calculated using the World Health Organization consensus TEF values (Van den Berg et al. 1998) for mammals presented in Table 2-8. The TEQ is calculated as the sum of each congener concentration multiplied by the corresponding TEF value. When the congener concentration is reported as nondetected, then the TEF will be multiplied by half the RL.

Table 2-8. Mammalian TEF values for dioxin/furan congeners

Dioxin/Furan Congener	TEF Value (unitless)
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1
1,2,3,7,8-Pentachlorodibenzofuran	0.05
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1
2,3,4,7,8-Pentachlorodibenzofuran	0.5
2,3,7,8-Tetrachlorodibenzofuran	0.1
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1
Octachlorodibenzofuran	0.0001
Octachlorodibenzo-p-dioxin	0.0001

2.8.4 Non-Direct Measurements

If information necessary for the project has not been measured directly in the field, non-direct measurement data may be obtained from literature files, texts, computer databases, etc. References utilized will be acknowledged sources within the specific discipline. An explanation of the rationale behind using the reference and a description of any concern on using the reference data (e.g., uncertainty, conflicting literature, etc.) shall be documented. Non-direct measurement data, after usage, will be filed within the project files for the length of the project.

2.8.5 Data Usage

The data generated in the field, laboratory, and/or office will be used to satisfy the individual task requirements. The specific equations and the calculations that are used to reduce the data in the acceptable format will be described and documented, as appropriate.

3. ASSESSMENT/OVERSIGHT

3.1 ASSESSMENT AND RESPONSE ACTIONS

Assessment activities will be conducted throughout the project to ensure compliance with the QAPP. The TtEC PM and/or FOL will conduct a "readiness review" for field activities prior to the commencement of the investigation. Equipment and supplies will be inventoried, and field instrumentation will be checked to ensure that all are in working order. Any maintenance activities performed during the "readiness review" are to be documented on instrument maintenance sheets or in a designated field logbook. During the sampling activities, the FOL will be responsible for auditing field activities to ensure conformance to the SAP. Auditing activities will include examination of field sampling records, field instrument operating records, sample collection, handling and transport in compliance with the established procedures, adherence to QA procedures, and appropriate chemical of concern procedures.

Nonconformances identified during audits will generate a nonconformance report or a need for corrective action. These issues will be addresses by the QA manager prior to continuing work. Audits will be conducted, as needed, based on the significance of work activities, level of quality required to meet project objectives, and status of nonconformances or corrective actions previously identified.

Internal laboratory audits will be conducted by the laboratory QA department in accordance with the laboratory's specific QAPP. The analytical laboratories used for this project will be assessed according to standard laboratory audit procedures and internal laboratory QA requirements. Internal systems and performance audits will be conducted by the analytical laboratories in accordance with the laboratory SOPs. These audits are typically conducted at several levels. From the laboratories, they shall cooperate with regulatory agency personnel with Agency-requested internal technical systems and/or performance audits. Surveillance of field program activities will be conducted by the PM and FOL. External laboratory audits may be conducted by the EPA or other oversight agencies at their discretion.

3.2 REPORTS TO MANAGEMENT

3.2.1 Contents of Laboratory Data Reports

The results of the laboratory analyses will be reported to the TtEC PM in a hardcopy report and in an electronic format. The hardcopy report shall consist of a fully data validatable package. The hardcopy laboratory report will contain information such as:

- Title and location of the project
- Project identification number
- Name of the report
- Date report was prepared
- Name, address and telephone number of the laboratory
- Case narrative (noting any problems encountered in receipt or during analysis of the samples, and the corrective actions utilized including telephone logs, etc.)
- Sample identification number
- Name and location of sample
- Type of sample (e.g., water, sediment)
- Analysis performed
- Parameter results
- Any special observations, circumstances, or comments that may be relevant for interpretation of the data
- Signature of laboratory manager

Each laboratory report will also include supporting documentation, such as copies of chromatograms, data system printouts, laboratory QC sample recoveries and RPDs, surrogate recoveries, data flags, instrument and extraction blank results, check standard recoveries, initial calibration data, internal sample tracking documentation, sample preparation and analysis logbooks, and standard preparation data, as appropriate. Each constituent tested will include the name of parameter, approved testing procedure references, results of analysis, and the units of the reported results. The sample data results shall also be submitted in standard electronic data format within the project-specific turnaround time.

The electronic data report will be provided in Access or SEDQUAL format and will include data in the following fields:

- Laboratory sample number
- Project sample identification
- Sample collection date
- Analytical method
- Analyte
- Flagging field associated with sample concentration
- Method detection limit
- Method reporting limit
- Sample-specific reporting limit
- Sample concentration
- Units
- Qualifier code
- Sample analysis date
- Sample matrix

3.2.2 Contents of Data Validation Reports

The chemistry analytical data in support of this project will be validated by a third-party independent data validation firm. The data validation subcontractor will prepare a data validation report. The data validation report will provide a thorough evaluation of the analytical data and will determine whether or not the data meets the project-specific criteria for data quality. The report will include a list of samples associated with the report, a discussion of quality issues of concern, a summary of sample result qualifications due to validation, and the signature of the validator.

3.2.3 Contents of Management Reports

The TtEC PM will provide weekly progress updates to LMC members by telephone. Following sampling activities, TtEC will provide to LMC reports summarizing all data collected in the field, followed by a report summarizing all sampling activities. Additional reports required for this project include a report containing the analytical results from sampling and a validation report.

4. DATA VALIDATION AND USABILITY

4.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Analytical data validation shall be completed on 100 percent of the samples. Validation will be performed by qualified third-party subcontractor in accordance with the National Functional Guidelines for Inorganic Data Review (EPA, 2004) and National Functional Guidelines for Organic Data Review (EPA, 1999). Analytical data validation will include a systematic review of the analytical data package for compliance with the established QC criteria. The validation will consider aspects such as proper laboratory sample handling, conformance to method requirements, acceptable QC sample results, and proper final data reporting. During data validation, any outstanding data issues will be resolved to determine the certainty with which data may be used in making project decisions. Results of the data review process will be used to determine whether to accept, reject, or qualify the analytical results.

The analytical laboratory will perform in-house analytical data reduction and data QA review prior to releasing the data to TtEC. The purpose of the review is to ensure that the analysis was performed correctly and that the results were reported correctly. The laboratory review will consider data comparability, integrity, and attainment of QC criteria as outlined in laboratory SOPs, established in EPA methods, or described in this QAPP. Laboratory reviews are typically conducted at several levels within the laboratory. The initial review is the responsibility of the analyst generating the data. The section manager may conduct a second level review. Finally, the laboratory QA manager will complete a thorough audit of reports at a specified frequency and will review all final reports for consistency and clarity of presentation. The laboratory QA manager will decide whether any sample reanalysis is required and on the approach for any corrective actions. The laboratory QA manager is responsible for assessing data quality and documenting any data that are considered “preliminary” or “unacceptable” or that would caution the data user of possible unreliability.

Qualifiers (as applicable) will be added to the project database by manual computer entry. All keyed entries will be verified and signed off as checked by the QA Manager or his designee.

4.2 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Data validation and usability are evaluated to determine whether or not project data conform to specified criteria and satisfy project DQOs. This process involves evaluating the project data with respect to the DQOs and resolving any outstanding data issues to determine the certainty with which data may be used in making project decisions. Data not meeting the DQO criteria

may be classified as screening (or characterization) data and used to provide additional information for the project, but it may not be used in the decision-making process.

Review and implementation of systems and procedures may result in recommendations for corrective action. Any deviations from the specified procedures within approved project plans due to unexpected site-specific conditions shall warrant corrective action. All errors, deficiencies, or other problems shall be brought to the immediate attention of the TtEC PM, who in turn shall contact the TtEC QA Manager or his designee (if applicable).

Procedures have been established to ensure that conditions adverse to data quality are promptly investigated, evaluated, and corrected. The procedures for review and implementation of a corrective action include the following:

- Define the problem
- Investigate the cause of the problem
- Develop a corrective action to eliminate the problem, in consultation with the personnel who defined the problem and who will implement the change
- Complete the required form describing the change and its rationale (see below for form requirements)
- Obtain all required written approvals
- Implement the corrective action
- Verify that the change has eliminated the problem

If any problems occur with the laboratory or analyses, the laboratory must immediately notify the TtEC designee. Corrective actions must be documented in writing (e.g., on telephone contact log sheets or by email), which shall become part of the written narrative of the final data report.

During the field investigation, all changes to the sampling program must be documented on a FCR form. FCRs shall be numbered serially, starting with the number "01." A copy of the FCR must be maintained at the site and in the project management files.

All corrective action documentation and FCRs shall include an explanation of the problem and a proposed solution. Each report must be approved by the necessary personnel (e.g., the TtEC PM, the LMC Project Manager) before implementation of the change occurs. At a minimum, copies of the approved FCR form will be distributed to the TtEC PM, the FOL, the QA Manager (as applicable), and the project files. A typical distribution list is provided at the bottom of the form. The TtEC PM shall be responsible for the controlling, tracking, implementing, and distributing of all identified changes/forms.

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ATTACHMENT 1
Laboratory
Quality Assurance Manual

QUALITY ASSURANCE MANUAL

Columbia Analytical Services, Inc.

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January 12, 2007

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3.0 INTRODUCTION AND COMPANY QUALITY ASSURANCE POLICY

Columbia Analytical Services, Inc. (CAS) is an employee-owned professional analytical services laboratory which performs chemical and microbiological analyses on a wide variety of sample matrices, including drinking water, groundwater, surface water, wastewater, soil, sludge, sediment, tissue, industrial and hazardous waste, and other material.

It is a policy at CAS that there will be sufficient Quality Assurance (QA) activities conducted in the laboratory to ensure that all analytical data generated and processed will be scientifically sound, legally defensible, of known and documented quality, and will accurately reflect the material being tested. This goal is achieved by ensuring that adequate Quality Control (QC) procedures are used throughout the monitoring process, and by establishing a means to assess performance of these Quality Control and other QA activities. Policies and procedures are established in order to meet the quality objectives of clients, accrediting authorities, and certifying organizations. The Quality System is established to meet the requirements of the National Environmental Laboratory Accreditation Conference (NELAC).

CAS maintains control of analytical results by adhering to written standard operating procedures (SOPs) and by observing sample custody requirements. All analytical results are calculated and reported in units consistent with project specifications to allow comparability of data.

We recognize that quality assurance requires a commitment to quality by everyone in the organization - individually, within each operating unit, and throughout the entire laboratory.

CAS is a network of laboratories. In addition to the Kelso, WA facility, to which this manual is applicable, CAS also operates laboratories in California, Florida, New York, Arizona, and Texas.

The information in this document has been organized according to the format described in *EPA Requirements for Quality Management Plans, EPA QA/R-2,* USEPA, 2001; and *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5,* USEPA, 2001.

4.0 PROGRAM DESCRIPTION

The purpose of the QA program at CAS is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality. The concept of Quality Assurance can be extended, and is expressed in the mission statement of CAS:

> "The mission of Columbia Analytical Services, Inc., is to provide high quality, cost-effective, and timely professional testing services to our customers. We recognize that our success as a company is based on our ability to maintain customer satisfaction. To do this requires constant attention to customer needs, maintenance of state-of-the-art testing capabilities and successful management of our most important asset - our people - in a way that encourages professional growth, personal development and company commitment."

In support of this mission, our QA program addresses all aspects of laboratory operations, including laboratory organization and personnel, standard operating procedures, sample management, sample and quality control data, calibration practices, standards traceability data, equipment maintenance records, method proficiency data (such as method detection limit studies and control charts), document control/storage and staff training records.

4.1 Facilities and Equipment

CAS features over 25,000 square feet of laboratory and administrative workspace. The laboratory has been designed and constructed to provide safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations. The ventilation system has been specially designed to meet the needs of the analyses performed in each work space. Also, CAS minimizes laboratory contamination sources by employing janitorial and maintenance staff to ensure that good housekeeping and facilities maintenance are performed. In addition, the segregated laboratory areas are designed for safe and efficient handling of a variety of sample types. These specialized areas (and access restrictions) include:

- Shipping and Receiving/Purchasing
- Sample Management Office, including controlled-access sample storage areas
- Inorganic/Metals Sample Preparation Laboratories (2)
- Inorganic/Metals “clean room” sample preparation laboratory
- ICP-AES Laboratory
- ICP-MS Laboratory
- AA Laboratory
- Water Chemistry & General Chemistry Laboratories
- Semi-volatile Organics Sample Preparation Laboratories (3)
- Gas Chromatography/High Performance Liquid Chromatography Laboratory

- Gas Chromatography/Mass Spectrometry Laboratory
- Petroleum Hydrocarbon Laboratory
- Semi-volatile Organics Drinking Water Laboratory
- Volatile Organics Laboratory
  - Separate sample preparation laboratory
  - Access by semi-volatile sample preparation staff only after removing lab coat and solvent-contaminated gloves, etc.
- Microbiology Laboratory
- Laboratory Deionized Water System
- Laboratory Management, Client Service, Report Generation and Administration
- Data Archival, Data Review and support functions areas
- Information Technology (IT) and LIMS

In addition, the designated areas for sample receiving, refrigerated sample storage, dedicated sample container preparation and shipping provide for the efficient and safe handling of a variety of sample types. Figure 4-1 shows the facility floor plan. The laboratory is equipped with state-of-the-art analytical and administrative support equipment. The equipment and instrumentation are appropriate for the procedures in use. Appendix C lists the major equipment, illustrating the laboratory's overall capabilities and depth.

4.2 Technical Elements of the Quality Assurance Program

The Quality Assurance Program provides a platform on which technical operations are based. The program provides laboratory organization, procedures, and policies by which the laboratory operates. The necessary certifications and approvals administered by external agencies are maintained. This includes method approvals and audit administration. In addition, internal audits are performed to assess compliance with policies and procedures. Standard Operating Procedures (SOPs) are maintained for technical and administrative functions. A document control system is used for SOPs, as well as laboratory notebooks, and this QA Manual. A list of QA Program documents is provided in Appendix A.

Acceptable calibration procedures are defined in the SOP for each test procedure. Calibration procedures for other laboratory equipment (balances, thermometers, etc.) are also defined. Quality Control (QC) procedures are used to monitor the testing performed. Each analytical procedure has associated QC requirements to be achieved in order to demonstrate data quality. The use of method detection limit studies, control charting, and preventative maintenance procedures further ensure the quality of data produced. Proficiency Testing (PT) samples are used as an external means of monitoring the quality and proficiency of the laboratory. PT samples are obtained from qualified vendors and are performed on a regular basis. In addition to method proficiency, documentation of analyst training is performed to ensure proficiency and competency of laboratory analysts and technicians. Sample handling and custody procedures are defined in SOPs. Procedures are also in place to monitor the sample storage areas. The technical elements of the QA program are discussed in further detail in later sections of this QA manual.

4.3 Operational Assessments

There are a number of methods used to assess the laboratory and its daily operations. In addition to the routine quality control (QC) measurements to measure quality, the senior laboratory management examines a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients. On-time performance, report quality, training, and Quality Assurance are a few of the items that are used to assess performance from an external perspective. A frequent, routine assessment must also be made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

CAS utilizes a number of different methods to ensure that adequate resources are available in anticipation of the demand for service. Regularly scheduled senior staff meetings, tracking of outstanding proposals and an accurate, current synopsis of incoming work all assist the senior staff in properly allocating resources to achieve the required results. All Requests for Proposal (RFP) documents are reviewed by the Project Chemist and appropriate managerial staff to identify any project specific requirements that differ from the standard practices of the laboratory. Any requirements that cannot be met are noted and communicated to the client, as well as requesting the client to provide any project specific Quality Assurance Plans (QAPPs) if available. A weekly status meeting is also conducted with the laboratory staff by the Client Services Manager to inform the staff of the status of incoming work, future projects, or project requirements.

4.4 Document Control

Procedures for control and maintenance of documents are described in the *SOP for Document Control (ADM-DOC_CTRL).* The procedures described in the SOP include distribution, tracking, filing, and copyrighting of CAS controlled documents. The requirements of the SOP apply to all standards preparation logbooks, instrument maintenance logbooks, run logbooks, standard operating procedures (SOPs), quality assurance manuals (QAMs), quality assurance project plans (QAPPs), Environmental Health & Safety (EHS) manuals, and other controlled CAS documents.

Each controlled copy of a controlled document will be released only after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the Quality Assurance Manager, or designee, and ensure that only the most current version of the document is distributed and in use. A document control number is assigned to logbooks. Completed logbooks that are no longer in use are archived in a master logbook file.

CAS maintains a records system that ensures all laboratory records (including raw data, reports, and supporting records) are retained and available. The archiving system is described in the *SOP for Data Archiving (ADM-ARCH).*

4.5 Subcontracting

Analytical services are subcontracted when CAS/Kelso needs to balance workload or when the requested analyses are not performed by CAS/Kelso. Subcontracting is only done with the knowledge and approval of the client. Subcontracting to another CAS laboratory is preferred over external-laboratory subcontracting. Further, sub-contracting is done using capable and qualified laboratories. Established procedures are used to qualify external subcontract laboratories. These procedures are described in the *SOP for Qualification of Subcontract Laboratories (ADM-SUBLAB).* The Quality Assurance Director is responsible for qualifying and oversight of subcontract laboratories.

4.6 Procurement

The quality level of reagents and materials (grade, traceability, etc.) required is specified in analytical SOPs. Department supervisors ensure that the proper materials are purchased. Inspection and verification of material ordered is performed at the time of receipt by receiving personnel. The receiving staff labels the material with the date received. Expiration dates are assigned (by the laboratory user) as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. The procedures for purchasing and procurement are described in the *SOP for Purchasing through CAS Purchasing Agent (SOP ADM-PUR).* Also, refer to section 10.4 for a discussion of reference materials.

Figure 4-1
CAS/Kelso Laboratory Floor Plan



Room Designations			
100A Organic Extractions Lab	111 General Chemistry Lab	213A Digestion Lab	220 Organic Extraction Lab
100B Electrical Room	112A Microbiology Lab	213B Sample Preparation	221 Organic Extraction Lab
102 Chromatography Lab	112B Copy Center	214 General Chemistry Lab	222 Purchasing Office
104A Organics Extraction Lab	113 Atomic Absorption Lab	215A Drinking Water Lab	223 General Receiving
104B Chromatography Lab	114A SMO / Receiving	215B Records/Admin	300 Janitorial Room
106 De-ionized Water Room	114B SMO / Receiving	216 Office Area	999 Switchboard
107 Oven Room	115A Metals Digestion Lab	217 Sample Storage	
108 TCLP Lab	115B ICP Lab	218A VOA Prepration	
109 Sample Preparation	212A ICP / MS Lab	218B VOA Lab	
110 Lunchroom	212B Clean Digestion Lab	219 GC/MS Lab	

TITLE	CAS Kelso Floor Plans
FILENAME	KELSOLABFLRPLAN.VSD
PAGE	1 OF 2
DATE	12/28/04
DESCRIPTION	Laboratory

Legend

Fume Hood — Sink

Emergency Shower — Sink

Cooler

5.0 PROFESSIONAL CONDUCT AND ETHICAL PRACTICES

One of the most important aspects of the success of CAS is the emphasis placed on the integrity of the data provided and services performed. To promote product quality, employees are required to comply with certain standards of conduct and ethical practices. The following examples of CAS policy are representative of these standards, and are not intended to be limiting or all-inclusive:

- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action. Unless specifically required in writing by a client, alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.

- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible. Employee discipline is progressive in its severity and each situation is handled individually in that the discipline is designed to fit the circumstances. Potential disciplinary actions may include a verbal warning, written warning, a second written notice (more severe and more strongly worded than a warning), suspension without pay, demotion, or termination.

- It is the responsibility of all CAS employees to safeguard sensitive company and client information. The nature of our business and the well being of our company and of our clients is dependent upon protecting and maintaining proprietary company/client information. All information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential. Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action.

All employees are required to sign and adhere to the requirements set forth in the CAS *Confidentiality and Conflicts of Interest Employee Agreement* and the CAS *Commitment to Excellence in Data Quality Policy.* All employees receive in-house ethics training and are periodically reminded of their data quality and ethical conduct responsibilities.

CAS makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work. Related policies are described in the CAS Employee Handbook. This includes the CAS Ombudsman Program, the CAS Open Door Policy, and the use of flexible work hours. Operational assessments are regularly made to ensure that project planning is performed and that adequate resources are available during anticipated periods of increased workloads (Section 4.3). Procedures for subcontracting work are established, and within the CAS laboratory network additional capacity is typically available for subcontracting, if necessary.

6.0 ORGANIZATION AND RESPONSIBILITIES

The CAS/Kelso staff, consisting of approximately 110 employees, includes chemists, technicians and support personnel. They represent diverse educational backgrounds and experience, and provide the comprehensive skills that the laboratory requires. During seasonal workload increases, additional temporary employees may be hired to perform specific tasks.

CAS is committed to providing an environment that encourages excellence. Everyone within CAS shares responsibility for maintaining and improving the quality of our analytical services. The responsibilities of key personnel within the laboratory are described below. Table 6-1 lists the CAS/Kelso personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. An organizational chart of the laboratory, as well as the resumes of these key personnel, can be found in Appendix B.

- The role of the **Laboratory Director** is to provide technical, operational, and administrative leadership through planning, allocation and management of personnel and equipment resources. The Laboratory Director provides leadership and support for the QA program and is responsible for overall laboratory efficiency and the financial performance of the Kelso facility. The Laboratory Director has the authority to stop work in response to quality problems. The Laboratory Director also provides resources for implementation of the QA program, reviews and approves this QA Manual, reviews and approves standard operating procedures (SOPs), and provides support for business development by identifying and developing new markets through continuing support of the management of existing client activities.
- The responsibility of the **Quality Assurance Manager** (QAM) is to oversee implementation of the quality program and to coordinate QA activities within the laboratory. The QAM works with laboratory production units to establish effective quality control and assessment plans. The QAM has the authority to stop work in response to quality problems. The QAM is responsible for maintaining the QA Manual and performing an annual review of it; reviewing and approving SOPs and coordinating the annual review of each SOP; maintaining QA records such as metrological records, archived logbooks, PT sample results, etc.; document control; conducting PT sample studies; approving nonconformity and corrective action reports; maintaining the laboratory's certifications and approvals; performing internal QA audits; preparing QA activity reports; etc. The QAM reports directly to the Laboratory Director. The QAM also interacts with the CAS Quality Assurance Director. It is important to note that when evaluating data, the QAM does so in an objective manner and free of outside, or managerial, influence.

  The Chief Quality Officer (CQO) is responsible for the overall QA program at all the CAS laboratories. The CQO is responsible for ensuring that annual internal audits are performed at each CAS laboratory; maintaining a data base of information about state certifications and accreditation programs; writing laboratory-wide SOPs; maintaining a data base of CAS-approved subcontract laboratories; providing assistance to the laboratory QA staff and laboratory managers; preparing a quarterly QA activity report; etc.

- In the case of absence of the Laboratory Director or QA Manager, deputies are assigned to act in that role. Default deputies for these positions are the Client Services Manager or Organics Department Manager (for the Laboratory Director) and the QA Director or Laboratory Director (for the QA manager).

- The **Environmental Health and Safety Officer** (EH&S) is responsible for the administration of the laboratory health and safety policies. This includes the formulation and implementation of safety policies, the supervision of new-employee safety training, the review of accidents, incidents and prevention plans, the monitoring of hazardous waste disposal and the conducting of departmental safety inspections. The EH&S officer is also designated as the Chemical Hygiene Officer. The EH&S Officer has a dotted-line reporting responsibility to CAS' EH&S Director.
- The **Client Services and Sample Management Office Manager** is responsible for the Client Services Department (customer services/project chemists, and Electronic Data Deliverables group) and the sample management office/bottle preparation sections. The Client Services Department provides a complete interface with clients from initial project specification to final deliverables. The sample management office handles all the activities associated with receiving, storage, and disposal of samples. The Client Services Manager has the authority to stop subcontractor work in response to quality problems.
- The **Project Chemist** is a senior-level scientist assigned to each client to act as a technical liaison between the client and the laboratory. The project chemist is responsible for ensuring that the analyses performed by the laboratory meet all project, contract, and regulatory-specific requirements. This entails coordinating with the CAS laboratory and administrative staff to ensure that client-specific needs are understood, and that the services CAS provides are properly executed and satisfy the requirements of the client.
- The Analytical Laboratory is divided into operational units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting a quality control program based upon the unique requirements within the department. Each **Department Manager and Supervisor** has the responsibility to ensure that quality control functions are carried out as planned, and to guarantee the production of high quality data. Department managers and bench-level supervisors have the responsibility to monitor the day-to-day operations to ensure that productivity and data quality objectives are met. Each department manager has the authority to stop work in response to quality problems in their area. Analysts have the responsibility to carry out testing according to prescribed methods, SOPs, and quality control guidelines particular to the laboratory in which he/she is working.
- The **Sample Management Office** plays a key role in the laboratory QA program by maintaining documentation for all samples received by the laboratory, and by assisting in the archival of all laboratory results. The sample management office staff is also responsible for the proper disposal of samples after analysis.
- **Information Technology** (IT) staff are responsible for the administration of the Laboratory Information Management System (LIMS) and other necessary support services. Other functions of the IT staff include laboratory network maintenance, IT systems development and implementation, education of analytical staff in the use of scientific software, Electronic Data Deliverable (EDD) generation, and data back-up, archival and integrity operations.

Table 6-1
Summary of Technical Experience and Qualifications

Personnel	Years of Experience	Project Role
Jeff Christian, B.S.	28	Laboratory Director
Lee Wolf, B.S.	21	Quality Assurance Manager
Lynda Huckestein, B.S.	18	Client Services Manager Sample Management Office Manager
Jeff Coronado, B.S.	17	Inorganics Department Manager
Todd Poyfair, B.S.	15	Gas Chromatography and Petroleum Hydrocarbons Department Manager
Jeff Grindstaff, B.S.	18	Volatiles and Semivolatiles GC/MS Department Manager
Jim Smith, B.S.	19	Organics Drinking Water Department Manager
Eileen Arnold, B.A.	25	Environmental Health and Safety Officer
Paul Gowan, B.A.	20	Technical Information Specialist
Gary Ward, M.S.	31	CAS Information Technology Director CAS Chief Quality Officer
Steve Vincent, B.S.	31	CAS President

7.0 INFORMATION MANAGEMENT

The generation, compilation, reporting, and archiving of electronic data is a critical component of laboratory operations. In order to generate data of known and acceptable quality, the quality assurance systems and quality control practices for electronic data systems must be complete and comprehensive and in keeping with the overall quality assurance objectives of the organization. CAS management provides the tools and resources to implement electronic data systems and establishes information technology standards and policies. Appendix C lists major automated data processing equipment.

7.1 Software Quality Assurance Plan

CAS has defined practices for assuring the quality of the computer software used throughout all laboratory operations to generate, compile, report, and store electronic data. These practices are described in the CAS Software Quality Assurance Plan (SQAP). The purpose of the SQAP is to describe the policies and practices for the procurement, configuration management, development, validation and verification, data security, maintenance, and use of computer software. The policies and practices described in the plan apply to purchased computer software as well as to internally developed computer software. Key components of configuration management plan are policies for controlling the software version that is in use in the laboratory.

7.2 IT Support

The local CAS Information Technology (IT) department is established to provide technical support for all computing systems. The IT department staff continually monitors the performance and output of operating systems. The IT department oversees routine system maintenance and data backups to ensure the integrity of all electronic data. A software inventory is maintained. Additional IT responsibilities are described in the SQAP.

In addition to the local IT department, CAS corporate IT provides support for network-wide systems. CAS also has personnel assigned to information management duties such as development and implementation of reporting systems; data acquisition, and Electronic Data Deliverable (EDD) generation.

7.3 Information Management Systems

CAS has various systems in place to address specific data management needs. The CAS Laboratory Information Management System (LIMS) is used to manage sample information and invoicing. Access is controlled by password. This system is used to establish and define sample identification, analysis specifications, and provide a means of sample tracking. This system is used during sample login to generate the internal Service Request. The Service

Request provides a summary of client information, sample information, required analyses, work instructions, deliverable requirements and other necessary information provided on the chain of custody. The LIMS also is the basis for valuable sample tracking mechanisms used throughout the laboratory. Laboratory analysts generate responsibility reports from the LIMS and perform internal chain of custody via the LIMS.

Where possible, instrument data acquired locally is immediately moved to a server (Microsoft Windows2003® domain) dedicated to this function. This provides a reliable, easily maintained, high-volume acquisition and storage system for electronic data files. With password entry, users may access the system from many available computer stations, improving efficiency and flexibility. Another server is dedicated to data reporting, EDD generation, and administrative functions. Access to these systems is controlled by password. A standardized EDI (electronic data interchange) format is used as a reporting platform, providing functionality and flexibility for end users. With a common standardized communication platform, the EDI provides data reporting in a variety of hardcopy and electronic deliverable formats, including Staged Electronic Data Deliverable (SEDD) format.

7.4 Backup and Security

CAS laboratory data is either acquired directly to the centralized acquisition server or acquired locally and then transferred to the server. All data is eventually moved to the centralized data acquisition server for reporting and archiving. Differential backups are performed on all file server information once per day, Sunday through Thursday. Full backups are performed each Friday night. Tapes are physically stored in a locked media cabinet within a locked, temperature controlled computer room, with every other full backup also securely stored offsite.

Access to sample information and data is on a need-to-know basis. Access is restricted to the person's areas of responsibility. Passwords are required on all systems. No direct external, non-CAS access is allowed to any of our network systems.

The external e-mail system and Internet access is established via a single gateway to discourage unauthorized entry. CAS uses a closed system for company e-mail. Files, such as electronic deliverables, are sent through the external e-mail system only via a trusted agent. The external messaging system operates through a single secure gateway. Email attachments sent in and out of the gateway are subject to a virus scan. Because the Internet is not regulated, we use a limited access approach to provide a firewall for added security. Virus screening is performed continuously on all network systems.

8.0 SAMPLE MANAGEMENT

8.1 Sampling and Sample Preservation

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples. CAS recommends that clients follow sampling guidelines described in 40 CFR 136, 40 CFR 141, USEPA SW-846, and state-specific sampling guidelines, if applicable. Sampling factors that must be taken into account to insure accurate, defensible analytical results include:

- Amount of sample taken
- Type of container used
- Type of sample preservation
- Sample storage time
- Proper custodial documentation

CAS uses the sample preservation, container, and holding-time recommendations published in a number of documents. The primary documents of reference are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IVA, IVB for hazardous waste samples, and USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, and Supplements; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples (see Section 18 for complete citations). The container, preservation and holding time information for these references is summarized in Table 8-1 for soil, water, and drinking water. The current EPA CLP Statement of Work should be referred to for container, preservation and holding time information for CLP procedures. Where allowed by project sampling and analysis protocols (such as Puget Sound Protocols) the holding time for sediment, soil, and tissue samples may be extended for a defined period when stored frozen at -20°C.

CAS routinely provides sample containers with appropriate preservatives for our clients. The containers are purchased as precleaned to a level 1 status, and conform to the requirements for analytical samples established by the USEPA. Certificates of analysis for the sampling containers are available to clients if requested. Reagent water used for sampling blanks (trip blanks, etc.) and chemical preservation reagents are tested by the laboratory to ensure that they are free of interferences and documented. Our sample kits typically consist of foam-lined, precleaned shipping coolers, (cleaned inside and out with appropriate cleaner, rinsed thoroughly and air-dried), specially prepared and labeled sample containers individually wrapped in protective material, (VOC vials are placed in a specially made, foam holder), chain-of-custody (COC) forms, and custody seals. Container labels and custody seals are provided for each container. Figure 8-1 shows the chain-of-custody form routinely used at CAS and included with sample kits. For large sample container shipments, the containers may be

shipped in their original boxes. Such shipments will consist of several boxes of labeled sample containers and sufficient materials (bubble wrap, COC forms, custody seals, shipping coolers, etc.) to allow the sampling personnel to process the sample containers and return them to CAS. The proper preservative is added to the sample containers prior to shipment, unless otherwise instructed by the client.

If any returning shipping cooler exhibits an odor or other abnormality after receipt and subsequent decontamination by laboratory personnel, a second, more vigorous decontamination process is employed. Containers exhibiting an odor or abnormality after the second decontamination process are promptly and properly discarded. CAS keeps client-specific shipping requirements on file and utilizes major transportation carriers to guarantee that sample shipping requirements (same-day, overnight, etc.) are met. CAS also provides courier service that makes regularly scheduled trips to the Greater Portland, Oregon Metropolitan area.

When CAS ships environmental samples to other laboratories for analysis each sample bottle is wrapped in protective material and placed in a plastic bag (preferably Ziploc®) to avoid any possible cross-contamination of samples during shipping. The sample management office (SMO) follows formalized procedures for maintaining the chain of custody of the sample(s) (SOP *for Chain of Custody for Sample Transfer between Laboratories* [SOP ADM-COC]), proper packaging and shipment, specification of proper methodology, etc. Blue or gel ice is the only temperature preservative used by CAS, unless otherwise specified by the client or receiving laboratory.

8.2 Sample Receipt and Handling

Standard Operating Procedures are established for the receiving of samples into the laboratory. These procedures ensure that samples are received and properly logged into the laboratory, and that all associated documentation, including chain of custody forms, is complete and consistent with the samples received. Complete documentation of all sample storage is maintained in order to preserve the integrity of the samples.

Once samples are delivered to the CAS sample management office (SMO), a Cooler Receipt and Preservation Check Form (CRF - See Figure 8-2 for an example) is used to assess the shipping cooler and its contents as received by the laboratory personnel. Verification of sample integrity includes the following activities:

- Assessment of custody seal presence/absence, location and signature;
- Temperature of sample containers upon receipt;
- Chain of custody documents properly used (entries in ink, signature present, etc.);
- Sample containers checked for integrity (broken, leaking, etc.);
- Sample is clearly marked and dated (bottle labels complete with required information);
- Appropriate containers (size, type) are received for the requested analyses;
- The minimum amount of sample material is provided for the analysis.

- Sample container labels and/or tags agree with chain of custody entries (identification, required analyses, etc.);
- Assessment of proper sample preservation (if inadequate, corrective action is employed); and
- VOC containers are inspected for the presence/absence of bubbles. (Assessment of proper preservation of VOC containers is performed by lab personnel).

Samples are logged into a Laboratory Information Management System (LIMS). Any anomalies or discrepancies observed during the initial assessment are recorded on the CRF and COC documents. Potential problems with a sample shipment are addressed by contacting the client and discussing the pertinent issues. When the Project Chemist and client have reached a satisfactory resolution, the login process may continue and analysis may begin. During the login process, each sample is given a unique laboratory code and a service request form is generated. The LIMS generates a Service Request that contains client information, sample descriptions, sample matrix information, required analyses, sample collection dates, analysis due dates and other pertinent information. The service request is reviewed by the appropriate Project Chemist for accuracy, completeness, and consistency of requested analyses and for client project objectives.

Samples are kept refrigerated until they undergo analysis, unless otherwise specified. CAS stores samples in various refrigerators or freezers, depending on the type of analysis and the matrix of the sample. CAS has five walk-in refrigerators which house the majority of sample containers received at the laboratory. In addition to the walk-in refrigerators, there are four additional refrigerators, including dedicated refrigerated storage of VOC samples. These refrigerators are segregated by matrix type (soil or water) and method of analysis. The dedicated storage areas for VOC samples are monitored using storage blanks, as described in the *SOP for VOA Storage Blanks (VOC-BLAN)*. CAS also has six sub-zero freezers capable of storing samples at -20° C; these are primarily used for tissue and sediment samples requiring specialized storage conditions. The temperature of each sample storage unit used at CAS is monitored daily and the data recorded in a bound logbook. Continuous-graph temperature recorders have also been placed in the walk-in refrigerators to provide a permanent record of the storage conditions to which samples are exposed.

CAS adheres to the method-prescribed or project-specified holding times for all analyses. In order to comply with holding time requirements, the sampling date and time are entered into the LIMS system at the time of sample receipt and login. Each analyst then monitors holding times by obtaining analysis-specific reports from the LIMS. These reports provide holding time information on all samples for the analysis, calculated from the sampling date and the holding time requirement. In order to report adherence to holding time requirements, the date and time analyzed is printed or written on the analytical raw data. For analyses with a holding time prescribed in hours it is essential that the sample collection time is provided, so that holding time compliance can be demonstrated based on the analysis time. If not, the sample collection time is assumed as the earliest in the day (i.e. the most conservative).

Unless other arrangements have been made in advance, upon completion of all analyses and submittal of the final report, aqueous samples and sample extracts are retained at ambient temperature for 30 days, soil samples are retained at ambient temperature for 60 days, and tissue samples are retained frozen for 3 months. Upon expiration of these time limits, the samples are either returned to the client or disposed of according to approved disposal practices. All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed of according to formal procedures outlined in the *CAS Environmental Health and Safety Manual.* All waste produced at the laboratory, including the laboratory's own various hazardous waste streams, is treated in accordance with applicable local and Federal laws. Documentation is maintained for each sample from initial receipt through final disposal to ensure that an accurate history of the sample from "cradle to grave" is available.

8.3 Sample Custody

Sample custody transfer at the time of sample receipt is documented using chain-of-custody (COC) forms accompanying the samples. During sample receipt, it is also noted if custody seals were present. This is described in the *SOP for Sample Receiving (SMO-GEN)*. Figure 8-1 is a copy of the chain-of-custody form routinely used at CAS.

Facility security and access is important in maintaining the integrity of samples received at CAS/Kelso. Access to the laboratory facility is limited by use of locked exterior doors with a coded entry, except for the reception area and sample receiving doors, which are manned during business hours and locked at all other times. In addition, the sample storage area within the laboratory is a controlled access area with locked doors with a coded entry. The CAS facility is equipped with an alarm system and CAS employs a private security firm to provide nighttime and weekend security.

A barcoding system is used to document internal sample custody. Each person removing or returning samples from/to sample storage while performing analysis is required to document this custody transfer. The system uniquely identifies the sample container and provides an electronic record of the custody of each sample. For sample extracts and digestates the analyst documents custody of the sample extract or digestate by signing on the benchsheet, or custody record, that they have accepted custody. The procedures are described in the *SOP for Sample Tracking and Internal Chain of Custody (SMO-SCOC).*

8.4 Project Setup

The analytical method(s) to be used for sample analysis are chosen based on the client's requirements. Unless specified otherwise, the most recent versions of reference methods are used. For SW-846 methods, some projects may require the most recent *promulgated* version, and some projects may require the most recent *published* version. The Project Chemist will ensure that the correct method version is used. LIMS codes are chosen to identify the analysis method used for analysis. The Project Chemist ensures that the correct methods are selected for analysis, deliverable requirements are identified, and due dates are specified on the LIMS generated Service Request. To communicate and specify project-specific requirements, a Tier V form (Figure 8-3) is used and accompanies the service request form.

Table 8-1
Sample Preservation and Holding Times[a]

DETERMINATION	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Bacterial Tests				
Coliform, Colilert	W, DW	P, Bottle or Bag	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Coliform, Fecal and Total	W, DW	P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Fecal Streptococci	W	P,G	Cool, 4°C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Inorganic Tests				
Acidity	W	P,G	Cool, 4°C	14 days[EPA]
Alkalinity	W, DW	P,G	Cool, 4°C	14 days[EPA]
Ammonia	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Biochemical Oxygen Demand (BOD)	W	P,G	Cool, 4°C	48 hours
Bromate	W, DW	P,G	50mg/L EDA, cool to 4°C	28 days
Bromide	W, DW	P,G	None Required	28 days
Chemical Oxygen Demand (COD)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Chloride – Method 300.0	W, DW	P,G	None Required	28 days
Chloride – Method 9056	W	P,G	Cool, 4°C	Analyze immediately
Chlorine, Total Residual	W, DW	P,G	None Required	24 hours
Chlorite	W, DW	P,G	50mg/L EDA, cool to 4°C	14 days
Chlorophyll-A	W	G Amber	Cool, 4°C	Analyze immediately
Chromium VI – Method 7196A	W	P,G	Cool, 4°C	24 hours
Color	W, DW	P,G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	W, DW	P,G	Cool, 4°C, NaOH to pH>12, plus 0.6 g Ascorbic Acid	14 days
Cyanide, Weak Acid Dissociable	W	P,G	Cool, 4°C, NaOH to pH >12	14 days
Ferrous Iron	W, DW	G Amber	Cool, 4°C	24 hours
Fluoride – Method 300.0	W, DW	P,G	None Required	28 days
Fluoride – Method 9056	W	P,G	Cool, 4°C	Analyze immediately
Hardness	W, DW	P,G	HNO_3 to pH<2	6 months
Hydrogen Ion (pH)	W, DW	P,G	None Required	Analyze immediately
Kjeldahl and Organic Nitrogen	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrate – Method 300.0	W, DW	P,G	Cool, 4°C	48 hours
Nitrate – Method 353.2	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	48 hours
Nitrate – Method 9056	W	P,G	Cool, 4°C	Analyze immediately
Nitrate-Nitrite – Method 353.2	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrite – Method 300.0	W, DW	P,G	Cool, 4°C	48 hours

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Nitrite – Method 353.2	W, DW	P,G	Cool, 4°C, H_2SO_4 to pH<2	48 hours
Nitrite – Method 9056	W	P,G	Cool, 4°C	Analyze immediately
Orthophosphate – Method 365.3	W, DW	P,G	Cool, 4°C	Analyze immediately
Oxygen, Dissolved (Probe)	W, DW	G, Bottle and Top	None Required	Analyze immediately
Oxygen, Dissolved (Winkler)	W, DW	G, Bottle and Top	Fix on Site and Store in Dark	8 hours
Perchlorate	W, DW	P,G	Protect from temp. extremes	28 days
Phenolics, Total	W	G Only	Cool, 4°C, H_2SO_4 to pH<2	28 days
Phosphorus, Elemental	W	G Only	Cool, 4°C	48 hours
Phosphorus, Total	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Residue, Total	W	P,G	Cool, 4°C	7 days
Residue, Filterable (TDS)	W	P,G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	W	P,G	Cool, 4°C	7 days
Residue, Settleable	W	P,G	Cool, 4°C	48 hours
Residue, Volatile	W	P,G	Cool, 4°C	7 days
Silica	W	P Only	Cool, 4°C	28 days
Specific Conductance	W, DW	P,G	Cool, 4°C	28 days
Sulfate – Method 300.0	W, DW	P,G	Cool, 4°C	28 days
Sulfate – Method 9056	W	P,G	Cool, 4°C	Analyze immediately
Sulfide	W	P,G	Cool, 4°C, Add Zinc Acetate plus Sodium Hydroxide to pH>9	7 days
Sulfite	W	P,G	None Required	24 hours
Surfactants (MBAS)	W	P,G	Cool, 4°C	48 hours
Tannin and Lignin	W	P,G	Cool, 4°C	28 days
Temperature	W	P,G	None Required	Analyze immediately
Turbidity	W, DW	P,G	Cool, 4°C	48 hours
Metals				
Metals, except CrVI and Mercury	W, DW	P,G	HNO_3 to pH<2	6 months
	S	G, Teflon-Lined Cap	Cool, 4°C	6 months
Chromium VI – Method 7195	W	P,G	Cool, 4°C	24 hours
Mercury	W	P,G	HNO_3 to pH<2	28 days
	S	P,G	Cool, 4°C	28 days

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Organic Tests				
Oil and Grease, Hexane Extractable Material (EPA 1664)	W	G, Teflon-Lined Cap	Cool, 4°C, H_2SO_4 to pH<2	28 days
Organic Carbon, Total (TOC)	W	P,G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Organic Halogens, Total (TOX)	W	G, Teflon-Lined Cap	Cool, 4°C, H_2SO_4 to pH<2, No headspace	28 days
Organic Halogens, Adsorbable (AOX)	W	G, Teflon-Lined Cap	Cool, 4°C, HNO_3 to pH<2	6 months
Petroleum Hydrocarbons, Total	W	G, Teflon-Lined Cap	Cool, 4°C, HCl or H_2SO_4 to pH<2	7 days until extraction; 40 days after extraction
	S	G, Teflon-Lined Cap	Cool, 4°C	14 days until extraction; 40 days after extraction
Volatile Organics				
Petroleum Hydrocarbons, Volatile (Gasoline-Range Organics)	W	G, Teflon-Lined Septum Cap	Cool, 4°C, HCl to pH<2 No Headspace	14 days
	S	G, Teflon-Lined Cap	Cool, 4°C Minimize Headspace	14 days
Purgeable Halocarbons	W	G, Teflon-Lined Septum Cap, No Headspace	**No Residual Chlorine Present**: HCl to pH<2, Cool, 4°C, No Headspace **Residual Chlorine Present**: 10% $Na_2S_2O_3$, HCl to pH<2, Cool, 4°C	14 days
	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days
	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4°C Sodium Bisulfate Cool, 4°C	7 days 48 hrs to prepare from Encore, 14 days after preparation. 48 hrs to prepare from Encore, 14 days after preparation.

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE)	W	G, Teflon-Lined Septum Cap, No Headspace	**No Residual Chlorine Present**: HCl to pH<2, Cool, 4°C, No Headspace **Residual Chlorine Present**: 10% $Na_2S_2O_3$, HCl to pH<2, Cool 4°C	14 days
	S	G, Teflon-Lined Cap	Cool, 4°C, Minimize Headspace	14 days
	S	Method 5035	Encore, Freeze at -20°C Methanol, Cool, 4°C Sodium Bisulfate Cool, 4°C	7 days 48 hrs to prepare from Encore, 14 days after preparation. 48 hrs to prepare from Encore, 14 days after preparation.
Acrolein, Acrylonitrile, Acetonitrile	W	G, Teflon-Lined Septum Cap	Adjust pH to 4-5, Cool, 4°C, No Headspace	14 days
EDB and DBCP	W,S	G, Teflon-Lined Cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	28 days
Semivolatile Organics				
Petroleum Hydrocarbons, Extractable (Diesel-Range Organics)	W,S	G, Teflon-Lined Cap	Cool, 4°C	7 days until extraction;[f] 40 days after extraction
Alcohols and Glycols	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Phenols	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Phthalate Esters	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Nitrosamines	W,S	G, Teflon-Lined Cap	Cool, 4°C, Store in Dark[g]	7 days until extraction;[f] 40 days after extraction
Organochlorine Pesticides and PCBs	W,S	G, Teflon-Lined Cap	Cool, 4°C	7 days until extraction;[f] 40 days after extraction

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Nitroaromatics and Cyclic Ketones	W,S	G, Teflon-Lined Cap	Cool, 4°C, Store in Dark[g]	7 days until extraction;[f] 40 days after extraction
Polynuclear Aromatic Hydrocarbons	W,S	G, Teflon-Lined Cap	Cool, 4°C, Store in Dark[g]	7 days until extraction;[f] 40 days after extraction
Haloethers	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Chlorinated Hydrocarbons	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Organophosphorus Pesticides	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Nitrogen- and Phosphorus-Containing Pesticides	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Chlorinated Herbicides	W,S	G, Teflon-Lined Cap	Cool, 4°C[g]	7 days until extraction;[f] 40 days after extraction
Chlorinated Phenolics	W	G, Teflon-Lined Cap	H_2SO_4 to pH<2, Cool, 4°C[g]	30 days until extraction; 30 days after extraction
Resin and Fatty Acids	W	G, Teflon-Lined Cap	NaOH to pH $\geq$10, Cool, 4°C[g]	30 days until extraction; 30 days after extraction
Drinking Water Organics				
Purgeable Organics	DW	G, Teflon-Lined Septum Cap,	Ascorbic Acid, HCl to pH$\leq$2, Cool, 4°C, No Headspace	14 days
EDB, DBCP, and TCP	DW	G, Teflon-Lined Septum Cap	Cool, 4°C, 3 mg $Na_2S_2O_3$, No Headspace	14 days
Carbamates, Carbamoyloximes	DW	G, Amber, Teflon-Lined Cap	1.8 mL monochloroacetic acid to pH<3; 80 mg/L $Na_2S_2O_3$ if Res.Cl.; Cool, 4°C	28 days
Chlorinated Herbicides	DW	G, Amber, Teflon-Lined Cap	If Res.Cl, 2mg/4omL NaS; Cool, <6°C	14 days until extraction; 21 days after extraction
Chlorinated Pesticides	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH$\leq$ 2; Cool, 4°C	14 days until extraction; 30 days after extraction

Table 8-1 (continued)
Sample Preservation and Holding Times[a]

DETERMINATION	MATRIX[b]	CONTAINER[c]	PRESERVATION	MAXIMUM HOLDING TIME
Diquat and Paraquat	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$ if Res.Cl., Cool, 4°C,	7days until extraction; 21 days after extraction
Endothall	DW	G, Amber, Teflon-Lined Cap	Cool, 4°C	7 days until extraction; 14 days after extraction
Glyphosate	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$, Cool, 4°C	14 days
Haloacetic Acids	DW	G, Amber, Teflon-Lined Cap	100 mg/L NH_4Cl, Cool, 4°C	14 days until extraction; 7 days after extraction
Semivolatile Organics	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH$\leq$ 2; Cool, 4°C	14 days until extraction; 30 days after extraction
Toxicity Characteristic Leaching Procedure (TCLP)				
Mercury	HW	P,G	Sample: Cool, 4°C TCLP extract: HNO_3 to pH<2	28 days until extraction; 28 days after extraction
Metals, except Mercury	HW	P,G	Sample: Cool, 4°C TCLP extract: HNO_3 to pH<2	180 days until extraction; 180 days after extraction
Volatile Organics	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C Minimize Headspace TCLP extract: Cool, 4°C, HCl to pH<2, No Headspace	14 days until extraction; 14 days after extraction
Semivolatile Organics	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C, Store in Dark[g] TCLP extract: Cool, 4°C, Store in Dark[g]	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction
Organochlorine Pesticides	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C TCLP extract: Cool, 4°C	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction
Chlorinated Herbicides	HW	G, Teflon-Lined Cap	Sample: Cool, 4°C TCLP extract: Cool, 4°C	14 days until TCLP ext'n; 7 days until extraction; 40 days after extraction

a See Section 18.0 for sources of holding time information.
b DW = Drinking Water, W = Water; S = Soil or Sediment; HW = Hazardous Waste
c P = Polyethylene; G = Glass
d For chlorinated water samples
e The maximum holding time is dependent upon the geographical proximity of sample source to the laboratory.
f Fourteen days until extraction for soil, sediment, and sludge samples.
g If the water sample contains residual chlorine, 10% sodium thiosulfate is used to dechlorinate.

Figure 8-1
Chain of Custody Form

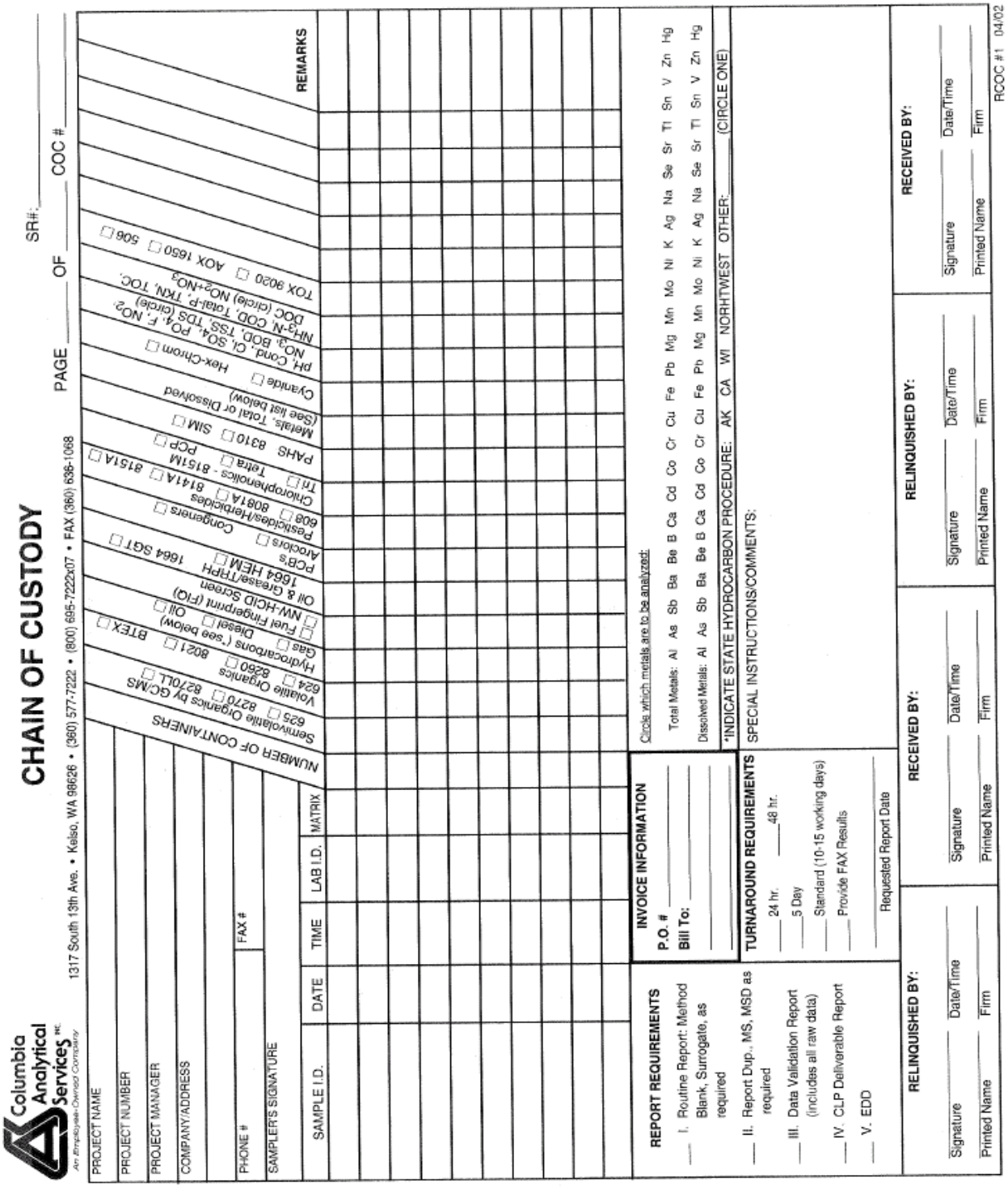


Figure 8-2

Columbia Analytical Services Inc.
Cooler Receipt and Preservation Form

Project/Client_____Work Order K060_____

Cooler received on _____ and opened on _____by_____

1.	Were custody seals on outside of coolers?	Y	N
	If yes, how many and where?_____		
2.	Were seals intact and signature & date correct?	Y	N
3.	Is the shipper's airbill available and filed? If no, record airbill number:_____	Y	N
4.	COC# _____ _____ _____ _____		
	Temperature of cooler(s) upon receipt: _____ _____ _____ _____		
	Temperature Blank: _____ _____ _____ _____		
5.	Were custody papers properly filled out (ink, signed, etc.)?	Y	N
6.	Type of packing material present_____		
7.	Did all bottles arrive in good condition (unbroken)?	Y	N
8.	Were all bottle labels complete (i.e analysis, preservation, etc.)?	Y	N
9.	Did all bottle labels and tags agree with custody papers?	Y	N
10.	Were the correct types of bottles used for the tests indicated?	Y	N
11.	Were all of the preserved bottles received at the lab with the appropriate pH?	Y	N
12.	Were VOA vials checked for absence of air bubbles, and if present, noted below?	Y	N
13.	Did the bottles originate from CAS/K or a branch laboratory?	Y	N
14.	Are CWA Microbiology samples received with >1/2 the 24hr. hold time remaining from collection?	Y	N
15.	Was C12/Res negative?	Y	N

Explain any discrepancies:_____
_____
_____
_____
_____
_____

RESOLUTION:_____

Samples that required preservation or received out of temperature:

Sample ID	Reagent	Volume	Lot Number	Bottle Type	Rec'd out of Temperature	Initials

Figure 8-3
Tier V Form

Client :

Project Chemist :

Project Name :

Service Request :

Project Number :

SMO LimsTemplate ID :

Project Description :

QAPP/SOW Information :

Reporting

Tier Level :

PDF:

Report to :

In result field use :

EDD :

Flagging Requirements :

Other Requirements :

Sample Considerations

Sample Limitations :

Sample Prep/Analysis :

Non-Standard Holdtimes :

Historical Data :

Comments :

9.0 ANALYTICAL PROCEDURES

CAS employs methods and analytical procedures from a variety of sources. The primary method references are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IVA, IVB, and online updates for hazardous waste samples, and USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, and Supplements; and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples. Complete citations for these references can be found in Section 18.0. Other published procedures, such as state-specific methods, program-specific methods (such as Puget Sound Protocols), or in-house methods may be used. Several factors are involved with the selection of analytical methods to be used in the laboratory. These include the method detection limit, the concentration of the analyte being measured, method selectivity, accuracy and precision of the method, the type of sample being analyzed, and the regulatory compliance objectives. The implementation of methods by CAS is described in SOPs specific to each method. A list of SOPs and NELAC-accredited methods are given in Appendix E. Further details are described below.

9.1 Standard Operating Procedures (SOPs) and Laboratory Notebooks.

CAS maintains SOPs for use in both technical and administrative functions. SOPs are written following standardized format and content requirements. Each SOP is reviewed and approved by a minimum of two managers (the Laboratory Director and/or Department Manager and the Quality Assurance Manager). All SOPs undergo a documented annual review to make sure current practices are described. The QA Manager maintains a comprehensive list of current SOPs. The document control process ensures that only the most currently prepared version of an SOP is being used. The QA Manual, QAPPs, SOPs, standards preparation logbooks, maintenance logbooks, et al., are controlled documents. The procedures for document control are described in the *SOP for Document Control* (ADM-DOC_CTRL). In addition to SOPs, each laboratory department maintains a current file, accessible to all laboratory staff, of the current methodology used to perform analyses. Laboratory notebook entries are standardized following the guidelines in the *Making Entries into Logbooks and onto Benchsheets* SOP (ADM-DATANTRY). Entries made into laboratory notebooks are reviewed and approved by the appropriate supervisor at a regular interval.

9.2 Deviation from Standard Operating Procedures

When a customer requests a modification to an SOP (such as a change in reporting limit, addition or deletion of target analyte(s), etc.), the project chemist handling that project must discuss the proposed deviation with the department manager in charge of the analysis and obtain their approval to accept the project. The project chemist is responsible for documenting the approved or allowed deviation from the SOP by placing a detailed description of the deviation attached to the quotation or in the project file and also providing an appropriate comment on the service request when the samples are received.

For circumstances when a deviation or departure from company policies or procedures involving any non-technical function is found necessary, approval must be obtained from the appropriate supervisor, manager, the laboratory director, or other level of authority. Frequent departure from policy is not encouraged. However, if frequent departure from any policy is noted, the laboratory director will address the possible need for a change in policy.

9.3 Modified Procedures

CAS strives to perform published methods as described in the referenced documents. If there is a material deviation from the published method, the method is cited as a "Modified" method in the analytical report. Modifications to the published methods are listed in the standard operating procedure. Standard operating procedures are available to analysts and are also available to our clients for review, especially those for "Modified" methods. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

9.4 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that CAS has adopted for the analytical batch is listed below. The overriding principle for describing an analytical batch is that all the samples in a batch, both field samples and quality control samples, are to be handled exactly the same way, and all of the data from each analysis is to be manipulated in exactly the same manner. The minimum requirements of an analytical batch are:

1) The number of (field) samples in a batch is not to exceed 20.

2) All (field) samples in a batch are of the same matrix.

3) The QC samples to be processed with the (field) samples include:

   a) Method Blank (a.k.a. Laboratory Reagent Blank)

      Function: Determination of laboratory contamination.

   b) Laboratory Control Sample (a.k.a. Laboratory Fortified Blank)

      Function: Assessment of method performance

   c) Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*

      Function: Assessment of matrix bias

   d) Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

      Function: Assessment of batch precision

   * A sample identified as a field blank, an equipment blank, or a trip blank is not to be matrix spiked or duplicated.

4) A single lot of reagents is used to process the batch of samples.

5) Each operation within the analysis is performed by a single analyst, technician, chemist, or by a team of analysts/technicians/chemists.

6) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours.

7) (Field) samples are assigned to batches commencing at the time that sample processing begins. For example: for analysis of metals, sample processing begins when the samples are digested. For analysis of organic constituents, it begins when the samples are extracted.

8) The QC samples are to be analyzed in conjunction with the associated field samples prepared with them. However, for tests which have a separate sample preparation step that defines a batch (digestion, extraction, etc.), the QC samples in the batch do not require analysis each time a field sample within the preparation batch is analyzed (multiple instrument sequences to analyze all field samples in the batch need not include re-analyses of the QC samples).

9) The batch is to be assigned a unique identification number that can be used to correlate the QC samples with the field samples.

10) Batch QC refers to the QC samples that are analyzed in a batch of (field) samples.

11) Project-specific requirements may be exceptions. If project, program, or method requirements are more stringent than these laboratory minimum requirements, then the project, program, or method requirements will take precedence. However, if the project, program, or method requirements are less stringent than these laboratory minimum requirements, these laboratory minimum requirements will take precedence.

9.5 Specialized Procedures

CAS not only strives to provide results that are scientifically sound, legally defensible, and of known and documented quality; but also strives to provide the best solution to analytical challenges. Procedures using specialized instrumentation and methodology have been developed to improve sensitivity (provide lower detection limits), selectivity (minimize interferences while maintaining sensitivity), and overall data quality for low concentration applications. Examples are reductive precipitation metals analysis, specialized GC/MS analyses, and ultra-low level pesticides and PCBs.

9.6 Sample Cleanup

CAS commonly employs several cleanup procedures to minimize known common interferences prior to analysis. EPA methods for cleanup of sample extracts for organics analysis are routinely used to minimize or eliminate interferences that may adversely affect sample results and data usability.

10.0 CALIBRATION PROCEDURES AND FREQUENCY

All equipment and instruments used at CAS are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment and instruments are described below. Records are maintained to provide traceability of reference materials.

Any item of the equipment which has been subjected to overloading or mishandling, or has been shown by verification or otherwise to be defective; is taken out of service until it has been repaired. The equipment is placed back in service only after verifying by calibration that the equipment performs satisfactorily. An evaluation of the effect of this defect on previous calibrations or tests is made and documented appropriately.

Calibration verification is performed according to the applicable analytical methodology. Calibration verification procedures and criteria are listed in laboratory Standard Operating Procedures. Documentation of calibration verification is maintained in appropriate reference files. For NELAP accredited methods, the concentration of calibration verification standards are varied within the calibration range periodically.

10.1 Temperature Control Devices

Temperatures are monitored and recorded for all of the temperature-regulating support equipment such as sample refrigerators, freezers, and standards refrigerators. Bound record books are kept which contain daily-recorded temperatures, identification and location of equipment, acceptance criteria and the initials of the technician who performed the checks. The procedure for performing these measurements is provided in the *SOP for Support Equipment Monitoring and Calibration (SOP ADM-SEMC).* The SOP also includes the use of acceptance criteria and correction factors.

Where the operating temperature is specified as a test condition (such as ovens, incubators, evaporators) the temperature is recorded on the raw data. All thermometers are identified according to serial number, and the calibration of these thermometers is checked annually against a National Institute of Standards and Technology (NIST) certified thermometer. The NIST thermometer is recertified by a professional metrology organization on an annual basis.

10.2 Analytical Balances

Analytical balances are serviced on a semi-annual basis by a professional metrology organization. New certificates of calibration for each balance are issued to the laboratory on a semi-annual basis. The calibration of each analytical balance is checked by the user each day

of use with three Class S or S-1 weights, which assess the accuracy of the balance at low, mid-level and high levels within the working range. Records are kept which contain the recorded measurements, identification of the balance, acceptance criteria, and the initials of user who performed the check. The weights are recertified using NIST traceable standards by a professional metrology organization on an annual basis.

As needed, the balances are recalibrated using the manufacturers recommended operating procedures. The procedure for performing these measurements and use of acceptance criteria is described in the SOP ADM-SEMC.

10.3 Water Purification System

The water purification system is designed to produce deionized water with specific resistivity no less than 18 megohms-cm at 25°C, meeting specifications for Type I water, as described in *Standard Methods for the Examination of Water and Wastewater (SM1080)*. The system is monitored continuously for conductivity and resistivity with an on-line meter, which is recorded daily in a bound record book. The accuracy of the meter is verified annually. Deionizers are rotated and replaced on a regular schedule, and are monitored by an indicator light on the unit. The status of the system is monitored and recorded daily in a bound record book following a written SOP. Activated carbon filters are also in series with the demineralizers to produce "organic-free" water. Water for microbiology is checked at a point downstream of the purification system at a tap in the laboratory, and the monitoring documented.

10.4 Source and Preparation of Standard Reference Materials

All analytical measurements generated at CAS are performed using materials and/or processes that are traceable to a reference material. Metrology equipment (analytical balances, thermometers, etc.) is calibrated using reference materials traceable to the National Institute of Standards and Technology (NIST). These primary reference materials are themselves recertified on an annual basis. All sampling containers provided to the client by the laboratory are purchased as precleaned (Level 1) containers, with certificates of analysis available for each bottle type. This information is provided to the client when requested.

Consumable reference materials routinely purchased by the laboratories (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. All vendors have fulfilled the requirements for ISO 9001 certification and/or are accredited by A_2LA. CAS relies on a primary vendor for the majority of its analytical supplies. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. Supelco, Ultra Scientific, AccuStandard, Chem Services, Inc., Aldrich Chemical Co., Baker, Spex, etc. are examples of the vendors used. Reference material information is recorded in the appropriate logbook(s) and materials are stored under conditions that provide maximum protection against deterioration and contamination. The logbook entry includes such information as an assigned logbook identification code, the source of the material (i.e. vendor identification), solvent (if applicable) and concentration of analyte(s), reference to the certificate of analysis and an assigned expiration date. The date that the standard is received in the laboratory is marked on the container. When the reference material is used for the first time, the date of usage and the initials of the analyst are also recorded on the container.

Stock solutions and calibration standard solutions are prepared fresh as often as necessary according to their stability. All standard solutions are properly labeled as to analyte concentration, solvent, date, preparer, and expiration date; these entries are also recorded in the appropriate notebook(s) following the *SOP for Making Entries into Logbooks and onto Benchsheets* (SOP No. ADM-DATANTRY). Prior to sample analysis, all calibration reference materials are verified with a second, independent source of the material (see section 11.3.5).

10.5 Inductively Coupled Plasma-Atomic Emission Spectrograph (ICP-AES)

Each emission line on the ICP is calibrated daily against a blank and against standards. Analyses of calibration standards, initial and continuing calibration verification standards, and inter-element interference check samples are carried out as specified in the applicable method SOP and analytical method (i.e. EPA 200.7, 6010B, 6010C, CLP SOW, etc.).

10.6 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

Each element of interest is calibrated for using a blank and a single standard. Prior to calibration, a short-term stability check is performed on the system. Following calibration, an independent check standard is analyzed, and a continuing calibration verification standard (CCV) is analyzed with every ten samples.

10.7 Atomic Absorption Spectrophotometers (AAS)

These instruments are calibrated daily using a minimum of four standards and a blank. Calibration is validated using reference standards, and is verified at a minimum frequency of once every ten samples. Initial calibration points cannot be “dropped” from the resulting calibration curve.

10.8 GC/MS Systems

All GC/MS instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise) using procedures outlined in Standard Operating Procedures and/or appropriate USEPA method citations. All reference materials used for this function are vendor-certified standards. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method. Compounds selected as system performance check compounds (SPCCs) must show a method-specified response factor in order for the calibration to be considered valid. Calibration check compounds (CCCs) must also meet method specifications for percent difference from the multipoint calibration. For isotope dilution procedures, the internal standard response(s) and labeled compound recovery must meet method criteria. Method-specific instrument tuning is regularly checked using bromofluorobenzene (BFB) for volatile organic chemical (VOC) analysis, or decafluorotriphenylphosphine (DFTPP) for semi-volatile analysis. Mass spectral peaks for the tuning compounds must conform both in mass numbers and in relative intensity criteria before analyses can proceed. Calibration policies for organics chromatographic analyses are described in the *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOP SOC-CAL).*

10.9 Gas Chromatographs and High Performance Liquid Chromatographs

Calibration and standardization follow SOP guidelines and/or appropriate USEPA method citations. All GC and HPLC instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise). The lowest standard is equivalent to the method reporting limit; additional standards define the working range of the GC or LC detector. Results are used to establish response factors (or calibration curves) and retention-time windows for each analyte. Calibration is verified at a minimum frequency of once every ten samples, unless otherwise specified by the reference method. *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOP SOC-CAL).*

10.10 UV-Visible Spectrophotometer (manual colorimetric analyses)

Routine calibrations for colorimetric and turbidimetric analyses involve generating a 5-point calibration curve including a blank. Initial calibration points cannot be "dropped" from the resulting calibration curve. Correlation coefficients must meet method or SOP specifications before analysis can proceed. Independent calibration verification standards (ICVs) are analyzed with each batch of samples. Continuing calibration is verified at a minimum frequency of once every ten samples. Typical UV-Visible spectrophotometric methods at CAS include total phenolics, phosphates, surfactants and tannin-lignin.

10.11 Flow Injection Analyzer (automated colorimetric analysis)

A minimum of six standards and a blank are used to calibrate the instrument for cyanide analysis. A blank and (minimum of) five standards are used to calibrate the instrument for all other automated chemistries. Initial calibration points cannot be "dropped" from the resulting calibration curve. Standard CAS acceptance limits are used to evaluate the calibration curve prior to sample analysis.

10.12 Ion Chromatographs

Calibration of the ion chromatograph (IC) involves generating a 5-point calibration curve. Initial calibration points cannot be "dropped" from the resulting calibration curve. A correlation coefficient of $\geq$ 0.995 for the curve is required before analysis can proceed. Quality Control (QC) samples that are routinely analyzed include blanks and laboratory control samples. The target analytes typically determined by the IC include nitrate, nitrite, chloride, fluoride, sulfate and bromide. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method.

10.13 Turbidimeter

Calibration of the turbidimeter requires analysis of three Nephelometric Turbidity Unit (NTU) formazin standards. Quality Control samples that are routinely analyzed include blanks, Analytical Products Group® QC samples (or equivalent) and duplicates.

10.14 Ion-selective electrode

The method-prescribed number of standards (typically two for Standard Methods and EPA wastewater methods) are used to calibrate the electrodes before analysis. The slope of the curve must be within acceptance limits before analysis can proceed. Quality Control samples that are routinely analyzed include blanks, LCSs and duplicates.

10.15 Pipets

The calibration of pipets and autopipettors used to make critical-volume measurements is verified following the *SOP for Checking Pipet Calibration*. Both accuracy and precision verifications are performed, at intervals applicable to the pipet and use. The results of all calibration verifications are recorded in bound logbooks.

10.16 Other Instruments

Calibration for the total organic carbon (TOC), total organic halogen (TOX), and other instruments is performed following manufacturer's recommendations and applicable SOPs.

11.0 QUALITY CONTROL

A primary focus of Columbia Analytical Services Quality Assurance (QA) Program is to ensure the accuracy, precision and comparability of all analytical results. Prior to using a procedure for the analysis of field samples, acceptable method performance is established by performing demonstration of capability analyses and performance characteristics are established by performing method detection limit studies and assessing accuracy and precision according to the reference method. CAS has established Quality Control (QC) objectives for precision and accuracy that are used to determine the acceptability of the data that is generated. These QC limits are either specified in the methodology or are statistically derived based on the laboratory's actual historical data obtained from the various QC measurements for each analytical method. The Quality Control objectives are defined below.

11.1 Quality Control Objectives

11.1.2 Demonstration of Capability - Where required by mandatory test method, regulation, or accreditation protocols, a demonstration of capability (DOC) is made prior to using any test method. This demonstration is made following regulatory, accreditation, or method specified procedures. In general, this demonstration does not test the performance of the method in real world samples, but in the applicable clean matrix free of target analytes and interferences.

A quality control reference material or quality control sample is obtained. The analyte(s) is (are) diluted in a volume of clean matrix (for analytes which do not lend themselves to spiking, e.g., TSS, the demonstration of capability may be performed using quality control samples). Where specified, the method-required concentration levels are used. Four aliquots are prepared and analyzed according to the test procedure. The mean recovery and standard deviations are calculated and compared to the corresponding acceptance criteria for precision and accuracy in the test method or laboratory-generated acceptance criteria (if there are not established mandatory criteria). All parameters must meet the acceptance criteria. Where spike levels are not specified, actual Laboratory Control Sample results or MDL study results may be used to meet this requirement, provided acceptance criteria is met.

11.1.3 Accuracy - Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e. matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery (% REC.) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or

caused by an artifact of the measurement system (e.g., contamination). CAS utilizes several quality control measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement

11.1.4 Precision - Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling and in laboratory analysis. The American Society of Testing and Materials (ASTM) recognizes two levels of precision: repeatability - the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions, and reproducibility - the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

"Within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

11.1.5 Control Limits - The control limits for accuracy and precision originate from two different sources: For analyses having enough QC data, control limits are calculated at the 99% confidence limits. For analyses not having enough QC data, or where the method is prescriptive, control limits are taken from the method on which the procedure is based. If the method does not have stated control limits, then control limits are assigned method-default or reasonable values. Control limits are updated periodically when new statistical limits are generated for the appropriate surrogate, laboratory control sample, and matrix spike compounds (typically once a year) or when method prescribed limits change. The updated limits are reviewed by the Quality Assurance Manager. The new control limits replace the previous limits and data is assessed using the new values. The current acceptance limits for accuracy and precision are available from the laboratory and on the accompanying CD-ROM. For inorganics, the precision limit values listed are for laboratory duplicates. For organics, the precision limit values listed are for duplicate laboratory control samples or duplicate matrix spike analyses.

11.1.6 Representativeness - Representativeness is the degree to which the field sample, being properly preserved, free of contamination, and analyzed within holding time, represents the overall sample site or material. This can be extended to the sample itself, in that representativeness is the degree to which the subsample that is analyzed represents the entire field sample submitted for analysis. CAS has sample handling procedures to ensure that the sample used for analysis is representative of the entire sample. These include the *SOP for Subsampling and Compositing of Samples* and the *SOP for Tissue Sample Preparation*. Further, analytical SOPs specify appropriate sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

11.1.8 Comparability – Comparability expresses the confidence with which one data set can be compared to another and is directly affected by data quality (accuracy and precision) and sample handling (sampling, preservation, etc). Only data of known quality can be compared. The CAS objective is to generate data of known quality with the highest level of comparability, completeness, and usability to the client. This is achieved by employing the quality controls listed below and standard operating procedures for the handling and analysis of all samples. Data is reported in units specified by the client and using specified data qualifiers where necessary.

11.2 Method Detection Limits and Method Reporting Limits

Method Detection Limits (MDL) for analytical methods routinely performed at CAS/Kelso are determined annually, thus may change slightly from year to year. The MDLs are determined by following the *SOP for the Determination of Method Detection Limits,* which is based on the procedure in 40 CFR Part 136, Appendix B. As required by NELAC and DoD protocols, the validity of derived MDLs is verified using MDL verification samples. The Method Reporting Limit (MRL) is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e. the lower limit of quantitation). Therefore, analyses are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the MDL (or greater). The current MDLs and MRLs are available from the laboratory.

11.3 Quality Control Procedures

The specific types, frequencies, and processes for quality control sample analysis are described in detail in method-specific standard operating procedures and listed below. These sample types and frequencies have been adopted for each method and a definition of each type of QC sample is provided below. In addition, a number of other quality control processes that may impact analytical results are also described below.

11.3.1 Method Blank (a.k.a. Laboratory Reagent Blank)

The method blank is either analyte-free water or analyte-free soil (when available), subjected to the entire analytical process. When analyte-free soil is not available, anhydrous sodium sulfate, organic-free sand, or an acceptable substitute may be used instead. The method blank is analyzed to demonstrate that the analytical system itself is not contaminated with the analyte(s) being measured. The method blank results should be below the Method Reporting Limit (MRL) or, if required for DoD projects, below half of the MRL for the analyte(s) being tested. Otherwise, corrective action must be taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

11.3.2 Calibration Blanks

For some methods, calibration blanks are prepared along with calibration standards in order to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve. Additional project-specific requirements may also apply to calibration blanks.

11.3.3 Continuing Calibration Blanks

Continuing calibration blanks (CCBs) are solutions of either analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free when CCV standards are analyzed. The frequency of CCB analysis is either once every ten samples or as indicated in the method, whichever is greater. Additional project-specific requirements may also apply to continuing calibration blanks.

11.3.4 Calibration Standards

Calibration standards are solutions of known concentration prepared from primary standard or stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

11.3.5 Initial (or Independent) Calibration Verification Standards

Initial (or independent) calibration verification standards (ICVs) are standards that are analyzed *after* calibration with newly prepared standard(s) but *prior to* sample analysis, in order to verify the validity and accuracy of the standards used in the calibration. Once it is determined that there is no reference material defect or systematic error in preparation of the calibration standard(s), standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). ICVs are also analyzed in accordance with method-specific requirements.

11.3.6 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) are midrange standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every ten samples, or as indicated in the method.

11.3.7 Internal Standards

Internal standards are known amounts of specific compounds that are added to each sample prior to instrument analysis. Internal standards are generally used for GC/MS and ICP-MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by matrix effects. The requirements for evaluation of internal standards are specified in each method and SOP.

11.3.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and chromatographic behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to extraction and analysis in order to monitor the method performance on each sample. The percent recovery is calculated for each surrogate, and the recovery is a measurement of the overall method performance.

11.3.9 Laboratory Control Samples (a.k.a. Laboratory Fortified Blanks)

The laboratory control sample (LCS) is an aliquot of analyte-free water or analyte-free solid (or anhydrous sodium sulfate or equivalent) to which known amounts of the method analyte(s) is(are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent. The LCS sample is prepared and analyzed in exactly the same manner as the field samples. The percent recovery of the target analytes in the LCS is compared to established control limits and assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to-batch precision and accuracy.

11.3.10 Matrix Spikes (a.k.a. Laboratory Fortified Sample Matrix)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) is(are) added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as are routine samples. For the appropriate methods, matrix spiked samples are prepared and analyzed and at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per twenty samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Spike recoveries are calculated as follows:

$$Recovery\ (\%) = (S - A) \times 100 \div T$$

Where: S = The observed concentration of analyte in the spiked sample,
A = The analyte concentration in the original sample, and
T = The theoretical concentration of analyte added to the spiked sample.

11.3.11 Laboratory Duplicates and Duplicate Matrix Spikes

Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample (MS/DMS) are analyzed. The relative percent difference between duplicate analyses or between an MS and DMS is a measure of the precision for a given method and analytical batch. The relative percent difference (RPD) for these analyses is calculated as follows:

$$\textit{Relative Percent Difference (RPD)} = (S1 - S2) \times 100 \div S_{ave}$$

Where S1 and S2 = The observed concentrations of analyte in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and

S_{ave} = The average of observed analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike.

Depending on the method of analysis, either duplicates (and/or matrix spikes) or MS/DMS analyses are performed at a minimum frequency of one set per 20 samples. If an insufficient quantity of sample is available to perform a laboratory duplicate or duplicate matrix spikes, duplicate LCSs will be prepared and analyzed.

11.3.12 Interference Check Samples

An interference check sample (ICS) is a solution containing both interfering and analyte elements of known concentration that can be analyzed to verify background and interelement correction factors in metals analyses. The ICS is prepared to contain known concentrations (method or program specific) of elements that will provide an adequate test of the correction factors. The ICS is analyzed at the beginning and end of an analytical run or at a method-specified frequency. Results must meet method criteria and any project-specific criteria.

11.3.13 Post Digestion Spikes

Post digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method-specified minimum concentration above the method reporting limit. A post digestion spike is analyzed with each batch of samples and recovery criteria are specified for each method.

11.3.13 Control Charting

The generation of control charts is routinely performed at CAS. Surrogate, Matrix Spike and LCS recoveries are all monitored and charted. In addition, the laboratory also monitors the Relative Percent Difference (RPD) measurement of precision. Control charts are available to each individual laboratory unit to monitor the data generated in its facility using control charts that have been programmed to identify various trends in the analytical results. If trends in the data are perceived, various means of corrective action may then be employed in order to prevent future problems with the analytical system(s). Finally, data quality reports using control charts are generated for specific clients and projects pursuant to contract requirements. The control charting procedure is described in the SOP for *Control Charting Quality Control Data* (ADM-CHRT).

11.3.14 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at CAS undergoes a rigorous cleansing procedure prior to every usage. A number of SOPs have been generated that outline the various procedures used at CAS; each is specific to the end-use of the equipment as well as to the overall analytical requirements of the project. In addition, other equipment that may be routinely used at the laboratory is also cleaned following instructions in the appropriate SOP.

12.0 DATA REDUCTION, VALIDATION, AND REPORTING

CAS reports the analytical data produced in its laboratories to the client via the certified analytical report (CAR). This report includes a transmittal letter, a case narrative, client project information, specific test results, quality control data, chain of custody information, and any other project-specific support documentation. The following procedures describe our data reduction, validation and reporting procedures.

12.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the data. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are found in the applicable analytical SOPs. The resulting data set is either manually entered (e.g., titrimetric or microbiological data) into an electronic report form or is electronically transferred into the report from the software used to process the original data set (e.g., chromatographic software). Once the complete data set has been transferred into the proper electronic report form(s), it is then printed. The resulting hardcopy version of the electronic report is then reviewed by the analyst for accuracy. Once the primary analyst has checked the data for accuracy and acceptability, the hardcopy is forwarded to the supervisor or second qualified analyst, who reviews the data for errors. Where calculations are not performed a validated software system, the reviewer rechecks a minimum of 10% of the calculations. When the entire data set has been found to be acceptable, a final copy of the report is printed and signed by the laboratory supervisor, departmental manager or designated laboratory staff. The entire data package is then placed into the appropriate service request file, and an electronic copy of the final data package is forwarded to the appropriate personnel for archival. Data review procedures are described in the *SOP for Laboratory Data Review Process.*

Policies and procedures for manual editing of data are established. The analyst making the change must initial and date the edited data entry, without obliteration of the original entry. The policies and procedures are described in the *SOP for Making Entries into Logbooks and onto Benchsheets* (SOP ADM-DATANTRY).

Policies and procedures for electronic manual integration of chromatographic data are established. The analyst performing the integration must document the integration change by printing both the "before" and "after" integrations and including them in the raw data records. The policies and procedures are described in the *SOP for Manual Integration of Chromatographic Peaks* (SOP ADM-INT).

12.2 Confirmation Analysis

12.2.1 Gas Chromatographic and Liquid Chromatographic Analyses

For gas chromatographic (GC) and liquid chromatographic (LC) analyses, all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis, unless exempted by one of the following situations:

- The analyte of interest produces a chromatogram containing multiple peaks exhibiting a characteristic pattern, which matches appropriate standards. This is limited to petroleum hydrocarbon analyses (e.g., gasoline and diesel) and does not include polychlorinated biphenyls.

- The sample meets all of the following requirements:

    1. All samples (liquid or solid) come from the same source (e.g., groundwater samples from the same well) for continuous monitoring. Samples of the same matrix from the same site, but from different sources (e.g., different sampling locations) are not exempt.

    2. All analytes have been previously analyzed in sample(s) from the same source (within the last year), identified and confirmed by a second column or by GC/MS. The chromatogram is largely unchanged from the one for which confirmation was carried out. The documents indicating previous confirmation must be available for review.

12.2.2 Confirmation Data

Confirmation data will be provided as specified in the method. Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods

    1. The analyte must fall within plus or minus three times the standard deviation (established for the analyte/column) of the retention time of the daily midpoint standard in order to be qualitatively identified. The retention-time windows will be established and documented, as specified in the appropriate Standard Operating Procedure (SOP).

    2. When sample results are confirmed by two dissimilar columns or detectors, the agreement between quantitative results must be evaluated. The relative percent difference between the two results is calculated and evaluated against SOP and/or method criteria.

- GC/MS Methods - Two criteria are used to verify identification:

    1. Elution of the analyte in the sample will occur at the same relative retention time (RRT) as that of the analyte in the standard.

    2. The mass spectrum of the analyte in the sample must, in the opinion of a qualified analyst or the department manager, correspond to the spectrum of the analyte in the standard or the current GC/MS reference library.

12.3 Data Review and Validation

The integrity of the data generated is assessed through the evaluation of the results of the calibrations and analysis of QC samples (method blanks, laboratory control samples, sample duplicates, matrix spikes, trip blanks, etc.). A brief description of the evaluation of these analyses is described below. Details are provided in applicable SOPs. The numerical criteria for evaluation of these QC samples are listed within each method-specific Standard Operating Procedure. Other data evaluation measures may include (as necessary) a check of the accuracy check of the QC standards and a check of the system sensitivity. Data transcriptions and calculations are also reviewed.

Note: Within the scope of this document, all possible data assessment requirements for various project protocols cannot be included in the listing below. This listing gives a general description of data evaluation practices used in the laboratory in compliance with NELAC Quality Systems requirements. Additional requirements exist for certain programs, such as projects under the DoD QSM protocols, AFCEE QAPP protocols, and project-specific QAPPs.

- Method Calibration – Following the analysis of calibration blanks and standards according to the applicable SOP the calibration correlation coefficient, average response factor, etc. is calculated and compared to specified criteria. If the calibration meets criteria analysis may continue. If the calibration fails, any problems are isolated and corrected and the calibration standards reanalyzed. Following calibration and analysis of the independent calibration verification standard(s) the percent difference for the ICV is calculated. If the percent difference is within the specified limits the calibration is complete. If not, the problem associated with the calibration and/or ICV are isolated and corrected and verification and/or calibration is repeated.

- Continuing Calibration Verification (CCV) – Following the analysis of the CCV standard the percent difference is calculated and compared to specified criteria. If the CCV meets the criteria analysis may continue. If the CCV fails, routine corrective action is performed and documented and a 2nd CCV is analyzed. If this CCV meets criteria, analysis may continue, including any reanalysis of samples that were associated with a failing CCV. If the routine corrective action failed to produce an immediate CCV within criteria, then either acceptable performance is demonstrated (after additional corrective action) with two consecutive calibration verifications, or a new initial calibration is performed. For DoD projects, the concentration of these two consecutive must be varied as required by the DoD QSM, Version 3.

- Method Blank – Results for the method blank are calculated as performed for samples. If results are less than the MRL (<½ MRL for DoD projects), the blank may be reported. If not, associated sample results are evaluated to determine the impact of the blank result. If possible, the source of the contamination is determined. If the contamination has affected sample results the blank and samples are reanalyzed. If positive blank results are reported, the blank (and sample) results are flagged with an appropriate flag, qualifier, or footnote.

- Sample Results (Inorganic) – Following sample analysis and calculations (including any dilutions made due to the sample matrix) it is verified that the result is within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. For sample and sample duplicate analyzed for precision, the calculated RPD is compared to the specified limits. The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis. For metals, additional measures described in the applicable SOP may be taken to further evaluate results (dilution tests and/or post-digestion spikes). Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed the MRL is elevated accordingly and qualified. The MRL must meet project requirements.

- Sample Results (Organic) – For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is diluted and reanalyzed. It is verified that the result is within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. For GC and HPLC tests, results from confirmation analysis are evaluated to confirm positive results and to determine the reported value. If obvious matrix interferences are present, additional cleanup of the sample using appropriate procedures may be necessary and the sample is reanalyzed. Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed the MRL is elevated accordingly and qualified. The MRL must meet project requirements.

- Surrogate Results (Organic) – Following sample analysis and calculations the percent recovery of each surrogate is compared to specified control limits. If recoveries are acceptable and other sample evaluation is complete, the results are reported. If recoveries do not fall within control limits, the sample matrix is evaluated. When matrix interferences are present or documented, the results are reported with a qualifier that matrix interferences are present. If no matrix interferences are present and there is no cause for the outlier, the sample is reprepared and reanalyzed. However, if the recovery is above the upper control limit with non-detected target analytes, the sample may be reported. All surrogate recovery outliers are appropriately qualified on the report.

- Duplicate Sample and/or Duplicate Matrix Spike Results – The RPD is calculated and compared to the specified control limits. If the RPD is within the control limits the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. Despite the use of homogenizing procedures prior to sample preparation or analysis, the sample may not be homogenous or duplicate sample containers may not have been sample consistently. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. Also, the results are compared to the MRL. If the results are less than five times the MRL, the results are reported with a qualifier that the high RPD is due to the results being near the MRL. If the sample is homogenous and results above five times the MRL, the samples and duplicates are reanalyzed. If re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.

- Laboratory Control Sample Results – Following analysis of the LCS the percent recovery is calculated and compared to specified control limits. If the recovery is within control limits, the analysis is in control and results may be reported. If not, this indicates that the analysis is not in control. The source of the problem is identified and, depending on the source of the problem, the LCS and the associated batch is reanalyzed or re-prepared and reanalyzed.

- Matrix Spike Results – Following analysis of the MS the percent recovery is calculated and compared to specified control limits. If the recovery is within control limits the results may be reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as performing any additional cleanups, dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

12.4 Data Reporting

When an analyst determines that a data package has met the data quality objectives (and/or any client-specific data quality objectives) of the method and has qualified any anomalies in a clear, acceptable fashion, the data package is reviewed by a trained chemist. Prior to release of the report to the client, the project chemist reviews and approves the entire report for completeness and to ensure that any and all client-specified objectives were successfully achieved. The original raw data, along with a copy of the final report, is filed in project files by service request number for archiving. CAS maintains control of analytical results by adhering to standard operating procedures and by observing sample custody requirements. All data are calculated and reported in units consistent with project specifications, to enable easy comparison of data from report to report.

To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). The *SOP for Data Reporting and Report Generation* addresses the flagging and qualification of data. The CAS-defined data qualifiers, state-specific data qualifiers, or project-defined data qualifiers are used depending on project requirements. A case narrative may be written by the project chemist to explain problems with a specific analysis or sample, etc.

For subcontracted analyses, the Project Chemist verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were performed, the analyses were performed for each sample as requested, a report is provided for each analysis, and the report is signed. The Project Chemist accepts the report if all verification items are complete. Acceptance is demonstrated by forwarding the report to the CAS client.

12.5 Documentation

CAS maintains a records system which ensures that all laboratory records of analysis data retained and available. Analysis data is retained for 5 years from the report date unless contractual terms or regulations specify a longer retention time. The archiving system is described in the *SOP for Data Archiving*.

12.5.1 Documentation and Archiving of Sample Analysis Data

The archiving system includes the following items for each set of analyses performed:

- Benchsheets describing sample preparation (if appropriate) and analysis;
- Instrument parameters (or reference to the data acquisition method);
- Sample analysis sequence;
- Instrument printouts, including chromatograms and peak integration reports for all samples, standards, blanks, spikes and reruns;
- Logbook ID number for the appropriate standards;
- Copies of report sheets submitted to the work request file; and
- Copies of Nonconformity and Corrective Action Reports, if necessary.

Individual sets of analyses are identified by analysis date and service request number. Since many analyses are performed with computer-based data systems, the final sample concentrations can be automatically calculated. If additional calculations are needed, they are written on the integration report or securely stapled to the chromatogram, if done on a separate sheet.

12.5.2 Documentation of Batch-related QC and Calibration Data

For organics analysis, data applicable to all analyses within the batch, such as GCMS tunes, CCVs, batch QC, and analysis sequences; are kept using a separate documentation system. This system is used to archive data on a batch-specific basis and is segregated according to the date of analysis. This system also includes results for the most recent calibration curves, as well as method validation results.

12.6 Deliverables

In order to meet individual project needs, CAS provides several levels of analytical reports. Basic specifications for each level of deliverable are described in Table 12-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) to following specialized deliverables:

- ADEC – Alaska Department of Conservation specified data package
- ACOE/HTRW – Army Corps of Engineers HTRW specified data package and reporting requirements
- AFCEE – Air Force Center for Environmental Excellence project-specific reporting

When requested, CAS provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. The EDD is prepared by report production staff using the electronic version of the laboratory report to minimize transcription errors. User guides and EDD specification outlines are used in preparing the EDD. The EDD is reviewed and compared to the hard-copy report for accuracy.

Table 12-1
Descriptions of CAS Data Deliverables

Tier I. Routine Certified Analytical Report (CAR) includes the following:

1. Transmittal letter
2. Sample analytical results
3. Method blank results
4. Surrogate recovery results and acceptance criteria for applicable organic methods
5. Chain of custody documents
6. Dates of sample preparation and analysis for all tests

Tier II and IIA. In addition to the Tier I Deliverables, this CAR includes the following:

1. Matrix spike result(s) with calculated recovery and including associated acceptance criteria
2. Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
3. Tier IIA also includes Laboratory Control Sample (LCS) result(s) with calculated recovery and including associated acceptance criteria

Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:

1. Case narrative
2. Calibration records and results of initial and continuing calibration verification standards, with calculated recoveries
3. Results of laboratory control sample (LCS) or Quality Control check sample, with calculated recovery and/or associated acceptance limit criteria
4. Results of calibration blanks or solvent blanks (as appropriate to method)
5. Summary forms for associated QC and calibration parameters
6. Copies of all raw data, including extraction/preparation bench sheets, chromatograms, and instrument printouts. For GC/MS, this includes tuning criteria and mass spectra of all positive hits. Results and spectra of TIC compounds will be included upon request.

Tier IV. CLP-Level Data Validation Package.

A complete Data Validation Package containing all sample results, quality control and calibration results, and raw data necessary to fulfill all deliverable requirements of an EPA Contract Laboratory Program (CLP) data package.

13.0 PERFORMANCE AND SYSTEM AUDITS

Quality audits are an essential part of CAS/Kelso's quality assurance program. There are two types of audits used at the facility: System Audits are conducted to qualitatively evaluate the operational details of the QA program, while Performance Audits are conducted by analyzing proficiency testing samples in order to quantitatively evaluate the outputs of the various measurement systems.

13.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of CAS/Kelso are conducted regularly by various regulatory agencies and clients. Table 13-1 summarizes some of the major programs in which CAS/Kelso participates. Programs and certifications are added as required. Additionally, internal system audits of CAS/Kelso are conducted regularly by the Quality Assurance Manager. The internal audit procedures are described in the *SOP for Internal Audits*. The internal audits are performed as follows:

- Comprehensive lab-wide system audit – performed annually. This audit is conducted such that systems, technical operations, hardcopy data, and electronic data are assessed.
- Hardcopy report audits – minimum of 3 per quarter.
- Electronic audit trail reviews – each applicable instrument per quarter.

All audit findings, and corrective actions are documented. The results of each audit are reported to the Laboratory Director and Department Managers for review. Any deficiencies identified are summarized in the audit report. Managers must respond with corrective actions correcting the deficiency within 30 days. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification within the 30 day corrective action period (if not already provided).

Electronic data audits may be performed in conjunction with hardcopy data audits. The electronic audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices and files, GCMS tuning data, peak response data, use of appropriate files, and other components of the analysis. The audit also verifies that the electronic data supports the hardcopy reported data.

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

13.2 Performance Audits

CAS/Kelso also participates in the analysis of interlaboratory proficiency testing (PT) samples. Participation in PT studies is performed on a regular basis and is designed to evaluate all analytical areas of the laboratory. CAS routinely participates in the following studies:

- Water Pollution (WP) and additional water parameters, 2 per year.
- Water Supply (WS) PT studies, 2 per year.
- Hazardous Waste/Soil PT studies, 2 per year.
- Underground Storage Tank PT studies, 2 per year.
- Microbiology (WS and WP) PT studies, 2 per year.
- Other studies as required for specific certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples (assigned Service Request, due date, testing requirements, etc.) and are processed the same as field samples. The laboratory sections handle samples the same as field samples, performing the analyses following method requirements and performing data review. The laboratory sections submit results to the QA Manager for subsequent reporting to the appropriate agencies or study provider. Results of the performance evaluation samples and audits are reviewed by the Quality Assurance Manager, Laboratory Director, the laboratory staff, and the CAS Quality Assurance Director. For any results outside acceptance criteria, the analysis data is reviewed to identify a possible cause for the deficiency, and corrective action is taken and documented.

Table 13-1
Current CAS Performance and System Audit Programs

Federal and National Programs

- Naval Facilities Engineering Service Center
  Validated Laboratory for NFESC Parameters
- U.S. Air Force, Air Force Center for Environmental Excellence (AFCEE)
  Approved Laboratory for AFCEE Projects
- U.S. Army Corps of Engineers - MRD, HTRW Center of Expertise
  Validated Laboratory for HTRW parameters
- National Environmental Laboratory Accreditation Conference (NELAC) Accredited

State and Local Programs

- State of Alaska, Department of Environmental Conservation
  UST Laboratory, Lab I.D. UST040
- State of Arizona, Department of Health Services
  License No. AZ0339
- State of Arkansas, Department of Environmental Quality
  Certified Environmental Laboratory, Lab I.D. 88-0637
- State of California, Department of Health Services, Environmental Laboratory Accreditation Program
  Certification No. 2286
- State of Colorado, Department of Public Health and Environment
  Certified Drinking Water Laboratory
- State of Florida, Department of Health
  Primary NELAC Accreditation No. E87412
- State of Hawaii, Department of Health
  Certified Drinking Water Laboratory
- State of Idaho, Department of Health and Welfare
  Certified Drinking Water Laboratory
- State of Indiana, Department of Health
  Certified Drinking Water Laboratory, Lab I.D. C-WA-01
- State of Louisiana, Department of Environmental Quality
  Accredited Environmental Laboratory, Lab I.D. 3016
- State of Louisiana, Department of Health and Hospitals
  Accredited Drinking Water Laboratory, Lab I.D. LA070008
- State of Maine, Department of Human Services
  Certified Environmental Laboratory, Lab I.D. WA0035
- State of Michigan, Department of Environmental Quality
  Certified Drinking Water Laboratory, Lab I.D. 9949
- State of Minnesota, Department of Health
  Certified Environmental Laboratory, Lab I.D. 053-999-368
- State of Montana, Department of Health and Environmental Sciences
  Certified Drinking Water Laboratory, Lab I.D. 0047
- State of Nevada, Division of Environmental Protection
  Certified Drinking Water Laboratory, Lab I.D. WA35
- State of New Jersey, Department of Environmental Protection
  Accredited Environmental Laboratory, Lab I.D. WA005

Table 13-1 (continued)

State and Local Programs (continued)

- State of New Mexico, Environment Department
  Certified Drinking Water Laboratory
- State of North Carolina, Department of Environment and Natural Resources
  Certified Environmental Laboratory, Lab I.D. 605
- State of Oklahoma, Department of Environmental Quality
  General Water Quality/Sludge Testing, Lab I.D. 9801
- State of Oregon, ORELAP Laboratory Accreditation Program
  Accredited Environmental Laboratory, Lab I.D. WA200001
- State of Pennsylvania Department of Environmental Protection
  Registered Environmental Laboratory
- State of South Carolina, Department of Health and Environmental Control
  Certified Environmental Laboratory, Lab I.D. 61002
- State of Utah, Department of Health, Division of Laboratory Services
  Accredited Environmental Laboratory
- State of Washington, Department of Ecology, Environmental Laboratory Accreditation Program
  Accreditation No. C1203
- State of Wisconsin, Department of Natural Resources
  Accredited Environmental Laboratory, Lab I.D. 998386840

14.0 PREVENTIVE MAINTENANCE

Preventive maintenance is a crucial element of the Quality Assurance program. Instruments at CAS (e.g., ICP/MS and ICP systems, GC/MS systems, atomic absorption spectrometers, analytical balances, gas and liquid chromatographs, etc.) are maintained under commercial service contracts or by qualified, in-house personnel. All instruments are operated and maintained according to the instrument operating manuals. All routine and special maintenance activities pertaining to the instruments are recorded in instrument maintenance logbooks. The maintenance logbooks used at CAS contain extensive information about the instruments used at the laboratory.

An initial demonstration of analytical control is required on every instrument used at CAS before it maybe used for sample analysis. If an instrument is modified or repaired, a return to analytical control is required before subsequent sample analyses can occur. When an instrument is acquired at the laboratory, the following information is noted in a bound maintenance notebook specifically associated with the new equipment:

- The equipment's serial number;
- Date the equipment was received;
- Date the equipment was placed into service;
- Condition of equipment when received (new, used, reconditioned, etc.); and
- Prior history of damage, malfunction, modification or repair (if known).

Equipment records also include a copy of the manufacturer's manual(s) and dates and results of calibrations.

Preventive maintenance procedures, frequencies, etc. are available for each instrument used at CAS. They may be found in the various SOPs for routine methods performed on an instrument and may also be found in the operating or maintenance manuals provided with the equipment at the time of purchase.

Responsibility for ensuring that routine maintenance is performed lies with the section supervisor. The supervisor may perform the maintenance or assign the maintenance task to a qualified bench level analyst who routinely operates the equipment. In the case of non-routine repair of capital equipment, the section supervisor is responsible for providing the repair, either by performing the repair themselves with manufacturer guidance or by acquiring on-site manufacturer repair. Each laboratory section maintains a critical parts inventory. The parts inventories include the items needed to perform the preventive maintenance procedures listed in Appendix D.

This inventory or “parts list” also includes the items needed to perform any other routine maintenance and certain in-house non-routine repairs such as gas chromatography/mass spectrometry jet separators and electron multipliers and ICP/MS nebulizer. When performing maintenance on an instrument (whether preventive or corrective), additional information about the problem, attempted repairs, etc. is also recorded in the notebook. Typical logbook entries include the following information:

- Details and symptoms of the problem;
- Repairs and/or maintenance performed;
- Description and/or part number of replaced parts;
- Source(s) of the replaced parts;
- Analyst's signature and date; and
- Demonstration of return to analytical control.

See the table in Appendix D for a list of preventive maintenance activities and frequency for each instrument.

15.0 CORRECTIVE ACTION

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If a quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). Failure to meet established analytical controls, such as the quality control objectives outlined in Section 11, prompts corrective action. In general, corrective action may take several forms and may involve a review of the calculations, a check of the instrument maintenance and operation, a review of analytical technique and methodology, and reanalysis of quality control and field samples. If a potential problem develops that cannot be solved directly by the responsible analyst, the supervisor, team leader, the department manager, and/or the Quality Assurance Manager may examine and pursue alternative solutions. In addition, the appropriate project chemist may be notified in order to ascertain if contact with the client is necessary.

Problems with analysis, as well as the corresponding corrective actions taken, are documented on Nonconformity and Corrective Action Reports (See Figure 15-1) following the requirements in the *SOP for Nonconformity and Corrective Action Documentation* (SOP No. ADM - NCAR). This form is utilized to document corrective actions in response to out-of-control situations. The Quality Assurance Manager reviews each problem, ensuring that appropriate corrective action has been taken by the appropriate personnel. The Nonconformity and Corrective Action Report (NCAR) is filed in the associated service request file and a copy is kept by the Quality Assurance Manager. The Quality Assurance Manager periodically reviews all NCARs looking for chronic, systematic problems that need more in-depth investigation and alternative corrective action consideration. In addition, the appropriate project chemist is promptly notified of any problems in order to inform the client and proceed with any action the client may want to initiate.

Corrective action due to a performance audit or a check sample problem is initiated by the Quality Assurance Manager; the affected laboratory supervisors and managers are promptly informed of performance audit results requiring corrective action.

Figure 15-1

Nonconformity and Corrective Action Report

NONCONFORMITY N&CA Report No. _____

PROCEDURE (SOP or METHOD): EVENT DATE: _____

EVENT: ☐ Missed Holding Time ☐ QC Failure ☐ Lab Error (spilled sample, spiking error, etc.)
☐ Method Blank Contamination ☐ Login Error ☐ Project Management Error
☐ Equipment Failure ☐ Unacceptable PT Sample Result ☐ Other (describe):

SAMPLES / PROJECTS / CUSTOMERS / SYSTEMS AFFECTED

DETAILED DESCRIPTION

ORIGINATOR: _____ DATE: _____

PROJECT CHEMIST(s): _____ NOTIFIED BY: _____ DATE: _____

CORRECTIVE ACTION AND OUTCOME

Re-establishment of conformity must be demonstrated and documented. Describe the steps that were taken, or are planned to be taken, to correct the particular Nonconformity and prevent its reoccurrence. Include Project Chemist instructions here.

Is the data to be flagged in the Analytical Report with an appropriate qualifier? ☐ **No** ☐ **Yes**

APPROVAL AND NOTIFICATION

Supervisor Verification and Approval of Corrective Action _____ Date: _____
Comments:

QA PM Verification and Approval of Corrective Action _____ Date: _____
Comments:

Customer Notified by ☐ Telephone ☐ Fax ☐ E-mail ☐ Narrative ☐ Not notified
Project Chemist Verification and Approval of Corrective Action _____ Date: _____
Comments: (Retain record)

Page 1 of 1
Original: Customer File Photocopies: Supervisor and QA PM N&CA Report 2004.doc 3/26/2004

16.0 QUALITY ASSURANCE REPORTS

Quality assurance requires an active, ongoing commitment by CAS personnel at all levels of the organization. Information flow and feedback mechanisms are designed so that analysts, supervisors and managers are aware of quality assurance issues in the laboratory. Analysts performing routine testing are responsible for generating a Data Quality Report (DQR), or similar form, with every analytical batch they process. This report contains explicit documentation of the various controls that must be met during the analysis. This report also allows the analyst to provide appropriate notes and/or a case narrative if problems were encountered with the analyses. A Non-Conformity and Corrective Action Report (NCAR) (see Section 15.0) may also be attached to the data prior to review. Supervisors or qualified analysts review all of the completed analytical batches to ensure that all QC criteria have been examined and any deficiencies noted and corrected if possible.

It is the responsibility of each laboratory unit to provide the project chemist with a final report of the data, accompanied by signature approval. Footnotes and/or narrative notes must accompany any data package if problems were encountered that require further explanation to the client. Each data package is submitted to the appropriate project chemist, who in turn reviews the entire collection of analytical data for completeness. The project chemist must also review the entire body of data to ensure that any and all client-specified objectives were successfully achieved. A case narrative may be written by the project chemist to explain any unusual problems with a specific analysis or sample, etc.

The Quality Assurance Manager (QAM) provides overview support to the project chemists as required (e.g., contractually specified, etc.). The QAM is also responsible for the oversight of all internal and external audits, for all proficiency testing sample and analysis programs, and for all laboratory certification/accreditation responsibilities. The QAM provides the Laboratory Director with quarterly reports that summarize the various QA/QC activities that occurred during the previous quarter. The report addresses such topics as the following:

- Status, schedule, and results of internal and external audits;
- Status, schedule, and results of internal and external proficiency testing studies;
- Status of certifications, accreditations, and approvals;
- Status of QA Manual and SOP review and revision;
- Status of MDLs studies;
- Discussion of QC problems in the laboratory;
- Discussion of corrective action program issues;
- Status of staff training and qualification; and
- Other topics as appropriate.

Any operational or quality assurance problems noted by the Laboratory Director are then addressed during the senior staff operations meetings with all appropriate department managers. The Laboratory Director also performs an annual documented review of the laboratory quality system to identify any necessary changes or improvements to the quality system or quality assurance policies.

17.0 PERSONNEL TRAINING

Technical position descriptions are available for all employees, regardless of position or level of seniority. These documents are maintained by the Human Resources personnel and are available for review. In order to assess the technical capabilities and qualifications of a potential employee, all candidates for employment at CAS are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at CAS when the company policies are presented and discussed. Safety and QA/QC requirements are integral parts of all technical SOPs and, consequently, are integral parts of all training processes at CAS. Safety training begins with the reading of the *Environmental Health and Safety Manual.* Employees are also required to attend periodic safety meetings where additional safety training may be performed by the Environmental, Health and Safety Officer. Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s).

Each employee participates in Ethics training, which is part of the CAS Improper Practices Prevention Program. CAS also encourages its personnel to continue to learn and develop new skills that will enhance their performance and value to the Company. Ongoing training occurs for all employees through a variety of mechanisms. The "CAS University" education system, external and internal technical seminars and training courses, and laboratory-specific training exercises are all used to provide employees with professional growth opportunities.

A training plan is developed for each Standard Operating Procedure. The training plan includes a description of the step-by-step process for training an employee and for initial demonstration of proficiency. Where the analyst performs the entire procedure, a generic training plan may be used. In cases where work cells are used, a training plan specific to the work cell is established.

17.1 Initial Demonstration of Capability

Training in analytical procedures typically begins with the reading of the Standard Operating Procedure (SOP) for the method. Hands-on training begins with the observation of an experienced analyst performing the method, followed by the trainee performing the method under close supervision, and culminating with independent performance of the method on quality control samples. Successful completion of the applicable Demonstration of Capability analysis qualifies the analyst to perform the method independently. Demonstration of Capability is performed by one of the following:

- Successful completion of an Initial Precision and Recovery (IPR) study (required where mandated by the method).

- Analysis of 4 consecutive Laboratory Control Samples, with acceptable accuracy and precision. (For use of this option, LCSs must be from "second-source" standard materials independent of the calibration standards materials.).

- Where spiking is not possible but QC standards are used ("non-spiked" Laboratory Control Samples), analysis of 4 consecutive Laboratory Control Samples with acceptable accuracy and precision.

- Where one of the three above is not possible, special requirements are as follows:

    - Total Settleable Solids: Successful single-blind PT sample analysis and duplicate results with RPD<10%.
    - Color: Four consecutive prepared LCSs with acceptable accuracy and precision of <10% RSD.
    - Physical Tests (Grain size, Corrosivity to Steel, etc.): Supervisor acknowledgement of training and approval.

A flowchart identifying the Demonstration of Proficiency requirements is given in Figure 17-1. The flowchart identifies allowed approaches to assessing Demonstration of Capability when a 4-replicate study is not mandated by the method, when spiking is not an option, or when QC samples are not readily available.

17.2 Continuing Demonstration of Proficiency

A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- Successful performance on external (independent) single-blind PT sample analyses using the test method, or a similar test method using the same technology.

- Performing Initial Demonstration of Capability as described above, with acceptable levels of precision and accuracy.

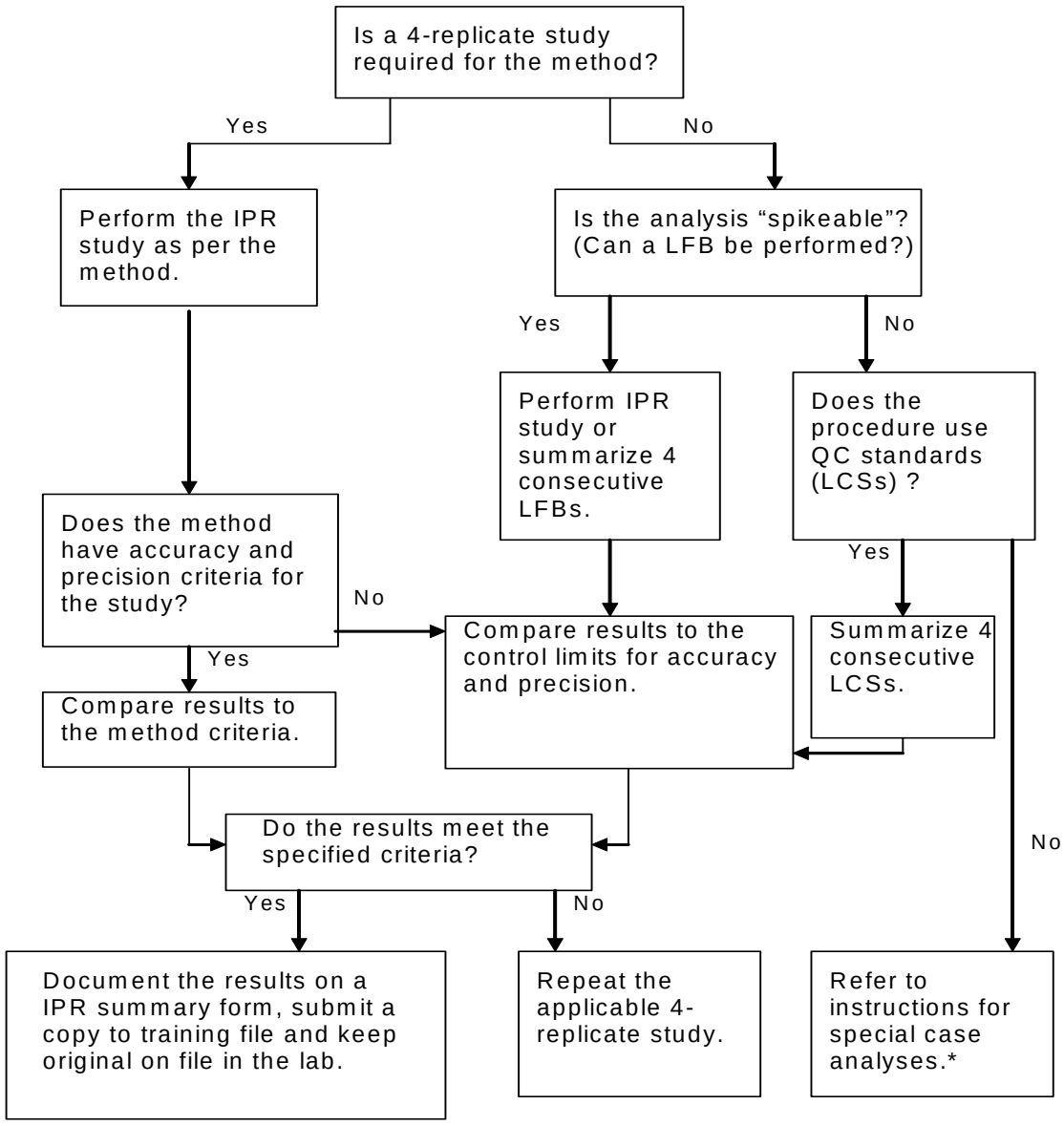
- Analysis of at least 4 consecutive LCSs with acceptable levels of accuracy and precision from in-control analytical batches.

- For methods for which PT samples are not available and a spiked analysis (LFB, MDL, etc.) is not possible, analysis of field samples that have been analyzed by another analyst with statistically indistinguishable results.

17.3 Documentation of Training

Records are maintained to indicate the employee has the necessary training, education, and experience to perform their functions. Information of previously acquired skills and abilities for a new employee is maintained in Human Resources personnel files and CAS resumes. A database is used to record the various technical skills and training acquired while employed by CAS. Information includes the employee's name, a description of the skill including the appropriate method and SOP reference, the mechanism used to document proficiency, and the date the training was completed. General procedures for documenting technical training are described in the *SOP for Documentation of Training (SOP No. ADM-TRANDOC).*

Figure 17-1
Initial Demonstration of Capability Requirements[a]



[a] For IDOC IPR or LFB studies, "second-source" reference materials are used, as per NELAC requirements
*Total Settleable Solids: Successful PT sample analysis and duplicate results with RPD<10%.
*Color: Four consecutive prepared LCSs with acceptable accuracy and precision of <10% RSD.
* Physical Tests (Grain size, Corrosivity to Steel, etc.): Supervisor acknowledgement of training and approval.

18.0 REFERENCES FOR ANALYTICAL PROCEDURES

The analytical methods used at CAS generally depend upon the end-use of the data. Since most of our work involves the analysis of environmental samples for regulatory purposes, specified federal and/or state testing methodologies are used and followed closely. Typical methods used at CAS are taken from the following references:

- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, (September 1986) and Updates I (July 1992), II (September 1994), IIA (August 1993), IIB (January 1995), III (December 1996), Proposed Update IV, and updates posted online at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm. See Chapters 1, 2, 3, and 4. Unless otherwise specified, the most current published version is used.

- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, (Revised March 1983).

- *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600/R-93/100 (August 1993).

- *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010 (June 1991) and Supplements.

- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA 600/4-82-057 (July 1982) and 40 CFR Part 136, Appendix A.

- *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039 (December 1988) and Supplements.

- *Standard Methods for the Examination of Water and Wastewater*, 16th Edition (1985); 17th Edition (1989); 18th Edition (1992); 19th Edition (1995). See Introduction in Part 1000.

- 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act.

- 40 CFR Part 141, National Primary Drinking Water Regulations.

- *Analytical Methods for Petroleum Hydrocarbons*, ECY 97-602, Washington State Department of Ecology, June 1997.

- State-specific total petroleum hydrocarbon methods for the analysis of samples for gasoline, diesel, and other petroleum hydrocarbon products (Alaska, Arizona, California, Oregon, Washington, Wisconsin, etc.).

- Annual Book of ASTM Standards, Part 31, Water.

- EPA Contract Laboratory Program, Statement of Work for Organic Analysis, SOW Nos. OLM01.8, OLM02.0, OLM03.1, OLM03.2, OLM04.2, and OLM04.3.

- EPA Contract Laboratory Program, Statement of Work for Inorganic Analysis, SOW No. ILM04.0, ILM04.1, and ILM05.2.

- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA-540/R-94/012 (February 1993).

- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA-540/R-94/013 (February 1994).

- National Institute for Occupational Safety and Health (NIOSH) *Manual of Analytical Methods*, Third Edition (August 1987); Fourth Edition (August 1994).

- *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*, for USEPA and USACE (March 1986), with revisions through April 1997.

- WDOE 83-13, *Chemical Testing Methods for Complying with the State of Washington Dangerous Waste Regulations* (March 1982) and as Revised (July 1983 and April 1991).

- *Identification and Listing of Hazardous Waste,* California Code of Regulations, Title 22, Division 4.5, Chapter 11.

- *Analytical Methods for the Determination of Pollutants in Pulp and Paper Industry Wastewater*, EPA 821-R-93-017 (October 1993).

- *Analytical Methods for the Determination of Pollutants in Pharmaceutical Manufacturing Industry Wastewaters*, EPA 821-B-98-016 (July 1998).

- National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI).

- *Good Automated Laboratory Practices, Principles and Guidance to Regulations For Ensuring Data Integrity In Automated Laboratory Operations*, EPA 2185 (August 1995).

- *Manual for the Certification of Laboratories Analyzing Drinking Water*, 4th Edition, EPA 815-B-97-001 (March 1997).

- National Environmental Laboratory Accreditation Conference (NELAC), 2003 Quality Standards.

- *Department of Defense Quality Systems Manual for Environmental Laboratories*, Final Version 2 (June 2002) and Final Version 3 (January 2006).

APPENDIX A

LIST of QA PROGRAM DOCUMENTS

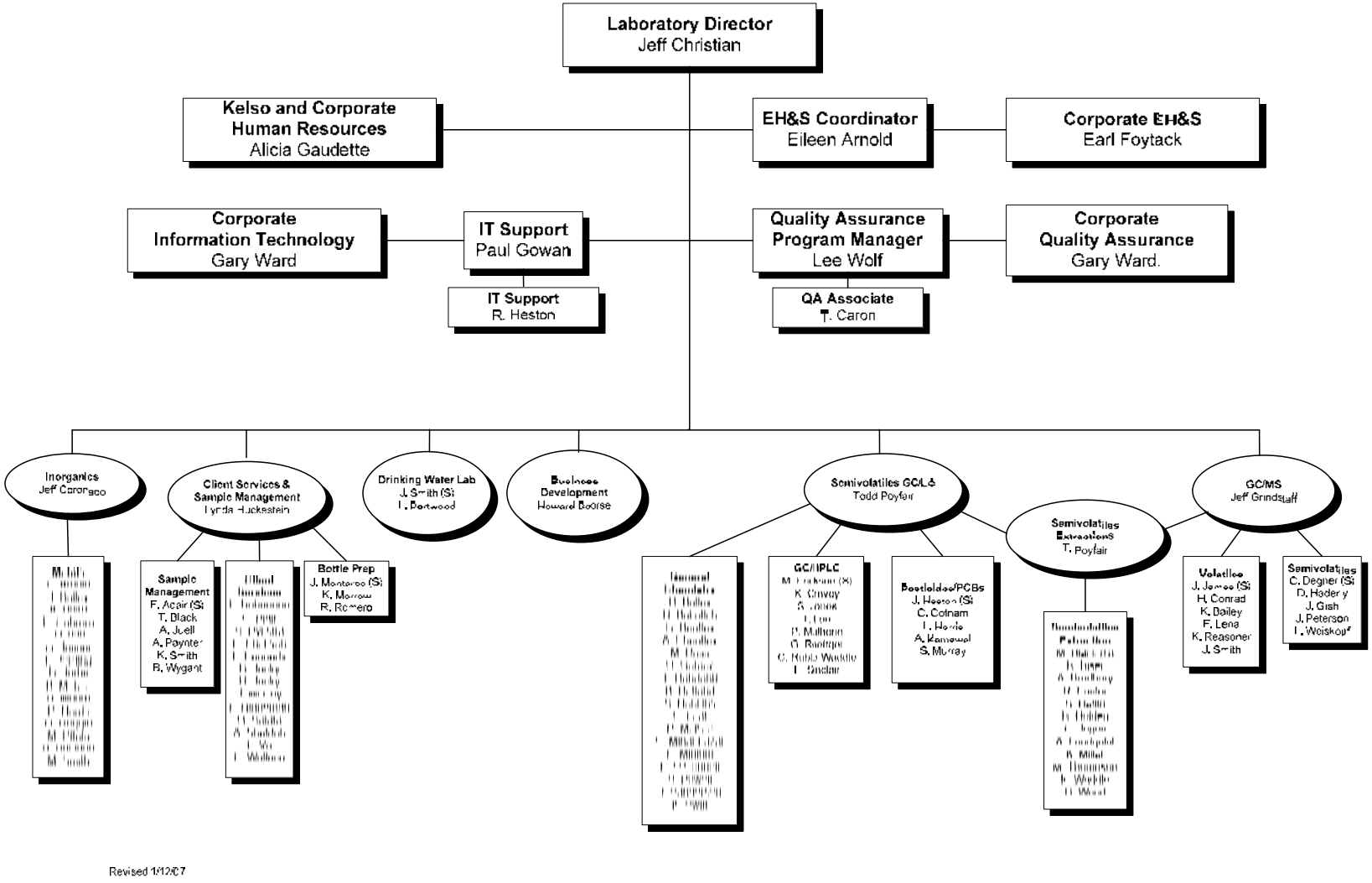
Quality Assurance Manual	1/10/07
Software Quality Assurance Plan	7/11/05
CAS-Kelso Certifications/Accreditations	Cert_kel.xls
Columbia Analytical Services MDL Tracking Spreadsheet	Mdl_list.xls
Technical Training Summary Database	TrainDat.mdb
Approved Signatories List	AppSignatories.pdf
Personnel resumes/qualifications	HR Department
Personnel Job Descriptions	HR Department
Quality Control Acceptance Criteria	Qclimits.xls
Master Logbook of Laboratory Logbooks	Masterlog-001
TECHNICAL STANDARD OPERATING PROCEDURES	
SOP TABLE OF CONTENTS	SOPLIST.DOC
ADMINISTRATIVE STANDARD OPERATING PROCEDURES	
ADMINISTRATIVE - CORPORATE	**FILE NAME**
CHAIN OF CUSTODY FOR SAMPLE TRANSFER BETWEEN LABORATORIES	ADM-COC
CHECKING NEW LOTS OF CHEMICALS FOR CONTAMINATION	ADM-CTMN
CONTROL LIMITS	ADM-CTRL_LIM
DEALING WITH COMPLAINTS	ADM-CMPLT
DOCUMENT CONTROL	ADM-DOCCTRL
DOCUMENTATION OF TRAINING	ADM-TRANDOC
ELECTRONIC DATA AUDITING	ADM-E_DATAUDIT
MAKING ENTRIES INTO LOGBOOKS AND ONTO BENCHSHEETS	ADM-DATANTRY
MANUAL INTEGRATION OF CHROMATOGRAPHIC PEAKS	ADM-INT
NONCONFORMITY AND CORRECTIVE ACTION	ADM-NCAR
PREPARATION OF STANDARD OPERATING PROCEDURES	ADM-SOP
PURCHASING THROUGH CAS PURCHASING AGENT	ADM-PUR
QUALIFICATION OF SUBCONTRACT LABORATORIES	ADM-SUBLAB
SAMPLE BATCHES	ADM-BATCH
SIGNIFICANT FIGURES	ADM-SIG.FIG
THE DETERMINATION OF METHOD DETECTION LIMITS AND LODs	ADM-MDL

ADMINISTRATIVE – LOCAL LABORATORY	**FILE NAME**
ARMY CORPS OF ENGINEERS HTRW PROJECT MANAGEMENT	ADM-HTRW
CHECKING PIPET CALIBRATION	ADM-CPIP
CONTINGENCY PLAN FOR LABORATORY EQUIPMENT FAILURE	ADM-ECP
CONTROL CHARTING QUALITY CONTROL DATA	ADM-CHRT
DATA ARCHIVING	ADM-ARCH
DATA REPORTING AND REPORT GENERATION	ADM-RG
ELECTRONIC DATA BACKUP AND ARCHIVING	ADM-EBACKUP
FACILITY AND LABORATORY CLEANING	ADM-FACL
INTERNAL QUALITY ASSURANCE AUDITS	ADM-IAUD
LABORATORY DATA REVIEW PROCESS	ADM-DREV
METHOD DETECTION LIMIT DOCUMENTATION AND CONTROL	ADM-MDLC
PROJECT MANAGEMENT	ADM-PCM
REAGENT LOGIN AND TRACKING	ADM-RLT
SUPPORT EQUIPMENT MONITORING AND CALIBRATION	ADM-SEMC
THERMOMETER CALIBRATION	ADM-TCAL
SAMPLE MANAGEMENT SOPS	**FILE NAME**
BOTTLE ORDER PREPARATION AND SHIPPING	SMO-BORD
FOREIGN SOILS HANDLING TREATMENT	SMO-FSHT
SAMPLE DISPOSAL	SMO-SDIS
SAMPLE RECEIVING	SMO-GEN
SAMPLE TRACKING AND LABORATORY CHAIN OF CUSTODY	SMO-SCOC

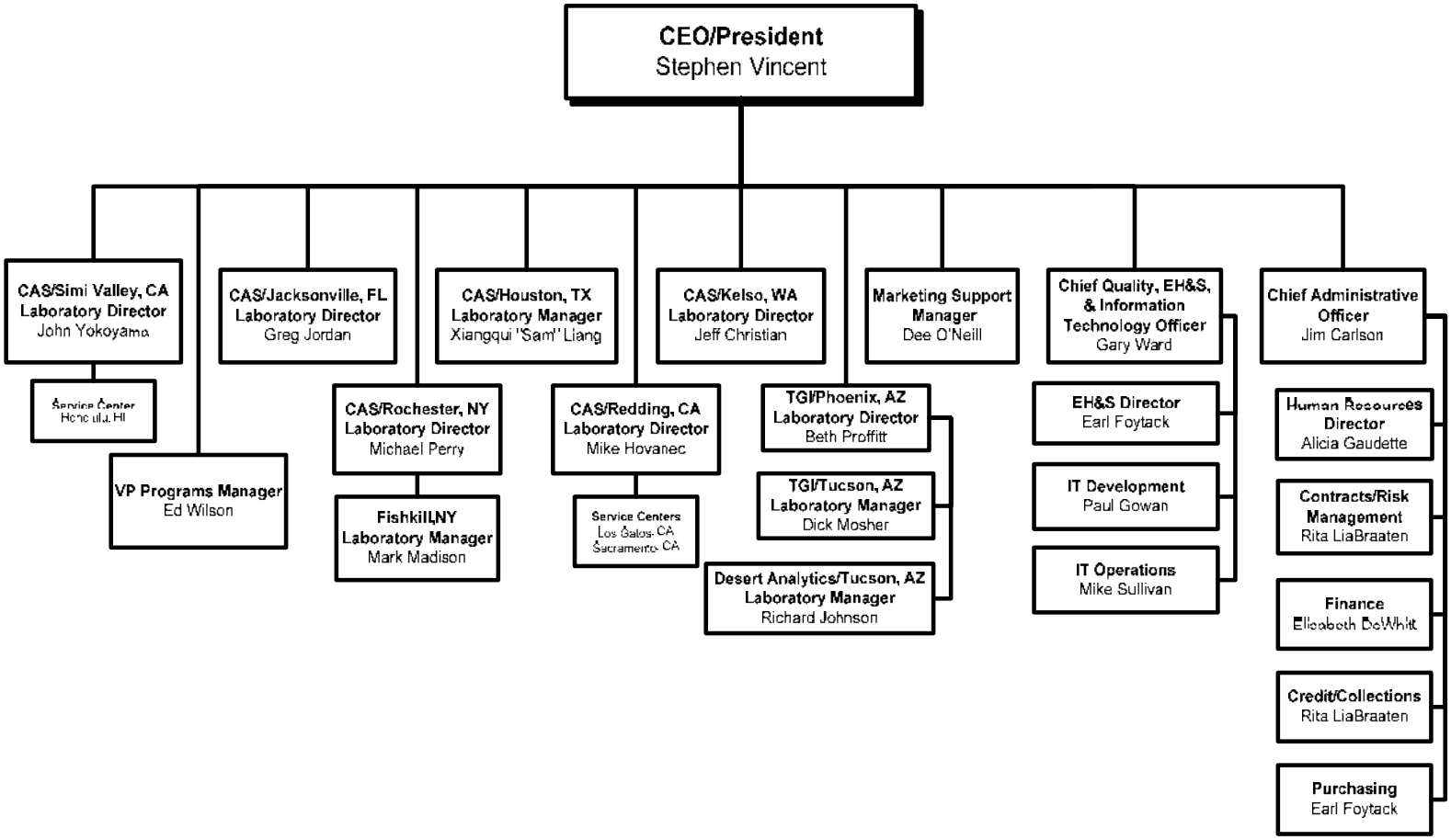
APPENDIX B

ORGANIZATIONAL CHARTS and RESUMES OF KEY PERSONNEL

Columbia Analytical Services, Inc.
Kelso, Washington Laboratory Organization



Columbia Analytical Services, Inc.
Laboratory Division Organization



JEFFREY D. CHRISTIAN

1989 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

VICE PRESIDENT/NW REGIONAL DIRECTOR – 1996 to Present

Responsibilities

Responsible for all phases of laboratory operations at the Kelso (WA) and Redding (CA) facilities, including project planning, budgeting, and quality assurance. Primary duties include the direct management of the Kelso laboratory (i.e. serves as the Kelso Laboratory Director, 1993-present). Also responsible for additional duties acquired as a member of the Columbia Analytical Services Holdings, Inc., Board of Directors.

Experience

Laboratory Director, Kelso Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1993-1995. Responsible for all phases of laboratory operations, including project planning, budgeting, and quality assurance.

Operations Manager, Kelso Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1992-1993. Responsibilities included directing the daily operation of the Kelso laboratory. Other responsibilities and duties included functioning as a technical consultant to clients, providing assistance in developing and planning analytical schemes to match client objectives, and writing and developing analytical procedures/methods. Also, served as Project Manager for State of Alaska Department of Environmental Conservation contract and Coordinator for EPA Special Analytical Services (SAS) contracts.

Project Chemist and Manager, Metals Analysis Laboratory, *Columbia Analytical Services, Kelso, Washington,* 1989-1992. Responsible for directing the daily operation of the Metals Laboratory, including the sample preparation, AAS, ICP-OES, and ICP-MS Laboratories.

Scientist, *Weyerhaeuser Technology Center, Federal Way, Washington,* 1986-1989. Responsibilities included supervising atomic spectroscopy laboratory which included flame and furnace AAS, ICP-OES, and sample preparation capabilities to handle a wide variety of sample types. Interfaced with internal and external clients to provide technical support. Wrote and developed analytical procedures/methods.

Lead Technician, Metals Lab, *Weyerhaeuser Technology Center, Federal Way, Washington,* 1981-1986. Responsibilities included primary ICP and AAS analyst for EPA-CLP contract work. Extensive experience in wide variety of environmental and product-related testing.

Research Assistant, *ITT Rayonier, Olympic Research Division, Shelton, Washington,* 1978-1981. Responsibilities included performing water quality tests, product-related analytical tests, corrosion tests (i.e., potentiometric polarization techniques), and operated pilot equipment specific to the pulp and paper industry.

Education

B.S., Chemistry, *Evergreen State College, Olympia, Washington,* 1993.
ICP/MS Training Course, *VG-Elemental,* 1992.
Coursework, *Pacific Lutheran University, Tacoma, Washington.* 1988-1989.
Coursework, *Tacoma Community College, Tacoma, Washington.* 1970-1971, 1988-1989.
Perkin-Elmer Advanced Furnace, *Norwalk, Connecticut,* 1986.
CERTIFICATION, Chemistry, *L.H. Bates Technical, Tacoma, Washington,* 1978.
Coursework, *Central Washington University, Ellensburg, Washington.* 1969-1970.

Publications/ Presentations

On request.

LEE E. WOLF

1988 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

TECHNICAL MANAGER IV, KELSO QUALITY ASSURANCE MANAGER – 2002 to Present

Responsibilities

Responsible for the overall coordination of the laboratory QA program, and for ensuring that established quality objectives are met. Responsible for Quality Assurance function, including the Quality Assurance Manual, certifications, documenting SOPs, and maintaining performance evaluation records. Oversee balance calibration and sample storage temperature control. Maintain certifications/accreditations for regulatory agencies and client certifications or approval programs. Act as primary point of contact during laboratory audits. Provides audit responses and initiates any changes in procedures resulting from an audit. Coordinate the analysis of performance evaluation samples required for certification/accreditation programs. Report and review results for these analyses. Conduct internal audits and make recommendations for corrective action.

Experience

Scientist IV, Kelso Quality Assurance Manager, *Columbia Analytical Services, Inc., Kelso, Washington,* 1996-2002. Duties primarily as listed above.

Project Chemist/Principal Organic Scientist, *Columbia Analytical Services, Inc., Kelso, Washington,* 1994-1996. Responsibilities included GC and GC/MS method development and special projects coordination. Acts as technical advisor to the GC and GC/MS laboratories and GC/MS interpretation specialist and CLP organics specialist. Also responsible for Project Chemist functions, including management and coordination of projects for clients, identifying client needs, and preparation of data reports.

Semi-VOA Department Manager, *Columbia Analytical Services,* 1988-1994. Responsibilities included overall management of the Semi-VOA department. Oversee the operation of Semi-VOA GC/MS, data review and reporting and related QA/QC function. Also responsible for supervision of staff, including training, scheduling, and other personnel issues. Beginning in 1992, increased responsibilities to include Project Chemist functions for organics EPA-SAS and other clients. This involved scheduling projects for clients, identifying client needs, and preparing data reports.

GC/MS Chemist, *U.S. Testing Co., Richland, Washington,* 1985-1988. Responsibilities included GC and GC/MS analysis of water and soil samples for volatiles and Semi-VOA by EPA protocol, including Methods 8240, 8270 and CLP. Coordinated extraction and GC-GC/MS areas to manage sample/data flow through the lab. Experience also with pesticide/PCB analysis by EPA Methods 8080 and CLP. Responsible for development of analysis methods for non-routine pesticides and herbicides and performed HPLC analysis.

Laboratory Assistant, *Eastern Washington University, Cheney, Washington,* 1985. Responsibilities included supervision and instruction of organic chemistry labs. Experience with GC and IR operation. Responsible for lab safety.

Chemist Assistant, *Spokane County Air Pollution Control Authority, Spokane, Washington,* 1984. Responsibilities included gathering and analyzing air samples for CO content using IR equipment.

Education

Documenting Your Quality System, *A2LA Short Course, Las Vegas, Nevada,* 1998.
Internal Laboratory Audits, *A2LA Short Course, Las Vegas, Nevada,* 1998.
Mass Spectra Interpretation, *ACS Short Course, Denver, Colorado,* 1992.
BS, Chemistry, Minor in Geology, *Eastern Washington University, Cheney, Washington,* 1985.

Publications/ Presentations

On Request.

Affiliations

American Chemical Society.

LYNDA A. HUCKESTEIN

1989 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

CLIENT SERVICES MANAGER IV – 1998 to Present

Responsibilities

Management of the Client Services Departments: Project Management, Electronic Data Deliverables and Report Generation, and Sample Management. Personally responsible for approximately 1.5 million dollars of client work annually performing technical project management and client service. Provides technical and regulatory interpretation assistance as-well-as project organization to work received by the laboratory.

Documentation of Demonstration of Capabilities is available for review.

Experience

Project Chemist, *Columbia Analytical Service, Inc., Kelso, Washington,* 1992-1998. Primary responsibilities included technical project management and client service in areas of pulp & paper, marine services, mining, and DOD. Also responsible for providing technical and regulatory interpretation assistance as-well-as project organization to work received by the laboratory

Project Chemist and Department Manager, General Chemistry Laboratory, *Columbia Analytical Services, Inc.,* 1989-1992. Responsible for management of the General Chemistry laboratory for routine wastewater, bioassay, and microbiological analyses. Also responsible for supervision of staff, data review, and reporting.

Analyst III, *Columbia Analytical Services, Inc., Kelso, Washington,* 1989. Primary responsibilities included coliform testing, total recoverable petroleum hydrocarbon extractions and analysis, BODs, ammonias, and TKN, in addition to miscellaneous wet chemistry analyses.

Microbiologist/Chemist, *Coffey Laboratories, Portland, Oregon,* 1983. Coliform analysis; water chemistry.

Laboratory Assistant, *Oregon State University, Corvallis, Oregon,* 1983. Wheat spike dissection and tissue culture.

Education

BS, Microbiology, *Oregon State University, Corvallis, Oregon,* 1983.

JEFFREY A. CORONADO

1989 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

TECHNICAL MANAGER IV, INORGANICS DEPARTMENT MANAGER – 2001 to Present

Responsibilities

Primary responsibilities include management of the Metals laboratory department. Responsible for training oversight, data review, report accuracy and timeliness QA/QC implementation, tracking department workload, and scheduling and performance of the Metals department. Also responsible for departmental budgets, method development efforts, and resource allocation.

Documentation of Demonstration of Capabilities is available for review.

Experience

Metals Department Manager, *Columbia Analytical Services, Inc., Kelso, Washington,* 1992-2001. Responsibilities included management of all aspects of the metal laboratory operation, including personnel training and evaluation, review of all metals data, and report generation. Also responsible for client service on a number of ongoing CAS accounts. Technical duties include primary analytical responsibility for trace level metals analysis by ICP/MS. Analyses range from routine water and soil analysis, to marine tissues, as well as industrial applications such as ultra-trace QA/QC work for various semiconductor clients. Also responsible for a number of specialized sample preparation techniques including trace metals in seawater by reductive precipitation, and arsenic and selenium speciation by ion-exchange chromatography. Developed methodology for performing mercury analysis at low part per trillion levels by cold vapor atomic fluorescence..

Supervisor, GFAA Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1989-1992. Responsibilities included supervision of metals analysis by graphite furnace atomic absorption following SW-846 and EPA CLP methodologies. Duties include workload scheduling, data review, instrument maintenance, personnel training and evaluation.

Education

Field Immunoassay Training Course, *EnSys Inc*., 1995.
Winter Conference on Plasma Spectrochemistry, *San Diego, California*, 1994.
ICP-MS Training Course, *VG-Elemental*, 1992.
BS, Chemistry, *Western Washington University, Bellingham, Washington,* 1988.
BA, Business Administration, *Western Washington University, Bellingham, Washington,* 1985.

JEFFREY A. GRINDSTAFF

1991 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

TECHNICAL MANAGER III, GC/MS VOA AND SEMI-VOA LABORATORIES – 1997 to Present

Responsibilities

Primary responsibilities include management of the GC/MS SemiVoa and VOA laboratory departments. Responsible for training oversight, data review, report accuracy and timeliness QA/QC implementation, tracking department workload, and scheduling and performance of the GC/MS departments. Also responsible for departmental budgets, method development efforts, and resource allocation. Also performs GC/MS maintenance and troubleshooting.

Documentation of Demonstration of Capabilities is available for review.

Experience

Manager, GC/MS VOA Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1994-1997. Responsible for supervision of GC/MS VOA staff, method development, training, data review, tracking department workload, scheduling analyses, and general maintenance and troubleshooting of GC/MS systems.

Scientist III, GC/MS VOA Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1991-1994. Responsibilities included scheduling workload, data review, instrument maintenance and troubleshooting, and personnel training and evaluation. Also responsible for supervision of extraction personnel and instrument analysts. Additional supervisory duties included report generation and data review for GC analyses. Responsibilities also included project management and customer service.

Chemist, *Enseco-CRL, Ventura, California,* 1990-1991. Established GC/MS department including inventory maintenance, preparation of state certification data packages, method development, SOPs, and extended data programs. Performed daily maintenance and troubleshooting of GC and GC/MS instrumentation. Scheduled and performed routine and non-routine VOA analyses.

GC/MS Chemist, VOA Laboratory *Coast-to-Coast Analytical Service, San Luis Obispo, California,* 1990-1991. Responsible for standard preparation for VOA analyses and instrument calibration, tuning, and maintenance. Also implemented and further developed EPA methods for quantitative analysis of pesticides and priority pollutants..

Education

Mass Selective Detector Maintenance, *Hewlett-Packard Education Center,* 1993.
Interpretation of Mass Spectra I, *Hewlett-Packard Analytical Education Center,* 1992.
B.S., Chemistry, *California Polytechnic State University, San Luis Obispo, California,* 1989.
A.A., Liberal Arts, *Allan Hancock College, Santa Maria, California.* 1986

Publications/ Presentations

Alternate Method to Lower Detection Limits to Satisfy Regulatory Action Levels for Volatiles in Groundwater, with David Edelman, Kairas Parvez, and Paul Laymon. TAPPI National Meeting, Orlando, Florida. 1996

Affiliations

American Chemical Society. 1989

TODD N. POYFAIR

1991 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

TECHNICAL MANAGER III, SVG LABORATORIES – 2001 to Present

Responsibilities

Primary responsibilities include management of the GC, HPLC, and General Chemistry laboratory departments. Responsible for training oversight, data review, report accuracy and timeliness QA/QC implementation, tracking department workload, and scheduling and performance of the these departments. Also responsible for departmental budgets, method development efforts, and resource allocation.

Documentation of Demonstration of Capabilities is available for review.

Experience

Supervisor/Manager, General Chemistry Department, *Columbia Analytical Services, Inc., Kelso, Washington,* 1995-2001. Responsibilities included supervision, management, and training of General Chemistry staff. Also responsible for workload coordination, data review, reporting, and instrument maintenance within the General Chemistry department.

Project Chemist, Client Services Group, *Columbia Analytical Services, Inc., Kelso, Washington,* 1993-1995. Responsibilities included technical project management and customer service. Responsible for meeting the clients' needs of timely and appropriate analyses, and to acted as liaison for all client-related activities within CAS.

Scientist II, General Chemistry Laboratory, *Columbia Analytical Services, Inc., Kelso, Washington,* 1992-1993. Responsibilities included the review and summarization of pH, alkalinity, conductivity, turbidity, hardness, and CODs.

Scientist I, **General Chemistry Laboratory,** *Columbia Analytical Services, Inc., Kelso, Washington,* 1992. Responsibilities included analysis of Total Organic Halogens, Chemical Oxygen Demand, Sulfides, Ammonia, TKN, Nitrate/Nitrite by Lachat, and Cyanide.

Analyst III, **General Chemistry Laboratory,** *Columbia Analytical Services, Inc., Kelso, Washington,* 1991-1992. Responsibilities included analysis of pH, Conductivity, Alkalinity, Turbidity, and Oil and Grease.

Education

BS, Chemistry, *Portland State University, Portland, Oregon,* 1991.
BA, German, *Portland State University, Portland, Oregon,* 1990.
COURSEWORK, *Brigham Young University, Provo, Utah.* 1982-1983 & 1985-1986.

JAMES R. "JIM" SMITH

2001 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

TECHNICAL MANAGER I, DRINKING WATER LABORATORY SUPERVISOR – 2002 to Present

Responsibilities

Primary responsibilities include management of the Semivolatiles Drinking Water laboratory department. Responsible for training oversight, data review, report accuracy and timeliness QA/QC implementation, tracking department workload, and scheduling and performance of the department. Also responsible for departmental budgets, method development efforts, and resource allocation. Project management of Drinking water accounts. Operation of Varian GC/MS, Agilant GC/ECD and Agilant HPLC.

Documentation of Demonstration of Capabilities is available for review.

Experience

Project Manager III, *Columbia Analytical Services, Inc., Kelso, Washington,* 2001-2002. Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and providing technical support to clients regarding laboratory application to projects. Extensive technical experience with the various GC and GC/MS method allow for detailed technical review of organics projects. Also has extensive experience coordinating drinking water and sediment projects. Currently responsible for coordination of approximately $200,000 of analyses in the laboratory on a monthly basis. Current large clients include Bechtel (Navy work), which involves numerous groundwater-monitoring projects, the Port of Seattle and URS. Also responsible for various storm water studies for Bremerton Naval Shipyard.

Director, Trace Organics and Project Manager, *Amtest, Inc., Redmond, Washington,* 1987-2001. Responsible for project management, client contact, data review, and writing reports. Additional responsibilities pertained to supervision of the trace organics department and running the GC/MS system. Performed various methods by GC/MS for volatiles, semi-volatiles and by GC for pesticides, PCBs, herbicides, and fuels (LUST). Also performed hazardous waste characterization including completion of waste profile forms.

Education

BS, Chemistry, *Rochester Institute of Technology, Rochester, New York,* 1985.

EILEEN M. ARNOLD

1987 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

SCIENTIST IV, METALS LABORATORY, KELSO HEALTH AND SAFTEY OFFICER – 1994 to Present

Responsibilities

Duties include the operation and maintenance of the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques. Health and Safety Officer responsibilities included development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment and documents, and performance of monthly safety audits.

Documentation of Demonstration of Capabilities is available for review.

Experience

Project Chemist, Client Services Group, Kelso Health and Safety Officer, *Columbia Analytical Services, Inc., Kelso, Washington,* 1992-1994. Duties included technical project management and customer service. Responsible for meeting the clients' needs of timely and appropriate analyses, and to act as liaison for all client-related activities within Columbia Analytical Services, Inc. Health and Safety Officer responsibilities included development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment and documents, and performance of monthly safety audits.

Scientist IV, Metals Laboratory, Health and Safety Officer, *Columbia Analytical Services, Inc., Kelso, Washington, 1987-1992.* Duties include the operation and maintenance of the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques. Health and Safety Officer responsibilities included development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment and documents, and performance of monthly safety audits.

Chemist, *Dow Corning Corporation, Springfield, Oregon,* 1986-1987. Responsibilities included ICP and atomic absorption work in silicon manufacturing. Methods development for ICP analysis of minor impurities found in silicon.

Chemist, *Ametek, Inc., Harleysville, Pennsylvania,* 1982-1985. Responsibilities included product research and development chemist involved in production of thin-film semiconductors for use as solar cells. Work involved AA and SEM techniques.

Chemist, *Janbridge, Inc., Philadelphia, Pennsylvania,* 1978-1982. Responsibilities included maintaining electroplating process lines through wet chemical analysis techniques, and performed Quality Assurance testing on printed circuit boards.

Education

BA, Chemistry, *Immaculata College, Immaculata, Pennsylvania,* 1977.

Affiliations

American Chemical Society, Member since 1987.

PAUL GOWAN

1994 TO PRESENT

CAS Holdings Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

IT MANAGER II, 2002 to Present

Responsibilities

Identify and plan IT requirements by interacting with management personnel to identify current and long-term user objectives. Assist in developing and tracking the IT computer capital budget. Provide electronic data deliverable (EDD) and LIMS system guidance to management personnel throughout the company. Ensure the effective utilization of computer systems. Train users as required. Establish IT policies, standards, practices, and specifications. Participate in the LIMS planning group.

Plan and supervise IT department staffing, organization, hardware and software acquisitions to meet requirements. Acquire, develop, and maintain a skilled staff through effective performance review and career development programs. Develop and maintain relationships with local and national vendors of computer hardware, software, and telephone equipment.

Experience

KELSO IT MANAGER, *Columbia Analytical Services, Inc., Kelso, Washington,* 1999-2002. Responsible for all IT efforts related to the CAS laboratory in Kelso, WA, including, but not excluded to computing equipment specification, purchasing and maintenance; network infrastructure; software development; strategic planning for future IT initiatives; budget preparation performance reviews, and career growth planning for IT staff.

TECHNICAL INFORMATION SPECIALIST, *CAS Holdings,Inc., Kelso, Washington,* 1994-1999. Primary responsibilities included support automation of HP chemstation and Enviroquant; support continued development of unified organic laboratories; support and development of project-specific data deliverables, technical assistance in Information Technology at Kelso to meet CAS IT objectives as related to LIMS.

Organics Section Manager, *Anametrix, Inc., San Jose, California,* 1992-1994. Responsibilities included managing the GC/MS and GC/Pesticide Departments, following protocols of the Department of Defense NEESA contracts (demanding stringent QA/QC and "Level D" data package submittals). Primary responsibilities included supervisor training and development, budget preparation and maintenance, performance reviews, data review, continuing research on environmental trends, SOP generation and updates, method development, capital equipment evaluation for laboratories, and project management.

GC/MS Program Manager, *Anametrix, Inc., San Jose, California,* 1988-1992. Responsibilities included supervision of five chemists, two Finnigan 4000 GC/MS Systems, and three HP 5971 GC/MS Systems. Primary responsibilities were to maintain high productivity and insure that the GC/MS department generated legally defensible data. Also responsible for sample scheduling and tracking, instrument maintenance and troubleshooting, analyst training and review, client interfacing, and purchasing.

GC/MS Analyst, *Anametrix, Inc., San Jose, California,* 1986-1988. Responsibilities included analyzing for VOA and Semi-VOA priority pollutants using EPA Methods 624/625 and 8240/8370.

Education

BA, Biochemistry, *San Jose State University, San Jose, California,* 1986.

GARY K. WARD

2001 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

VICE PRESIDENT, CHIEF QUALITY, SAFETY, AND ETHICS OFFICER – 2001 to Present

Responsibilities

Responsibilities include directing and managing the overall corporate-wide quality systems, ethics and safety programs for all CAS facilities, as well as strategic planning, marketing, business development, and information technology. Responsible for all interaction and liaison with government entities involving quality, technical and operational issues.

Experience

Deputy Director, Laboratory Standards, *Intertek Testing Services, Houston, Texas,* 1998-2001. Responsibilities included professional standards/quality assurance for 240 laboratories in 93 countries, involving laboratory tests ranging from petroleum products and environmental samples to toys, textiles, and building products. Resolution of issues with a variety of governments, agiences, and companies with particular focus on interactions with the US EPA. Was previously responsible for all operations of over 100 labs in the Americas, ranging from Canada to South America, including duties to improve quality, raise profits and revenues, and implement a LIMS.

Director, Technical Operations, *Environmental Health Laboratories, South Bend, Indiana,* 1995-1998. Responsibilities included operations and quality assurance of the laboratory. Directed, administered and coordinated activities of the lab in accordance with goals and objectives of the company. Responsible for the R&D program, laboratory throughput and financial performance, and implementation of the new LIMS system.

Executive Scientist, *Quanterra (Enseco), Arvada, Colorado,* 1987-1995. Responsibilities included providing expertise and experience in laboratory analysis and operations to the entire laboratory system. Duties included implementation of network-wide LIMS as well as coordination of the Technology, QA, IS, and Operations groups. As Director of Technology and Quality Assurance was responsible for management of the R&D program, Quality Assurance program, and Environment, Health and Safety program throughout the Enseco lab system. Direct reports were all QA managers, safety managers, and chief scientists from each of the 13 laboratories.

Deputy Branch Chief, *U.S. Environmental Protection Agency,* 1983-1987. Responsibilities included providing expertise to entire Superfund program ranging from lab analytical services to sampling. Duties involved managing the CLP program as well as the Superfund R&D program. As CLP National Program Manager was responsible for development and implementation of CLP analytical protocols, administration of contracts for over 100 laboratories throughout the country, and liasion with contract divisions, other EPA programs, and enforcement. Responsible for development and implementation of disk deliverables, automated contract screening, as well as writing new protocols for specific methods such as ICP/MS and for EPA methods such as included in SW846, 3rd Edition. Duties also included coordination of the annual CLP conferences.

Education

MS, Chemical Oceanography, *RSMAS, University of Miami, Miami, Florida,* 1973.
BS, Chemistry, *Loyola University, Los Angeles, California,* 1970.

Publications, Presentations. And Affiliations

Mr. Ward has a number of publications and presentations, and is affiliated with several professional organizations. For a list of these, please contact CAS.

STEPHEN W. VINCENT

1986 TO PRESENT

Columbia Analytical Services, Inc., 1317 S. 13th Avenue, Kelso, WA 98626 (360) 577-7222

Current Position

PRESIDENT, CAS HOLDINGS INC. – 1986 to Present

Responsibilities

Responsible for the overall growth and profitability of the CAS laboratory network. This includes establishing and implementing long-range objectives, plans, and policies, and representing the company with its major customers, technical community, and the public.

Experience

Laboratory Manager, *Weyerhaeuser Company, Federal Way, Washington,* 1979-1986. Responsibilities involved all phases of technical and administrative management. This included management of organic, inorganic, and microbiological analyses and management of capital; an annual operating budget of approximately $2 million; management of thirty staff members; contract procurement, and project management. Projects included an EPA Inorganic CLP contract; an EPA acid rain deposition contract; a contract with the Fish and Wildlife Service to measure trace organic contaminants in animal tissues; and others.

Analytical Chemist, *Weyerhaeuser Company, Longview, Washington,* 1975-1979. Responsibilities: Method development, routine analysis and supervision for the Weyerhaeuser Multi-Region Support Lab. Responsible for setting up a company-wide laboratory audit, round robin, and quality assurance program.

Education

Market Strategy for Technology Based Companies, *Executives Program, Stanford University.* 1994.

Advanced Technical Management Program, *University of California at Los Angeles, Department of Business, Engineering and Management,* 1991.

Completion of Coursework for MS, Pulp and Paper Technology, *University of Washington, Seattle, Washington,* 1984.

Post Graduate Coursework, Engineering and Management, *University of California at Los Angeles, Graduate School of Engineering and Applied Science, Los Angeles, California,* 1981.

BS, Oceanography, *University of Washington, Seattle, Washington,* 1974.

Publications/ Presentations

Mr. Vincent has a number of publications and presentations. For a list of these publications and presentations, please contact CAS.

Affiliations

American Chemical Society.
Technical Association of the Pulp and Paper Industry.

APPENDIX C

MAJOR ANALYTICAL EQUIPMENT

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balances (9):			
Precisa and Mettler models	1988-2000	MM	15
Autoclave - Market Forge Sterilmatic	1988	LM	5
Calorimeters (2):			
Parr 1241 EA Adiabatic	1987	LM	4
Parr 6300 Isoparabolic	2005	LM	4
Centrifuge - Damon/IEC Model K	1992	LM	15
Colony Counter - Quebec Darkfield	1988	LM	4
Conductivity Meters (2):			
YSI Model 3200	2004	LM	4
VWR	2001	LM	4
Digestion Systems (5):			
COD (4)	1987, 1989	LM	3
Kjeldahl, Lachat 46-place (1)	1999	LM	3
Dissolved Oxygen Meter - YSI Model 58 (3)	1987, 1988, 1991	LM	5
Distillation apparatus (Midi) - Easy Still (2)	1996, 2000	LM	7
Drying Ovens (11):			
Shel-Lab and VWR models	1988 - 2003	LM	15
Flash Point Testers (2):			
ERDCO Setaflash Tester	1991	LM	4
Petroleum Systems Services	2005	LM	4
Flow-Injection Analyzers (2):			
Lachat Quik-Chem AE	1990	LM	5
Bran-Leubbe	2002	LM	4
Ion Chromatographs (3)			
Dionex 2000i with Peaknet Data Systems	1988	LM	3
Dionex DX-120 with Peaknet Data System	1998	LM	3
Dionex ICS-2500 with Chromchem Data System	2002	LM	3
Ion Selective Electrode Meters (5)			
Fisher Scientific Accument Model 50	1997	LM	6
Fisher Scientific Accument Model 25	1993	LM	6
Fisher Scientific Accument Model 20	2000	LM	6
Orion Model 920A	1990	LM	6
Corning pH/ion Meter Model 135	1992	LM	6
Microscopes (2):			
Bausch & Lomb	1988	LM	1
Swift	1988	LM	1
Muffle Furnace- Sybron Thermolyne Model F-A1730	1991	LM	15
pH Meters (2):			
Fisher Scientific Accument Model 20	1993	LM	6
Fisher Scientific Accument Model AR25	2005	LM	6

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY (continued)			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Shatter Box - GP 1000	1989	LM	5
Sieve Shakers (2):			
CE Tyler - Portable RX 24	1990	LM	5
WS Tyler - RX 86	1991	LM	5
Thomas-Wiley Laboratory Mill, Model 4	1989	LM	7
Total Organic Carbon (TOC) Analyzers (2)			
Coulemetrics Model 5012	1997	LM	3
O-I Corporation Model 1010	2002	LM	3
Total Organic Halogen (TOX) Analyzers (3):			
Mitsubishi TOX-Sigma	1995	LM	4
Mitsubishi TOX-100 (2)	2001	LM	4
Turbidimeter - Hach Model 2100N	1996	LM	8
UV-Visible Spectrophotometers (2):			
Hitachi 100-40 Single Beam	1986	LM	5
Beckman-Coulter DU520	2005	LM	5
Vacuum Pumps (2):			
Welch Duo-Seal Model 1376	1990	LM	13
Busch R-5 Series Single Stage	1991	LM	13
Water Baths/Incubators (6):			
Hach Model 15320 Incubator	1986	LM	15
Precision Model L-6 (2)	1989, 1990	LM	15
VWR 1540	1991	LM	15
Fisher 11-680-626M Incubator	1992	LM	15
Fisher Isotemp Incubator	2001	LM	15

METALS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (6)			
Various Mettler AE 200 analytical balance	1990	MM	12
Various Mettler models (5)	1988	MM	12
Atomic Absorption Spectrophotometers (5):			
Varian SpectrAA Zeeman/220 AA w/Data Systems (2)	2000	LM	3
CETAC Mercury Analyzer	2000	LM	2
Perkin Elmer AAnalyst 200 Flame AA	2005	MM	2
Atomic Fluorescence Spectrophotometer			
Brooks-Rand Model III (2)	1996, 2005	LM	3
Leeman Mercury Analyzer (1)	2006	LM	2
Centrifuge - IEC Model Clinical Centrifuge	1990	LM	12
Drying Oven - VWR Model 1370F	1990	LM	12
Freeze Dryers (2) - Labconco	1992, 2006	LM	5
Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES) - Thermo Jarrell Ash Model 61E	1988	LM	4
Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES): Thermo Jarrell Ash, Model IRIS	2000	MM	4
Inductively Coupled Plasma Mass Spectrometers (ICP-MS):			
VG PQ-S	1997	MM	3
VG Excell	2001	MM	3
Thermo X-Series	2006	MM	3
Muffle Furnace - Thermolyne Furnatrol Model 53600 (2)	1991, 2005	LM	5
Shaker - Burrell Wrist Action Model 75	1990	LM	12
TCLP Extractors (3)	1989, 2002	LM	5

SEMIVOLATILE ORGANICS SAMPLE PREPARATION LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Accelerated Solvent Extractor - Dionex ASE 200	1996	LM	5
Analytical Balance (3)			
Mettler BB240	1987	MM	12
Satorious B610 (2)	1999, 2000	MM	12
Aspirator pumps - Labconco Cole Parmer (1)	1994	LM	7
Centrifuges (2):			
Adams Model DYNAC	1986	LM	12
Sorvall Model GLC-1	1988	LM	12
Drying Oven - Fisher Model 655 G	1991	LM	7
Evaporators (10):			
Organomation N-Evap (5)	1989-90,1998-2001	LM	12
Organomation S-Evap (5)	1989-1991	LM	12
Extractors: Lab-Line Multi-Unit Extraction Heaters (60)	1987-1992	LM	12
Extractors (64):			
Continuous Liquid/Liquid Extractors (24)	1991	LM	10
Branson Model 450 Sonifier (2)	1991	LM	4
Tekmar Sonifier (2)	1994	LM	4
Soxhtherm (36)	2000	LM	5
Gel Permeation Chromatography (GPC) (4)			
ABC single column (2)	1998, 1999	LM	4
ABC Autoprep 1000	1995	LM	4
J2 Scientific	2005	LM	4
Muffle Furnace - Parflow MIC 6000	1994	LM	12
Solid Phase Extractors (8) – Dionex SPE-Dex 4790	2003, 2006	LM	6
Vacuum Pump - Edwards	1992	LM	8

GC SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler AT 250	1989	MM	5
Chromatography Data Systems (12)			
HP Enviroquant (8)	1994-2002	LM	5
Thruput Target (4)	1998-2000	LM	5
Gas Chromatographs (13):			
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual ECD Detectors (7)	1990 – 1995	LM	5
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual FPD Detectors	1991	LM	5
Agilent 6890 GC with Agilent 7683 Autosampler and Dual ECD Detectors (4)	2001, 2005	LM	5
Agilent 6890 GC with Agilent 7683 Autosampler and Dual FPD Detectors	2003	MM	5

GC/MS SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
HP Enviroquant Chromatography Data Systems (9)	1994-2002	LM	6
Gas Chromatograph: Hewlett-Packard 5890 with HP 7673 autosampler and FID Detector	1994	LM	2
Semivolatile GC/MS Systems (8):			
Agilent 6890/5973 with ATAS Optic2 LVI and HP 7673 Autosampler (2)	1997, 2001	MM	4
Agilent 5890/5970 with ATAS Optic2 LVI and HP 7673 Autosampler (2)	1990,1994	MM	4
Agilent 5890/5972 with ATAS Optic2 LVI and HP 7673 Autosampler (3)	1993, 1994, 1998	MM	4
Agilent 6890/5973 with ATAS Optic3 LVI and 7683 Autosampler (1)	2004	MM	4

PETROLEUM HYDROCARBONS GC/HPLC LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
SAMPLE PREPARATION			
Analytical Balance (3)			
Mettler BB300	1991	MM	6
Mettler BB240	1994	MM	6
Mettler AE166	1994	MM	6
Aspirator pumps – GAST (2)	2002, 2004	LM	6
Drying Oven - Fisher Model 630F	1991	LM	6
Evaporators (2):			
Organomation N-Evap	1990	LM	6
Organomation S-Evap	1991	LM	6
Extractors (4):			
Sonic Horns (2): Branson, Ultrasonics, Fisher Models	1991-1994	LM	6
INSTRUMENTATION			
HP Enviroquant Chromatography Data Systems (10)	1994-2002	LM	6
Gas Chromatographs (5):			
Hewlett-Packard 5890 Series II with PID/PID/FID:	1991	LM	3
Tekmar LSC-2000 Purge and Trap Concentrator	1991	LM	3
Dynatech Archon 5100 Autosampler	1992	LM	3
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual FID Detectors (2)	1990 - 1995	LM	3
Agilent 6890 with Dual FID Detectors and Agilent 7873 Autosampler (2)	2001, 2005	LM	3
High-Performance Liquid Chromatographs (2):			
HP 1090M Series II with Diode Array UV Detector	1999	LM	3
HP 1050/1100 Series with Fluorescence & Diode Array UV Detectors	2004	LM	3
High-Performance Liquid Chromatograph/Mass Spectrometer - Thermo Electron TSQ Quantum LC/MS/MS with Thermo Surveyor HPLC and Autosampler	2005	MM	2

VOLATILE ORGANICS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance			
Mettler PE 160	1989	MM	6
Baxter Vortex Mixer	1989	LM	6
Extractors (10):			
Millipore TCLP Zero Headspace Extractors (10)	1987-1992	LM	2
TCLP Extractor - Tumbler (12 position)	1989	LM	2
HP Enviroquant Chromatography Data Systems (10)	1994-2002	LM	6
Drying Ovens (2):			
Narco 420	1989	LM	6
VWR 1305 U	1991	LM	6
Sonic Water Bath - Branson Model 2200	1989	LM	6
Volatile GC/MS Systems (8):			
Agilent 5890/5970 (2)	1989	MM	4
Tekmar 3000 Purge and Trap Concentrator	1995	LM	4
Dynatech ARCHON 5100 Autosampler	1996	LM	4
Agilent 5890/5970	1999	MM	4
EST Encon Purge and Trap Concentrator	2002	LM	4
Dynatech ARCHON 5100 Autosampler	1999	LM	4
Agilent 5890/5971	1991	MM	4
Tekmar 3000 Purge and Trap Concentrator	2001	LM	4
Dynatech ARCHON 5100 Autosampler	1995	LM	4
Agilent 5890/5972A	1993	MM	4
Tekmar 3000 Purge and Trap Concentrator	1995	LM	4
Dynatech ARCHON 5100 Autosampler	1996	LM	4
Agilent 6890/5973 (2)	2001, 2007	MM, LM	4
Tekmar 3100 Purge and Trap Concentrator	2001, 2007	LM	4
Varian Archon Autosampler	2001, 2007	LM	4
Agilent 6890/5973	2005	MM	4
Tekmar Velocity Purge and Trap Concentrator	2005	LM	4
Tekmar Aquatech Autosampler	2005	LM	4

DRINKING WATER ORGANICS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler BB300	1991	MM	2
Extractors (5) – Horizon SPE-DEX Solid Phase Extractor	2003	LM	2
Aglinet Enviroquant Chromatography Data Systems (2)	2003	LM	2
Varian Saturn Chromatography Data System	2003	LM	2
Evaporator - Organomation N-Evap	2003	LM	2
Agilent 1100 HPLC w/post-column derivitization:	2003	LM	2
UV/Fluoescence detectors	2003	LM	2
Pickering PCX-5200 Post-column derivitization unit	2003	LM	2
Agilent 6890N GC/ECD system:	2003	LM	2
Dual micro-ECD detectors	2003	LM	2
Agilent autosampler	2003	LM	2
Varian Ion trap GC/MS:	2003	LM	2
Varian 3800 GC w/CP8400 autosampler	2006	LM	2
Varian 3900 GC	2003	LM	2
Varian Saturn 2100T mass spectrometer	2003	LM	2

PHARMACEUTICAL TESTING LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Thermo High-Performance Liquid Chromatograph with Diode Array UV Detector	2005	MM	2
Thermo FTIR	2005	MM	4
Viscometer	2006	LM	1
Analytical Balance - Mettler AB104-5 and AT-250	2004	MM	4
Incubator – VWR 1510E	2004	LM	2
Karl Fisher Titrators (2) – Mettler DL38 and DL39	2004	MM	3
Melting point apparatus – Optimelt	2004	LM	3
Refractometer – Reichert Abbe Mark II	2004	LM	2
Rotary evaporator – Labonco/Cole-Parmer aspirator pump	2004	LM	3
Rotary shakers – Thermolyne Rotomix (2)	2004	LM	2
Vacuum oven – Precision Model 19 w/GAST aspirator	2004	LM	3
Water baths (3) – VWR Models 1212, 1235 and Labline 18002	2004	LM	2
Gas Chromatographs (2):			
Hewlett-Packard 5890 Series II with TCD/FID detector	1988	LM	3
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual FID Detectors	1990	LM	3

AUTOMATED DATA PROCESSING EQUIPMENT			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
1-WAN: LIMS Sample Manager using Oracle 10g DBMS running on Redhat Advanced Server 3.0 (Linux) platform connected/linked on a frame relay WAN environment	1994-2004	LM	NA
2 - Network Servers Pentium 4 class, 1 for Reporting and Data Acquisition running Windows 2003 Advanced Server, 1 for Applications running Windows 2003 Advanced Server. Data acquisition capacity at 65GB with redundant tape and disk arrays.	1994 - 2004	LM	NA
Approximately 50+ HP and Dell Laserjet printers (various types including IIIs, 4s, 5s, 8150s, 4000s, 4050s, 4250, 8150s, W5300s)	1991 - 2004	LM	NA
Approximately 130 Gateway/Dell PC/Workstations running Windows 2000/XP on LAN connected via 10BT/100BT and TCP/IP for LIMs Terminal Emulation	1993 - 2004	LM	NA
Microsoft Office 2003 Professional as the base application for all PC/Workstations. Some systems using Office 2000/97.	1996 - 2004	LM	NA
E-Mail with link to SMTP for internal/external messaging. Web mail via Outlook Web Access interface. Microsoft Outlook 2003.	1994 - 2006	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Standard Excel (R) reporting platform application linked to LAN/WAN for data connectivity and EDD generation.	1996 - 2004	LM	NA
Facsimile Machines 9600 - 33600 Baud, (2) Brother 4750e, 15 ppm; (1) Brother MFC 1970MC, 2ppm; (1) Canon CFX-L4000	1991 - 2004	LM	NA
Copiers/Scanners (2) Konica 7085, 85ppm, 20GB; (2) Konica 7155; (1) Konica 7035, BizHub. The 7085s and one 7155 are accessible via LAN for network scanning.	2000 - 2004	LM	NA
Dot Matrix Epson FX-880, LQ-1050, LX-300	1991 - 2004	LM	NA
Thruput, MARRS, Stealth, Harold, Blackbird, EDDGE, StarLIMS reporting software systems.	1998 - 2004	LM	NA

NA: Not applicable. This equipment administered by IT staff but may be used by all staff.

APPENDIX D

PREVENTIVE MAINTENANCE PROCEDURES

Instrument	Activity	Frequency
Refrigerators and Coolers	Record temperatures	Daily
	Clean coils	Annually
	Check coolant	Annually or if temperature outside limits
Vacuum Pumps	Clean and change pump oil	Every month or as needed
Fume Hoods	Face velocity measured	Quarterly
	Sash operation	As needed
	Change filters	Annually
	Inspect fan belts	Annually
Ovens	Clean	As needed or if temperature outside lim.
	Record temperatures	Daily, when in use
Incubators	Record temperatures	Daily, morning and evening
Water Baths	Record temperatures	Daily, morning and evening
	Wash with disinfectant solution	When water is murky, dirty, or growth appears
Autoclave	Check sterility	Every month
	Check temperature	Every month
	Clean	When mold or growth appears
Analytical Balances	Check alignment	Before every use
	Check calibration	Daily
	Clean pans and compartment	After every use
Dissolved Oxygen Meter	Change membrane	When fluctuations occur
pH probes	Condition probe	When fluctuations occur
Fluoride ISE	Store in storage solution	Between uses
Ammonia ISE	Store in storage solution	Between uses
UV-visible Spectrophotometer	Wavelength check	Annually
Total Organic Carbon Analyzers	Check IR zero	Weekly
	Check digestion/condensation vessels	Each use
	Clean digestion chamber	Every 2000 hours, or as needed
	Clean permeation tube	Every 2000 hours, or as needed
	Clean six-port valves	Every 200 - 2000 hours, or as needed
	Clean sample pump	Every 200 - 2000 hours, or as needed
	Clean carbon scrubber	Every 200 - 2000 hours, or as needed
	Clean IR cell	Every 2000 - 4000 hours, or as needed

Instrument	Activity	Frequency
Total Organic Halogen Analyzers	Change cell electrolyte	Daily
	Change electrode fluids	Daily
	Change pyrolysis tube	As needed
	Change inlet and outlet tubes	As needed
	Change electrodes	As needed
Flow Injection Analyzer	Check valve flares	Each use
	Check valve ports	Each use
	Check pump tubing	Each use
	Check light counts	Each use
	Check flow cell flares	Quarterly
	Change bulb	As needed
	Check manifold tubing	Each use
	Check T's and connectors	Each use
Ion Chromatographs	Change column	Every six months or as needed
	Change valve port face & hex nut	Every six months or as needed
	Clean valve slider	Every six months or as needed
	Change tubing	Annually or as needed
	Eluent pump	Annually
Atomic Absorption Spectro-photometers - FAA and CVAA	Check gases	Daily
	Clean burner head	Daily
	Check aspiration tubing	Daily
	Clean optics	Every three months
	Empty waste container	Weekly
Atomic Absorption Spectro-photometers - GFAA	Check gases	Daily
	Check argon dewar	Daily
	Change graphite tube	Daily, as needed
	Clean furnace windows	Monthly
ICP - AES	Check argon dewar	Daily
	Replace peristaltic pump tubing	Daily
	Empty waste container	Weekly
	Clean nebulizer, spray chamber, and torch	Every two weeks
	Replace water filter	Quarterly
	Replace vacuum air filters	Monthly

Instrument	Activity	Frequency
ICP - MS	Check argon dewar	Daily
	Check water level in chiller	Daily
	Complete instrument log	Daily
	Replace peristaltic pump tubing	Daily
	Clean sample and skimmer cones	As needed
	Clean RF contact strip	As needed
	Inspect nebulizer, spray chamber, and torch	Clean as needed
	Clean lens stack/extraction lens	As needed
	Check rotary pump oil	Monthly
	Change rotary pump oil	Every six months
Gel-Permeation Chromatographs	Clean and repack column	As needed
	Backflush valves	As needed
High Pressure Liquid Chromatographs	Backflush guard column	As needed
	Backflush column	As needed
	Change guard column	As needed when back pressure too high
	Change column	Annually or as needed
	Change in-line filters	As needed
	Leak check	After column maintenance
	Change pump seals	As needed
	Change pump diaphragm	Annually
	Clean flow cell	As needed
	Fluorescence detector check	Daily
	Diode array absorbance check	Daily
Gas Chromatographs, Semivolatiles	Check gas supplies	Daily, replace if pressure reaches 50psi
	Change in-line filters	Quarterly or after 30 tanks of gas
	Change septum	Daily
	Change injection port liner	Weekly or as needed
	Clip first 6-12" of capillary column	As needed
	Change guard column	As needed
	Replace analytical column	As needed when peak resolution fails
	Check system for gas leaks	After changing columns and after any power failure
	Clean FID	Weekly or as needed
	Clean ECD	Quarterly or as needed
	Leak test ECD	Annually

Instrument	Activity	Frequency
Gas Chromatograph/Mass Spectrometers, Semivolatiles	Check gas supplies	Daily, replace if pressure reaches 50psi
	Change in-line filters	Annually or as needed
	Change septum	Daily, when in use
	Change injection port liner	Weekly or as needed
	Clip first 6-12" of capillary column	As needed
	Change guard column	As needed
	Replace analytical column	As needed when peak resolution fails
	Clean source	As needed when tuning problems
	Change pump oil	As specified by service specifications
Purge and Trap Concentrators	Change trap	Every four months or as needed
	Change transfer lines	Every six months or as needed
	Clean purge vessel	Daily
Gas Chromatographs, Volatiles	Check gas supplies	Daily, replace when pressure reaches 50 psi
	Change in-line filters	Quarterly or after 30 tanks of gas
	Change septum	Daily
	Clip first 6-12" of capillary column	As needed
	Change guard column	As needed
	Replace analytical column	As needed when peak resolution fails
	Check system for gas leaks	After changing columns and after any power failure
	Clean PID lamp	As needed
	Clean FID	As needed
	Change ion exchange resin	Every 60 days
	Replace nickel tubing	Quarterly or as needed
Gas Chromatograph/Mass Spectrometers, Volatiles	Check gas supplies	Daily, replace when pressure reaches 50 psi
	Change in-line filters	Annually or as needed
	Change septum	Daily
	Clip first foot of capillary column	As needed
	Change guard column	As needed
	Replace analytical column	As needed when peak resolution fails
	Clean jet separator	As needed
	Clean source	As needed when tuning problems
	Change pump oil	As specified by service specifications

APPENDIX E

SOP LIST AND LIST OF NELAC ACCREDITED METHODS

COLUMBIA ANALYTICAL SERVICES, INC. , KELSO, WA.
STANDARD OPERATING PROCEDURES TABLE OF CONTENTS
January 11, 2006

SOP NAME	FILE NAME	REV #
ARMY CORPS OF ENGINEERS HTRW PROJECT MANAGEMENT	ADM-HTRW	1
CHECKING PIPETTE CALIBRATION	ADM-CPIP	4
CONTINGENCY PLAN FOR LABORATORY EQUIPMENT FAILURE	ADM-ECP	0
CONTROL CHARTING QUALITY CONTROL DATA	ADM-CHRT	1
DATA ARCHIVING	ADM-ARCH	3
DATA REPORTING AND REPORT GENERATION	ADM-RG	5
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT	ADM-DOD	0
ELECTRONIC DATA BACKUP AND ARCHIVING	ADM-EBACKUP	0
FACILITY AND LABORATORY CLEANING	ADM-FACL	0
INTERNAL QUALITY ASSURANCE AUDITS	ADM-IAUD	5
LABORATORY DATA REVIEW PROCESS	ADM-DREV	4
METHOD DETECTION LIMIT DOCUMENTATION AND CONTROL	ADM-MDLC	2
PROJECT MANAGEMENT	ADM-PCM	6
REAGENT LOGIN AND TRACKING	ADM-RLT	2
SUPPORT EQUIPMENT MONITORING AND CALIBRATION	ADM-SEMC	8
COLIFORM, FECAL	BIO-9221FC	5
COLIFORM, FECAL (MEMBRANE FILTER PROCEDURE)	BIO-9222D	1
COLIFORM, TOTAL	BIO-9221TC	4
COLIFORM, TOTAL (DRINKING WATER)	BIO-9221DW	3
COLILERT COMPLETED TEST VERIFICATION OF E. COLI IN MUG CULTURES	BIO-CCT	0
COLILERT P/A	BIO-COLI	2
ENTEROLERT	BIO-ENT	0
FECAL STREPTOCOCCUS/ENTEROCOCCUS	BIO-9230B	5
HEPTEROTROPHIC PLATE COUNT	BIO-HPC	3
MICROBIOLOGY QUALITY ASSURANCE AND QUALITY CONTROL	BIO-QAQC	10
SHEEN SCREEN/OIL DEGRADING MICROORGANISMS	BIO-SHEEN	0

EPA CLP ORGANICS ANALYSES	CLP_ORGA	1
ADDITION OF SPIKES AND SURROGATES	EXT-SAS	5
AUTOMATED SOXHLET EXTRACTION	EXT-3541	3
CONTINUOUS LIQUID - LIQUID EXTRACTION	EXT-3520	10
CONTINUOUS LIQUID - LIQUID EXTRACTION FROM AQUEOUS SOURCE SAMPLING IMPINGERS	EXT-3520IMP	0
DIAZOMETHANE PREPARATION	EXT-DIAZ	4
FLORISIL CLEANUP	EXT-FLOR	1
ORGANIC EXTRACTIONS GLASSWARE CLEANING	EXT-GC	2
MASS BALANCE DETERMINATION OF TETRACHLOROETHYLENE AND ACETONE IN POLLEN PRODUCTION	EXT-MASSBAL	0
MEASURING SAMPLE WEIGHTS AND VOLUMES FOR ORGANIC ANALYSIS	EXT-WVOL	2
PREPARATION OF ANHYDROUS SODIUM SULFATE , MARTIX SAND, SODIUM CHLORIDE, AND POTASSIUM CARBONATE	EXT-SULF	2
PRESSURIZED FLUID EXTRACTION	EXT-3545	5
SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION	EXT-3510	7
SOLID PHASE DISPERSION IN TISSUES	EXT-SPD	0
SOLID PHASE EXTRACTION	EXT-3535	2
SOXHLET EXTRACTION	EXT-3540	8
ULTRASONIC EXTRACTION	EXT-3550	9
WASTE DILUTION EXTRACTION	EXT-3580	1
ACIDITY	GEN-305.2	1
ALKALINITY TOTAL	GEN-310.1	5
AMMONIA AS NITROGEN BY ION SPECIFIC ELECTRODE	GEN-350.3	5
AMMONIA BY FLOW INJECTION ANALYSIS	GEN-350.1	6
AUTOFLUFF	GEN-AUTOFLU	0
BIOCHEMICAL OXYGEN DEMAND	GEN-405.1	8
BULK DENSITY OF SOLID WASTE FRACTIONS	GEN-E1109	0
CARBON, TOTAL ORGANIC DETERMINATION (WALKELY BLACK METHOD)	GEN-OSU	1
CARBON, TOTAL ORGANIC IN SOIL	GEN-ASTM	5
CARBONATE (CO3) BY EVOLUTION AND COLUMETRIC TITRATION	GEN-D513-82M	0
CHEMICAL OXYGEN DEMAND	GEN-COD	5

CHLORIDE (TITRIMETRIC, MERCURIC NITRATE)	GEN-325.3	3
CHLORINE, TOTAL/FREE RESIDUAL	GEN-330-4	1
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COLOR, NCASI	GEN-NCAS	1
CONDUCTIVITY IN WATER AND WASTES	GEN-COND	8
CORROSIVITY TOWARDS STEEL	GEN-CORR	1
CYANIDE EXTRACTION OF SOLIDS AND OILS	GEN-9013	0
CYANIDE, WEAK ACID DISSOCIABLE	GEN-CNWAD	0
DETERMINATION OF INORGANIC ANIONS IN DRINKING WATER BY ION CHROMATOGRAPHY	GEN-300_1	2
DISSOLVED SILICA	GEN-370.1	0
FERROUS IRON IN WATER	GEN-FeII	2
FLASHPOINT DETERMINATION - SETAFLASH	GEN-1020	5
FLUORIDE BY ION SELECTIVE ELECTRODE	GEN-FISE	5
FORMALDEHYDE COLORIMETRIC DETERMINATION	GEN-FORM	1
GLASSWASHING FOR INORGANIC ANALYSES	GEN-WASH	3
GRAVIMETRIC SULFATE	GEN-375.3	1
HALIDES, ADSORBABLE ORGANIC (AOX)	GEN-1650	2
HALIDES, ADSORBABLE ORGANIC (AOX) - SM 5320B	GEN-5320B	1
HALIDES, EXTRACTABLE ORGANIC (EOX)	GEN-9020M	2
HALIDES, TOTAL ORGANIC (TOX)	GEN-9020	7
HALOGENS TOTAL AS CHLORIDE BY BOMB COMBUSTION	GEN-5050	2
HARDNESS, TOTAL	GEN-130.2	4
HEAT OF COMBUSTION	GEN-BTU	2
HEXAVALENT CHROMIUM - COLORIMETRIC	GEN-CR6	7
HYDAZINE IN WATER USING COLORIMETRIC PROCEDURE	GEN-HYD	1
HYDROGEN HALIDES BY ION CHROMATOGTRAPHY (METHOD 26)	GEN-HA26	2
ION CHROMATOGRAPHY	GEN-IONC	9
MBAS	GEN-425.1	2
MERCURY IN COAL SAMPLE PREPARATION BY PARR BOMB COMBUSTION	GEN-HGPREP	0
NITRATE/NITRITE, NITRITE BY FLOW INJECTION ANALYSIS	GEN-353.2	6
NITRITE BY COLORIMETRIC PROCEDURE	GEN-354.1	0

NITROGEN, TOTAL AND SOLUBLE KJELDAHL	GEN-TKN	8
ORTHOPHOSPHORUS BY FLOW INJECTION ANALYSIS - SM 4500P-F	GEN-4500P-F	0
OXYGEN CONSUMPTION RATE	GEN-O2RATE	0
PARTICLE SIZE DETERMINATION	GEN-PSP	4
PARTICLE SIZE DETERMINATION - ASTM PROCEDURE	GEN-PSASTM	0
PERCHLORATE BY ION CHROMATOGRAPHY	GEN-314-0	10
Ph IN SOIL AND SOLIDS	GEN-Phs	7
Ph IN WATER	GEN-Phw	7
PHENOLICS, TOTAL	GEN-420.1	10
PHOSPHORUS DETERMINATION USING COLORMETRIC PROCEDURE	GEN-365.3	8
POST DIGESTION DETERMINATION OF TOTAL KJELDAHL NITROGEN BY SEMIAUTOMATED COLORIMETRY	GEN-TKNAA	0
SETTEABLE SOLIDS	GEN-160.5	2
SOLIDS, TOTAL DISSOLVED (TDS)	GEN-160.1	6
SOLIDS, TOTAL SUSPENDED (TSS)	GEN-160.2	6
SOLIDS, TOTAL VOLATILE AND PERCENT ASH IN SOIL AND SOLID SAMPLES	GEN-160.4	4
SPECIFIC GRAVITY	GEN-SPGRAV	0
SUBSAMPLING AND COMPOSITING OF SAMPLES	GEN-SUBS	1
SULFIDE, SOLUBLE DETERMINATION OF SOLUBLE SULFIDE IN SEDIMENT	GEN-DIS.S2	1
SULFIDE, TITRIMETRIC (IODINE)	GEN-376-1	0
SULFIDES, ACIDS VOLATILE	GEN-AVS	5
SULFIDE, METHYLENE BLUE	GEN-376-2	0
SULFIDES, REACTIVE	GEN-RS	4
SULFITE	GEN-SO3	1
TANNIN AND LIGNIN	GEN-5550	4
THIOCYANATE	GEN-THIOCN	0
TOTAL CYANIDES AND CYANIDES AMENABLE TO CHLORINATION	GEN-335	11
TOTAL HALIDES BY OXIDATIVE COMBUSTION AND MICROCOULOMETRY	GEN-9076	1
TOTAL ORGANIC CARBON IN WATER	GEN-TOC	7
TOTAL SOLIDS	GEN-160.3	10
TOTAL SULFIDE BY PSEP	GEN-S2PS	0
TOTAL SULFIDES BY METHYLENE BLUE DETERMINATION	GEN-9030M	8

TOTAL SULFUR FOR ION CHROMATOGRAPHY	GEN-ICS	1
TURBIDITY MEASUREMENT	GEN-TURB	3
ULTIMATE BOD	GEN-UBOD	0
CATION-EXCHANGE CAPACITYOF SOILS (SODIUM ACETATE) - METHOD 9081	MET-9081	1
CLOSED VESSEL OIL DIGESTION	MET-3051M	0
DETERMINATION OF LEAD BY FLAME ATOMIC ABSORPTION (FAA)	MET-7420	1
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 6020)	MET-6020	8
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 200.8)	MET-ICP.MS	10
DETERMINATION OF METALS AND TRACE ELEMENTS BY ICP/AES	MET-ICP	18
DETERMINATION OF TRACE METALS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY (GFAA)	MET-GFAA	15
FLAME ATOMIC ABSORPTION SPECTROPHOTOMETRIC ANALYSES	MET-FAA	1
MERCURY ANALYSIS BY COLD VAPOR ABSORPTION SPECTROPHOTOMETRY	MET-HG	4
MERCURY IN LIQUID WASTE	MET-7470A	9
MERCURY IN SOLID OR SEMISOLID WASTE	MET-7471A	10
MERCURY IN WATER	MET-245.1	10
MERCURY IN WATER BY OXIDATION, PURGE&TRAP, AND COLD VAPOR ATOMIC FLUORES. SPECTROMETRY	MET-1631	7
METALS AND SEMIVOLATILES TCLP EXTRACTION (EPA METHOD 1311)	MET-TCLP	6
METALS DIGESTION	MET-3005A	3
METALS DIGESTION	MET-3010A	8
METALS DIGESTION	MET-3020A	10
METALS DIGESTION	MET-3050	8
METALS DIGESTION	MET-7195	5
METALS DIGESTION - CLP	MET-DIG	8
METALS LABORATORY GLASSWARE CLEANING	MET-GC	2
METHYL MERCURY IN SOIL AND SEDIMENT BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630S	0
METHYL MERCURY IN TISSUE BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630T	0
METHYL MERCURY IN WATER BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630W	0
MULTIPLE EXTRACTION PROCEDURE	MET-MEP	0
SAMPLE FILTRATION FOR METALS ANALYSIS	MET-FILT	0
SAMPLE PREPARATION OF AQUEOUS SAMPLES BY "CLEAN" TECHNIQUES	MET-ACT	3

SAMPLE PREPARATION OF BIOLOGICAL TISSUES FOR METALS ANALYSIS BY GFAA, ICP-OES, AND ICP-MS	MET-TDIG	1
SELENIUM BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7742	2
TISSUE SAMPLE PREPARATION	MET-TISP	4
TRACE METALS IN WATER BY PRECONCENTRATION USING REDUCTIVE PRECIPITATION FOLLOWED BY ICP-MS	MET-RPMS	4
WASTE EXTRACTION TEST (WET) PROCEDURE (STLC) for NONVOLATILE and SEMIVOLATILE PARAMETERS	MET-STLC	0
ANALYSIS OF SOLID AND AQUEOUS SAMPLES FOR STATE OF WISCONSIN DIESEL RANGE ORGANICS	PHC-WIDRO	0
ANALYSIS OF WATER, SOLIDS AND SOLUBLE WASTE SAMPLES FOR SEMI-VOLATILE FUEL HYDROCARBONS	PET-SVF	10
GASOLINE RANGE ORGANICS BY GAS CHROMATOGRAPHY	PET-GRO	7
GRAVIMETRIC DETERMINATION OF HEAXANE EXTRACTABLE MATERIAL (1664)	PET-1664	5
BOTTLE ORDER PREPARATION AND SHIPPING	SMO-BORD	7
FOREIGN SOILS HANDLING TREATMENT	SMO-FSHT	7
SAMPLE DISPOSAL	SMO-SDIS	6
SAMPLE RECEIVING	SMO-GEN	22
SAMPLE TRACKING AND LABORATORY CHAIN OF CUSTODY	SMO-SCOC	10
ALDEHYDES BY HPLC	SOC-8315A	4
BUTYLTINS	SOC-BUTYL	7
CALIBRATION OF INSTRUMENTS FOR ORGANICS CHROMATOGRAPHIC ANALYSES	SOC-CAL	5
CARBON CLEANUP	SOC-CARCU	0
CHLORINATED HERBICIDES	SOC-8151	12
CHLORINATED PHENOLICS IN WASTE WATER BY IN-SITU	SOC-1653A	5
CHLORINATED PHENOLS METHOD 8151 MODIFIED	SOC-8151M	7
CONFIRMATION PROCEDURE FOR GC AND HPLC ANALYSES	SOC-CONF	4
CONGENER-SPECIFIC DETERMINATION OF PCBS BY GG/ECD	SOC-8082C	7
DETERMINATION OF NITROGEN OR PHOSPHORUS CONTAINING PESTICIDES	SOC-8141	9
DIMP	SOC-DIMP	5
DMD SYNTHESIS	SOC-DMD	1
EXTRACTION METHOD FOR ORGANOTINS IN SEDIMENTS, WATER, AND TISSUE	SOC-OSWT	5
GEL PERMEATION CHROMATOGRAPHY	SOC-3640A	5

GLYCOLS	SOC-8015M	7
HAPS AND OTHER COMPOUNDS IN IMPINGER/CANISTER SAMPLES FROM WOOD PRODUCTS FACILITIES	SOC-9902	1
HAZARDOUS AIR POLLUTANTS (HAPS) IN PULP AND PAPER INDUSTRY CONDENSATES	SOC-9901	2
METHANOL IN PROCESS LIQUIDS	SOC-9403	3
MONOCHLOROACETIC ACID BY GC-ECD	SOC-MCA	4
NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	SOC-8330	10
NITROGLYCERIN AND PETN BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	SOC-8332	5
NITROGUANIDINE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	SOC-NITG	1
N-NITROSODIMETHYLAMINE BY GC/MS	SOC-NDMA	1
N-NITROSAMINES BY GC/MS/MS	SOC-521	0
N-NITROSODIMETHYLAMINE BY GC/MS/MS	SOC-521M	0
ORGANIC ACIDS IN AQUEOUS MATRICES BY HPLC	SOC-OALC	1
ORGANOCHLORINE PESTICIDES AND PCBs (METHOD 608)	SOC-608	4
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081	8
PCBS AS AROCLORS	SOC-8082A	9
PERCENT LIPIDS	SOC-LIPID	0
PHARMACEUTICALS, PERSONAL CARE PRODUCTS AND ENDOCRINE DISRUPTING COMPOUNDS (EDCS) BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	SOC-LCMS	1
PICRIC ACID AND PICRAMIC ACID BY HPLC	SOC-PICRIC	2
POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SOC-8270P	5
POLYNUCLEAR AROMATIC HYDROCARBONS BY HPLC	SOC-8310	11
REMOVAL OF SULFUR USING COPPER	SOC-3660	3
RESIN AND FATTY ACIDS BY GC/MS	SOC-85.01	3
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SOC-625	4
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SOC-8270C	8
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - LOW LEVEL PROCEDURE	SOC-8270L	3
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTED ION MONITORING	SOC-8270S	4
SEMI-VOLATILE ORGANICS SCREENING	SOC-SCR	2
SILICA GEL CLEANUP	SOC-3630C	0
SULFURIC ACID CLEANUP	SOC-3665	1
TENTATIVELY IDENTIFIED COMPOUNDS BY GCMS ON EXTRACTS FROM AQUEOUS SOURCE SAMPLING IMPINGERS	SOC-IMPTIC	0

1,2-DIBROMOETHANE, 1,2-DIBROMO-3-CHLOROPROPANE, AND 1,2,3-TCP BY GC	SVD-504	4
CARBAMATES AND CARBAMOYLOXIMES IN WATER BY POST-COLUMN DERIVITIZATION HPLC	SVD-531 -1	4
CHLORINATED HEBICIDES IN DRINKING WATER	SVD-515_4	4
DIQUAT AND PARAQUAT BY HPLC	SVD-549	3
ENDOTHALL IN DRINKING WATER BY GC/MS	SVD-548	5
GLYPHOSATE IN DRINKING WATER BY HPLC	SVD-547	3
HALOACETIC ACIDS IN DRINKING WATER	SVD-552	5
ORGANOCHLORINE PESTICIDES AND PCBS IN DRINKING WATER	SVD-508_1	3
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS (METHOD 525.2)	SVD-525	5
AROMATIC VOLATILE ORGANICS (BTEX) BY GC - METHOD 602	VOC-602BTEX	2
AROMATIC VOLATILE ORGANICS (BTEX) BY GC - METHOD 8021	VOC-8021BTEX	4
PURGE AND TRAP FOR AQUEOUS SAMPLES	VOC-5030	3
PURGE AND TRAP/EXTRACTION FOR VOC IN SOIL AND WASTE SAMPLES , CLOSED SYSTEM	VOC-5035	5
SAMPLE SCREENING FOR VOLATILE ORGANIC COMPOUNDS IN SOIL, WATER AND MISC. MATRICES	VOC-BVOC	3
TENTATIVELY IDENTIFIED COMPOUND ANALYSIS BY DIRECT INJECTION GCMS ON EXTRACTS FROM AQUEOUS SOURCE SAMPLING IMPINGERS	VOC-IMPTIC	0
VOA STORAGE BLANKS	VOC-BLAN	4
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-524.2	10
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-624	8
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-8260B	10
WA-DOH DRINKING WATER PROTOCOL	VOC-WA.DOH	2
ZERO HEADSPACE EXTRACTION (EPA METHOD 1311)	VOC-ZHE	5
SOP NAME - PHARMACEUTICAL TESTING SOPS	**FILE NAME**	**REV #**
PHARMACEUTICAL TEST METHOD SOPs		
DETERMINATION OF ORGANIC VOLATILE IMPURITIES (OVI's) IN PHARMACEUTICAL EXCIPIENTS BY GC	PHC-POVI	0
FDA EXTRACTABLES	PHC-FDAEX	0
GC-FID IMPURITIES IN METHYLSULFONYLMETHANE (MSM)	PHM-MSM	0
AMINO ACID ASSAY IN PHARMACUETICAL MANUFACTURING MATERIALS USING HPLC	SOC-AALC	0
TIN AS STANNOUS FLUORIDE IN CHOLETEC BY ICP-AES	PHM-SnCholetec	0
PHARMACEUTICAL EQUIPMENT SOPs		

OPERATION, CALIBRATION, AND MAINTENANCE OF THE METTLER TOLEDO AB104-S ANALYTICAL BALANCE	PHM-IN01	0
OPERATION, CALIBRATION, AND MAINTENANCE OF THE VWR VACUUM OVEN	PHM-IN02	2
OPERATION, CALIBRATION, AND MAINTENANCE OF THE METTLER TOLEDO DL38 TITRATOR	PHM-IN03	1
OPERATION, CALIBRATION, AND MAINTENANCE OF THE HEWLETT PACKARD 5890 GAS CHROMATOGRAPH	PHM-IN04	1
OPERATION, CALIBRATION, AND MAINTENANCE OF THE HEWLETT PACKARD 1050 SERIES HPLC	PHM-IN05	1
OPERATION, CALIBRATION, AND MAINTENANCE OF THE METTLER TOLEDO DL39 COULOMETRIC TITRATOR	PHM-IN06	0
OPERATION, CALIBRATION, AND MAINTENANCE OF THE SRS MPA100 AUTOMATED MELTING POINT SYSTEM	PHM-IN07	2
OPERATION, CALIBRATION, AND MAINTENANCE OF THE SUN INSTRUMENTS TYPE WXG-D DISK POLARIMETER	PHM-IN08	1
OPERATION, CALIBRATION, AND MAINTENANCE OF THE REICHERT ABBE MARK II MODEL 10480 REFRACTOMETER	PHM-IN09	0
OPERATION, CALIBRATION, AND MAINTENANCE OF THE LAB-LINE MODEL 18002 UTILITY HEATED WATER BATH	PHM-IN10	0
OPERATION, CALIBRATION, AND MAINTENANCE OF THE Brookfield DV-III Ultra Programmable Rheometer	PHM-IN11	1
OPERATION, CALIBRATION, AND MAINTENANCE OF THE THERMOE ELECTRON NICOLET 4700 FTIR	PHM-IN12	1
OPERATION, CALIBRATION, AND MAINTENANCE OF THE METTLER TOLEDO AT250 ANALYTICAL BALANCE	PHM-IN13	0
OPERATION, CALIBRATION, AND MAINTENANCE OF The PERKIN ELMER AANALYST 200 FLAME ATOMIC ABSORPTION SPECTROMETER (Flame Only)	PHM-IN14	1
OPERATION, CALIBRATION, AND MAINTENANCE OF THE VARIAN SPECTRA AA 220ZGFAA SPECTROMETER	PHM-IN15	1
OPERATION, CALIBRATION, AND MAINTENANCE OF THE THERMO IRIS ADVANTAGE ICP-AES	PHM-IN17	1
OPERATION, CALIBRATION, AND MAINTENANCE OF The PERKIN ELMER AANALYST 200 FLAME AA AND FIAS 100 FOR CVAA MERCURY	PHM-IN18	0
OPERATION, CALIBRATION, AND MAINTENANCE OF The VWR 1540 INCUBATOR	PHM-IN19	1
OPERATION, CALIBRATION, AND MAINTENANCE of the BECKMAN COULTER DU500 UV/Vis SPECTROPHOMETER	PHM-IN20	0
OPERATION, CALIBRATION, AND MAINTENANCE OF The FISHER ISOTEMP INCUBATOR	PHM-IN21	0
OPERATION, CALIBRATION, AND MAINTENANCE OF The NAPCO 6300 INCUBATOR	PHM-IN23	0
OPERATION, CALIBRATION, AND MAINTENANCE OF The VWR 2020 INCUBATOR	PHM-IN24	0
OPERATION, CALIBRATION, AND MAINTENANCE OF The HANNA AUTOTITRATOR	PHM-IN25	0
OPERATION, CALIBRATION, AND MAINTENANCE OF THE METTLER TOLEDO SEVENMULTI ELECTROCHEMICAL ANALYTICAL METER	PHM-IN26	0
PHARMACEUTICAL QUALITY ASSURANCE SOPs		
CONTROLLED SUBSTANCES	PHM-CSUB	1
VALIDATION OF PHARMACEUTICAL AND NUTRACEUTICAL TESTING METHODS	PHM-QA01	0
INSTRUMENT QUALIFICATION AND VERIFICATION	PHM-QA02	3
PHARMACEUTICAL TESTING DOCUMENTATION AND RECORDKEEPING	PHM-QA03	3
DETERMINATION OF TEST SPECIFICATIONS	PHM-QA04	0
EVALUATING AND SELECTING TEST METHODS FOR PHARMACEUTICAL AND NUTRACEUTICAL TESTING	PHM-QA05	2

OUT OF SPECIFICATION (OOS) INVESTIGATION AND RETESTING	PHM-QA06	2
CHANGE CONTROL	PHM-QA07	2
DATA MANAGEMENT OF PHARMACEUTICAL TESTING RECORDS	PHM-QA08	0
PHARMACEUTICAL PERSONNEL TRAINING	PHM-QA09	0
VALIDATION OF SOFTWARE USED FOR PHARMACEUTICAL TESTING	PHM-QA10	0
DATA SYSTEMS ACCESS AND AUDIT TRAILS	PHM-QA11	0
QUALITY CONTROL OF PHARMCEUTICAL TESTING DATA	PHM-QA12	0
SOP NAME - CORPORATE ADMINISTRATIVE SOPS MAINTAINED BY CORPORATE QA	**FILE NAME**	**REV #**
CHAIN OF CUSTODY FOR SAMPLE TRANSFER BETWEEN LABORATORIES	ADM-COC	1
CHECKING NEW LOTS OF CHEMICALS FOR CONTAMINATION	ADM-CTMN	2
CONTROL LIMITS	ADM-CTRL_LIM	4
DEALING WITH COMPLAINTS	ADM-CMPLT	3
DETERMINATION OF METHOD DETECTION LIMITS AND LIMITS OF DETECTION	ADM-MDL	6
DOCUMENT CONTROL	ADM-DOCCTRL	5
DOCUMENTATION OF TRAINING	ADM-TRANDOC	9
ELECTRONIC DATA AUDITING	ADM-E_DATAAUDIT	1
ESTIMATION OF UNCERTAINTY OF MEASUREMENTS	ADM-UNCERT	2
MAKING ENTRIES INTO LOGBOOKS AND ONTO BENCHSHEETS	ADM-DATANTRY	6
MANAGERIAL REVIEW OF THE LABORATORY"S QUALITY SYSTEM	ADM-MGMTRVW	1
MANUAL INTEGRATION OF CHROMATOGRAPHIC PEAKS	ADM-INT	2
NONCONFORMITY AND CORRECTIVE ACTION	ADM-NCAR	4
PREPARATION OF ELECTRONIC DATA FOR ORGANIC ANALYSES ELECTRONIC DATA AUDITS	ADM-EDATA	2
PREPARATION OF STANDARD OPERATING PROCEDURES	ADM-SOP	6
PROFICIENCY TESTING SAMPLE ANALYSIS	ADM-PTS	0
PURCHASING THROUGH CAS PURCHASING AGENT	ADM-PUR	1
QUALIFICATION OF SUBCONTRACT LABORATORIES OUTSIDE OF CAS NETWORK	ADM-SUBLAB	2
SAMPLE BATCHES	ADM-BATCH	7
SIGNIFICANT FIGURES	ADM-SIG.FIG	6

Laboratory Scope of Accreditation

Attachment to Certificate #: E87412-05, expiration date June 30, 2007. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E87412** EPA Lab Code: **WA00035** **(360) 577-7222**

E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,1,1-Trichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
1,1,2,2-Tetrachloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,1,2-Trichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
1,1-Dichloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,1-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
1,1-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,2,3-Trichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,2,3-Trichloropropane	EPA 504.1	Group II Unregulated Contaminants	NELAP	7/17/2003
1,2,3-Trichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,2,4-Trichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
1,2,4-Trimethylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1	Synthetic Organic Contaminants	NELAP	7/17/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1	Synthetic Organic Contaminants	NELAP	7/17/2003
1,2-Dichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
1,2-Dichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
1,2-Dichloropropane	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
1,3,5-Trimethylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,3-Dichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,3-Dichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
1,4-Dichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
2,2-Dichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
2,4,5-T	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
2,4-D	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 525.2	Group III Unregulated Contaminants	NELAP	7/17/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 525.2	Group III Unregulated Contaminants	NELAP	7/17/2003
2-Chlorotoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
3-Hydroxycarbofuran	EPA 531.1	Group I Unregulated Contaminants	NELAP	7/17/2003
4,4'-DDD	EPA 508.1	Group I Unregulated Contaminants	NELAP	7/17/2003
4,4'-DDD	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
4,4'-DDE	EPA 508.1	Group I Unregulated Contaminants	NELAP	7/17/2003
4,4'-DDE	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
4,4'-DDT	EPA 508.1	Group I Unregulated Contaminants	NELAP	7/17/2003
4,4'-DDT	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
4-Chlorotoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
4-Isopropyltoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001

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E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Acetochlor	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Acifluorfen	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
Alachlor	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Aldicarb (Temik)	EPA 531.1	Group I Unregulated Contaminants	NELAP	7/17/2003
Aldicarb sulfone	EPA 531.1	Group I Unregulated Contaminants	NELAP	7/17/2003
Aldicarb sulfoxide	EPA 531.1	Group I Unregulated Contaminants	NELAP	7/17/2003
Aldrin	EPA 508.1	Group I Unregulated Contaminants	NELAP	7/17/2003
Aldrin	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Alkalinity as CaCO3	SM 2320 B	Primary Inorganic Contaminants	NELAP	10/8/2001
Aluminum	EPA 200.7	Secondary Inorganic Contaminants	NELAP	10/8/2001
Aluminum	EPA 200.8	Secondary Inorganic Contaminants	NELAP	10/8/2001
Antimony	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
Antimony	EPA 200.9	Primary Inorganic Contaminants	NELAP	10/8/2001
Arsenic	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
Arsenic	EPA 200.9	Primary Inorganic Contaminants	NELAP	10/8/2001
Atrazine	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Barium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001
Barium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
Benzene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Benzo(a)pyrene	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Beryllium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001
Beryllium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Bromate	EPA 300.1	Primary Inorganic Contaminants	NELAP	7/17/2003
Bromide	EPA 300.1	Primary Inorganic Contaminants	NELAP	7/17/2003
Bromoacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Bromobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Bromochloroacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Bromochloromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	7/17/2003
Bromodichloromethane	EPA 524.2	Other Regulated Contaminants,Group II Unregulated Contaminants	NELAP	10/8/2001
Bromoform	EPA 524.2	Other Regulated Contaminants,Group II Unregulated Contaminants	NELAP	10/8/2001
Butachlor	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Butyl benzyl phthalate	EPA 525.2	Group III Unregulated Contaminants	NELAP	7/17/2003
Cadmium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001

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State Laboratory ID: **E87412** EPA Lab Code: **WA00035** **(360) 577-7222**

E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Cadmium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
Calcium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001
Carbaryl (Sevin)	EPA 531.1	Group I Unregulated Contaminants	NELAP	7/17/2003
Carbofuran (Furaden)	EPA 531.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Carbon tetrachloride	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Chlorate	EPA 300.1	Secondary Inorganic Contaminants	NELAP	12/23/2005
Chlordane (tech.)	EPA 508.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Chloride	EPA 300.0	Secondary Inorganic Contaminants	NELAP	10/8/2001
Chlorite	EPA 300.1	Primary Inorganic Contaminants	NELAP	7/17/2003
Chloroacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Chlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Chloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Chloroform	EPA 524.2	Other Regulated Contaminants,Group II Unregulated Contaminants	NELAP	10/8/2001
Chromium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001
Chromium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
cis-1,2-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
cis-1,3-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Color	SM 2120 B	Secondary Inorganic Contaminants	NELAP	7/17/2003
Conductivity	SM 2510 B	Primary Inorganic Contaminants	NELAP	10/8/2001
Copper	EPA 200.7	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	10/8/2001
Copper	EPA 200.8	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	10/8/2001
Copper	EPA 200.9	Primary Inorganic Contaminants	NELAP	10/8/2001
Cyanide	EPA 335.4	Primary Inorganic Contaminants	NELAP	10/8/2001
Dacthal (DCPA)	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Dalapon	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
DCPA di acid degradate	EPA 515.4	Group I Unregulated Contaminants	NELAP	7/17/2003
DCPA mono acid degradate	EPA 515.4	Group I Unregulated Contaminants	NELAP	7/17/2003
Di(2-ethylhexyl)adipate	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Dibromoacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Dibromochloromethane	EPA 524.2	Other Regulated Contaminants,Group II Unregulated Contaminants	NELAP	10/8/2001
Dibromomethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001

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Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Dicamba	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
Dichloroacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Dichlorodifluoromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Dichloromethane (DCM, Methylene chloride)	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Dieldrin	EPA 508.1	Group I Unregulated Contaminants	NELAP	7/17/2003
Dieldrin	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Diethyl phthalate	EPA 525.2	Group III Unregulated Contaminants	NELAP	7/17/2003
Dimethyl phthalate	EPA 525.2	Group III Unregulated Contaminants	NELAP	7/17/2003
Di-n-butyl phthalate	EPA 525.2	Group III Unregulated Contaminants	NELAP	7/17/2003
Di-n-octyl phthalate	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
Diquat	EPA 549.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Endothall	EPA 548.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Endrin	EPA 508.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Endrin	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Ethylbenzene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Fluoride	EPA 300.0	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	10/8/2001
Fluoride	SM 4500 F-C	Secondary Inorganic Contaminants,Primary Inorganic Contaminants	NELAP	10/8/2001
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 508.1	Synthetic Organic Contaminants	NELAP	7/17/2003
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Glyphosate	EPA 547	Synthetic Organic Contaminants	NELAP	7/17/2003
Heptachlor	EPA 508.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Heptachlor	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Heptachlor epoxide	EPA 508.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Heptachlor epoxide	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Heterotrophic plate count	SM 9215 B	Microbiology	NELAP	7/17/2003
Hexachlorobenzene	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Hexachlorobutadiene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Hexachlorocyclopentadiene	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Iron	EPA 200.7	Secondary Inorganic Contaminants	NELAP	10/8/2001
Isophorone	EPA 525.2	Group III Unregulated Contaminants	NELAP	7/17/2003
Isopropylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001

Laboratory Scope of Accreditation

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Lead	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
Lead	EPA 200.9	Primary Inorganic Contaminants	NELAP	10/8/2001
Magnesium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001
Manganese	EPA 200.7	Secondary Inorganic Contaminants	NELAP	10/8/2001
Manganese	EPA 200.8	Secondary Inorganic Contaminants	NELAP	10/8/2001
Mercury	EPA 245.1	Primary Inorganic Contaminants	NELAP	10/8/2001
Methomyl (Lannate)	EPA 531.1	Group I Unregulated Contaminants	NELAP	7/17/2003
Methoxychlor	EPA 508.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Methoxychlor	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Methyl bromide (Bromomethane)	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Methyl chloride (Chloromethane)	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Methyl tert-butyl ether (MTBE)	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Metolachlor	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Metribuzin	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Molinate	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Naphthalene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
n-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Nickel	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001
Nickel	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
Nitrate	EPA 300.0	Primary Inorganic Contaminants	NELAP	10/8/2001
Nitrate	EPA 353.2	Primary Inorganic Contaminants	NELAP	10/8/2001
Nitrite	EPA 300.0	Primary Inorganic Contaminants	NELAP	10/8/2001
Nitrite	EPA 353.2	Primary Inorganic Contaminants	NELAP	10/8/2001
n-Propylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Orthophosphate as P	SM 4500-P F	Primary Inorganic Contaminants	NELAP	10/8/2001
Oxamyl	EPA 531.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Paraquat	EPA 549.2	Synthetic Organic Contaminants	NELAP	12/23/2005
PCBs	EPA 508.1	Synthetic Organic Contaminants	NELAP	7/17/2003
Pentachlorophenol	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
Pentachlorophenol	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Perchlorate	EPA 314.0	Primary Inorganic Contaminants	NELAP	7/17/2003
pH	EPA 150.1	Secondary Inorganic Contaminants,Primary Inorganic Contaminants	NELAP	10/8/2001
Picloram	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
Propachlor (Ramrod)	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
sec-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001

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Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Selenium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/8/2001
Selenium	EPA 200.9	Primary Inorganic Contaminants	NELAP	10/8/2001
Silica as SiO2	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001
Silver	EPA 200.7	Secondary Inorganic Contaminants	NELAP	10/8/2001
Silver	EPA 200.8	Secondary Inorganic Contaminants	NELAP	10/8/2001
Silvex (2,4,5-TP)	EPA 515.4	Synthetic Organic Contaminants	NELAP	7/17/2003
Simazine	EPA 525.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Sodium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/8/2001
Styrene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Sulfate	EPA 300.0	Secondary Inorganic Contaminants,Primary Inorganic Contaminants	NELAP	10/8/2001
Terbacil	EPA 525.2	Group I Unregulated Contaminants	NELAP	7/17/2003
tert-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Tetrachloroethylene (Perchloroethylene)	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Thallium	EPA 200.8	Primary Inorganic Contaminants	NELAP	11/18/2004
Thallium	EPA 200.9	Primary Inorganic Contaminants	NELAP	10/8/2001
Toluene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Total coliforms & E. coli	SM 9223 B	Microbiology	NELAP	10/8/2001
Total dissolved solids	SM 2540 C	Secondary Inorganic Contaminants	NELAP	10/8/2001
Total haloacetic acids	EPA 552.2	Synthetic Organic Contaminants	NELAP	7/17/2003
Total nitrate-nitrite	EPA 300.0	Primary Inorganic Contaminants	NELAP	10/8/2001
Total nitrate-nitrite	EPA 353.2	Primary Inorganic Contaminants	NELAP	10/8/2001
Total trihalomethanes	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Toxaphene (Chlorinated camphene)	EPA 508.1	Synthetic Organic Contaminants	NELAP	7/17/2003
trans-1,2-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
trans-1,3-Dichloropropylene	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Trichloroacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	7/17/2003
Trichloroethene (Trichloroethylene)	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Trichlorofluoromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	10/8/2001
Turbidity	EPA 180.1	Secondary Inorganic Contaminants	NELAP	10/8/2001
Vinyl chloride	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Xylene (total)	EPA 524.2	Other Regulated Contaminants	NELAP	10/8/2001
Zinc	EPA 200.7	Secondary Inorganic Contaminants	NELAP	10/8/2001
Zinc	EPA 200.8	Secondary Inorganic Contaminants	NELAP	10/8/2001

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E87412
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Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,1-Trichloroethane	EPA 624	Volatile Organics	NELAP	10/8/2001
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2,2-Tetrachloroethane	EPA 624	Volatile Organics	NELAP	10/8/2001
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2-Trichloroethane	EPA 624	Volatile Organics	NELAP	10/8/2001
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethane	EPA 624	Volatile Organics	NELAP	10/8/2001
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethylene	EPA 624	Volatile Organics	NELAP	10/8/2001
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 625	Extractable Organics	NELAP	10/8/2001
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	10/8/2001
1,2-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	10/8/2001
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2-Dichloroethane	EPA 624	Volatile Organics	NELAP	10/8/2001
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichloropropane	EPA 624	Volatile Organics	NELAP	10/8/2001
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	10/8/2001
1,3-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	10/8/2001
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003

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Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	10/8/2001
1,4-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	10/8/2001
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,4-Phenylenediamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',5-Trichlorobiphenyl (BZ 18)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,3,4,6-Tetrachlorophenol	EPA 1653	Extractable Organics	NELAP	10/8/2001
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,3-Dichlorobiphenyl (BZ 5)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4',5-Trichlorobiphenyl (BZ 31)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4,5-Trichlorophenol	EPA 1653	Extractable Organics	NELAP	10/8/2001
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trichlorophenol	EPA 1653	Extractable Organics	NELAP	10/8/2001

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Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,4,6-Trichlorophenol	EPA 625	Extractable Organics	NELAP	10/8/2001
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-Dichlorophenol	EPA 625	Extractable Organics	NELAP	10/8/2001
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dimethylphenol	EPA 625	Extractable Organics	NELAP	10/8/2001
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrophenol	EPA 625	Extractable Organics	NELAP	10/8/2001
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	Extractable Organics	NELAP	10/8/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	Extractable Organics	NELAP	10/8/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2-Acetylaminofluorene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chlorobiphenyl (BZ 1)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2-Chloroethyl vinyl ether	EPA 624	Volatile Organics	NELAP	10/8/2001
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chloronaphthalene	EPA 625	Extractable Organics	NELAP	10/8/2001
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorophenol	EPA 625	Extractable Organics	NELAP	10/8/2001
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Hexanone	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Methyl-4,6-dinitrophenol	EPA 625	Extractable Organics	NELAP	10/8/2001
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrophenol	EPA 625	Extractable Organics	NELAP	10/8/2001

Laboratory Scope of Accreditation

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State Laboratory ID: **E87412** EPA Lab Code: **WA00035** **(360) 577-7222**

E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Sec-butyl-4,6-dinitrophenol (DNBP, Dinoseb)	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dichlorobenzidine	EPA 625	Extractable Organics	NELAP	10/8/2001
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,4,5-Trichlorocatechol	EPA 1653	Extractable Organics	NELAP	10/8/2001
3,4,5-Trichloroguaiacol	EPA 1653	Extractable Organics	NELAP	10/8/2001
3,4,6-Trichlorocatechol	EPA 1653	Extractable Organics	NELAP	10/8/2001
3,4,6-Trichloroguaiacol	EPA 1653	Extractable Organics	NELAP	10/8/2001
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
4,4'-DDD	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDE	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDT	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,5,6-Trichloroguaiacol	EPA 1653	Extractable Organics	NELAP	10/8/2001
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	7/1/2003
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Bromophenyl phenyl ether	EPA 625	Extractable Organics	NELAP	10/8/2001
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloro-3-methylphenol	EPA 625	Extractable Organics	NELAP	10/8/2001
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorophenyl phenylether	EPA 625	Extractable Organics	NELAP	10/8/2001
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Dimethyl aminoazobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrophenol	EPA 625	Extractable Organics	NELAP	10/8/2001

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Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
5-Nitro-o-toluidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
7,12-Dimethylbenz(a) anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
a-a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthene	EPA 625	Extractable Organics	NELAP	10/8/2001
Acenaphthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 625	Extractable Organics	NELAP	10/8/2001
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Acetone	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetophenone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acrolein (Propenal)	EPA 624	Volatile Organics	NELAP	7/17/2003
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acrylonitrile	EPA 624	Volatile Organics	NELAP	7/17/2003
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Adsorbable organic halogens (AOX)	EPA 1650	General Chemistry	NELAP	10/8/2001
Aldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Alkalinity as CaCO3	EPA 310.1	General Chemistry	NELAP	10/8/2001
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
Aluminum	EPA 200.7	Metals	NELAP	10/8/2001
Aluminum	EPA 200.8	Metals	NELAP	10/8/2001
Aluminum	EPA 6010	Metals	NELAP	7/1/2003
Aluminum	EPA 6020	Metals	NELAP	7/1/2003
Aluminum	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Amenable cyanide	EPA 335.1	General Chemistry	NELAP	10/8/2001
Ammonia as N	EPA 350.1	General Chemistry	NELAP	10/8/2001
Ammonia as N	EPA 350.3	General Chemistry	NELAP	10/8/2001
Aniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 625	Extractable Organics	NELAP	10/8/2001

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Antimony	EPA 200.7	Metals	NELAP	10/8/2001
Antimony	EPA 200.8	Metals	NELAP	10/8/2001
Antimony	EPA 6010	Metals	NELAP	7/1/2003
Antimony	EPA 6020	Metals	NELAP	7/1/2003
Antimony	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Aramite	EPA 8270	Extractable Organics	NELAP	7/1/2003
Aroclor-1016 (PCB-1016)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1221 (PCB-1221)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1232 (PCB-1232)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1242 (PCB-1242)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1248 (PCB-1248)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1254 (PCB-1254)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1260 (PCB-1260)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Arsenic	EPA 200.7	Metals	NELAP	10/8/2001
Arsenic	EPA 200.8	Metals	NELAP	10/8/2001
Arsenic	EPA 200.9	Metals	NELAP	10/8/2001
Arsenic	EPA 6010	Metals	NELAP	10/8/2001
Arsenic	EPA 6020	Metals	NELAP	7/1/2003
Arsenic	EPA 7060	Metals	NELAP	10/8/2001
Arsenic	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Azinphos-methyl (Guthion)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Barium	EPA 200.7	Metals	NELAP	10/8/2001
Barium	EPA 200.8	Metals	NELAP	10/8/2001
Barium	EPA 6010	Metals	NELAP	7/1/2003
Barium	EPA 6020	Metals	NELAP	7/1/2003
Barium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Benzene	EPA 624	Volatile Organics	NELAP	10/8/2001

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Benzene	EPA 8021	Volatile Organics	NELAP	7/1/2003
Benzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Benzidine	EPA 625	Extractable Organics	NELAP	10/8/2001
Benzo(a)anthracene	EPA 625	Extractable Organics	NELAP	10/8/2001
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(a)pyrene	EPA 625	Extractable Organics	NELAP	10/8/2001
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 625	Extractable Organics	NELAP	10/8/2001
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 625	Extractable Organics	NELAP	10/8/2001
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 625	Extractable Organics	NELAP	10/8/2001
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Benzoic acid	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Beryllium	EPA 200.7	Metals	NELAP	10/8/2001
Beryllium	EPA 200.8	Metals	NELAP	10/8/2001
Beryllium	EPA 6010	Metals	NELAP	7/1/2003
Beryllium	EPA 6020	Metals	NELAP	7/1/2003
Beryllium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
beta-Naphthylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Biochemical oxygen demand	EPA 405.1	General Chemistry	NELAP	10/8/2001
bis(2-Chloroethoxy)methane	EPA 625	Extractable Organics	NELAP	10/8/2001
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroethyl) ether	EPA 625	Extractable Organics	NELAP	10/8/2001
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 625	Extractable Organics	NELAP	10/8/2001
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	7/1/2003

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Analyte	Method/Tech	Category	Certification Type	Effective Date
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	Extractable Organics	NELAP	10/8/2001
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Bolstar (Sulprofos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Boron	EPA 200.7	Metals	NELAP	10/8/2001
Bromide	EPA 300.0	General Chemistry	NELAP	10/8/2001
Bromobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromodichloromethane	EPA 624	Volatile Organics	NELAP	10/8/2001
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromoform	EPA 624	Volatile Organics	NELAP	10/8/2001
Bromoform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Butyl benzyl phthalate	EPA 625	Extractable Organics	NELAP	10/8/2001
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Cadmium	EPA 200.7	Metals	NELAP	10/8/2001
Cadmium	EPA 200.8	Metals	NELAP	10/8/2001
Cadmium	EPA 6010	Metals	NELAP	10/8/2001
Cadmium	EPA 6020	Metals	NELAP	7/1/2003
Cadmium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Calcium	EPA 200.7	Metals	NELAP	10/8/2001
Calcium	EPA 6010	Metals	NELAP	10/8/2001
Calcium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Carbazole	EPA 8270	Extractable Organics	NELAP	7/1/2003
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	7/1/2003
Carbon tetrachloride	EPA 624	Volatile Organics	NELAP	10/8/2001
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chemical oxygen demand	EPA 410.1	General Chemistry	NELAP	10/8/2001
Chemical oxygen demand	EPA 410.2	General Chemistry	NELAP	12/23/2005
Chlordane (tech.)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Chloride	EPA 300.0	General Chemistry	NELAP	10/8/2001
Chloride	EPA 325.3	General Chemistry	NELAP	10/8/2001
Chlorobenzene	EPA 624	Volatile Organics	NELAP	10/8/2001
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chlorobenzilate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Chloroethane	EPA 624	Volatile Organics	NELAP	10/8/2001
Chloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Chloroform	EPA 624	Volatile Organics	NELAP	10/8/2001
Chloroform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroprene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chlorpyrifos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Chromium	EPA 200.7	Metals	NELAP	10/8/2001
Chromium	EPA 200.8	Metals	NELAP	10/8/2001
Chromium	EPA 6010	Metals	NELAP	7/1/2003
Chromium	EPA 6020	Metals	NELAP	7/1/2003
Chromium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Chromium VI	EPA 7195	Metals	NELAP	7/1/2003
Chromium VI	EPA 7196	General Chemistry	NELAP	7/1/2003
Chrysene	EPA 625	Extractable Organics	NELAP	10/8/2001
Chrysene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Chrysene	EPA 8310	Extractable Organics	NELAP	7/1/2003
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
cis-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	10/8/2001
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
cis-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Cobalt	EPA 200.7	Metals	NELAP	10/8/2001
Cobalt	EPA 200.8	Metals	NELAP	10/8/2001
Cobalt	EPA 6010	Metals	NELAP	7/1/2003
Cobalt	EPA 6020	Metals	NELAP	7/1/2003
Cobalt	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Color	EPA 110.2	General Chemistry	NELAP	10/8/2001
Conductivity	EPA 120.1	General Chemistry	NELAP	10/8/2001
Copper	EPA 200.7	Metals	NELAP	10/8/2001
Copper	EPA 200.8	Metals	NELAP	10/8/2001
Copper	EPA 6010	Metals	NELAP	10/8/2001
Copper	EPA 6020	Metals	NELAP	7/1/2003
Copper	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Coumaphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
delta-BHC	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Demeton-o	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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State Laboratory ID: **E87412** EPA Lab Code: **WA00035** **(360) 577-7222**

E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Diazinon	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dibenz(a,h) anthracene	EPA 625	Extractable Organics	NELAP	10/8/2001
Dibenz(a,h) anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibenz(a,h) anthracene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibromochloromethane	EPA 624	Volatile Organics	NELAP	10/8/2001
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dibromomethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dichlorovos (DDVP, Dichlorvos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dieldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diesel range organics (DRO)	CA-LUFT	Extractable Organics	NELAP	7/1/2003
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	7/28/2003
Diesel range organics (DRO)	NWTPH-Dx	Extractable Organics	NELAP	7/1/2003
Diethyl phthalate	EPA 625	Extractable Organics	NELAP	10/8/2001
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dimethoate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dimethyl phthalate	EPA 625	Extractable Organics	NELAP	10/8/2001
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-butyl phthalate	EPA 625	Extractable Organics	NELAP	10/8/2001
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-octyl phthalate	EPA 625	Extractable Organics	NELAP	10/8/2001
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Disulfoton	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Disulfoton	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan I	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan II	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan sulfate	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin aldehyde	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Ethanol	EPA 8015	Volatile Organics	NELAP	7/1/2003
Ethoprop	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Ethyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Ethylbenzene	EPA 624	Volatile Organics	NELAP	10/8/2001
Ethylbenzene	EPA 8021	Volatile Organics	NELAP	7/1/2003
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Ethylene glycol	EPA 8015	Volatile Organics	NELAP	7/1/2003
Famphur	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Fecal coliforms	SM 9221 E	Microbiology	NELAP	10/8/2001
Fensulfothion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Fenthion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Fluoranthene	EPA 625	Extractable Organics	NELAP	10/8/2001
Fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluoranthene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 625	Extractable Organics	NELAP	10/8/2001
Fluorene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Fluoride	EPA 300.0	General Chemistry	NELAP	10/8/2001
Fluoride	EPA 340.2	General Chemistry	NELAP	10/8/2001
Formaldehyde	EPA 8315	Extractable Organics	NELAP	7/1/2003
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	12/23/2005
Gasoline range organics (GRO)	CA-LUFT	Extractable Organics	NELAP	7/1/2003
Gasoline range organics (GRO)	EPA 8015	Volatile Organics	NELAP	7/17/2003
Gasoline range organics (GRO)	NWTPH-Gx	Extractable Organics	NELAP	7/1/2003
Hardness	EPA 130.2	General Chemistry	NELAP	10/8/2001
Heptachlor	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Heptachlor epoxide	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Hexachlorobenzene	EPA 625	Extractable Organics	NELAP	10/8/2001
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 625	Extractable Organics	NELAP	10/8/2001
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorocyclopentadiene	EPA 625	Extractable Organics	NELAP	10/8/2001
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloroethane	EPA 625	Extractable Organics	NELAP	10/8/2001
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorophene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloropropene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Ignitability	EPA 1020	General Chemistry	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 625	Extractable Organics	NELAP	10/8/2001
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Iron	EPA 200.7	Metals	NELAP	10/8/2001
Iron	EPA 6010	Metals	NELAP	7/1/2003
Iron	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Isodrin	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Isophorone	EPA 625	Extractable Organics	NELAP	10/8/2001
Isophorone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Isosafrole	EPA 8270	Extractable Organics	NELAP	7/1/2003
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Kjeldahl nitrogen - total	EPA 351.4	General Chemistry	NELAP	10/8/2001
Lead	EPA 200.7	Metals	NELAP	10/8/2001
Lead	EPA 200.8	Metals	NELAP	10/8/2001
Lead	EPA 200.9	Metals	NELAP	10/8/2001
Lead	EPA 6010	Metals	NELAP	10/8/2001
Lead	EPA 6020	Metals	NELAP	7/1/2003
Lead	EPA 7421	Metals	NELAP	10/8/2001
Lead	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Magnesium	EPA 200.7	Metals	NELAP	10/8/2001
Magnesium	EPA 6010	Metals	NELAP	7/1/2003

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Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Magnesium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Malathion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Manganese	EPA 200.7	Metals	NELAP	10/8/2001
Manganese	EPA 200.8	Metals	NELAP	10/8/2001
Manganese	EPA 6010	Metals	NELAP	7/1/2003
Manganese	EPA 6020	Metals	NELAP	7/1/2003
Manganese	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Mercury	EPA 1631	Metals	NELAP	10/8/2001
Mercury	EPA 245.1	Metals	NELAP	10/8/2001
Mercury	EPA 7470	Metals	NELAP	10/8/2001
Mercury	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Merphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methanol	NCASI 94.03	Volatile Organics	NELAP	10/8/2001
Methanol	NCASI 99.01	Volatile Organics	NELAP	10/8/2001
Methapyrilene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Methyl bromide (Bromomethane)	EPA 624	Volatile Organics	NELAP	10/8/2001
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl chloride (Chloromethane)	EPA 624	Volatile Organics	NELAP	10/8/2001
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl parathion (Parathion, methyl)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Methyl parathion (Parathion, methyl)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methylene chloride	EPA 624	Volatile Organics	NELAP	10/8/2001
Methylene chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Mevinphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Molybdenum	EPA 200.7	Metals	NELAP	10/8/2001
Molybdenum	EPA 200.8	Metals	NELAP	10/8/2001
Molybdenum	EPA 6010	Metals	NELAP	10/8/2001
Molybdenum	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Naphthalene	EPA 625	Extractable Organics	NELAP	10/8/2001
Naphthalene	EPA 8260	Volatile Organics	NELAP	7/1/2003

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Naphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Naphthalene	EPA 8310	Extractable Organics	NELAP	7/1/2003
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Nickel	EPA 200.7	Metals	NELAP	10/8/2001
Nickel	EPA 200.8	Metals	NELAP	10/8/2001
Nickel	EPA 6010	Metals	NELAP	10/8/2001
Nickel	EPA 6020	Metals	NELAP	7/1/2003
Nickel	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Nitrate as N	EPA 300.0	General Chemistry	NELAP	10/8/2001
Nitrate as N	EPA 353.2	General Chemistry	NELAP	7/17/2003
Nitrate-nitrite	EPA 353.2	General Chemistry	NELAP	10/8/2001
Nitrite as N	EPA 300.0	General Chemistry	NELAP	10/8/2001
Nitrite as N	EPA 353.2	General Chemistry	NELAP	7/17/2003
Nitrobenzene	EPA 625	Extractable Organics	NELAP	10/8/2001
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	7/1/2003
Nitroquinoline-1-oxide	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodimethylamine	EPA 625	Extractable Organics	NELAP	10/8/2001
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitroso-di-n-butylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodi-n-propylamine	EPA 625	Extractable Organics	NELAP	10/8/2001
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodiphenylamine	EPA 625	Extractable Organics	NELAP	10/8/2001
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosomethylethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Oil & Grease	EPA 1664	General Chemistry	NELAP	10/8/2001
Orthophosphate as P	EPA 365.3	General Chemistry	NELAP	10/8/2001
o-Toluidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Parathion, ethyl	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Parathion, ethyl	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

Laboratory Scope of Accreditation

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Pentachloronitrobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pentachlorophenol	EPA 1653	Extractable Organics	NELAP	10/8/2001
Pentachlorophenol	EPA 625	Extractable Organics	NELAP	10/8/2001
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
pH	EPA 150.1	General Chemistry	NELAP	10/8/2001
pH	EPA 9040	General Chemistry	NELAP	7/1/2003
Phenacetin	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenanthrene	EPA 625	Extractable Organics	NELAP	10/8/2001
Phenanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenanthrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Phenol	EPA 625	Extractable Organics	NELAP	10/8/2001
Phenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phorate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Phorate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Phosphorus, total	EPA 365.3	General Chemistry	NELAP	10/8/2001
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Potassium	EPA 200.7	Metals	NELAP	10/8/2001
Potassium	EPA 6010	Metals	NELAP	10/8/2001
Potassium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Pyrene	EPA 625	Extractable Organics	NELAP	10/8/2001
Pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pyrene	EPA 8310	Extractable Organics	NELAP	7/1/2003
Pyridine	EPA 8270	Extractable Organics	NELAP	7/1/2003
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Residual free chlorine	EPA 330.4	General Chemistry	NELAP	10/8/2001
Residue-filterable (TDS)	EPA 160.1	General Chemistry	NELAP	10/8/2001
Residue-nonfilterable (TSS)	EPA 160.2	General Chemistry	NELAP	10/8/2001
Residue-settleable	EPA 160.5	General Chemistry	NELAP	10/8/2001
Residue-total	EPA 160.3	General Chemistry	NELAP	10/8/2001
Residue-volatile	EPA 160.4	General Chemistry	NELAP	10/8/2001
Ronnel	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Safrole	EPA 8270	Extractable Organics	NELAP	7/1/2003
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Selenium	EPA 200.7	Metals	NELAP	10/8/2001

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Selenium	EPA 200.8	Metals	NELAP	10/8/2001
Selenium	EPA 200.9	Metals	NELAP	10/8/2001
Selenium	EPA 6010	Metals	NELAP	10/8/2001
Selenium	EPA 7740	Metals	NELAP	10/8/2001
Selenium	EPA 7742	Metals	NELAP	7/17/2003
Selenium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Silver	EPA 200.7	Metals	NELAP	10/8/2001
Silver	EPA 200.8	Metals	NELAP	10/8/2001
Silver	EPA 6010	Metals	NELAP	7/1/2003
Silver	EPA 6020	Metals	NELAP	7/1/2003
Silver	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Sodium	EPA 200.7	Metals	NELAP	10/8/2001
Sodium	EPA 6010	Metals	NELAP	7/1/2003
Sodium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Stirofos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Styrene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Sulfate	EPA 300.0	General Chemistry	NELAP	10/8/2001
Sulfide	EPA 376.1	General Chemistry	NELAP	10/8/2001
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tetrachlorocatechol	EPA 1653	Extractable Organics	NELAP	10/8/2001
Tetrachloroethylene (Perchloroethylene)	EPA 624	Volatile Organics	NELAP	10/8/2001
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tetrachloroguaiacol	EPA 1653	Extractable Organics	NELAP	10/8/2001
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Thallium	EPA 200.7	Metals	NELAP	10/8/2001
Thallium	EPA 200.8	Metals	NELAP	10/8/2001
Thallium	EPA 200.9	Metals	NELAP	10/8/2001
Thallium	EPA 6020	Metals	NELAP	7/1/2003
Thallium	EPA 7841	Metals	NELAP	7/1/2003
Thallium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Thionazin (Zinophos)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Tin	EPA 200.7	Metals	NELAP	7/17/2003
Titanium	EPA 200.7	Metals	NELAP	7/17/2003
Tokuthion (Prothiophos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Toluene	EPA 624	Volatile Organics	NELAP	10/8/2001

Laboratory Scope of Accreditation

Attachment to Certificate #: E87412-05, expiration date June 30, 2007. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E87412** EPA Lab Code: **WA00035** **(360) 577-7222**

E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Toluene	EPA 8021	Volatile Organics	NELAP	7/1/2003
Toluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Total coliforms	SM 9221 B	Microbiology	NELAP	10/8/2001
Total cyanide	EPA 335.4	General Chemistry	NELAP	7/17/2003
Total cyanide	EPA 9012	General Chemistry	NELAP	12/23/2005
Total cyanide	ILM04.1-Exhibit D	General Chemistry	NELAP	7/1/2003
Total hardness as CaCO3	EPA 200.7	Metals	NELAP	10/8/2001
Total organic carbon	EPA 415.1	General Chemistry	NELAP	10/8/2001
Total organic carbon	EPA 9060	General Chemistry	NELAP	7/1/2003
Total organic halides (TOX)	EPA 9020	General Chemistry	NELAP	7/1/2003
Total Petroleum Hydrocarbons (TPH)	EPA 1664	General Chemistry	NELAP	10/8/2001
Total Petroleum Hydrocarbons (TPH)	EPA 8015	Extractable Organics	NELAP	7/1/2003
Total Petroleum Hydrocarbons (TPH)	NWTPH-HCID	Extractable Organics	NELAP	7/1/2003
Total phenolics	EPA 420.1	General Chemistry	NELAP	10/8/2001
Toxaphene (Chlorinated camphene)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
trans-1,2-Dichloroethylene	EPA 624	Volatile Organics	NELAP	10/8/2001
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,3-Dichloropropylene	EPA 624	Volatile Organics	NELAP	10/8/2001
trans-1,3-Dichloropropylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichloroethene (Trichloroethylene)	EPA 624	Volatile Organics	NELAP	10/8/2001
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichlorofluoromethane	EPA 624	Volatile Organics	NELAP	10/8/2001
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichloronate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Trichlorosyringol	EPA 1653	Extractable Organics	NELAP	10/8/2001
Turbidity	EPA 180.1	General Chemistry	NELAP	10/8/2001
Uranium	EPA 200.8	Metals	NELAP	10/8/2001
Vanadium	EPA 200.7	Metals	NELAP	10/8/2001
Vanadium	EPA 200.8	Metals	NELAP	10/8/2001
Vanadium	EPA 6010	Metals	NELAP	7/1/2003
Vanadium	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Vinyl chloride	EPA 624	Volatile Organics	NELAP	10/8/2001
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003

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Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Xylene (total)	EPA 624	Volatile Organics	NELAP	10/8/2001
Xylene (total)	EPA 8021	Volatile Organics	NELAP	7/1/2003
Xylene (total)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Zinc	EPA 200.7	Metals	NELAP	10/8/2001
Zinc	EPA 200.8	Metals	NELAP	10/8/2001
Zinc	EPA 6010	Metals	NELAP	10/8/2001
Zinc	EPA 6020	Metals	NELAP	7/1/2003
Zinc	ILM04.1-Exhibit D	Metals	NELAP	7/1/2003

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1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	10/8/2001
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270	Extractable Organics	NELAP	7/17/2003
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	10/8/2001
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270	Extractable Organics	NELAP	10/8/2001
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	10/8/2001
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	10/8/2001
1,4-Phenylenediamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
1-Chlorohexane	EPA 8260	Volatile Organics	NELAP	7/17/2003
1-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	7/17/2003
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001

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State Laboratory ID: **E87412** EPA Lab Code: **WA00035** **(360) 577-7222**

E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2',5-Trichlorobiphenyl (BZ 18)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	10/8/2001
2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,3-Dichlorobiphenyl (BZ 5)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,4',5-Trichlorobiphenyl (BZ 31)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	10/8/2001
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	10/8/2001
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	10/8/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	10/8/2001
2-Acetylaminofluorene	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	10/8/2001
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	10/8/2001

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E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-Chlorobiphenyl (BZ 1)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	10/8/2001
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	10/8/2001
2-Hexanone	EPA 8260	Volatile Organics	NELAP	10/8/2001
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Nitropropane	EPA 8260	Volatile Organics	NELAP	7/17/2003
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	10/8/2001
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	10/8/2001
2-Sec-butyl-4,6-dinitrophenol (DNBP, Dinoseb)	EPA 8270	Extractable Organics	NELAP	10/8/2001
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	10/8/2001
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	10/8/2001
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	10/8/2001
3-Methylphenol (m-Cresol)	EPA 8270	Extractable Organics	NELAP	7/17/2003
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	10/8/2001
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	10/8/2001
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	10/8/2001
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	10/8/2001
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	10/8/2001
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	10/8/2001
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	10/8/2001
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	10/8/2001
4-Dimethyl aminoazobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	10/8/2001
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	10/8/2001
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	10/8/2001
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001

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Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	10/8/2001
5-Nitro-o-toluidine	EPA 8270	Extractable Organics	NELAP	10/8/2001
7,12-Dimethylbenz(a) anthracene	EPA 8270	Extractable Organics	NELAP	10/8/2001
a-a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
Acenaphthene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Acenaphthene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Acenaphthylene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Acetone	EPA 8260	Volatile Organics	NELAP	10/8/2001
Acetonitrile	EPA 8260	Volatile Organics	NELAP	10/8/2001
Acetophenone	EPA 8270	Extractable Organics	NELAP	10/8/2001
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	10/8/2001
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	10/8/2001
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Aluminum	EPA 6010	Metals	NELAP	10/8/2001
Aluminum	EPA 6020	Metals	NELAP	10/8/2001
Aluminum	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Aniline	EPA 8270	Extractable Organics	NELAP	10/8/2001
Anthracene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Anthracene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Antimony	EPA 6010	Metals	NELAP	10/8/2001
Antimony	EPA 6020	Metals	NELAP	10/8/2001
Antimony	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Aramite	EPA 8270	Extractable Organics	NELAP	10/8/2001
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Arsenic	EPA 6010	Metals	NELAP	7/1/2003
Arsenic	EPA 6020	Metals	NELAP	10/8/2001

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Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Arsenic	EPA 7060	Metals	NELAP	10/8/2001
Arsenic	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Azinphos-methyl (Guthion)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Barium	EPA 6010	Metals	NELAP	10/8/2001
Barium	EPA 6020	Metals	NELAP	10/8/2001
Barium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Benzene	EPA 8021	Volatile Organics	NELAP	10/8/2001
Benzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Benzo(a)anthracene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Benzo(a)pyrene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Benzo(b)fluoranthene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Benzo(g,h,i)perylene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Benzo(k)fluoranthene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Benzoic acid	EPA 8270	Extractable Organics	NELAP	10/8/2001
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	10/8/2001
Beryllium	EPA 6010	Metals	NELAP	10/8/2001
Beryllium	EPA 6020	Metals	NELAP	10/8/2001
Beryllium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
beta-Naphthylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	10/8/2001
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	10/8/2001
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	10/8/2001
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	10/8/2001
Bolstar (Sulprofos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Bromobenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
Bromoform	EPA 8260	Volatile Organics	NELAP	10/8/2001
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	10/8/2001
Cadmium	EPA 6010	Metals	NELAP	10/8/2001

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Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
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Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Cadmium	EPA 6020	Metals	NELAP	10/8/2001
Cadmium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Calcium	EPA 6010	Metals	NELAP	10/8/2001
Calcium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Carbazole	EPA 8270	Extractable Organics	NELAP	10/8/2001
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	10/8/2001
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	10/8/2001
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Chloride	EPA 300.0	General Chemistry	NELAP	2/17/2006
Chloride	EPA 9056	General Chemistry	NELAP	7/17/2003
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Chlorobenzilate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Chloroethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
Chloroform	EPA 8260	Volatile Organics	NELAP	10/8/2001
Chloroprene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Chlorpyrifos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Chromium	EPA 6010	Metals	NELAP	10/8/2001
Chromium	EPA 6020	Metals	NELAP	10/8/2001
Chromium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Chromium VI	EPA 7195	Metals	NELAP	10/8/2001
Chromium VI	EPA 7196	General Chemistry	NELAP	10/8/2001
Chrysene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Chrysene	EPA 8310	Extractable Organics	NELAP	10/8/2001
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	10/8/2001
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	10/8/2001
cis-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Cobalt	EPA 6010	Metals	NELAP	10/8/2001
Cobalt	EPA 6020	Metals	NELAP	10/8/2001
Cobalt	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Copper	EPA 6010	Metals	NELAP	10/8/2001
Copper	EPA 6020	Metals	NELAP	10/8/2001
Copper	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Corrosivity (pH)	EPA 1110	General Chemistry	NELAP	10/8/2001
Coumaphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001

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Demeton-o	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Demeton-s	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Diazinon	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Dibenz(a,h) anthracene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Dibenz(a,h) anthracene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	10/8/2001
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
Dibromomethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Dichlorovos (DDVP, Dichlorvos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Diesel range organics (DRO)	CA-LUFT	Extractable Organics	NELAP	10/8/2001
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	7/17/2003
Diesel range organics (DRO)	NWTPH-Dx	Extractable Organics	NELAP	10/8/2001
Diethyl ether	EPA 8260	Volatile Organics	NELAP	7/17/2003
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	10/8/2001
Dimethoate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Dimethoate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	10/8/2001
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	10/8/2001
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	10/8/2001
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Disulfoton	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Disulfoton	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
EPN	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Ethoprop	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	7/17/2003
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	10/8/2001

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Ethyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	10/8/2001
Ethylbenzene	EPA 8021	Volatile Organics	NELAP	10/8/2001
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Ethylene glycol	EPA 8015	Volatile Organics	NELAP	10/8/2001
Famphur	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Fensulfothion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Fenthion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Fluoranthene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Fluoranthene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Fluorene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Fluorene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Fluoride	EPA 300.0	General Chemistry	NELAP	2/17/2006
Fluoride	EPA 9056	General Chemistry	NELAP	7/17/2003
Formaldehyde	EPA 8315	Extractable Organics	NELAP	10/8/2001
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Gasoline range organics (GRO)	CA-LUFT	Extractable Organics	NELAP	10/8/2001
Gasoline range organics (GRO)	EPA 8015	Extractable Organics	NELAP	7/17/2003
Gasoline range organics (GRO)	NWTPH-Gx	Extractable Organics	NELAP	10/8/2001
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	10/8/2001
Hexachlorophene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Hexachloropropene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Ignitability	EPA 1020	General Chemistry	NELAP	10/8/2001
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Indeno(1,2,3-cd)pyrene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Iron	EPA 6010	Metals	NELAP	10/8/2001
Iron	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Isodrin	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Isophorone	EPA 8270	Extractable Organics	NELAP	10/8/2001
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Isosafrole	EPA 8270	Extractable Organics	NELAP	10/8/2001
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Lead	EPA 6010	Metals	NELAP	10/8/2001
Lead	EPA 6020	Metals	NELAP	10/8/2001
Lead	EPA 7421	Metals	NELAP	10/8/2001
Lead	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Magnesium	EPA 6010	Metals	NELAP	10/8/2001
Magnesium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Malathion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Manganese	EPA 6010	Metals	NELAP	10/8/2001
Manganese	EPA 6020	Metals	NELAP	10/8/2001
Manganese	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Mercury	EPA 7470	Metals	NELAP	10/8/2001
Mercury	EPA 7471	Metals	NELAP	10/8/2001
Mercury	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Merphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	10/8/2001
Methapyrilene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	10/8/2001
Methyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	7/17/2003
Methyl parathion (Parathion, methyl)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Methyl parathion (Parathion, methyl)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Methylene chloride	EPA 8260	Volatile Organics	NELAP	10/8/2001
Mevinphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Molybdenum	EPA 6010	Metals	NELAP	10/8/2001
Molybdenum	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Naphthalene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Naphthalene	EPA 8270	Extractable Organics	NELAP	10/8/2001

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Naphthalene	EPA 8310	Extractable Organics	NELAP	10/8/2001
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Nickel	EPA 6010	Metals	NELAP	10/8/2001
Nickel	EPA 6020	Metals	NELAP	10/8/2001
Nickel	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Nitrate	EPA 9056	General Chemistry	NELAP	7/17/2003
Nitrite	EPA 9056	General Chemistry	NELAP	7/17/2003
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	10/8/2001
Nitroglycerin	EPA 8332	Extractable Organics	NELAP	7/17/2003
Nitroquinoline-1-oxide	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitroso-di-n-butylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitrosomethylethylamine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	10/8/2001
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
o,o,o-Triethyl phosphorothioate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	10/8/2001
Oil & Grease	EPA 1664	General Chemistry	NELAP	10/8/2001
Oil & Grease	EPA 9071	General Chemistry	NELAP	10/8/2001
o-Toluidine	EPA 8270	Extractable Organics	NELAP	10/8/2001
Parathion, ethyl	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Parathion, ethyl	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
p-Dioxane	EPA 8260	Volatile Organics	NELAP	10/8/2001
Pentachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/17/2003
Pentachloronitrobenzene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
pH	EPA 9040	General Chemistry	NELAP	10/8/2001
pH	EPA 9045	General Chemistry	NELAP	7/17/2003
Phenacetin	EPA 8270	Extractable Organics	NELAP	10/8/2001
Phenanthrene	EPA 8270	Extractable Organics	NELAP	10/8/2001

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Phenanthrene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Phenol	EPA 8270	Extractable Organics	NELAP	10/8/2001
Phorate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Phorate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Potassium	EPA 6010	Metals	NELAP	10/8/2001
Potassium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	10/8/2001
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Pyrene	EPA 8270	Extractable Organics	NELAP	10/8/2001
Pyrene	EPA 8310	Extractable Organics	NELAP	10/8/2001
Pyridine	EPA 8270	Extractable Organics	NELAP	10/8/2001
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	10/8/2001
Ronnel	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Safrole	EPA 8270	Extractable Organics	NELAP	10/8/2001
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Selenium	EPA 6010	Metals	NELAP	7/17/2003
Selenium	EPA 7740	Metals	NELAP	10/8/2001
Selenium	EPA 7742	Metals	NELAP	7/17/2003
Selenium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Silver	EPA 6010	Metals	NELAP	10/8/2001
Silver	EPA 6020	Metals	NELAP	10/8/2001
Silver	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Sodium	EPA 6010	Metals	NELAP	10/8/2001
Sodium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Stirofos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Styrene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Sulfate	EPA 300.0	General Chemistry	NELAP	2/17/2006
Sulfate	EPA 9056	General Chemistry	NELAP	7/17/2003
Sulfide	EPA 9030/9034	General Chemistry	NELAP	7/17/2003
Sulfotepp	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	7/17/2003
Synthetic Precipitation Leaching Procedure	EPA 1312	General Chemistry	NELAP	7/17/2003
tert-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	7/17/2003
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	10/8/2001

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Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	10/8/2001
Thallium	EPA 6010	Metals	NELAP	7/17/2003
Thallium	EPA 6020	Metals	NELAP	10/8/2001
Thallium	EPA 7841	Metals	NELAP	10/8/2001
Thallium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Thionazin (Zinophos)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Tokuthion (Prothiophos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Toluene	EPA 8021	Volatile Organics	NELAP	10/8/2001
Toluene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Total cyanide	EPA 9012	General Chemistry	NELAP	12/23/2005
Total cyanide	ILM04.1-Exhibit D	General Chemistry	NELAP	10/8/2001
Total organic carbon	EPA 9060	General Chemistry	NELAP	10/8/2001
Total organic halides (TOX)	EPA 9020	General Chemistry	NELAP	10/8/2001
Total Petroleum Hydrocarbons (TPH)	NWTPH-HCID	Extractable Organics	NELAP	10/8/2001
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Toxicity Characteristic Leaching Procedure	EPA 1311	General Chemistry	NELAP	10/8/2001
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	10/8/2001
trans-1,3-Dichloropropylene	EPA 8260	Volatile Organics	NELAP	10/8/2001
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	10/8/2001
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	10/8/2001
Trichloronate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	10/8/2001
Vanadium	EPA 6010	Metals	NELAP	10/8/2001
Vanadium	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	10/8/2001
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	10/8/2001
Xylene (total)	EPA 8021	Volatile Organics	NELAP	10/8/2001
Xylene (total)	EPA 8260	Volatile Organics	NELAP	10/8/2001
Zinc	EPA 6010	Metals	NELAP	10/8/2001
Zinc	EPA 6020	Metals	NELAP	10/8/2001
Zinc	ILM04.1-Exhibit D	Metals	NELAP	10/8/2001

Laboratory Scope of Accreditation

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State Laboratory ID: **E87412** EPA Lab Code: **WA00035** **(360) 577-7222**

E87412
Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,2',5-Trichlorobiphenyl (BZ 18)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,3-Dichlorobiphenyl (BZ 5)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4',5-Trichlorobiphenyl (BZ 31)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	7/1/2003

Laboratory Scope of Accreditation

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Columbia Analytical Services, Inc. - WA
1317 South 13th Avenue
Kelso, WA 98626

Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	7/1/2003
2-Chlorobiphenyl (BZ 1)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	7/1/2003
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	7/1/2003
Acenaphthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aluminum	EPA 6010	Metals	NELAP	7/1/2003
Aluminum	EPA 6020	Metals	NELAP	7/1/2003
Aniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Antimony	EPA 6010	Metals	NELAP	7/1/2003
Antimony	EPA 6020	Metals	NELAP	7/1/2003

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Arsenic	EPA 6010	Metals	NELAP	7/1/2003
Arsenic	EPA 6020	Metals	NELAP	7/1/2003
Arsenic	EPA 7060	Metals	NELAP	7/1/2003
Barium	EPA 6010	Metals	NELAP	7/1/2003
Barium	EPA 6020	Metals	NELAP	7/1/2003
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzoic acid	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Beryllium	EPA 6010	Metals	NELAP	7/1/2003
Beryllium	EPA 6020	Metals	NELAP	7/1/2003
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Cadmium	EPA 6010	Metals	NELAP	7/1/2003
Cadmium	EPA 6020	Metals	NELAP	7/1/2003
Carbazole	EPA 8270	Extractable Organics	NELAP	7/1/2003
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Chromium	EPA 6010	Metals	NELAP	7/1/2003
Chromium	EPA 6020	Metals	NELAP	7/1/2003
Chromium VI	EPA 7196	Metals	NELAP	7/1/2003
Chrysene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Cobalt	EPA 6010	Metals	NELAP	7/1/2003

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Cobalt	EPA 6020	Metals	NELAP	7/1/2003
Copper	EPA 6010	Metals	NELAP	7/1/2003
Copper	EPA 6020	Metals	NELAP	7/1/2003
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dibenz(a,h) anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 8270	Extractable Organics	NELAP	7/1/2003
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Iron	EPA 6010	Metals	NELAP	7/1/2003
Isophorone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Lead	EPA 6010	Metals	NELAP	7/1/2003
Lead	EPA 6020	Metals	NELAP	7/1/2003
Lead	EPA 7421	Metals	NELAP	7/1/2003
Manganese	EPA 6010	Metals	NELAP	7/1/2003
Manganese	EPA 6020	Metals	NELAP	7/1/2003
Mercury	EPA 7471	Metals	NELAP	7/1/2003

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Matrix: **Biological Tissue**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Molybdenum	EPA 6010	Metals	NELAP	7/1/2003
Naphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Nickel	EPA 6010	Metals	NELAP	7/1/2003
Nickel	EPA 6020	Metals	NELAP	7/1/2003
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	7/1/2003
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pyridine	EPA 8270	Extractable Organics	NELAP	7/1/2003
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Selenium	EPA 6010	Metals	NELAP	7/1/2003
Selenium	EPA 7740	Metals	NELAP	7/1/2003
Selenium	EPA 7742	Metals	NELAP	7/1/2003
Silver	EPA 6010	Metals	NELAP	7/1/2003
Silver	EPA 6020	Metals	NELAP	7/1/2003
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	7/1/2003
Thallium	EPA 6020	Metals	NELAP	7/1/2003
Thallium	EPA 7841	Metals	NELAP	7/1/2003
Total cyanide	EPA 9012	General Chemistry	NELAP	12/23/2005
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Vanadium	EPA 6010	Metals	NELAP	7/1/2003
Zinc	EPA 6010	Metals	NELAP	7/1/2003
Zinc	EPA 6020	Metals	NELAP	7/1/2003

APPENDIX F

ADDITIONAL AGENCY-SPECIFIC DOCUMENTS

ATTACHMENT 2
Laboratory
Method Precision/Accuracy Objectives

GENERAL CHEMISTRY/WATER CHEMISTRY ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
1650A	NA	Water	Absorbable Organic Halides	10	4	ug/L
305.1	NA	Water	Acidity as $CaCO_3$	NA	NA	mg/L
310.1 / *SM* 2320B	NA	Water	Alkalinity as $CaCO_3$	2	0.8	mg/L
350.1M	SOP	Soil	Ammonia as Nitrogen	2.5	1	mg/kg
350.3M	SOP	Soil	Ammonia as Nitrogen	10	1	mg/kg
350.1	NA	Water	Ammonia as Nitrogen	0.05	0.006	mg/L
350.3	NA	Water	Ammonia as Nitrogen	0.05	0.009	mg/L
405.1	NA	Water	Biological Oxygen Demand	4	0.5	mg/L
300.1	NA	Water	Bromate	5	2	ug/L
300.0M/9056	SOP	Soil	Bromide	1	0.3	mg/kg
300.0	NA	Water	Bromide	0.2	0.02	mg/L
300.1	NA	Water	Bromide	20	2	ug/L
410.1	NA	Water	Chemical Oxygen Demand	50	20	mg/L
410.2	NA	Water	Chemical Oxygen Demand	5	2.5	mg/L
300.1	NA	Water	Chlorate	20	4	ug/L
300.0M/9056	SOP	Soil	Chloride	0.2	0.03	mg/kg
300.0	NA	Water	Chloride	0.2	0.03	mg/L
9252	NA	Water	Chloride, Titrimetric	0.5	0.2	mg/L
325.3/9252	NA	Water	Chloride, Titrimetric	0.5	0.2	mg/L
330.4	NA	Water	Chlorine, Total Residual	0.1	0.06	mg/L
300.1	NA	Water	Chlorite	20	3	ug/L
110.2	NA	Water	Color	NA	NA	Color
120.1 / *SM* 2510B	NA	Water	Conductivity	2	0.04	umhos/cm
1110	NA	Liquid	Corrosivity	NA	NA	mm/yr
9040	NA	Water	Corrosivity (pH)	NA	NA	pH units
335.2 / 335.4	NA	Water	Cyanide, Total	10	2	ug/L
9012A	9010B	Soil	Cyanide, Total and Amenable	0.1	0.04	mg/kg
9012A	9010B	Water	Cyanide, Total and Amenable	10	2	ug/L
335.1	NA	Water	Cyanides Amenable to Chlorination	0.01	0.003	mg/L
1020	NA	Soil	Flashpoint, Setaflash	NA	NA	Deg. F
1020	NA	Water	Flashpoint, Setaflash	NA	NA	Deg. F
300.0M/9056	SOP	Soil	Fluoride	0.2	0.005	mg/kg
300.0	NA	Water	Fluoride	0.2	0.005	mg/L

GENERAL CHEMISTRY/WATER CHEMISTRY ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
340.2 / *SM* 4500-F⁻C	NA	Water	Fluoride	0.2	0.009	mg/L
340.1M	SOP	Soil	Fluoride, Bellack Distillation	1	0.3	mg/kg
340.1	NA	Water	Fluoride, Bellack Distillation	1	0.3	mg/L
130.2 / *SM* 2340C	NA	Water	Hardness as $CaCO_3$	2	0.6	mg/L
7196A	3060A	Soil	Hexavalent Chromium	0.5	0.08	mg/kg
7196A	Method	Water	Hexavalent Chromium	0.05	0.02	mg/L
300.0M/9056	SOP	Soil	Nitrate as Nitrogen	0.1	0.004	mg/kg
300.0	NA	Water	Nitrate as Nitrogen	0.1	0.004	mg/L
300.0M/9056	SOP	Soil	Nitrite as Nitrogen	0.1	0.003	mg/kg
300.0	NA	Water	Nitrite as Nitrogen	0.1	0.003	mg/L
354.1	NA	Water	Nitrite as Nitrogen, Colorimetric	0.01	0.003	mg/L
353.2M	SOP	Soil	Nitrogen, Nitrate + Nitrite as Nitrogen	10	1.5	mg/kg
353.2	NA	Water	Nitrogen, Nitrate + Nitrite as Nitrogen	0.2	0.02	mg/L
351.4M	SOP	Soil	Nitrogen, Total Kjeldahl	20	4	mg/kg
351.4	NA	Water	Nitrogen, Total Kjeldahl	0.1	0.07	mg/L
365.3	NA	Water	Orthophosphate as Phosphorus	0.01	0.003	mg/L
SM 4500P-F	NA	Water	Orthophosphate as Phosphorus	0.02	0.006	mg/L
ASTM D1498	NA	Water	Oxidation-Reduction Potential	NA	NA	mV
314.0	NA	Water	Perchlorate	2	0.2	ug/L
9045C	NA	Soil	pH	NA	NA	pH units
150.1	NA	Water	pH	NA	NA	pH units
420.1	NA	Water	Phenolics, Total	0.01	0.008	mg/L
365.3	SOP	Soil	Phosphorus, Total	1	0.5	mg/kg
365.3	NA	Water	Phosphorus, Total	0.01	0.003	mg/L
160.5	NA	Water	Solids, Settleable	5	NA	mg/L
160.3	NA	Soil	Solids, Total	NA	NA	%
160.3	NA	Water	Solids, Total	5	NA	mg/L
160.1 / *SM* 2540C	NA	Water	Solids, Total Dissolved (Filterable)	5	NA	mg/L
160.2	NA	Water	Solids, Total Suspended (Nonfilterable)	5	NA	mg/L
160.4	NA	Soil	Solids, Volatile	NA	NA	%
160.4	NA	Water	Solids, Volatile	0.1	NA	mL/L
300.0M/9056	SOP	Soil	Sulfate	2	0.9	mg/kg
300.0	NA	Water	Sulfate	0.2	0.03	mg/L
376.1	NA	Water	Sulfide	2	0.3	mg/L

GENERAL CHEMISTRY/WATER CHEMISTRY ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
9030M	Method	Soil	Sulfides	0.5	0.03	mg/kg
9030M	NA	Water	Sulfides	0.1	0.04	mg/L
377.1	NA	Water	Sulfite	2	0.3	mg/L
425.1	NA	Water	Surfactants (MBAS)	0.05	0.03	mg/L
SM 5550B	NA	Water	Tannin and Lignin	0.2	0.05	mg/L
ASTM D4129-82M	NA	Soil	Total Organic Carbon	0.05	0.02	%
415.1	NA	Water	Total Organic Carbon	0.5	0.07	mg/L
9060A	NA	Water	Total Organic Carbon	0.5	0.07	mg/L
9020	NA	Water	Total Organic Halides	10	4	ug/L
180.1	NA	Water	Turbidity	0.2	0.06	NTU

a Method Detection Limits are subject to change as new MDL studies are completed.

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
7471A	Method	Soil	Mercury	0.02	0.004	mg/kg
245.1	Method	Water	Mercury	0.2	0.02	ug/L
1631	Method	Water	Mercury	1	0.04	ng/L
7470A	Method	Water	Mercury	0.2	0.02	ug/L
1630	Method	Soil	Methyl Mercury	0.1	0.06	ug/kg
1630	Method	Water	Methyl Mercury	0.1	0.02	ng/L
1630	Method	Tissue	Methyl Mercury	10	4	ug/kg
200.7 (ICP)	Method	Soil	Aluminum	10	10	mg/kg
200.7 (ICP)	Method	Soil	Antimony	10	8	mg/kg
200.7 (ICP)	Method	Soil	Arsenic	40	20	mg/kg
200.7 (ICP)	Method	Soil	Barium	1	0.2	mg/kg
200.7 (ICP)	Method	Soil	Beryllium	1	0.1	mg/kg
200.7 (ICP)	Method	Soil	Boron	10	2	mg/kg
200.7 (ICP)	Method	Soil	Cadmium	1	0.8	mg/kg
200.7 (ICP)	Method	Soil	Calcium	10	3	mg/kg
200.7 (ICP)	Method	Soil	Chromium	2	0.6	mg/kg
200.7 (ICP)	Method	Soil	Cobalt	2	2	mg/kg
200.7 (ICP)	Method	Soil	Copper	2	2	mg/kg
200.7 (ICP)	Method	Soil	Iron	4	3	mg/kg
200.7 (ICP)	Method	Soil	Lead	20	5	mg/kg
200.7 (ICP)	Method	Soil	Lithium	4	2	mg/kg
200.7 (ICP)	Method	Soil	Magnesium	4	2	mg/kg
200.7 (ICP)	Method	Soil	Manganese	1	0.3	mg/kg
200.7 (ICP)	Method	Soil	Molybdenum	2	2	mg/kg
200.7 (ICP)	Method	Soil	Nickel	4	3	mg/kg
200.7 (ICP)	Method	Soil	Phosphorus	40	30	mg/kg
200.7 (ICP)	Method	Soil	Potassium	400	300	mg/kg
200.7 (ICP)	Method	Soil	Selenium	40	20	mg/kg
200.7 (ICP)	Method	Soil	Silver	2	2	mg/kg
200.7 (ICP)	Method	Soil	Sodium	20	10	mg/kg
200.7 (ICP)	Method	Soil	Strontium	2	0.1	mg/kg
200.7 (ICP)	Method	Soil	Thallium	40	30	mg/kg

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
200.7 (ICP)	Method	Soil	Tin	20	6	mg/kg
200.7 (ICP)	Method	Soil	Titanium	2	0.3	mg/kg
200.7 (ICP)	Method	Soil	Vanadium	2	0.9	mg/kg
200.7 (ICP)	Method	Soil	Zinc	2	0.5	mg/kg
200.7 (ICP)	Method	Water	Aluminum	50	40	ug/L
200.7 (ICP)	Method	Water	Antimony	50	40	ug/L
200.7 (ICP)	Method	Water	Arsenic	100	40	ug/L
200.7 (ICP)	Method	Water	Barium	5	2	ug/L
200.7 (ICP)	Method	Water	Beryllium	5	0.4	ug/L
200.7 (ICP)	Method	Water	Boron	50	20	ug/L
200.7 (ICP)	Method	Water	Cadmium	5	5	ug/L
200.7 (ICP)	Method	Water	Calcium	50	20	ug/L
200.7 (ICP)	Method	Water	Chromium	5	3	ug/L
200.7 (ICP)	Method	Water	Cobalt	10	5	ug/L
200.7 (ICP)	Method	Water	Copper	10	7	ug/L
200.7 (ICP)	Method	Water	Iron	20	20	ug/L
200.7 (ICP)	Method	Water	Lead	50	30	ug/L
200.7 (ICP)	Method	Water	Lithium	20	4	ug/L
200.7 (ICP)	Method	Water	Magnesium	20	9	ug/L
200.7 (ICP)	Method	Water	Manganese	5	2	ug/L
200.7 (ICP)	Method	Water	Molybdenum	10	9	ug/L
200.7 (ICP)	Method	Water	Nickel	20	20	ug/L
200.7 (ICP)	Method	Water	Phosphorus	200	100	ug/L
200.7 (ICP)	Method	Water	Potassium	2000	700	ug/L
200.7 (ICP)	Method	Water	Selenium	100	60	ug/L
200.7 (ICP)	Method	Water	Silicon	400	200	ug/L
200.7 (ICP)	Method	Water	Silver	10	9	ug/L
200.7 (ICP)	Method	Water	Sodium	100	60	ug/L
200.7 (ICP)	Method	Water	Strontium	10	10	ug/L
200.7 (ICP)	Method	Water	Thallium	200	200	ug/L
200.7 (ICP)	Method	Water	Tin	100	50	ug/L
200.7 (ICP)	Method	Water	Titanium	10	4	ug/L

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
200.7 (ICP)	Method	Water	Vanadium	10	5	ug/L
200.7 (ICP)	Method	Water	Zinc	10	3	ug/L
200.8	Method	Soil/Sed.	Aluminum	2	2	mg/kg
200.8	Method	Soil/Sed.	Antimony	0.05	0.02	mg/kg
200.8	Method	Soil/Sed.	Arsenic	0.5	0.07	mg/kg
200.8	Method	Soil/Sed.	Barium	0.05	0.03	mg/kg
200.8	Method	Soil/Sed.	Beryllium	0.02	0.006	mg/kg
200.8	Method	Soil/Sed.	Cadmium	0.05	0.007	mg/kg
200.8	Method	Soil/Sed.	Chromium	0.2	0.04	mg/kg
200.8	Method	Soil/Sed.	Cobalt	0.02	0.01	mg/kg
200.8	Method	Soil/Sed.	Copper	0.1	0.02	mg/kg
200.8	Method	Soil/Sed.	Lead	0.05	0.02	mg/kg
200.8	Method	Soil/Sed.	Manganese	0.1	0.04	mg/kg
200.8	Method	Soil/Sed.	Molybdenum	0.05	0.008	mg/kg
200.8	Method	Soil/Sed.	Nickel	0.2	0.04	mg/kg
200.8	Method	Soil/Sed.	Selenium	1	0.2	mg/kg
200.8	Method	Soil/Sed.	Silver	0.02	0.003	mg/kg
200.8	Method	Soil/Sed.	Thallium	0.02	0.002	mg/kg
200.8	Method	Soil/Sed.	Uranium	0.02	0.004	mg/kg
200.8	Method	Soil/Sed.	Vanadium	0.2	0.03	mg/kg
200.8	Method	Soil/Sed.	Zinc	0.5	0.2	mg/kg
200.8	Method	Water	Aluminum	2	0.7	ug/L
200.8	Method	Water	Antimony	0.05	0.02	ug/L
200.8	Method	Water	Arsenic	0.5	0.2	ug/L
200.8	Method	Water	Barium	0.05	0.03	ug/L
200.8	Method	Water	Beryllium	0.02	0.007	ug/L
200.8	Method	Water	Boron	0.5	0.09	ug/L
200.8	Method	Water	Cadmium	0.02	0.02	ug/L
200.8	Method	Water	Chromium	0.2	0.06	ug/L
200.8	Method	Water	Cobalt	0.02	0.01	ug/L
200.8	Method	Water	Copper	0.1	0.03	ug/L
200.8	Method	Water	Lead	0.02	0.009	ug/L

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
200.8	Method	Water	Manganese	0.05	0.02	ug/L
200.8	Method	Water	Molybdenum	0.05	0.02	ug/L
200.8	Method	Water	Nickel	0.2	0.06	ug/L
200.8	Method	Water	Selenium	1	0.2	ug/L
200.8	Method	Water	Silver	0.02	0.009	ug/L
200.8	Method	Water	Thallium	0.02	0.004	ug/L
200.8	Method	Water	Tin	0.1	0.02	ug/L
200.8	Method	Water	Uranium	0.02	0.006	ug/L
200.8	Method	Water	Vanadium	0.2	0.03	ug/L
200.8	Method	Water	Zinc	0.5	0.3	ug/L
200.9	Method	Soil	Arsenic	1	0.2	mg/kg
200.9	Method	Soil	Lead	1	0.2	mg/kg
200.9	Method	Soil	Selenium	1	0.2	mg/kg
200.9	Method	Soil	Thallium	1	0.2	mg/kg
200.9/206.2	Method	Water	Arsenic	5	1	ug/L
200.9/239.2	Method	Water	Lead	2	1	ug/L
200.9/270.2	Method	Water	Selenium	5	1	ug/L
200.9/279.2	Method	Water	Thallium	5	1	ug/L
6010B	3050B	Soil	Aluminum	10	10	mg/kg
6010B	3050B	Soil	Antimony	10	8	mg/kg
6010B	3050B	Soil	Arsenic	40	20	mg/kg
6010B	3050B	Soil	Barium	1	0.2	mg/kg
6010B	3050B	Soil	Beryllium	1	0.1	mg/kg
6010B	3050B	Soil	Boron	10	2	mg/kg
6010B	3050B	Soil	Cadmium	1	0.8	mg/kg
6010B	3050B	Soil	Calcium	10	3	mg/kg
6010B	3050B	Soil	Chromium	2	0.6	mg/kg
6010B	3050B	Soil	Cobalt	2	2	mg/kg
6010B	3050B	Soil	Copper	2	2	mg/kg
6010B	3050B	Soil	Iron	4	3	mg/kg
6010B	3050B	Soil	Lead	20	5	mg/kg
6010B	3050B	Soil	Lithium	4	2	mg/kg

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
6010B	3050B	Soil	Magnesium	4	2	mg/kg
6010B	3050B	Soil	Manganese	1	0.3	mg/kg
6010B	3050B	Soil	Molybdenum	2	2	mg/kg
6010B	3050B	Soil	Nickel	4	3	mg/kg
6010B	3050B	Soil	Phosphorus	40	30	mg/kg
6010B	3050B	Soil	Potassium	400	300	mg/kg
6010B	3050B	Soil	Selenium	40	20	mg/kg
6010B	3050B	Soil	Silver	2	2	mg/kg
6010B	3050B	Soil	Sodium	20	10	mg/kg
6010B	3050B	Soil	Strontium	2	0.1	mg/kg
6010B	3050B	Soil	Thallium	40	30	mg/kg
6010B	3050B	Soil	Tin	20	6	mg/kg
6010B	3050B	Soil	Titanium	2	0.3	mg/kg
6010B	3050B	Soil	Vanadium	2	0.9	mg/kg
6010B	3050B	Soil	Zinc	2	0.5	mg/kg
6010B	CLP	Water	Aluminum	50	40	ug/L
6010B	CLP	Water	Antimony	50	40	ug/L
6010B	CLP	Water	Arsenic	100	40	ug/L
6010B	CLP	Water	Barium	5	2	ug/L
6010B	CLP	Water	Beryllium	5	0.4	ug/L
6010B	CLP	Water	Boron	50	20	ug/L
6010B	CLP	Water	Cadmium	5	5	ug/L
6010B	CLP	Water	Calcium	50	20	ug/L
6010B	CLP	Water	Chromium	5	3	ug/L
6010B	CLP	Water	Cobalt	10	5	ug/L
6010B	CLP	Water	Copper	10	7	ug/L
6010B	CLP	Water	Iron	20	20	ug/L
6010B	CLP	Water	Lead	50	30	ug/L
6010B	CLP	Water	Lithium	20	4	ug/L
6010B	CLP	Water	Magnesium	20	9	ug/L
6010B	CLP	Water	Manganese	5	2	ug/L
6010B	CLP	Water	Molybdenum	10	9	ug/L

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
6010B	CLP	Water	Nickel	20	20	ug/L
6010B	CLP	Water	Phosphorus	200	100	ug/L
6010B	CLP	Water	Potassium	2000	700	ug/L
6010B	CLP	Water	Selenium	100	60	ug/L
6010B	CLP	Water	Silicon	400	200	ug/L
6010B	CLP	Water	Silver	10	9	ug/L
6010B	CLP	Water	Sodium	100	60	ug/L
6010B	CLP	Water	Strontium	10	10	ug/L
6010B	CLP	Water	Thallium	200	200	ug/L
6010B	CLP	Water	Tin	100	50	ug/L
6010B	CLP	Water	Titanium	10	4	ug/L
6010B	CLP	Water	Vanadium	10	5	ug/L
6010B	CLP	Water	Zinc	10	3	ug/L
6020	3050B	Soil/Sed.	Aluminum	2	2	mg/kg
6020	3050B	Soil/Sed.	Antimony	0.05	0.02	mg/kg
6020	3050B	Soil/Sed.	Arsenic	0.5	0.07	mg/kg
6020	3050B	Soil/Sed.	Barium	0.05	0.03	mg/kg
6020	3050B	Soil/Sed.	Beryllium	0.02	0.006	mg/kg
6020	3050B	Soil/Sed.	Cadmium	0.05	0.007	mg/kg
6020	3050B	Soil/Sed.	Chromium	0.2	0.04	mg/kg
6020	3050B	Soil/Sed.	Cobalt	0.02	0.01	mg/kg
6020	3050B	Soil/Sed.	Copper	0.1	0.02	mg/kg
6020	3050B	Soil/Sed.	Lead	0.05	0.02	mg/kg
6020	3050B	Soil/Sed.	Manganese	0.1	0.04	mg/kg
6020	3050B	Soil/Sed.	Molybdenum	0.05	0.008	mg/kg
6020	3050B	Soil/Sed.	Nickel	0.2	0.04	mg/kg
6020	3050B	Soil/Sed.	Selenium	1	0.2	mg/kg
6020	3050B	Soil/Sed.	Silver	0.02	0.003	mg/kg
6020	3050B	Soil/Sed.	Thallium	0.02	0.002	mg/kg
6020	3050B	Soil/Sed.	Uranium	0.02	0.004	mg/kg
6020	3050B	Soil/Sed.	Vanadium	0.2	0.03	mg/kg
6020	3050B	Soil/Sed.	Zinc	0.5	0.2	mg/kg
6020	CLP	Water	Aluminum	2	0.7	ug/L

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
6020	CLP	Water	Antimony	0.05	0.02	ug/L
6020	CLP	Water	Arsenic	0.5	0.2	ug/L
6020	CLP	Water	Barium	0.05	0.03	ug/L
6020	CLP	Water	Beryllium	0.02	0.007	ug/L
6020	CLP	Water	Boron	0.5	0.9	ug/L
6020	CLP	Water	Cadmium	0.02	0.2	ug/L
6020	CLP	Water	Chromium	0.2	0.06	ug/L
6020	CLP	Water	Cobalt	0.02	0.1	ug/L
6020	CLP	Water	Copper	0.1	0.03	ug/L
6020	CLP	Water	Lead	0.02	0.009	ug/L
6020	CLP	Water	Manganese	0.05	0.02	ug/L
6020	CLP	Water	Molybdenum	0.05	0.02	ug/L
6020	CLP	Water	Nickel	0.2	0.06	ug/L
6020	CLP	Water	Selenium	1	0.2	ug/L
6020	CLP	Water	Silver	0.02	0.009	ug/L
6020	CLP	Water	Thallium	0.2	0.004	ug/L
6020	CLP	Water	Tin	0.1	0.02	ug/L
6020	CLP	Water	Uranium	0.02	0.006	ug/L
6020	CLP	Water	Vanadium	0.2	0.03	ug/L
6020	CLP	Water	Zinc	0.5	0.3	ug/L
7060A	3050B	Soil	Arsenic	1	0.2	mg/kg
7421	3050B	Soil	Lead	1	0.2	mg/kg
7740	3050B	Soil	Selenium	1	0.2	mg/kg
7742/*SM* 3114B	3050B	Soil	Selenium	0.1	0.02	mg/kg
7841	3050B	Soil	Thallium	1	0.2	mg/kg
7060A	CLP/3020A	Water	Arsenic	5	1	ug/L
7421	CLP/3020A	Water	Lead	2	1	ug/L
7740	CLP/3020A	Water	Selenium	5	1	ug/L
7742/*SM* 3114B	3010A	Water	Selenium	1	0.3	ug/L
7841	CLP/3020A	Water	Thallium	5	1	ug/L

a Method Detection Limits are subject to change as new MDL studies are completed.

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
1664	Method	Water	Hexane Extractable Material	5	0.64	mg/L
1664	Method	Water	Hexane Extractable Material - SGT	5	0.61	mg/L
1664	9071A	Soil	Hexane Extractable Material	100	60	mg/kg
1664	9071A	Soil	Hexane Extractable Material - SGT	100	50	mg/kg
600/4-81-045	Method	Oil	Aroclor 1016	1		mg/kg
600/4-81-045	Method	Oil	Aroclor 1221	2		mg/kg
600/4-81-045	Method	Oil	Aroclor 1232	1		mg/kg
600/4-81-045	Method	Oil	Aroclor 1242	1		mg/kg
600/4-81-045	Method	Oil	Aroclor 1248	1		mg/kg
600/4-81-045	Method	Oil	Aroclor 1254	1		mg/kg
600/4-81-045	Method	Oil	Aroclor 1260	1		mg/kg
608	3520C	Water	4,4'-DDD	0.01	0.0038	ug/L
608	3520C	Water	4,4'-DDE	0.01	0.005	ug/L
608	3520C	Water	4,4'-DDT	0.01	0.0063	ug/L
608	3520C	Water	Aldrin	0.01	0.0032	ug/L
608	3520C	Water	alpha-BHC	0.01	0.0037	ug/L
608	3520C	Water	alpha-Chlordane	0.01		ug/L
608	3520C	Water	beta-BHC	0.01	0.0051	ug/L
608	3520C	Water	Chlordane	0.2	0.027	ug/L
608	3520C	Water	delta-BHC	0.01	0.0041	ug/L
608	3520C	Water	Dieldrin	0.01	0.0037	ug/L
608	3520C	Water	Endosulfan I	0.01	0.0041	ug/L
608	3520C	Water	Endosulfan II	0.01	0.0039	ug/L
608	3520C	Water	Endosulfan Sulfate	0.01	0.0039	ug/L
608	3520C	Water	Endrin	0.01	0.0049	ug/L
608	3520C	Water	Endrin Aldehyde	0.01	0.0043	ug/L
608	3520C	Water	Endrin Ketone	0.01		ug/L
608	3520C	Water	gamma-BHC (Lindane)	0.01	0.0037	ug/L
608	3520C	Water	gamma-Chlordane	0.01		ug/L
608	3520C	Water	Heptachlor	0.01	0.0039	ug/L
608	3520C	Water	Heptachlor Epoxide	0.01	0.0039	ug/L
608	3520C	Water	Methoxychlor	0.01		ug/L
608	3520C	Water	Toxaphene	0.5	0.13	ug/L
608	3520C	Water	Aroclor 1016	0.1	0.10	ug/L
608	3520C	Water	Aroclor 1221	0.1	0.064	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
608	3520C	Water	Aroclor 1232	0.1	0.043	ug/L
608	3520C	Water	Aroclor 1242	0.1	0.084	ug/L
608	3520C	Water	Aroclor 1248	0.1	0.017	ug/L
608	3520C	Water	Aroclor 1254	0.1	0.0084	ug/L
608	3520C	Water	Aroclor 1260	0.1	0.021	ug/L
608	3520C	Water	Aroclor 1262	0.1	0.028	ug/L
608	3520C	Water	Aroclor 1268	0.1	0.021	ug/L
625	3510C/3520C	Water	1,2,4,5-Tetrachlorobenzene	10	0.51	ug/L
625	3510C/3520C	Water	1,2,4-Trichlorobenzene	10	0.58	ug/L
625	3510C/3520C	Water	1,2-Dichlorobenzene	10	0.71	ug/L
625	3510C/3520C	Water	1,2-Diphenylhydrazine	10	0.65	ug/L
625	3510C/3520C	Water	1,3-Dichlorobenzene	10	0.70	ug/L
625	3510C/3520C	Water	1,4-Dichlorobenzene	10	0.62	ug/L
625	3510C/3520C	Water	2,3,5,6-Tetrachlorophenol	10	0.62	ug/L
625	3510C/3520C	Water	2,4,6-Trichlorophenol	10	0.35	ug/L
625	3510C/3520C	Water	2,4-Dichlorophenol	10	0.36	ug/L
625	3510C/3520C	Water	2,4-Dimethylphenol	10	1.5	ug/L
625	3510C/3520C	Water	2,4-Dinitrophenol	25	2.6	ug/L
625	3510C/3520C	Water	2,4-Dinitrotoluene	10	1.7	ug/L
625	3510C/3520C	Water	2,6-Dinitrotoluene	10	0.52	ug/L
625	3510C/3520C	Water	2-Chloronaphthalene	10	0.58	ug/L
625	3510C/3520C	Water	2-Chlorophenol	10	0.32	ug/L
625	3510C/3520C	Water	2-Methyl-4,6-dinitrophenol	25	1.9	ug/L
625	3510C/3520C	Water	2-Nitrophenol	10	0.31	ug/L
625	3510C/3520C	Water	3,3'-Dichlorobenzidine	25	1.1	ug/L
625	3510C/3520C	Water	4-Bromophenyl Phenyl Ether	10	0.38	ug/L
625	3510C/3520C	Water	4-Chloro-3-methylphenol	10	0.41	ug/L
625	3510C/3520C	Water	4-Chlorophenyl Phenyl Ether	10	0.34	ug/L
625	3510C/3520C	Water	4-Methylphenol	10	0.68	ug/L
625	3510C/3520C	Water	4-Nitrophenol	25	2.9	ug/L
625	3510C/3520C	Water	Acenaphthene	10	0.53	ug/L
625	3510C/3520C	Water	Acenaphthylene	10	0.42	ug/L
625	3510C/3520C	Water	Anthracene	10	0.35	ug/L
625	3510C/3520C	Water	Benz(a)anthracene	10	0.31	ug/L
625	3510C/3520C	Water	Benzidine	50	37	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
625	3510C/3520C	Water	Benzo(a)pyrene	10	0.36	ug/L
625	3510C/3520C	Water	Benzo(b)fluoranthene	10	0.40	ug/L
625	3510C/3520C	Water	Benzo(g,h,i)perylene	10	0.39	ug/L
625	3510C/3520C	Water	Benzo(k)fluoranthene	10	0.45	ug/L
625	3510C/3520C	Water	Bis(2-chloroethoxy)methane	10	0.77	ug/L
625	3510C/3520C	Water	Bis(2-chloroethyl) Ether	10	0.39	ug/L
625	3510C/3520C	Water	Bis(2-chloroisopropyl) Ether	10	0.36	ug/L
625	3510C/3520C	Water	Bis(2-ethylhexyl) Phthalate	10	0.39	ug/L
625	3510C/3520C	Water	Butyl Benzyl Phthalate	10	0.24	ug/L
625	3510C/3520C	Water	Chrysene	10	0.33	ug/L
625	3510C/3520C	Water	Dibenz(a,h)anthracene	10	0.35	ug/L
625	3510C/3520C	Water	Diethyl Phthalate	10	0.41	ug/L
625	3510C/3520C	Water	Dimethyl Phthalate	10	0.36	ug/L
625	3510C/3520C	Water	Di-n-butyl Phthalate	10	0.54	ug/L
625	3510C/3520C	Water	Di-n-octyl Phthalate	10	0.30	ug/L
625	3510C/3520C	Water	Fluoranthene	10	0.37	ug/L
625	3510C/3520C	Water	Fluorene	10	0.34	ug/L
625	3510C/3520C	Water	Hexachlorobenzene	10	0.30	ug/L
625	3510C/3520C	Water	Hexachlorobutadiene	10	0.50	ug/L
625	3510C/3520C	Water	Hexachlorocyclopentadiene	10	0.35	ug/L
625	3510C/3520C	Water	Hexachloroethane	10	0.61	ug/L
625	3510C/3520C	Water	Indeno(1,2,3-cd)pyrene	10	0.56	ug/L
625	3510C/3520C	Water	Isophorone	10	0.37	ug/L
625	3510C/3520C	Water	Naphthalene	10	0.65	ug/L
625	3510C/3520C	Water	Nitrobenzene	10	0.44	ug/L
625	3510C/3520C	Water	N-Nitrosodiethylamine	10	0.66	ug/L
625	3510C/3520C	Water	N-Nitrosodimethylamine	25	0.50	ug/L
625	3510C/3520C	Water	N-Nitrosodi-n-butylamine	10	0.56	ug/L
625	3510C/3520C	Water	N-Nitrosodi-n-propylamine	10	0.45	ug/L
625	3510C/3520C	Water	N-Nitrosodiphenylamine	10	0.45	ug/L
625	3510C/3520C	Water	N-Nitrosopyrrolidine	10	0.61	ug/L
625	3510C/3520C	Water	Pentachlorobenzene	10	0.54	ug/L
625	3510C/3520C	Water	Pentachlorophenol	25	2.0	ug/L
625	3510C/3520C	Water	Phenanthrene	10	0.36	ug/L
625	3510C/3520C	Water	Phenol	10	0.47	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
625	3510C/3520C	Water	Pyrene	10	0.33	ug/L
1653	Method	Water	2,3,4,6-Tetrachlorophenol	2.5	0.38	ug/L
1653	Method	Water	2,4,5-Trichlorophenol	2.5	0.57	ug/L
1653	Method	Water	2,4,6-Trichlorophenol	2.5	0.71	ug/L
1653	Method	Water	2,4-Dichlorophenol	2.5	0.15	ug/L
1653	Method	Water	2,6-Dichlorophenol	2.5	1.39	ug/L
1653	Method	Water	2,6-Dichlorosyringaldehyde	5.0	1.13	ug/L
1653	Method	Water	2-Chlorosyringaldehyde	2.5	0.87	ug/L
1653	Method	Water	3,4,5-Trichlorocatechol	5.0	0.53	ug/L
1653	Method	Water	3,4,5-Trichloroguaiacol	2.5	0.49	ug/L
1653	Method	Water	3,4,6-Trichlorocatechol	5.0	0.44	ug/L
1653	Method	Water	3,4,6-Trichloroguaiacol	2.5	0.46	ug/L
1653	Method	Water	3,4-Dichlorocatechol	2.5	0.60	ug/L
1653	Method	Water	3,4-Dichloroguaiacol	2.5	0.52	ug/L
1653	Method	Water	3,6-Dichlorocatechol	2.5	0.57	ug/L
1653	Method	Water	4,5,6-Trichloroguaiacol	2.5	0.25	ug/L
1653	Method	Water	4,5-Dichlorocatechol	2.5	0.24	ug/L
1653	Method	Water	4,5-Dichloroguaiacol	2.5	0.52	ug/L
1653	Method	Water	4,6-Dichloroguaiacol	2.5	0.45	ug/L
1653	Method	Water	4-Chlorocatechol	1.25	0.59	ug/L
1653	Method	Water	4-Chloroguaiacol	1.25	0.09	ug/L
1653	Method	Water	4-Chlorophenol	1.25	1.11	ug/L
1653	Method	Water	5,6-Dichlorovanillin	5.0	0.80	ug/L
1653	Method	Water	5-Chlorovanillin	2.5	1.01	ug/L
1653	Method	Water	6-Chlorovanillin	2.5	0.94	ug/L
1653	Method	Water	Pentachlorophenol	5.0	0.28	ug/L
1653	Method	Water	Tetrachlorocatechol	5.0	0.76	ug/L
1653	Method	Water	Tetrachloroguaiacol	5.0	0.23	ug/L
1653	Method	Water	Trichlorosyringol	2.5	0.64	ug/L
8015B	Method	Water	Ethylene Glycol	5	1.2	mg/L
8015B	Method	Water	Propylene Glycol	5	1.8	mg/L
8015B	Method	Water	Isopropyl Ether	1	0.32	mg/L
8081A	3545	Soil	2,4'-DDD	5	0.42	ug/kg
8081A	3545	Soil	2,4'-DDE	5	0.52	ug/kg
8081A	3545	Soil	2,4'-DDT	5	0.51	ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8081A	3545	Soil	4,4'-DDD	5	0.43	ug/kg
8081A	3545	Soil	4,4'-DDE	5	0.34	ug/kg
8081A	3545	Soil	4,4'-DDT	5	0.47	ug/kg
8081A	3545	Soil	Aldrin	5	0.33	ug/kg
8081A	3545	Soil	alpha-BHC	5	0.29	ug/kg
8081A	3545	Soil	alpha-Chlordane	5	0.55	ug/kg
8081A	3545	Soil	beta-BHC	5	0.78	ug/kg
8081A	3545	Soil	Chlordane	100	3.9	ug/kg
8081A	3545	Soil	Chlorpyrifos	5	0.43	ug/kg
8081A	3545	Soil	cis-Nonachlor	5	0.57	ug/kg
8081A	3545	Soil	delta-BHC	5	0.48	ug/kg
8081A	3545	Soil	Dieldrin	5	0.63	ug/kg
8081A	3545	Soil	Endosulfan I	5	0.31	ug/kg
8081A	3545	Soil	Endosulfan II	5	0.31	ug/kg
8081A	3545	Soil	Endosulfan Sulfate	5	0.49	ug/kg
8081A	3545	Soil	Endrin	5	0.36	ug/kg
8081A	3545	Soil	Endrin Aldehyde	5	0.37	ug/kg
8081A	3545	Soil	Endrin Ketone	5	0.54	ug/kg
8081A	3545	Soil	gamma-BHC (Lindane)	5	0.58	ug/kg
8081A	3545	Soil	gamma-Chlordane	5	0.40	ug/kg
8081A	3545	Soil	Heptachlor	5	0.42	ug/kg
8081A	3545	Soil	Heptachlor Epoxide	5	0.63	ug/kg
8081A	3545	Soil	Hexachlorobenzene	5	1.4	ug/kg
8081A	3545	Soil	Hexachlorobutadiene	5	1.0	ug/kg
8081A	3545	Soil	Hexachloroethane	5	0.83	ug/kg
8081A	3545	Soil	Isodrin	5	0.66	ug/kg
8081A	3545	Soil	Methoxychlor	5	0.59	ug/kg
8081A	3545	Soil	Mirex	5	0.29	ug/kg
8081A	3545	Soil	Oxychlordane	5	0.32	ug/kg
8081A	3545	Soil	Toxaphene	250	9.7	ug/kg
8081A	3545	Soil	trans-Nonachlor	5	0.25	ug/kg
8081A	3540C	Soil-Low	2,4'-DDD	1.0	0.12	ug/kg
8081A	3540C	Soil-Low	2,4'-DDE	1.0	0.32	ug/kg
8081A	3540C	Soil-Low	2,4'-DDT	1.0	0.13	ug/kg
8081A	3540C	Soil-Low	4,4'-DDD	1.0	0.12	ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8081A	3540C	Soil-Low	4,4'-DDE	1.0	0.10	ug/kg
8081A	3540C	Soil-Low	4,4'-DDT	1.0	0.064	ug/kg
8081A	3540C	Soil-Low	Aldrin	1.0	0.15	ug/kg
8081A	3540C	Soil-Low	alpha-BHC	1.0	0.26	ug/kg
8081A	3540C	Soil-Low	alpha-Chlordane	1.0	0.23	ug/kg
8081A	3540C	Soil-Low	beta-BHC	1.0	0.30	ug/kg
8081A	3540C	Soil-Low	Chlordane	10	1.4	ug/kg
8081A	3540C	Soil-Low	Chlorpyrifos	1.0	0.054	ug/kg
8081A	3540C	Soil-Low	cis-Nonachlor	1.0	0.083	ug/kg
8081A	3540C	Soil-Low	delta-BHC	1.0	0.055	ug/kg
8081A	3540C	Soil-Low	Dieldrin	1.0	0.29	ug/kg
8081A	3540C	Soil-Low	Endosulfan I	1.0	0.17	ug/kg
8081A	3540C	Soil-Low	Endosulfan II	1.0	0.19	ug/kg
8081A	3540C	Soil-Low	Endosulfan Sulfate	1.0	0.079	ug/kg
8081A	3540C	Soil-Low	Endrin	1.0	0.20	ug/kg
8081A	3540C	Soil-Low	Endrin Aldehyde	1.0	0.053	ug/kg
8081A	3540C	Soil-Low	Endrin Ketone	1.0	0.082	ug/kg
8081A	3540C	Soil-Low	gamma-BHC (Lindane)	1.0	0.15	ug/kg
8081A	3540C	Soil-Low	gamma-Chlordane	1.0	0.064	ug/kg
8081A	3540C	Soil-Low	Heptachlor	1.0	0.080	ug/kg
8081A	3540C	Soil-Low	Heptachlor Epoxide	1.0	0.13	ug/kg
8081A	3540C	Soil-Low	Hexachlorobenzene	1.0	0.079	ug/kg
8081A	3540C	Soil-Low	Hexachlorobutadiene	1.0	0.49	ug/kg
8081A	3540C	Soil-Low	Hexachlorocyclopentadiene	1.0	0.39	ug/kg
8081A	3540C	Soil-Low	Hexachloroethane	1.0	0.16	ug/kg
8081A	3540C	Soil-Low	Isodrin	1.0	0.097	ug/kg
8081A	3540C	Soil-Low	Methoxychlor	1.0	0.10	ug/kg
8081A	3540C	Soil-Low	Mirex	1.0	0.10	ug/kg
8081A	3540C	Soil-Low	Oxychlordane	1.0	0.37	ug/kg
8081A	3540C	Soil-Low	Toxaphene	50	4.9	ug/kg
8081A	3540C	Soil-Low	trans-Nonachlor	1.0	0.089	ug/kg
8081A	3535	Water	2,4'-DDD	0.01	0.00078	ug/L
8081A	3535	Water	2,4'-DDE	0.01	0.0016	ug/L
8081A	3535	Water	2,4'-DDT	0.01	0.00089	ug/L
8081A	3535	Water	4,4'-DDD	0.01	0.0010	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8081A	3535	Water	4,4'-DDE	0.01	0.00053	ug/L
8081A	3535	Water	4,4'-DDT	0.01	0.0014	ug/L
8081A	3535	Water	Aldrin	0.01	0.00083	ug/L
8081A	3535	Water	alpha-BHC	0.01	0.0025	ug/L
8081A	3535	Water	alpha-Chlordane	0.01	0.00058	ug/L
8081A	3535	Water	beta-BHC	0.01	0.00091	ug/L
8081A	3535	Water	Chlordane	0.2	0.022	ug/L
8081A	3535	Water	Chlorpyrifos	0.01	0.0012	ug/L
8081A	3535	Water	cis-Nonachlor	0.01	0.00093	ug/L
8081A	3535	Water	delta-BHC	0.01	0.00048	ug/L
8081A	3535	Water	Dieldrin	0.01	0.00045	ug/L
8081A	3535	Water	Endosulfan I	0.01	0.00050	ug/L
8081A	3535	Water	Endosulfan II	0.01	0.00094	ug/L
8081A	3535	Water	Endosulfan Sulfate	0.01	0.00078	ug/L
8081A	3535	Water	Endrin	0.01	0.00049	ug/L
8081A	3535	Water	Endrin Aldehyde	0.01	0.00068	ug/L
8081A	3535	Water	Endrin Ketone	0.01	0.00062	ug/L
8081A	3535	Water	gamma-BHC (Lindane)	0.01	0.0014	ug/L
8081A	3535	Water	gamma-Chlordane	0.01	0.00029	ug/L
8081A	3535	Water	Heptachlor	0.01	0.00048	ug/L
8081A	3535	Water	Heptachlor Epoxide	0.01	0.0011	ug/L
8081A	3535	Water	Hexachlorobenzene	0.01	0.0011	ug/L
8081A	3535	Water	Hexachlorobutadiene	0.01	0.0067	ug/L
8081A	3535	Water	Hexachlorocyclopentadiene	0.01	0.01	ug/L
8081A	3535	Water	Hexachloroethane	0.01	0.0032	ug/L
8081A	3535	Water	Isodrin	0.01	0.0011	ug/L
8081A	3535	Water	Methoxychlor	0.01	0.0015	ug/L
8081A	3535	Water	Mirex	0.01	0.0012	ug/L
8081A	3535	Water	Oxychlordane	0.01	0.0032	ug/L
8081A	3535	Water	Toxaphene	0.5	0.14	ug/L
8081A	3535	Water	trans-Nonachlor	0.01	0.0013	ug/L
8081A	3520C	Water-Low	2,4'-DDD	0.5	0.060	ng/L
8081A	3520C	Water-Low	2,4'-DDE	0.5	0.047	ng/L
8081A	3520C	Water-Low	2,4'-DDT	0.5	0.12	ng/L
8081A	3520C	Water-Low	4,4'-DDD	0.5	0.047	ng/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8081A	3520C	Water-Low	4,4'-DDE	0.5	0.12	ng/L
8081A	3520C	Water-Low	4,4'-DDT	0.5	0.047	ng/L
8081A	3520C	Water-Low	Aldrin	0.5	0.14	ng/L
8081A	3520C	Water-Low	alpha-BHC	0.5	0.25	ng/L
8081A	3520C	Water-Low	alpha-Chlordane	0.5	0.044	ng/L
8081A	3520C	Water-Low	beta-BHC	0.5		ng/L
8081A	3520C	Water-Low	Chlordane	5		ng/L
8081A	3520C	Water-Low	Chlorpyrifos	0.5		ng/L
8081A	3520C	Water-Low	cis-Nonachlor	0.5		ng/L
8081A	3520C	Water-Low	delta-BHC	0.5	0.062	ng/L
8081A	3520C	Water-Low	Dieldrin	0.5	0.056	ng/L
8081A	3520C	Water-Low	Endosulfan I	0.5	0.10	ng/L
8081A	3520C	Water-Low	Endosulfan II	0.5	0.063	ng/L
8081A	3520C	Water-Low	Endosulfan Sulfate	0.5	0.13	ng/L
8081A	3520C	Water-Low	Endrin	0.5	0.054	ng/L
8081A	3520C	Water-Low	Endrin Aldehyde	0.5	0.038	ng/L
8081A	3520C	Water-Low	Endrin Ketone	0.5	0.030	ng/L
8081A	3520C	Water-Low	gamma-BHC (Lindane)	0.5	0.20	ng/L
8081A	3520C	Water-Low	gamma-Chlordane	0.5	0.065	ng/L
8081A	3520C	Water-Low	Heptachlor	0.5	0.073	ng/L
8081A	3520C	Water-Low	Heptachlor Epoxide	0.5	0.21	ng/L
8081A	3520C	Water-Low	Hexachlorobenzene	0.5	0.13	ng/L
8081A	3520C	Water-Low	Hexachlorobutadiene	0.5		ng/L
8081A	3520C	Water-Low	Hexachloroethane	0.5		ng/L
8081A	3520C	Water-Low	Isodrin	0.5	0.15	ng/L
8081A	3520C	Water-Low	Methoxychlor	0.5	0.17	ng/L
8081A	3520C	Water-Low	Mirex	0.5		ng/L
8081A	3520C	Water-Low	Oxychlordane	0.5		ng/L
8081A	3520C	Water-Low	Toxaphene	25	13	ng/L
8081A	3520C	Water-Low	trans-Nonachlor	0.5		ng/L
8082 Aroclors	3545	Soil	Aroclor 1016	0.10	0.013	mg/kg
8082 Aroclors	3545	Soil	Aroclor 1221	0.20	0.02	mg/kg
8082 Aroclors	3545	Soil	Aroclor 1232	0.10	0.025	mg/kg
8082 Aroclors	3545	Soil	Aroclor 1242	0.10	0.01	mg/kg
8082 Aroclors	3545	Soil	Aroclor 1248	0.10	0.013	mg/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Aroclors	3545	Soil	Aroclor 1254	0.10	0.015	mg/kg
8082 Aroclors	3545	Soil	Aroclor 1260	0.10	0.0071	mg/kg
8082 Aroclors	3545	Soil	Aroclor 1262	0.10	0.0058	mg/kg
8082 Aroclors	3545	Soil	Aroclor 1268	0.10	0.00057	mg/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1016	10	1.6	ug/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1221	20	1.6	ug/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1232	10	1.6	ug/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1242	10	1.6	ug/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1248	10	1.6	ug/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1254	10	1.6	ug/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1260	10	1.6	ug/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1262	10	1.6	ug/kg
8082 Aroclors	3540C	Soil-Low	Aroclor 1268	10	1.6	ug/kg
8082 Aroclors	3535	Water	Aroclor 1016	0.2	0.012	ug/L
8082 Aroclors	3535	Water	Aroclor 1221	0.4	0.054	ug/L
8082 Aroclors	3535	Water	Aroclor 1232	0.2	0.028	ug/L
8082 Aroclors	3535	Water	Aroclor 1242	0.2	0.019	ug/L
8082 Aroclors	3535	Water	Aroclor 1248	0.2	0.025	ug/L
8082 Aroclors	3535	Water	Aroclor 1254	0.2	0.01	ug/L
8082 Aroclors	3535	Water	Aroclor 1260	0.2	0.0085	ug/L
8082 Aroclors	3535	Water	Aroclor 1262	0.2	0.016	ug/L
8082 Aroclors	3535	Water	Aroclor 1268	0.2	0.015	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1016	0.005	0.0024	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1221	0.010	0.0024	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1232	0.005	0.0024	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1242	0.005	0.0024	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1248	0.005	0.0024	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1254	0.005	0.0024	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1260	0.005	0.0024	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1262	0.005	0.0024	ug/L
8082 Aroclors	3520C	Water-Low	Aroclor 1268	0.005	0.0024	ug/L
8082 Congeners	3540C	Soil	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (PCB206)	0.50	.095	ug/kg
8082 Congeners	3540C	Soil	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (PCB194)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB195)	0.50	.134	ug/kg
8082 Congeners	3540C	Soil	2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB170)	0.50	.062	ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Congeners	3540C	Soil	2,2',3,3',4,4'-Hexachlorobiphenyl (PCB128)	0.50	.290	ug/kg
8082 Congeners	3540C	Soil	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (PCB201)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,3',4',5,6-Heptachlorobiphenyl (PCB177)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,3',4,5,6'-Heptachlorobiphenyl (PCB174)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,3',4,6'-Hexachlorobiphenyl (PCB132)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4,4',5,5',6-Octachlorobiphenyl (PCB203)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB180)	0.50	.035	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB183)	0.50	.086	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4,4',5'-Hexachlorobiphenyl (PCB138)	0.50	.042	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4,4',6,6'-Heptachlorobiphenyl (PCB184)	0.50	.045	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB187)	0.50	.134	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4,5,5'-Hexachlorobiphenyl (PCB141)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4',5',6-Hexachlorobiphenyl (PCB149)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3',4,5-Pentachlorobiphenyl (PCB97)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4',5-Pentachlorobiphenyl (PCB90)	0.50	.045	ug/kg
8082 Congeners	3540C	Soil	2,2',3,4,5'-Pentachlorobiphenyl (PCB87)	0.50	.072	ug/kg
8082 Congeners	3540C	Soil	2,2',3,5,5',6-Hexachlorobiphenyl (PCB151)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,5',6-Pentachlorobiphenyl (PCB95)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',3,5'-Tetrachlorobiphenyl (PCB44)	0.50	.054	ug/kg
8082 Congeners	3540C	Soil	2,2',4,4',5,5'-Hexachlorobiphenyl (PCB153)	0.50	.104	ug/kg
8082 Congeners	3540C	Soil	2,2',4,4',5-Pentachlorobiphenyl (PCB99)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',4,5,5'-Pentachlorobiphenyl (PCB101)	0.50	.034	ug/kg
8082 Congeners	3540C	Soil	2,2',4,5'-Tetrachlorobiphenyl (PCB49)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,2',5,5'-Tetrachlorobiphenyl (PCB52)	0.50	.110	ug/kg
8082 Congeners	3540C	Soil	2,2',5-Trichlorobiphenyl (PCB18)	0.50	.053	ug/kg
8082 Congeners	3540C	Soil	2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB189)	0.50	.094	ug/kg
8082 Congeners	3540C	Soil	2,3,3',4,4',5'-Hexachlorobiphenyl (PCB157)	0.50	.195	ug/kg
8082 Congeners	3540C	Soil	2,3,3',4,4',5-Hexachlorobiphenyl (PCB156)	0.50	.093	ug/kg
8082 Congeners	3540C	Soil	2,3,3',4,4',6-Hexachlorobiphenyl (PCB158)	0.50	.041	ug/kg
8082 Congeners	3540C	Soil	2,3,3',4,4'-Pentachlorobiphenyl (PCB105)	0.50	.093	ug/kg
8082 Congeners	3540C	Soil	2,3,3',4',6-Pentachlorobiphenyl (PCB110)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,3,3',4'-Tetrachlorobiphenyl (PCB56)	0.50	.074	ug/kg
8082 Congeners	3540C	Soil	2,3',4,4',5,5'-Hexachlorobiphenyl (PCB167)	0.70	.328	ug/kg
8082 Congeners	3540C	Soil	2,3,4,4',5,6-Hexachlorobiphenyl (PCB166)	0.50	.106	ug/kg
8082 Congeners	3540C	Soil	2,3',4,4',5',6-Hexachlorobiphenyl (PCB168)	0.50	.25	ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Congeners	3540C	Soil	2,3,4,4',5-Pentachlorobiphenyl (PCB114)	0.50	.316	ug/kg
8082 Congeners	3540C	Soil	2',3,4,4',5-Pentachlorobiphenyl (PCB123)	0.50	.080	ug/kg
8082 Congeners	3540C	Soil	2,3',4,4',5-Pentachlorobiphenyl (PCB118)	0.50	.042	ug/kg
8082 Congeners	3540C	Soil	2,3',4,4',6-Pentachlorobiphenyl (PCB119)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,3,4,4'-Tetrachlorobiphenyl (PCB60)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,3',4,4'-Tetrachlorobiphenyl (PCB66)	0.50	.117	ug/kg
8082 Congeners	3540C	Soil	2,3',4',5-Tetrachlorobiphenyl (PCB70)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2',3,4-Trichlorobiphenyl (PCB33)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,3-Dichlorobiphenyl (PCB5)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,4,4',5-Tetrachlorobiphenyl (PCB74)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,4,4'-Trichlorobiphenyl (PCB28)	0.50	.072	ug/kg
8082 Congeners	3540C	Soil	2,4',5-Trichlorobiphenyl (PCB31)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	2,4'-Dichlorobiphenyl (PCB8)	0.50	.110	ug/kg
8082 Congeners	3540C	Soil	2-Chlorobiphenyl (PCB1)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	3,3',4,4',5,5'-Hexachlorobiphenyl (PCB169)	0.50	.133	ug/kg
8082 Congeners	3540C	Soil	3,3',4,4',5-Pentachlorobiphenyl (PCB126)	0.50	.140	ug/kg
8082 Congeners	3540C	Soil	3,3',4,4'-Tetrachlorobiphenyl (PCB77)	0.50	.05	ug/kg
8082 Congeners	3540C	Soil	3,4,4',5-Tetrachlorobiphenyl (PCB81)	0.50	.096	ug/kg
8082 Congeners	3540C	Soil	3,4,4'-Trichlorobiphenyl (PCB37)	0.50	.25	ug/kg
8082 Congeners	3540C	Soil	Decachlorobiphenyl (PCB209)	0.50	.055	ug/kg
8082 Congeners	3520C	Water	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (PCB206)	5	0.20	ng/L
8082 Congeners	3520C	Water	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (PCB194)	5	1.6	ng/L
8082 Congeners	3520C	Water	2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB195)	5	0.29	ng/L
8082 Congeners	3520C	Water	2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB170)	5	0.28	ng/L
8082 Congeners	3520C	Water	2,2',3,3',4,4'-Hexachlorobiphenyl (PCB128)	5	0.95	ng/L
8082 Congeners	3520C	Water	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (PCB201)	5	0.17	ng/L
8082 Congeners	3520C	Water	2,2',3,3',4,5,6'-Heptachlorobiphenyl (PCB174)	5	0.95	ng/L
8082 Congeners	3520C	Water	2,2',3,3',4',5,6-Heptachlorobiphenyl (PCB177)	5	0.19	ng/L
8082 Congeners	3520C	Water	2,2',3,3',4,6'-Hexachlorobiphenyl (PCB132)	5	0.25	ng/L
8082 Congeners	3520C	Water	2,2',3,4,4',5,5',6-Octachlorobiphenyl (PCB203)	5	0.21	ng/L
8082 Congeners	3520C	Water	2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB180)	5	0.35	ng/L
8082 Congeners	3520C	Water	2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB183)	5	0.20	ng/L
8082 Congeners	3520C	Water	2,2',3,4,4',5'-Hexachlorobiphenyl (PCB138)	5	0.23	ng/L
8082 Congeners	3520C	Water	2,2',3,4,4',6,6'-Heptachlorobiphenyl (PCB184)	5	0.19	ng/L
8082 Congeners	3520C	Water	2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB187)	5	0.26	ng/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Congeners	3520C	Water	2,2',3,4,5,5'-Hexachlorobiphenyl (PCB141)	5	0.23	ng/L
8082 Congeners	3520C	Water	2,2',3,4',5',6-Hexachlorobiphenyl (PCB149)	5	0.29	ng/L
8082 Congeners	3520C	Water	2,2',3,4,5'-Pentachlorobiphenyl (PCB87)	5	0.19	ng/L
8082 Congeners	3520C	Water	2,2',3,4',5-Pentachlorobiphenyl (PCB90)	5	1.1	ng/L
8082 Congeners	3520C	Water	2,2',3',4,5-Pentachlorobiphenyl (PCB97)	5	0.32	ng/L
8082 Congeners	3520C	Water	2,2',3,5,5',6-Hexachlorobiphenyl (PCB151)	5	0.21	ng/L
8082 Congeners	3520C	Water	2,2',3,5',6-Pentachlorobiphenyl (PCB95)	5	0.53	ng/L
8082 Congeners	3520C	Water	2,2',3,5'-Tetrachlorobiphenyl (PCB44)	5	0.35	ng/L
8082 Congeners	3520C	Water	2,2',4,4',5,5'-Hexachlorobiphenyl (PCB153)	5	0.51	ng/L
8082 Congeners	3520C	Water	2,2',4,4',5-Pentachlorobiphenyl (PCB99)	5	0.27	ng/L
8082 Congeners	3520C	Water	2,2',4,5,5'-Pentachlorobiphenyl (PCB101)	5	0.23	ng/L
8082 Congeners	3520C	Water	2,2',4,5'-Tetrachlorobiphenyl (PCB49)	5	0.51	ng/L
8082 Congeners	3520C	Water	2,2',5,5'-Tetrachlorobiphenyl (PCB52)	5	0.67	ng/L
8082 Congeners	3520C	Water	2,2',5-Trichlorobiphenyl (PCB18)	5	0.95	ng/L
8082 Congeners	3520C	Water	2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB189)	5	0.24	ng/L
8082 Congeners	3520C	Water	2,3,3',4,4',5-Hexachlorobiphenyl (PCB156)	5	0.29	ng/L
8082 Congeners	3520C	Water	2,3,3',4,4',5'-Hexachlorobiphenyl (PCB157)	5	0.32	ng/L
8082 Congeners	3520C	Water	2,3,3',4,4',6-Hexachlorobiphenyl (PCB158)	5	0.21	ng/L
8082 Congeners	3520C	Water	2,3,3',4,4'-Pentachlorobiphenyl (PCB105)	5	0.35	ng/L
8082 Congeners	3520C	Water	2,3,3',4',6-Pentachlorobiphenyl (PCB110)	5	0.19	ng/L
8082 Congeners	3520C	Water	2,3,3',4'-Tetrachlorobiphenyl (PCB56)	5	0.21	ng/L
8082 Congeners	3520C	Water	2,3',4,4',5,5'-Hexachlorobiphenyl (PCB167)	5	0.19	ng/L
8082 Congeners	3520C	Water	2,3,4,4',5,6-Hexachlorobiphenyl (PCB166)	5	0.44	ng/L
8082 Congeners	3520C	Water	2,3',4,4',5',6-Hexachlorobiphenyl (PCB168)	5	0.27	ng/L
8082 Congeners	3520C	Water	2,3,4,4',5-Pentachlorobiphenyl (PCB114)	5	0.23	ng/L
8082 Congeners	3520C	Water	2,3',4,4',5-Pentachlorobiphenyl (PCB118)	5	0.32	ng/L
8082 Congeners	3520C	Water	2',3,4,4',5-Pentachlorobiphenyl (PCB123)	5	0.20	ng/L
8082 Congeners	3520C	Water	2,3',4,4',6-Pentachlorobiphenyl (PCB119)	5	0.25	ng/L
8082 Congeners	3520C	Water	2,3,4,4'-Tetrachlorobiphenyl (PCB60)	5	0.26	ng/L
8082 Congeners	3520C	Water	2,3',4,4'-Tetrachlorobiphenyl (PCB66)	5	0.30	ng/L
8082 Congeners	3520C	Water	2,3',4',5-Tetrachlorobiphenyl (PCB70)	5	0.20	ng/L
8082 Congeners	3520C	Water	2',3,4-Trichlorobiphenyl (PCB33)	5	0.84	ng/L
8082 Congeners	3520C	Water	2,3-Dichlorobiphenyl (PCB5)	5	0.29	ng/L
8082 Congeners	3520C	Water	2,4,4',5-Tetrachlorobiphenyl (PCB74)	5	0.20	ng/L
8082 Congeners	3520C	Water	2,4,4'-Trichlorobiphenyl (PCB28)	5	5	ng/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Congeners	3520C	Water	2,4',5-Trichlorobiphenyl (PCB31)	5	0.39	ng/L
8082 Congeners	3520C	Water	2,4'-Dichlorobiphenyl (PCB8)	5	0.71	ng/L
8082 Congeners	3520C	Water	2-Chlorobiphenyl (PCB1)	5	1.1	ng/L
8082 Congeners	3520C	Water	3,3',4,4',5,5'-Hexachlorobiphenyl (PCB169)	5	0.41	ng/L
8082 Congeners	3520C	Water	3,3',4,4',5-Pentachlorobiphenyl (PCB126)	5	0.24	ng/L
8082 Congeners	3520C	Water	3,3',4,4'-Tetrachlorobiphenyl (PCB77)	5	0.25	ng/L
8082 Congeners	3520C	Water	3,4,4',5-Tetrachlorobiphenyl (PCB81)	5	0.26	ng/L
8082 Congeners	3520C	Water	3,4,4'-Trichlorobiphenyl (PCB37)	5	0.28	ng/L
8082 Congeners	3520C	Water	Decachlorobiphenyl (PCB209)	5	0.34	ng/L
8141A	3545	Soil	Azinphos-methyl (Guthion)	0.05	0.0063	mg/kg
8141A	3545	Soil	Bolstar (Sulprofos)	0.05	0.0089	mg/kg
8141A	3545	Soil	Chlorpyrifos	0.05	0.027	mg/kg
8141A	3545	Soil	Coumaphos	0.1	0.0077	mg/kg
8141A	3545	Soil	Demeton-O	0.04	0.0024	mg/kg
8141A	3545	Soil	Demeton-O,S	1.0	0.0124	mg/kg
8141A	3545	Soil	Demeton-S	0.06	0.010	mg/kg
8141A	3545	Soil	Diazinon	0.05	0.0072	mg/kg
8141A	3545	Soil	Dichlorvos	0.05	0.010	mg/kg
8141A	3545	Soil	Dimethoate	0.05	0.029	mg/kg
8141A	3545	Soil	Disulfoton	0.05	0.023	mg/kg
8141A	3545	Soil	EPN	0.05	0.0084	mg/kg
8141A	3545	Soil	Ethoprop (Prophos)	0.05	0.0070	mg/kg
8141A	3545	Soil	Ethyl Parathion	0.05	0.0083	mg/kg
8141A	3545	Soil	Fensulfothion	0.05	0.011	mg/kg
8141A	3545	Soil	Fenthion	0.05	0.0084	mg/kg
8141A	3545	Soil	Malathion	0.05	0.0076	mg/kg
8141A	3545	Soil	Merphos	0.05	0.0040	mg/kg
8141A	3545	Soil	Methyl Parathion	0.05	0.0084	mg/kg
8141A	3545	Soil	Mevinphos	0.05	0.0085	mg/kg
8141A	3545	Soil	Phorate	0.05	0.022	mg/kg
8141A	3545	Soil	Ronnel	0.05	0.0082	mg/kg
8141A	3545	Soil	Stirophos (Tetrachlorovinphos)	0.05	0.0069	mg/kg
8141A	3545	Soil	Sulfotep	0.05	0.0075	mg/kg
8141A	3545	Soil	Tokuthion (Prothiofos)	0.05	0.0077	mg/kg
8141A	3545	Soil	Trichloronate	0.05	0.028	mg/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8141A	3535	Water	Azinphos-methyl (Guthion)	1.0	0.20	ug/L
8141A	3535	Water	Bolstar (Sulprofos)	0.5	0.49	ug/L
8141A	3535	Water	Chlorpyrifos	0.2	0.14	ug/L
8141A	3535	Water	Coumaphos	1.0	0.14	ug/L
8141A	3535	Water	Demeton-O	0.4	0.22	ug/L
8141A	3535	Water	Demeton-O,S	2.0	0.317	ug/L
8141A	3535	Water	Demeton-S	1.6	0.097	ug/L
8141A	3535	Water	Diazinon	0.2	0.12	ug/L
8141A	3535	Water	Dichlorvos	0.5	0.17	ug/L
8141A	3535	Water	Dimethoate	0.5	0.11	ug/L
8141A	3535	Water	Disulfoton	1.0	0.13	ug/L
8141A	3535	Water	EPN	0.2	0.13	ug/L
8141A	3535	Water	Ethoprop (Prophos)	0.2	0.40	ug/L
8141A	3535	Water	Ethyl Parathion	0.5	0.093	ug/L
8141A	3535	Water	Fensulfothion	0.5	0.13	ug/L
8141A	3535	Water	Fenthion	0.5	0.44	ug/L
8141A	3535	Water	Malathion	0.2	0.095	ug/L
8141A	3535	Water	Merphos	0.2	0.052	ug/L
8141A	3535	Water	Methyl Parathion	0.5	0.10	ug/L
8141A	3535	Water	Mevinphos	0.5	0.15	ug/L
8141A	3535	Water	Phorate	0.5	0.48	ug/L
8141A	3535	Water	Ronnel	0.2	0.11	ug/L
8141A	3535	Water	Stirophos (Tetrachlorovinphos)	0.2	0.16	ug/L
8141A	3535	Water	Sulfotep	0.2	0.097	ug/L
8141A	3535	Water	Tokuthion (Prothiofos)	0.2	0.13	ug/L
8141A	3535	Water	Trichloronate	0.2	0.13	ug/L
8151A	Method	Soil	2,4,5-T	50	1.9	ug/kg
8151A	Method	Soil	2,4,5-TP (Silvex)	50	1.8	ug/kg
8151A	Method	Soil	2,4-D	50	2.3	ug/kg
8151A	Method	Soil	2,4-DB	50	13	ug/kg
8151A	Method	Soil	3,5-Dichlorobenzoic Acid	50		ug/kg
8151A	Method	Soil	Acifluorfen	50		ug/kg
8151A	Method	Soil	Bentazon	50		ug/kg
8151A	Method	Soil	Chloramben	50		ug/kg
8151A	Method	Soil	Dacthal	50		ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8151A	Method	Soil	Dalapon	50	6.6	ug/kg
8151A	Method	Soil	Dicamba	50	2.8	ug/kg
8151A	Method	Soil	Dichlorprop	50	2.5	ug/kg
8151A	Method	Soil	Dinoseb	50	2.5	ug/kg
8151A	Method	Soil	MCPA	10000	240	ug/kg
8151A	Method	Soil	MCPP	10000	270	ug/kg
8151A	Method	Soil	Pentachlorophenol	50		ug/kg
8151A	Method	Soil	Picloram	50		ug/kg
8151A	Method	Water	2,4,5-T	0.2	0.043	ug/L
8151A	Method	Water	2,4,5-TP (Silvex)	0.2	0.048	ug/L
8151A	Method	Water	2,4-D	0.4	0.048	ug/L
8151A	Method	Water	2,4-DB	0.4	0.10	ug/L
8151A	Method	Water	3,5-Dichlorobenzoic Acid	0.4		ug/L
8151A	Method	Water	Acifluorfen	0.4		ug/L
8151A	Method	Water	Bentazon	0.4		ug/L
8151A	Method	Water	Chloramben	0.4		ug/L
8151A	Method	Water	Dacthal	0.4		ug/L
8151A	Method	Water	Dalapon	0.4	0.23	ug/L
8151A	Method	Water	Dicamba	0.4	0.059	ug/L
8151A	Method	Water	Dichlorprop	0.4	0.058	ug/L
8151A	Method	Water	Dinoseb	0.2	0.068	ug/L
8151A	Method	Water	MCPA	100	35	ug/L
8151A	Method	Water	MCPP	100	6.0	ug/L
8151A	Method	Water	Pentachlorophenol	0.4		ug/L
8151A	Method	Water	Picloram	0.4		ug/L
8151M	Method	Soil	2,3,4,5-Tetrachlorophenol	5	0.62	ug/kg
8151M	Method	Soil	2,3,4,6-Tetrachlorophenol	5	0.3	ug/kg
8151M	Method	Soil	2,3,5,6-Tetrachlorophenol	5	0.3	ug/kg
8151M	Method	Soil	2,4,5-Trichlorophenol	5	0.55	ug/kg
8151M	Method	Soil	2,4,6-Trichlorophenol	5	0.39	ug/kg
8151M	Method	Soil	3,4,5-Trichlorophenol	10	0.84	ug/kg
8151M	Method	Soil	3,4-Dichlorophenol	10	0.57	ug/kg
8151M	Method	Soil	3,5-Dichlorophenol	10	1.7	ug/kg
8151M	Method	Soil	Pentachlorophenol	5	0.14	ug/kg
8151M	Method	Water	2,3,4,5-Tetrachlorophenol	0.5	0.15	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8151M	Method	Water	2,3,4,6-Tetrachlorophenol	0.5	0.11	ug/L
8151M	Method	Water	2,3,5,6-Tetrachlorophenol	0.5	0.11	ug/L
8151M	Method	Water	2,4,5-Trichlorophenol	0.5	0.27	ug/L
8151M	Method	Water	2,4,6-Trichlorophenol	0.5	0.33	ug/L
8151M	Method	Water	3,4,5-Trichlorophenol	1	0.27	ug/L
8151M	Method	Water	3,4-Dichlorophenol	2.0	0.64	ug/L
8151M	Method	Water	3,5-Dichlorophenol	2.0	0.27	ug/L
8151M	Method	Water	Pentachlorophenol	0.5	0.13	ug/L
8270C	3541	Soil	1,2,4,5-Tetrachlorobenzene	0.33	0.013	mg/kg
8270C	3541	Soil	1,2,4-Trichlorobenzene	0.33	0.0110	mg/kg
8270C	3541	Soil	1,2-Dichlorobenzene	0.33	0.0179	mg/kg
8270C	3541	Soil	1,2-Diphenylhydrazine	0.33	0.0146	mg/kg
8270C	3541	Soil	1,3,5-Trinitrobenzene	0.67	0.096	mg/kg
8270C	3541	Soil	1,3-Dichlorobenzene	0.33	0.0183	mg/kg
8270C	3541	Soil	1,3-Dinitrobenzene	0.33	0.011	mg/kg
8270C	3541	Soil	1,4-Dichlorobenzene	0.33	0.0175	mg/kg
8270C	3541	Soil	1,4-Dichlorobutane	0.33	0.33	mg/kg
8270C	3541	Soil	1,4-Dioxane	0.67	0.13	mg/kg
8270C	3541	Soil	1,4-Naphthoquinone	0.33	0.063	mg/kg
8270C	3541	Soil	1,6-Dinitropyrene	0.33	0.33	mg/kg
8270C	3541	Soil	1,8-Dinitropyrene	0.33	0.33	mg/kg
8270C	3541	Soil	1-Chloronaphthalene	0.33	0.33	mg/kg
8270C	3541	Soil	1-Methylnaphthalene	0.33	0.33	mg/kg
8270C	3541	Soil	1-Naphthylamine	0.33	0.058	mg/kg
8270C	3541	Soil	1-Nitropyrene	0.33	0.10	mg/kg
8270C	3541	Soil	2,3,4,6-Tetrachlorophenol	1.0	0.011	mg/kg
8270C	3541	Soil	2,4,5-Trichlorophenol	0.33	0.0171	mg/kg
8270C	3541	Soil	2,4,6-Trichlorophenol	0.33	0.0143	mg/kg
8270C	3541	Soil	2,4-Dichlorophenol	0.33	0.0164	mg/kg
8270C	3541	Soil	2,4-Dimethylphenol	0.33	0.0151	mg/kg
8270C	3541	Soil	2,4-Dinitrophenol	2.0	0.112	mg/kg
8270C	3541	Soil	2,4-Dinitrotoluene	0.33	0.0149	mg/kg
8270C	3541	Soil	2,6-Dichlorophenol	0.33	0.013	mg/kg
8270C	3541	Soil	2,6-Diisopropylnaphthalene	0.33	0.33	mg/kg
8270C	3541	Soil	2,6-Dinitrotoluene	0.33	0.0156	mg/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3541	Soil	2-Acetylaminofluorene	4.0	0.015	mg/kg
8270C	3541	Soil	2-Chloronaphthalene	0.33	0.0100	mg/kg
8270C	3541	Soil	2-Chlorophenol	0.33	0.0099	mg/kg
8270C	3541	Soil	2-Methyl-4,6-dinitrophenol	2.0	0.1434	mg/kg
8270C	3541	Soil	2-Methylnaphthalene	0.33	0.0110	mg/kg
8270C	3541	Soil	2-Methylphenol	0.33	0.0167	mg/kg
8270C	3541	Soil	2-Naphthylamine	0.33	0.0091	mg/kg
8270C	3541	Soil	2-Nitroaniline	2.0	0.0169	mg/kg
8270C	3541	Soil	2-Nitrofluorene	2.0	0.49	mg/kg
8270C	3541	Soil	2-Nitrophenol	0.33	0.0139	mg/kg
8270C	3541	Soil	2-Picoline	0.67	0.069	mg/kg
8270C	3541	Soil	3,3'-Dichlorobenzidine	2.0	0.0270	mg/kg
8270C	3541	Soil	3,3'-Dimethylbenzidine	2.0	1.2	mg/kg
8270C	3541	Soil	3-Methylcholanthrene	0.33	0.022	mg/kg
8270C	3541	Soil	3-Nitroaniline	2.0	0.175	mg/kg
8270C	3541	Soil	3-Nitrophenol	0.33	0.33	mg/kg
8270C	3541	Soil	4-Aminobiphenyl	0.33	0.012	mg/kg
8270C	3541	Soil	4-Bromophenyl Phenyl Ether	0.33	0.0122	mg/kg
8270C	3541	Soil	4-Chloro-3-methylphenol	0.33	0.0166	mg/kg
8270C	3541	Soil	4-Chloroaniline	0.33	0.0144	mg/kg
8270C	3541	Soil	4-Chlorophenyl Phenyl Ether	0.33	0.0160	mg/kg
8270C	3541	Soil	4-Methylphenol	0.33	0.0168	mg/kg
8270C	3541	Soil	4-Nitroaniline	2.0	0.179	mg/kg
8270C	3541	Soil	4-Nitrophenol	2.0	0.146	mg/kg
8270C	3541	Soil	4-Nitropyrene	0.33	0.092	mg/kg
8270C	3541	Soil	4-Nitroquinoline N-Oxide	3.0	0.068	mg/kg
8270C	3541	Soil	5-Methylchrysene	0.33	0.035	mg/kg
8270C	3541	Soil	5-Nitroacenaphthene	0.33	0.028	mg/kg
8270C	3541	Soil	5-Nitro-o-toluidine	0.33	0.015	mg/kg
8270C	3541	Soil	6-Nitrochrysene	0.33	0.096	mg/kg
8270C	3541	Soil	7,12-Dimethylbenz(a)anthracene	0.33	0.0098	mg/kg
8270C	3541	Soil	7H-Dibenzo(c,g)carbazole	0.33	0.049	mg/kg
8270C	3541	Soil	a,a-Dimethylphenethylamine	1.0	0.23	mg/kg
8270C	3541	Soil	Acenaphthene	0.33	0.0134	mg/kg
8270C	3541	Soil	Acenaphthylene	0.33	0.016	mg/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3541	Soil	Acetophenone	0.33	0.011	mg/kg
8270C	3541	Soil	Aniline	1.0	0.0216	mg/kg
8270C	3541	Soil	Anthracene	0.33	0.0139	mg/kg
8270C	3541	Soil	Aramite, Total	2.0	0.070	mg/kg
8270C	3541	Soil	Atrazine	0.33	0.017	mg/kg
8270C	3541	Soil	Azobenzene	0.33	0.0146	mg/kg
8270C	3541	Soil	Benz(a)anthracene	0.33	0.0123	mg/kg
8270C	3541	Soil	Benzaldehyde	0.33	0.009	mg/kg
8270C	3541	Soil	Benzidine	2.0	0.340	mg/kg
8270C	3541	Soil	Benzo(a)pyrene	0.33	0.0198	mg/kg
8270C	3541	Soil	Benzo(b)fluoranthene	0.33	0.0172	mg/kg
8270C	3541	Soil	Benzo(g,h,i)perylene	0.33	0.0202	mg/kg
8270C	3541	Soil	Benzo(j)fluoranthene	0.33	0.33	mg/kg
8270C	3541	Soil	Benzo(k)fluoranthene	0.33	0.0194	mg/kg
8270C	3541	Soil	Benzoic Acid	2.0	0.139	mg/kg
8270C	3541	Soil	Benzophenone	0.33	0.33	mg/kg
8270C	3541	Soil	Benzyl Alcohol	0.33	0.0168	mg/kg
8270C	3541	Soil	Biphenyl	0.33	0.009	mg/kg
8270C	3541	Soil	Bis(2-chloroethoxy)methane	0.33	0.0110	mg/kg
8270C	3541	Soil	Bis(2-chloroethyl) Ether	0.33	0.0117	mg/kg
8270C	3541	Soil	Bis(2-chloroisopropyl) Ether	0.33	0.0141	mg/kg
8270C	3541	Soil	Bis(2-ethylhexyl) Phthalate	0.33	0.0186	mg/kg
8270C	3541	Soil	Butyl Benzyl Phthalate	0.33	0.0163	mg/kg
8270C	3541	Soil	Caprolactam	0.67	0.147	mg/kg
8270C	3541	Soil	Carbazole	0.33	0.0112	mg/kg
8270C	3541	Soil	Chlorobenzilate	0.33	0.025	mg/kg
8270C	3541	Soil	Chrysene	0.33	0.0118	mg/kg
8270C	3541	Soil	Diallate	0.33	0.011	mg/kg
8270C	3541	Soil	Diazinon	0.33	0.33	mg/kg
8270C	3541	Soil	Dibenz(a,h)acridine	0.33	0.028	mg/kg
8270C	3541	Soil	Dibenz(a,h)anthracene	0.33	0.0275	mg/kg
8270C	3541	Soil	Dibenz(a,j)acridine	0.33	0.048	mg/kg
8270C	3541	Soil	Dibenzo(a,e)pyrene	0.67	0.17	mg/kg
8270C	3541	Soil	Dibenzo(a,h)pyrene	0.67	0.14	mg/kg
8270C	3541	Soil	Dibenzo(a,i)pyrene	0.67	0.20	mg/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3541	Soil	Dibenzo(a,l)pyrene	0.67	0.18	mg/kg
8270C	3541	Soil	Dibenzofuran	0.33	0.0118	mg/kg
8270C	3541	Soil	Dicyclopentadiene	0.33	0.032	mg/kg
8270C	3541	Soil	Diethyl Phthalate	0.33	0.0141	mg/kg
8270C	3541	Soil	Diethylene Glycol Dibenzoate	0.33	0.33	mg/kg
8270C	3541	Soil	Dimethoate	0.33	0.022	mg/kg
8270C	3541	Soil	Dimethyl Phthalate	0.33	0.0164	mg/kg
8270C	3541	Soil	Di-n-butyl Phthalate	0.33	0.0121	mg/kg
8270C	3541	Soil	Di-n-octyl Phthalate	0.33	0.0240	mg/kg
8270C	3541	Soil	Dinoseb	0.33	0.093	mg/kg
8270C	3541	Soil	Diphenylamine	0.33	0.010	mg/kg
8270C	3541	Soil	Disulfoton	0.33	0.013	mg/kg
8270C	3541	Soil	Ethyl Methanesulfonate	0.33	0.012	mg/kg
8270C	3541	Soil	Ethylene Glycol Butyl Ether (EGBE)	0.33	0.33	mg/kg
8270C	3541	Soil	Famphur	4.0	0.071	mg/kg
8270C	3541	Soil	Fluoranthene	0.33	0.0115	mg/kg
8270C	3541	Soil	Fluorene	0.33	0.0130	mg/kg
8270C	3541	Soil	Hexachlorobenzene	0.33	0.0147	mg/kg
8270C	3541	Soil	Hexachlorobutadiene	0.33	0.0141	mg/kg
8270C	3541	Soil	Hexachlorocyclopentadiene	0.33	0.0125	mg/kg
8270C	3541	Soil	Hexachloroethane	0.33	0.0216	mg/kg
8270C	3541	Soil	Hexachlorophene	6.7	1.2	mg/kg
8270C	3541	Soil	Hexachloropropene	0.33	0.014	mg/kg
8270C	3541	Soil	Indeno(1,2,3-cd)pyrene	0.33	0.0389	mg/kg
8270C	3541	Soil	Isodrin	0.33	0.016	mg/kg
8270C	3541	Soil	Isophorone	0.33	0.0140	mg/kg
8270C	3541	Soil	Isosafrole	0.67	0.011	mg/kg
8270C	3541	Soil	Kepone	4.0	0.39	mg/kg
8270C	3541	Soil	Malathion	0.83	0.83	mg/kg
8270C	3541	Soil	Methapyrilene	1.0	0.091	mg/kg
8270C	3541	Soil	Methyl Methanesulfonate	0.33	0.016	mg/kg
8270C	3541	Soil	Methyl Parathion	0.33	0.018	mg/kg
8270C	3541	Soil	N,N-Dimethylaniline	0.33	0.0604	mg/kg
8270C	3541	Soil	Naphthalene	0.33	0.0144	mg/kg
8270C	3541	Soil	n-Dodecane	0.33	0.33	mg/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3541	Soil	Nitrobenzene	0.33	0.0261	mg/kg
8270C	3541	Soil	N-Nitrosodiethylamine	0.33	0.015	mg/kg
8270C	3541	Soil	N-Nitrosodimethylamine	2.0	0.0251	mg/kg
8270C	3541	Soil	N-Nitrosodi-n-butylamine	0.33	0.025	mg/kg
8270C	3541	Soil	N-Nitrosodi-n-propylamine	0.33	0.0191	mg/kg
8270C	3541	Soil	N-Nitrosodiphenylamine	0.33	0.018	mg/kg
8270C	3541	Soil	N-Nitrosomethylethylamine	0.33	0.11	mg/kg
8270C	3541	Soil	N-Nitrosomorpholine	0.33	0.0096	mg/kg
8270C	3541	Soil	N-Nitrosopiperidine	0.33	0.015	mg/kg
8270C	3541	Soil	N-Nitrosopyrrolidine	0.33	0.012	mg/kg
8270C	3541	Soil	O,O,O-Triethyl Phosphorothioate	0.33	0.014	mg/kg
8270C	3541	Soil	o-Toluidine	0.33	0.012	mg/kg
8270C	3541	Soil	Parathion	0.33	0.022	mg/kg
8270C	3541	Soil	p-Dimethylaminoazobenzene	0.33	0.021	mg/kg
8270C	3541	Soil	Pentachlorobenzene	0.33	0.013	mg/kg
8270C	3541	Soil	Pentachloroethane	1.0	0.014	mg/kg
8270C	3541	Soil	Pentachloronitrobenzene	2.0	0.011	mg/kg
8270C	3541	Soil	Pentachlorophenol	2.0	0.125	mg/kg
8270C	3541	Soil	Phenacetin	2.0	0.021	mg/kg
8270C	3541	Soil	Phenanthrene	0.33	0.0100	mg/kg
8270C	3541	Soil	Phenol	0.33	0.0195	mg/kg
8270C	3541	Soil	Phorate	0.33	0.011	mg/kg
8270C	3541	Soil	Picric Acid	3.3	3.3	mg/kg
8270C	3541	Soil	p-Phenylenediamine	2.0	0.79	mg/kg
8270C	3541	Soil	Pronamide	0.33	0.017	mg/kg
8270C	3541	Soil	Pyrene	0.33	0.0140	mg/kg
8270C	3541	Soil	Pyridine	0.33	0.0199	mg/kg
8270C	3541	Soil	Safrole	0.33	0.013	mg/kg
8270C	3541	Soil	Sulfotep	0.33	0.011	mg/kg
8270C	3541	Soil	Thionazin	2.0	0.019	mg/kg
8270C	3541	Soil-Low	1,2,4,5-Tetrachlorobenzene	10	4.9	ug/kg
8270C	3541	Soil-Low	1,2,4-Trichlorobenzene	10	1.5	ug/kg
8270C	3541	Soil-Low	1,2-Dichlorobenzene	10	1.3	ug/kg
8270C	3541	Soil-Low	1,2-Diphenylhydrazine	10	2.4	ug/kg
8270C	3541	Soil-Low	1,3-Dichlorobenzene	10	1.6	ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3541	Soil-Low	1,4-Dichlorobenzene	10	1.9	ug/kg
8270C	3541	Soil-Low	2,4,5-Trichlorophenol	10	3.0	ug/kg
8270C	3541	Soil-Low	2,4,6-Trichlorophenol	10	1.8	ug/kg
8270C	3541	Soil-Low	2,4-Dichlorophenol	10	1.8	ug/kg
8270C	3541	Soil-Low	2,4-Dimethylphenol	50	5.5	ug/kg
8270C	3541	Soil-Low	2,4-Dinitrophenol	200	36	ug/kg
8270C	3541	Soil-Low	2,4-Dinitrotoluene	10	2.8	ug/kg
8270C	3541	Soil-Low	2,6-Dinitrotoluene	10	2.8	ug/kg
8270C	3541	Soil-Low	2-Chloronaphthalene	10	3.6	ug/kg
8270C	3541	Soil-Low	2-Chlorophenol	10	1.7	ug/kg
8270C	3541	Soil-Low	2-Methyl-4,6-dinitrophenol	100	1.7	ug/kg
8270C	3541	Soil-Low	2-Methylnaphthalene	10	1.2	ug/kg
8270C	3541	Soil-Low	2-Methylphenol	10	3.4	ug/kg
8270C	3541	Soil-Low	2-Nitroaniline	20	2.7	ug/kg
8270C	3541	Soil-Low	2-Nitrophenol	10	2.6	ug/kg
8270C	3541	Soil-Low	3,3'-Dichlorobenzidine	100	3.7	ug/kg
8270C	3541	Soil-Low	3-Nitroaniline	20	2.6	ug/kg
8270C	3541	Soil-Low	4-Bromophenyl Phenyl Ether	10	1.4	ug/kg
8270C	3541	Soil-Low	4-Chloro-3-methylphenol	10	2.1	ug/kg
8270C	3541	Soil-Low	4-Chloroaniline	10	2.1	ug/kg
8270C	3541	Soil-Low	4-Chlorophenyl Phenyl Ether	10	2.0	ug/kg
8270C	3541	Soil-Low	4-Methylphenol	10	2.9	ug/kg
8270C	3541	Soil-Low	4-Nitroaniline	20	3.4	ug/kg
8270C	3541	Soil-Low	4-Nitrophenol	100	30	ug/kg
8270C	3541	Soil-Low	Acenaphthene	10	1.0	ug/kg
8270C	3541	Soil-Low	Acenaphthylene	10	1.4	ug/kg
8270C	3541	Soil-Low	Acetophenone	50	12	ug/kg
8270C	3541	Soil-Low	Aniline	20	1.5	ug/kg
8270C	3541	Soil-Low	Anthracene	10	1.4	ug/kg
8270C	3541	Soil-Low	Atrazine	10	2.2	ug/kg
8270C	3541	Soil-Low	Azobenzene	10	2.4	ug/kg
8270C	3541	Soil-Low	Benz(a)anthracene	10	1.4	ug/kg
8270C	3541	Soil-Low	Benzaldehyde	20	8.8	ug/kg
8270C	3541	Soil-Low	Benzidine	200	200	ug/kg
8270C	3541	Soil-Low	Benzo(a)pyrene	10	1.6	ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3541	Soil-Low	Benzo(b)fluoranthene	10	2.5	ug/kg
8270C	3541	Soil-Low	Benzo(g,h,i)perylene	10	2.3	ug/kg
8270C	3541	Soil-Low	Benzo(k)fluoranthene	10	2.5	ug/kg
8270C	3541	Soil-Low	Benzoic Acid	200	96	ug/kg
8270C	3541	Soil-Low	Benzyl Alcohol	10	3.7	ug/kg
8270C	3541	Soil-Low	Biphenyl	20	4.8	ug/kg
8270C	3541	Soil-Low	Bis(2-chloroethoxy)methane	10	1.3	ug/kg
8270C	3541	Soil-Low	Bis(2-chloroethyl) Ether	10	2.4	ug/kg
8270C	3541	Soil-Low	Bis(2-chloroisopropyl) Ether	10	1.2	ug/kg
8270C	3541	Soil-Low	Bis(2-ethylhexyl) Phthalate	200	1.7	ug/kg
8270C	3541	Soil-Low	Butyl Benzyl Phthalate	10	1.5	ug/kg
8270C	3541	Soil-Low	Caprolactam	20	12	ug/kg
8270C	3541	Soil-Low	Carbazole	10	1.3	ug/kg
8270C	3541	Soil-Low	Chrysene	10	1.4	ug/kg
8270C	3541	Soil-Low	Dibenz(a,h)anthracene	10	2.2	ug/kg
8270C	3541	Soil-Low	Dibenzofuran	10	1.3	ug/kg
8270C	3541	Soil-Low	Diethyl Phthalate	10	3.5	ug/kg
8270C	3541	Soil-Low	Dimethyl Phthalate	10	1.8	ug/kg
8270C	3541	Soil-Low	Di-n-butyl Phthalate	10	2.6	ug/kg
8270C	3541	Soil-Low	Di-n-octyl Phthalate	10	1.2	ug/kg
8270C	3541	Soil-Low	Fluoranthene	10	2.2	ug/kg
8270C	3541	Soil-Low	Fluorene	10	1.7	ug/kg
8270C	3541	Soil-Low	Hexachlorobenzene	10	2.1	ug/kg
8270C	3541	Soil-Low	Hexachlorobutadiene	10	1.4	ug/kg
8270C	3541	Soil-Low	Hexachlorocyclopentadiene	50	15	ug/kg
8270C	3541	Soil-Low	Hexachloroethane	10	2.2	ug/kg
8270C	3541	Soil-Low	HPAH	10	10	ug/kg
8270C	3541	Soil-Low	Indeno(1,2,3-cd)pyrene	10	1.9	ug/kg
8270C	3541	Soil-Low	Isophorone	10	1.6	ug/kg
8270C	3541	Soil-Low	LPAH	10	10	ug/kg
8270C	3541	Soil-Low	Naphthalene	10	1.3	ug/kg
8270C	3541	Soil-Low	Nitrobenzene	10	2.0	ug/kg
8270C	3541	Soil-Low	N-Nitrosodimethylamine	50	6.1	ug/kg
8270C	3541	Soil-Low	N-Nitrosodi-n-propylamine	10	3.2	ug/kg
8270C	3541	Soil-Low	N-Nitrosodiphenylamine	10	2.2	ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3541	Soil-Low	Pentachlorophenol	100	8.5	ug/kg
8270C	3541	Soil-Low	Phenanthrene	10	1.3	ug/kg
8270C	3541	Soil-Low	Phenol	30	1.9	ug/kg
8270C	3541	Soil-Low	Pyrene	10	1.3	ug/kg
8270C	3541	Soil-Low	Pyridine	50	3.0	ug/kg
8270C	3520C	Water	1,2,4,5-Tetrachlorobenzene	10	0.26	ug/L
8270C	3520C	Water	1,2,4-Trichlorobenzene	10	0.355	ug/L
8270C	3520C	Water	1,2-Dichlorobenzene	10	0.431	ug/L
8270C	3520C	Water	1,2-Diphenylhydrazine	10	0.509	ug/L
8270C	3520C	Water	1,3,5-Trinitrobenzene	25	0.38	ug/L
8270C	3520C	Water	1,3-Dichlorobenzene	10	0.352	ug/L
8270C	3520C	Water	1,3-Dinitrobenzene	10	0.52	ug/L
8270C	3520C	Water	1,4-Dichlorobenzene	10	0.317	ug/L
8270C	3520C	Water	1,4-Dichlorobutane	10	1	ug/L
8270C	3520C	Water	1,4-Dioxane	25	3.7	ug/L
8270C	3520C	Water	1,4-Naphthoquinone	10	0.21	ug/L
8270C	3520C	Water	1,6-Dinitropyrene	10	10	ug/L
8270C	3520C	Water	1,8-Dinitropyrene	10	10	ug/L
8270C	3520C	Water	1-Chloronaphthalene	10	1	ug/L
8270C	3520C	Water	1-Methylnaphthalene	10	10	ug/L
8270C	3520C	Water	1-Naphthylamine	10	0.70	ug/L
8270C	3520C	Water	1-Nitropyrene	10	0.53	ug/L
8270C	3520C	Water	2,3,4,6-Tetrachlorophenol	10	0.55	ug/L
8270C	3520C	Water	2,3,5,6-Tetrachlorophenol	10	0.62	ug/L
8270C	3520C	Water	2,4,5-Trichlorophenol	10	0.381	ug/L
8270C	3520C	Water	2,4,6-Trichlorophenol	10	0.203	ug/L
8270C	3520C	Water	2,4-Dichlorophenol	10	0.297	ug/L
8270C	3520C	Water	2,4-Dimethylphenol	10	0.264	ug/L
8270C	3520C	Water	2,4-Dinitrophenol	25	2.22	ug/L
8270C	3520C	Water	2,4-Dinitrotoluene	10	0.274	ug/L
8270C	3520C	Water	2,6-Dichlorophenol	10	0.48	ug/L
8270C	3520C	Water	2,6-Dinitrotoluene	10	0.349	ug/L
8270C	3520C	Water	2-Acetylaminofluorene	100	0.23	ug/L
8270C	3520C	Water	2-Chloronaphthalene	10	0.290	ug/L
8270C	3520C	Water	2-Chlorophenol	10	0.311	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3520C	Water	2-Methyl-4,6-dinitrophenol	25	2.12	ug/L
8270C	3520C	Water	2-Methylnaphthalene	10	0.239	ug/L
8270C	3520C	Water	2-Methylphenol	10	0.328	ug/L
8270C	3520C	Water	2-Naphthylamine	10	1.0	ug/L
8270C	3520C	Water	2-Nitroaniline	25	0.336	ug/L
8270C	3520C	Water	2-Nitrofluorene	50	15	ug/L
8270C	3520C	Water	2-Nitrophenol	10	0.373	ug/L
8270C	3520C	Water	2-Picoline	25	4.5	ug/L
8270C	3520C	Water	3- and 4-Methylphenol Coelution	10	0.478	ug/L
8270C	3520C	Water	3,3'-Dichlorobenzidine	25	0.270	ug/L
8270C	3520C	Water	3,3'-Dimethylbenzidine	20	5.4	ug/L
8270C	3520C	Water	3-Methylcholanthrene	10	0.31	ug/L
8270C	3520C	Water	3-Nitroaniline	25	3.25	ug/L
8270C	3520C	Water	3-Nitrophenol	10	1	ug/L
8270C	3520C	Water	4-Aminobiphenyl	10	1.4	ug/L
8270C	3520C	Water	4-Bromophenyl Phenyl Ether	10	0.274	ug/L
8270C	3520C	Water	4-Chloro-3-methylphenol	10	0.490	ug/L
8270C	3520C	Water	4-Chloroaniline	10	0.375	ug/L
8270C	3520C	Water	4-Chlorophenyl Phenyl Ether	10	0.278	ug/L
8270C	3520C	Water	4-Methylphenol	10	0.478	ug/L
8270C	3520C	Water	4-Nitroaniline	25	4.03	ug/L
8270C	3520C	Water	4-Nitrophenol	25	1.92	ug/L
8270C	3520C	Water	4-Nitropyrene	10	2.9	ug/L
8270C	3520C	Water	4-Nitroquinoline N-Oxide	100	4.6	ug/L
8270C	3520C	Water	5-Methylchrysene	10	1.1	ug/L
8270C	3520C	Water	5-Nitroacenaphthene	10	0.78	ug/L
8270C	3520C	Water	5-Nitro-o-toluidine	10	1.0	ug/L
8270C	3520C	Water	6-Nitrochrysene	10	2.4	ug/L
8270C	3520C	Water	7,12-Dimethylbenz(a)anthracene	10	0.32	ug/L
8270C	3520C	Water	7H-Dibenzo(c,g)carbazole	10	0.90	ug/L
8270C	3520C	Water	a,a-Dimethylphenethylamine	25	6.4	ug/L
8270C	3520C	Water	Acenaphthene	10	0.281	ug/L
8270C	3520C	Water	Acenaphthylene	10	0.236	ug/L
8270C	3520C	Water	Acetophenone	10	0.35	ug/L
8270C	3520C	Water	alpha-Terpineol	10	10	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3520C	Water	Aniline	25	0.487	ug/L
8270C	3520C	Water	Anthracene	10	0.612	ug/L
8270C	3520C	Water	Aramite, Total	50	0.52	ug/L
8270C	3520C	Water	Atrazine	10	0.401	ug/L
8270C	3520C	Water	Azobenzene	10	0.509	ug/L
8270C	3520C	Water	Benz(a)anthracene	10	0.591	ug/L
8270C	3520C	Water	Benzaldehyde	10	0.441	ug/L
8270C	3520C	Water	Benzidine	50	8.8	ug/L
8270C	3520C	Water	Benzo(a)pyrene	10	0.651	ug/L
8270C	3520C	Water	Benzo(b)fluoranthene	10	0.584	ug/L
8270C	3520C	Water	Benzo(g,h,i)perylene	10	0.812	ug/L
8270C	3520C	Water	Benzo(j)fluoranthene	10	10	ug/L
8270C	3520C	Water	Benzo(k)fluoranthene	10	0.827	ug/L
8270C	3520C	Water	Benzoic acid	25	5.819	ug/L
8270C	3520C	Water	Benzyl alcohol	10	0.377	ug/L
8270C	3520C	Water	Biphenyl	10	0.305	ug/L
8270C	3520C	Water	Bis(2-chloroethoxy)methane	10	0.276	ug/L
8270C	3520C	Water	Bis(2-chloroethyl) Ether	10	0.333	ug/L
8270C	3520C	Water	Bis(2-chloroisopropyl) Ether	10	0.311	ug/L
8270C	3520C	Water	Bis(2-ethylhexyl) Phthalate	10	1.89	ug/L
8270C	3520C	Water	Butyl Benzyl Phthalate	10	0.470	ug/L
8270C	3520C	Water	Caprolactam	25	2.88	ug/L
8270C	3520C	Water	Carbazole	10	0.237	ug/L
8270C	3520C	Water	Chlorobenzilate	10	0.45	ug/L
8270C	3520C	Water	Chrysene	10	0.787	ug/L
8270C	3520C	Water	Diallate	10	0.47	ug/L
8270C	3520C	Water	Dibenz(a,h)acridine	10	0.90	ug/L
8270C	3520C	Water	Dibenz(a,h)anthracene	10	0.752	ug/L
8270C	3520C	Water	Dibenz(a,j)acridine	10	6.1	ug/L
8270C	3520C	Water	Dibenzo(a,e)pyrene	10	2.8	ug/L
8270C	3520C	Water	Dibenzo(a,h)pyrene	10	5.9	ug/L
8270C	3520C	Water	Dibenzo(a,i)pyrene	10	2.6	ug/L
8270C	3520C	Water	Dibenzo(a,l)pyrene	10	1.2	ug/L
8270C	3520C	Water	Dibenzofuran	10	0.325	ug/L
8270C	3520C	Water	Dicyclopentadiene	10	0.59	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3520C	Water	Diethyl Phthalate	10	0.289	ug/L
8270C	3520C	Water	Dimethoate	10	0.69	ug/L
8270C	3520C	Water	Dimethyl Phthalate	10	0.254	ug/L
8270C	3520C	Water	Di-n-butyl Phthalate	10	0.364	ug/L
8270C	3520C	Water	Di-n-octyl Phthalate	10	0.626	ug/L
8270C	3520C	Water	Dinoseb	10	0.42	ug/L
8270C	3520C	Water	Diphenylamine	10	0.42	ug/L
8270C	3520C	Water	Disulfoton	10	0.57	ug/L
8270C	3520C	Water	Ethyl Methanesulfonate	10	0.28	ug/L
8270C	3520C	Water	Famphur	10	0.27	ug/L
8270C	3520C	Water	Fluoranthene	10	0.652	ug/L
8270C	3520C	Water	Fluorene	10	0.323	ug/L
8270C	3520C	Water	Hexachlorobenzene	10	0.628	ug/L
8270C	3520C	Water	Hexachlorobutadiene	10	0.291	ug/L
8270C	3520C	Water	Hexachlorocyclopentadiene	10	1.21	ug/L
8270C	3520C	Water	Hexachloroethane	10	0.289	ug/L
8270C	3520C	Water	Hexachlorophene	150	44	ug/L
8270C	3520C	Water	Hexachloropropene	10	0.19	ug/L
8270C	3520C	Water	Indeno(1,2,3-cd)pyrene	10	0.684	ug/L
8270C	3520C	Water	Isodrin	10	0.36	ug/L
8270C	3520C	Water	Isophorone	10	0.246	ug/L
8270C	3520C	Water	Isosafrole	10	0.48	ug/L
8270C	3520C	Water	Kepone	10	4.1	ug/L
8270C	3520C	Water	Malathion	25	1	ug/L
8270C	3520C	Water	Methapyrilene	100	9.3	ug/L
8270C	3520C	Water	Methyl Methanesulfonate	10	0.31	ug/L
8270C	3520C	Water	Methyl Parathion	10	0.51	ug/L
8270C	3520C	Water	N,N-Dimethylaniline	10	2.22	ug/L
8270C	3520C	Water	Naphthalene	10	0.365	ug/L
8270C	3520C	Water	Nitrobenzene	10	0.567	ug/L
8270C	3520C	Water	N-Nitrosodiethylamine	10	0.41	ug/L
8270C	3520C	Water	N-Nitrosodimethylamine	25	0.479	ug/L
8270C	3520C	Water	N-Nitrosodi-n-butylamine	10	0.57	ug/L
8270C	3520C	Water	N-Nitrosodi-n-propylamine	10	0.496	ug/L
8270C	3520C	Water	N-Nitrosodiphenylamine	10	0.48	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3520C	Water	N-Nitrosomethylethylamine	25	4.6	ug/L
8270C	3520C	Water	N-Nitrosomorpholine	10	0.25	ug/L
8270C	3520C	Water	N-Nitrosopiperidine	10	0.32	ug/L
8270C	3520C	Water	N-Nitrosopyrrolidine	10	0.39	ug/L
8270C	3520C	Water	O,O,O-Triethyl Phosphorothioate	10	0.37	ug/L
8270C	3520C	Water	o-Toluidine	10	1.4	ug/L
8270C	3520C	Water	Parathion	10	0.51	ug/L
8270C	3520C	Water	p-Dimethylaminoazobenzene	10	0.31	ug/L
8270C	3520C	Water	Pentachlorobenzene	10	0.31	ug/L
8270C	3520C	Water	Pentachloroethane	25	0.28	ug/L
8270C	3520C	Water	Pentachloronitrobenzene	50	0.23	ug/L
8270C	3520C	Water	Pentachlorophenol	25	2.44	ug/L
8270C	3520C	Water	Phenacetin	50	0.42	ug/L
8270C	3520C	Water	Phenanthrene	10	0.482	ug/L
8270C	3520C	Water	Phenol	10	0.324	ug/L
8270C	3520C	Water	Phorate	10	0.36	ug/L
8270C	3520C	Water	p-Phenylenediamine	100	4.3	ug/L
8270C	3520C	Water	Pronamide	10	0.41	ug/L
8270C	3520C	Water	Pyrene	10	0.731	ug/L
8270C	3520C	Water	Pyridine	25	7.50	ug/L
8270C	3520C	Water	Quinoline	10	10	ug/L
8270C	3520C	Water	Safrole	10	0.36	ug/L
8270C	3520C	Water	Sulfotep	10	0.26	ug/L
8270C	3520C	Water	Thionazin	25	0.71	ug/L
8270C	3520C	Water-Low	1,2,4,5-Tetrachlorobenzene	0.2	0.057	ug/L
8270C	3520C	Water-Low	1,2,4-Trichlorobenzene	0.2	0.0153	ug/L
8270C	3520C	Water-Low	1,2-Dichlorobenzene	0.2	0.0141	ug/L
8270C	3520C	Water-Low	1,2-Diphenylhydrazine	0.2	0.0119	ug/L
8270C	3520C	Water-Low	1,3-Dichlorobenzene	0.2	0.0106	ug/L
8270C	3520C	Water-Low	1,4-Dichlorobenzene	0.2	0.0133	ug/L
8270C	3520C	Water-Low	2,4,5-Trichlorophenol	0.5	0.0251	ug/L
8270C	3520C	Water-Low	2,4,6-Trichlorophenol	0.5	0.0367	ug/L
8270C	3520C	Water-Low	2,4-Dichlorophenol	0.5	0.0235	ug/L
8270C	3520C	Water-Low	2,4-Dimethylphenol	2	0.318	ug/L
8270C	3520C	Water-Low	2,4-Dinitrophenol	4	0.529	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3520C	Water-Low	2,4-Dinitrotoluene	0.2	0.0191	ug/L
8270C	3520C	Water-Low	2,6-Dinitrotoluene	0.2	0.00879	ug/L
8270C	3520C	Water-Low	2-Chloronaphthalene	0.2	0.0151	ug/L
8270C	3520C	Water-Low	2-Chlorophenol	0.5	0.0145	ug/L
8270C	3520C	Water-Low	2-Methyl-4,6-dinitrophenol	2	0.0130	ug/L
8270C	3520C	Water-Low	2-Methylnaphthalene	0.2	0.0112	ug/L
8270C	3520C	Water-Low	2-Methylphenol	0.5	0.0594	ug/L
8270C	3520C	Water-Low	2-Nitroaniline	0.2	0.0146	ug/L
8270C	3520C	Water-Low	2-Nitrophenol	0.5	0.0134	ug/L
8270C	3520C	Water-Low	3,3'-Dichlorobenzidine	2	0.428	ug/L
8270C	3520C	Water-Low	3-Nitroaniline	1	0.227	ug/L
8270C	3520C	Water-Low	4-Bromophenyl Phenyl Ether	0.2	0.0176	ug/L
8270C	3520C	Water-Low	4-Chloro-3-methylphenol	0.5	0.0289	ug/L
8270C	3520C	Water-Low	4-Chloroaniline	0.2	0.0174	ug/L
8270C	3520C	Water-Low	4-Chlorophenyl Phenyl Ether	0.2	0.00842	ug/L
8270C	3520C	Water-Low	4-Methylphenol	0.5	0.0508	ug/L
8270C	3520C	Water-Low	4-Nitroaniline	1	0.163	ug/L
8270C	3520C	Water-Low	4-Nitrophenol	2	0.534	ug/L
8270C	3520C	Water-Low	Acenaphthene	0.2	0.00872	ug/L
8270C	3520C	Water-Low	Acenaphthylene	0.2	0.0102	ug/L
8270C	3520C	Water-Low	Acetophenone	0.5	0.16	ug/L
8270C	3520C	Water-Low	Aniline	1.0	0.25	ug/L
8270C	3520C	Water-Low	Anthracene	0.2	0.0143	ug/L
8270C	3520C	Water-Low	Atrazine	0.2	0.053	ug/L
8270C	3520C	Water-Low	Azobenzene	0.2	0.0119	ug/L
8270C	3520C	Water-Low	Benz(a)anthracene	0.2	0.0116	ug/L
8270C	3520C	Water-Low	Benzaldehyde	0.2	0.046	ug/L
8270C	3520C	Water-Low	Benzo(a)pyrene	0.2	0.0159	ug/L
8270C	3520C	Water-Low	Benzo(b)fluoranthene	0.2	0.0191	ug/L
8270C	3520C	Water-Low	Benzo(g,h,i)perylene	0.2	0.0164	ug/L
8270C	3520C	Water-Low	Benzo(k)fluoranthene	0.2	0.0191	ug/L
8270C	3520C	Water-Low	Benzoic Acid	5	1.71	ug/L
8270C	3520C	Water-Low	Benzyl Alcohol	5	0.971	ug/L
8270C	3520C	Water-Low	Biphenyl	0.2	0.037	ug/L
8270C	3520C	Water-Low	Bis(2-chloroethoxy)methane	0.2	0.0113	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C	3520C	Water-Low	Bis(2-chloroethyl) Ether	0.2	0.0142	ug/L
8270C	3520C	Water-Low	Bis(2-chloroisopropyl) Ether	0.2	0.0167	ug/L
8270C	3520C	Water-Low	Bis(2-ethylhexyl) Phthalate	2	0.270	ug/L
8270C	3520C	Water-Low	Butyl Benzyl Phthalate	0.2	0.0254	ug/L
8270C	3520C	Water-Low	Caprolactam	0.50	0.22	ug/L
8270C	3520C	Water-Low	Carbazole	0.2	0.0126	ug/L
8270C	3520C	Water-Low	Chrysene	0.2	0.0139	ug/L
8270C	3520C	Water-Low	Dibenz(a,h)anthracene	0.2	0.0303	ug/L
8270C	3520C	Water-Low	Dibenzofuran	0.2	0.0131	ug/L
8270C	3520C	Water-Low	Diethyl Phthalate	0.2	0.0259	ug/L
8270C	3520C	Water-Low	Dimethyl Phthalate	0.2	0.0125	ug/L
8270C	3520C	Water-Low	Di-n-butyl Phthalate	0.2	0.0263	ug/L
8270C	3520C	Water-Low	Di-n-octyl Phthalate	0.2	0.0320	ug/L
8270C	3520C	Water-Low	Fluoranthene	0.2	0.0122	ug/L
8270C	3520C	Water-Low	Fluorene	0.2	0.0120	ug/L
8270C	3520C	Water-Low	Hexachlorobenzene	0.2	0.0141	ug/L
8270C	3520C	Water-Low	Hexachlorobutadiene	0.2	0.0194	ug/L
8270C	3520C	Water-Low	Hexachlorocyclopentadiene	1	0.0406	ug/L
8270C	3520C	Water-Low	Hexachloroethane	0.2	0.0184	ug/L
8270C	3520C	Water-Low	Indeno(1,2,3-cd)pyrene	0.2	0.0239	ug/L
8270C	3520C	Water-Low	Isophorone	0.2	0.00842	ug/L
8270C	3520C	Water-Low	Naphthalene	0.2	0.0120	ug/L
8270C	3520C	Water-Low	Nitrobenzene	0.2	0.00740	ug/L
8270C	3520C	Water-Low	N-Nitrosodimethylamine	2.0	0.42	ug/L
8270C	3520C	Water-Low	N-Nitrosodi-n-propylamine	0.2	0.0323	ug/L
8270C	3520C	Water-Low	N-Nitrosodiphenylamine	0.2	0.0278	ug/L
8270C	3520C	Water-Low	Pentachlorophenol	1	0.0283	ug/L
8270C	3520C	Water-Low	Phenanthrene	0.2	0.0102	ug/L
8270C	3520C	Water-Low	Phenol	0.5	0.0196	ug/L
8270C	3520C	Water-Low	Pyrene	0.2	0.0145	ug/L
8270C	3520C	Water-Low	Pyridine	5.0	1.4	ug/L
8270C-SIM PAH	3541	Soil	1-Methylnaphthalene	5	0.25	ug/kg
8270C-SIM PAH	3541	Soil	1-Methylphenanthrene	5	0.24	ug/kg
8270C-SIM PAH	3541	Soil	2,3,5-Trimethylnaphthalene	5	0.15	ug/kg
8270C-SIM PAH	3541	Soil	2,6-Dimethylnaphthalene	5	0.27	ug/kg

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C-SIM PAH	3541	Soil	2-Methylnaphthalene	5	0.34	ug/kg
8270C-SIM PAH	3541	Soil	Acenaphthene	5	0.16	ug/kg
8270C-SIM PAH	3541	Soil	Acenaphthylene	5	0.22	ug/kg
8270C-SIM PAH	3541	Soil	Anthracene	5	0.22	ug/kg
8270C-SIM PAH	3541	Soil	Benz(a)anthracene	5	0.16	ug/kg
8270C-SIM PAH	3541	Soil	Benzo(a)pyrene	5	0.22	ug/kg
8270C-SIM PAH	3541	Soil	Benzo(b)fluoranthene	5	0.48	ug/kg
8270C-SIM PAH	3541	Soil	Benzo(e)pyrene	5	0.39	ug/kg
8270C-SIM PAH	3541	Soil	Benzo(g,h,i)perylene	5	0.23	ug/kg
8270C-SIM PAH	3541	Soil	Benzo(k)fluoranthene	5	0.33	ug/kg
8270C-SIM PAH	3541	Soil	Biphenyl	5	0.43	ug/kg
8270C-SIM PAH	3541	Soil	Carbazole	5	0.65	ug/kg
8270C-SIM PAH	3541	Soil	Chrysene	5	0.41	ug/kg
8270C-SIM PAH	3541	Soil	Dibenz(a,h)anthracene	5	0.26	ug/kg
8270C-SIM PAH	3541	Soil	Dibenzofuran	5	0.17	ug/kg
8270C-SIM PAH	3541	Soil	Dibenzothiophene	5	0.23	ug/kg
8270C-SIM PAH	3541	Soil	Fluoranthene	5	0.34	ug/kg
8270C-SIM PAH	3541	Soil	Fluorene	5	0.19	ug/kg
8270C-SIM PAH	3541	Soil	Indeno(1,2,3-cd)pyrene	5	0.24	ug/kg
8270C-SIM PAH	3541	Soil	Naphthalene	5	0.34	ug/kg
8270C-SIM PAH	3541	Soil	Pentachlorophenol	200	15	ug/kg
8270C-SIM PAH	3541	Soil	Perylene	5	0.17	ug/kg
8270C-SIM PAH	3541	Soil	Phenanthrene	5	0.33	ug/kg
8270C-SIM PAH	3541	Soil	Pyrene	5	0.36	ug/kg
8270C-SIM PAH	3520C	Water	1-Methylnaphthalene	0.02	0.00250	ug/L
8270C-SIM PAH	3520C	Water	1-Methylphenanthrene	0.02	0.00193	ug/L
8270C-SIM PAH	3520C	Water	2,3,5-Trimethylnaphthalene	0.02	0.00110	ug/L
8270C-SIM PAH	3520C	Water	2,6-Dimethylnaphthalene	0.02	0.00237	ug/L
8270C-SIM PAH	3520C	Water	2-Methylnaphthalene	0.02	0.00268	ug/L
8270C-SIM PAH	3520C	Water	Acenaphthene	0.02	0.00198	ug/L
8270C-SIM PAH	3520C	Water	Acenaphthylene	0.02	0.00178	ug/L
8270C-SIM PAH	3520C	Water	Anthracene	0.02	0.00103	ug/L
8270C-SIM PAH	3520C	Water	Benz(a)anthracene	0.02	0.0021	ug/L
8270C-SIM PAH	3520C	Water	Benzo(a)pyrene	0.02	0.00158	ug/L
8270C-SIM PAH	3520C	Water	Benzo(b)fluoranthene	0.02	0.00194	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C-SIM PAH	3520C	Water	Benzo(e)pyrene	0.02	0.00182	ug/L
8270C-SIM PAH	3520C	Water	Benzo(g,h,i)perylene	0.02	0.00368	ug/L
8270C-SIM PAH	3520C	Water	Benzo(k)fluoranthene	0.02	0.00134	ug/L
8270C-SIM PAH	3520C	Water	Biphenyl	0.02	0.00351	ug/L
8270C-SIM PAH	3520C	Water	Carbazole	0.02	0.019	ug/L
8270C-SIM PAH	3520C	Water	Chrysene	0.02	0.00124	ug/L
8270C-SIM PAH	3520C	Water	Dibenz(a,h)anthracene	0.02	0.00162	ug/L
8270C-SIM PAH	3520C	Water	Dibenzofuran	0.02	0.00705	ug/L
8270C-SIM PAH	3520C	Water	Dibenzothiophene	0.02	0.00401	ug/L
8270C-SIM PAH	3520C	Water	Fluoranthene	0.02	0.00238	ug/L
8270C-SIM PAH	3520C	Water	Fluorene	0.02	0.00258	ug/L
8270C-SIM PAH	3520C	Water	Indeno(1,2,3-cd)pyrene	0.02	0.00208	ug/L
8270C-SIM PAH	3520C	Water	Naphthalene	0.02	0.00316	ug/L
8270C-SIM PAH	3520C	Water	Pentachlorophenol	1	0.095	ug/L
8270C-SIM PAH	3520C	Water	Perylene	0.02	0.00116	ug/L
8270C-SIM PAH	3520C	Water	Phenanthrene	0.02	0.00320	ug/L
8270C-SIM PAH	3520C	Water	Pyrene	0.02	0.00222	ug/L
8310	3550B	Soil	2-Methylnaphthalene/Dibenzofuran	0.100	0.032	mg/kg
8310	3550B	Soil	Acenaphthene	0.100	0.023	mg/kg
8310	3550B	Soil	Acenaphthylene	0.100	0.029	mg/kg
8310	3550B	Soil	Anthracene	0.010	0.00069	mg/kg
8310	3550B	Soil	Benz(a)anthracene	0.010	0.0013	mg/kg
8310	3550B	Soil	Benzo(a)pyrene	0.010	0.0010	mg/kg
8310	3550B	Soil	Benzo(b)fluoranthene	0.02	0.00071	mg/kg
8310	3550B	Soil	Benzo(g,h,i)perylene	0.020	0.0025	mg/kg
8310	3550B	Soil	Benzo(k)fluoranthene	0.010	0.00096	mg/kg
8310	3550B	Soil	Chrysene	0.010	0.00092	mg/kg
8310	3550B	Soil	Dibenz(a,h)anthracene	0.02	0.0021	mg/kg
8310	3550B	Soil	Fluoranthene	0.02	0.0014	mg/kg
8310	3550B	Soil	Fluorene	0.02	0.0025	mg/kg
8310	3550B	Soil	Indeno(1,2,3-cd)pyrene	0.010	0.0023	mg/kg
8310	3550B	Soil	Naphthalene	0.100	0.021	mg/kg
8310	3550B	Soil	Phenanthrene	0.01	0.0023	mg/kg
8310	3550B	Soil	Pyrene	0.02	0.00084	mg/kg
8310	3510C	Water	2-Methylnaphthalene/Dibenzofuran	1.0	0.24	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8310	3510C	Water	Acenaphthene	1.0	0.31	ug/L
8310	3510C	Water	Acenaphthylene	1.0	0.42	ug/L
8310	3510C	Water	Anthracene	0.1	0.021	ug/L
8310	3510C	Water	Benz(a)anthracene	0.1	0.024	ug/L
8310	3510C	Water	Benzo(a)pyrene	0.1	0.026	ug/L
8310	3510C	Water	Benzo(b)fluoranthene	0.2	0.032	ug/L
8310	3510C	Water	Benzo(g,h,i)perylene	0.2	0.050	ug/L
8310	3510C	Water	Benzo(k)fluoranthene	0.1	0.035	ug/L
8310	3510C	Water	Chrysene	0.1	0.021	ug/L
8310	3510C	Water	Dibenz(a,h)anthracene	0.2	0.047	ug/L
8310	3510C	Water	Fluoranthene	0.2	0.028	ug/L
8310	3510C	Water	Fluorene	0.2	0.024	ug/L
8310	3510C	Water	Indeno(1,2,3-cd)pyrene	0.1	0.029	ug/L
8310	3510C	Water	Naphthalene	1.0	0.25	ug/L
8310	3510C	Water	Phenanthrene	0.1	0.020	ug/L
8310	3510C	Water	Pyrene	0.2	0.020	ug/L
8315	Method	Soil	Acetaldehyde	2	1.1	mg/kg
8315	Method	Soil	Formaldehyde	2	0.81	mg/kg
8315	Method	Water	Acetaldehyde	100	12	ug/L
8315	Method	Water	Formaldehyde	100	11	ug/L
8330	Method	Soil	1,3,5-Trinitrobenzene	2.0	0.088	mg/kg
8330	Method	Soil	1,3-Dinitrobenzene	2.0	0.089	mg/kg
8330	Method	Soil	2,4,6-Trinitrotoluene	2.0	0.092	mg/kg
8330	Method	Soil	2,4-Dinitrotoluene	2.0	0.059	mg/kg
8330	Method	Soil	2,6-Dinitrotoluene	2.0	0.11	mg/kg
8330	Method	Soil	2-Amino-4,6-dinitrotoluene	2.0	0.099	mg/kg
8330	Method	Soil	2-Nitrotoluene	2.0	0.082	mg/kg
8330	Method	Soil	3-Nitrotoluene	2.0	0.081	mg/kg
8330	Method	Soil	4-Amino-2,6-dinitrotoluene	2.0	0.12	mg/kg
8330	Method	Soil	4-Nitrotoluene	2.0	0.11	mg/kg
8330	Method	Soil	HMX	2.0	0.072	mg/kg
8330	Method	Soil	Nitrobenzene	2.0	0.12	mg/kg
8330	Method	Soil	RDX	2.0	0.15	mg/kg
8330	Method	Soil	TETRYL	2.0	0.23	mg/kg
8330	Method	Water	1,3,5-Trinitrobenzene	2.0	0.38	ug/L

SEMIVOLATILE ORGANIC COMPOUNDS (SOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8330	Method	Water	1,3-Dinitrobenzene	2.0	0.27	ug/L
8330	Method	Water	2,4,6-Trinitrotoluene	2.0	0.50	ug/L
8330	Method	Water	2,4-Dinitrotoluene	2.0	0.32	ug/L
8330	Method	Water	2,6-Dinitrotoluene	2.0	0.39	ug/L
8330	Method	Water	2-Amino-4,6-dinitrotoluene	2.0	0.46	ug/L
8330	Method	Water	2-Nitrotoluene	2.0	0.32	ug/L
8330	Method	Water	3-Nitrotoluene	2.0	0.34	ug/L
8330	Method	Water	4-Amino-2,6-dinitrotoluene	2.0	0.53	ug/L
8330	Method	Water	4-Nitrotoluene	2.0	0.50	ug/L
8330	Method	Water	HMX	2.0	0.46	ug/L
8330	Method	Water	Nitrobenzene	2.0	0.45	ug/L
8330	Method	Water	RDX	2.0	0.38	ug/L
8330	Method	Water	TETRYL	2.0	0.37	ug/L
8332	Method	Soil	Nitroglycerin	2	0.49	mg/kg
8332	Method	Soil	PETN	2	0.50	mg/kg
8332	Method	Water	Nitroglycerin	2	0.69	ug/L
8332	Method	Water	PETN	2	0.84	ug/L
AK 102	Method	Soil	Diesel Range Petroleum Hydrocarbons	20	2.5	mg/kg
8015	3550B	Soil	Diesel Range Petroleum Hydrocarbons	10	2.7	mg/kg
NWTPH-Dx	Method	Soil	Diesel Range Petroleum Hydrocarbons	25	2.7	mg/kg
AK 102	Method	Water	Diesel Range Petroleum Hydrocarbons	800	7.6	ug/L
8015	3510C	Water	Diesel Range Petroleum Hydrocarbons	50	13	ug/L
NWTPH-Dx	Method	Water	Diesel Range Petroleum Hydrocarbons	100	7.6	ug/L
AK 103	3550B	Soil	Residual Range Petroleum Hydrocarbons	100	4.5	mg/kg
8015/CA-TPH-D	3510C	Water	Residual Range Petroleum Hydrocarbons	100	28	ug/L

a Method Detection Limits are subject to change as new MDL studies are completed.

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
602	Method	Water	Benzene	0.5	0.12	ug/L
602	Method	Water	Ethylbenzene	1.0	0.13	ug/L
602	Method	Water	m,p-Xylenes	1.0	0.23	ug/L
602	Method	Water	o-Xylene	1.0	0.15	ug/L
602	Method	Water	Toluene	1.0	0.13	ug/L
624	Method	Water	1,1,1-Trichloroethane (TCA)	5	0.23	ug/L
624	Method	Water	1,1,2,2-Tetrachloroethane	5	0.21	ug/L
624	Method	Water	1,1,2-Trichloroethane	5	0.22	ug/L
624	Method	Water	1,1-Dichloroethane	5	0.29	ug/L
624	Method	Water	1,1-Dichloroethene	5	0.21	ug/L
624	Method	Water	1,2-Dichlorobenzene	5	0.19	ug/L
624	Method	Water	1,2-Dichloroethane (EDC)	5	0.28	ug/L
624	Method	Water	1,2-Dichloropropane	5	0.15	ug/L
624	Method	Water	1,3-Dichlorobenzene	5	0.18	ug/L
624	Method	Water	1,4-Dichlorobenzene	5	0.19	ug/L
624	Method	Water	2-Butanone (MEK)	20	4.6	ug/L
624	Method	Water	2-Chloroethyl Vinyl Ether	10	0.11	ug/L
624	Method	Water	2-Hexanone	20	3.5	ug/L
624	Method	Water	Acetone	20	6	ug/L
624	Method	Water	Acrolein	50	2.9	ug/L
624	Method	Water	Acrylonitrile	10	0.91	ug/L
624	Method	Water	Benzene	5	0.16	ug/L
624	Method	Water	Bromodichloromethane	5	0.24	ug/L
624	Method	Water	Bromoform	5	0.26	ug/L
624	Method	Water	Bromomethane	5	0.41	ug/L
624	Method	Water	Carbon Disulfide	5	0.21	ug/L
624	Method	Water	Carbon Tetrachloride	5	0.23	ug/L
624	Method	Water	Chlorobenzene	5	0.21	ug/L
624	Method	Water	Chloroethane	5	0.24	ug/L
624	Method	Water	Chloroform	5	0.24	ug/L
624	Method	Water	Chloromethane	5	0.3	ug/L
624	Method	Water	cis-1,2-Dichloroethene	5	0.19	ug/L
624	Method	Water	cis-1,3-Dichloropropene	5	0.16	ug/L

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
624	Method	Water	Dibromochloromethane	5	0.15	ug/L
624	Method	Water	Dichlorodifluoromethane	5	0.18	ug/L
624	Method	Water	Ethylbenzene	5	0.17	ug/L
624	Method	Water	m,p-Xylenes	5	0.29	ug/L
624	Method	Water	Methylene Chloride	5	0.22	ug/L
624	Method	Water	o-Xylene	5	0.12	ug/L
624	Method	Water	Styrene	5	0.16	ug/L
624	Method	Water	Tetrachloroethene (PCE)	5	0.17	ug/L
624	Method	Water	Toluene	5	0.2	ug/L
624	Method	Water	trans-1,2-Dichloroethene	5	0.24	ug/L
624	Method	Water	trans-1,3-Dichloropropene	5	0.16	ug/L
624	Method	Water	Trichloroethene (TCE)	5	0.23	ug/L
624	Method	Water	Trichlorofluoromethane	5	0.31	ug/L
624	Method	Water	Trichlorotrifluoroethane	5	0.22	ug/L
624	Method	Water	Vinyl Acetate	10	0.43	ug/L
624	Method	Water	Vinyl Chloride	5	0.28	ug/L
8021B	5035/5030B	Soil	Benzene	0.05	0.0064	mg/kg
8021B	5035/5030B	Soil	Ethylbenzene	0.10	0.0052	mg/kg
8021B	5035/5030B	Soil	m,p-Xylenes	0.10	0.0068	mg/kg
8021B	5035/5030B	Soil	o-Xylene	0.10	0.0066	mg/kg
8021B	5035/5030B	Soil	Toluene	0.10	0.0027	mg/kg
8021B	5030B	Water	Benzene	0.5	0.11	ug/L
8021B	5030B	Water	Ethylbenzene	1.0	0.2	ug/L
8021B	5030B	Water	m,p-Xylenes	1.0	0.2	ug/L
8021B	5030B	Water	o-Xylene	1.0	0.08	ug/L
8021B	5030B	Water	Toluene	1.0	0.27	ug/L
8260B	5030A/5035	Soil	1,1,1,2-Tetrachloroethane	5.0	0.51	ug/kg
8260B	5030A/5035	Soil	1,1,1-Trichloroethane (TCA)	5.0	0.57	ug/kg
8260B	5030A/5035	Soil	1,1,2,2-Tetrachloroethane	5.0	0.73	ug/kg
8260B	5030A/5035	Soil	1,1,2-Trichloroethane	5.0	0.69	ug/kg
8260B	5030A/5035	Soil	1,1-Dichloroethane	5.0	0.78	ug/kg
8260B	5030A/5035	Soil	1,1-Dichloroethene	5.0	0.69	ug/kg
8260B	5030A/5035	Soil	1,1-Dichloropropene	5.0	0.73	ug/kg

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5030A/5035	Soil	1,2,3-Trichlorobenzene	20	0.90	ug/kg
8260B	5030A/5035	Soil	1,2,3-Trichloropropane	5.0	0.61	ug/kg
8260B	5030A/5035	Soil	1,2,4-Trichlorobenzene	20	0.77	ug/kg
8260B	5030A/5035	Soil	1,2,4-Trimethylbenzene	20	0.82	ug/kg
8260B	5030A/5035	Soil	1,2-Dibromo-3-chloropropane	20	0.85	ug/kg
8260B	5030A/5035	Soil	1,2-Dibromoethane (EDB)	20	0.79	ug/kg
8260B	5030A/5035	Soil	1,2-Dichlorobenzene	5.0	0.65	ug/kg
8260B	5030A/5035	Soil	1,2-Dichloroethane (EDC)	5.0	0.67	ug/kg
8260B	5030A/5035	Soil	1,2-Dichloropropane	5.0	0.72	ug/kg
8260B	5030A/5035	Soil	1,3,5-Trimethylbenzene	20	0.82	ug/kg
8260B	5030A/5035	Soil	1,3-Dichlorobenzene	5.0	0.71	ug/kg
8260B	5030A/5035	Soil	1,3-Dichloropropane	5.0	0.52	ug/kg
8260B	5030A/5035	Soil	1,4-Dichlorobenzene	5.0	0.82	ug/kg
8260B	5030A/5035	Soil	1,4-Dioxane	250	110	ug/kg
8260B	5030A/5035	Soil	1-Chlorohexane	5.0	0.69	ug/kg
8260B	5030A/5035	Soil	2,2-Dichloropropane	5.0	0.81	ug/kg
8260B	5030A/5035	Soil	2-Butanone (MEK)	20	8.4	ug/kg
8260B	5030A/5035	Soil	2-Chloroethyl Vinyl Ether	10	1.0	ug/kg
8260B	5030A/5035	Soil	2-Chlorotoluene	20	0.73	ug/kg
8260B	5030A/5035	Soil	2-Hexanone	20	6.1	ug/kg
8260B	5030A/5035	Soil	2-Nitropropane	20	3.8	ug/kg
8260B	5030A/5035	Soil	4-Chlorotoluene	20	.74	ug/kg
8260B	5030A/5035	Soil	4-Isopropyltoluene	20	0.72	ug/kg
8260B	5030A/5035	Soil	4-Methyl-2-pentanone (MIBK)	20	5.5	ug/kg
8260B	5030A/5035	Soil	Acetone	20	10	ug/kg
8260B	5030A/5035	Soil	Acetonitrile	100	69	ug/kg
8260B	5030A/5035	Soil	Acrolein	100	14	ug/kg
8260B	5030A/5035	Soil	Acrylonitrile	20	3.2	ug/kg
8260B	5030A/5035	Soil	Allyl Chloride	20	2.7	ug/kg
8260B	5030A/5035	Soil	Benzene	5.0	0.79	ug/kg
8260B	5030A/5035	Soil	Bromobenzene	5.0	0.81	ug/kg
8260B	5030A/5035	Soil	Bromochloromethane	5.0	0.52	ug/kg
8260B	5030A/5035	Soil	Bromodichloromethane	5.0	0.53	ug/kg
8260B	5030A/5035	Soil	Bromoform	5.0	0.65	ug/kg

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5030A/5035	Soil	Bromomethane	5.0	0.8	ug/kg
8260B	5030A/5035	Soil	Carbon Disulfide	5.0	1.5	ug/kg
8260B	5030A/5035	Soil	Carbon Tetrachloride	5.0	0.60	ug/kg
8260B	5030A/5035	Soil	Chlorobenzene	5.0	0.70	ug/kg
8260B	5030A/5035	Soil	Chloroethane	5.0	0.78	ug/kg
8260B	5030A/5035	Soil	Chloroform	5.0	0.57	ug/kg
8260B	5030A/5035	Soil	Chloromethane	5.0	0.99	ug/kg
8260B	5030A/5035	Soil	Chloroprene	20	3.3	ug/kg
8260B	5030A/5035	Soil	cis-1,2-Dichloroethene	5.0	0.83	ug/kg
8260B	5030A/5035	Soil	cis-1,3-Dichloropropene	5.0	0.76	ug/kg
8260B	5030A/5035	Soil	cis-1,4-Dichloro-2-butene	20	14	ug/kg
8260B	5030A/5035	Soil	Cyclohexane	5.0	0.67	ug/kg
8260B	5030A/5035	Soil	Dibromochloromethane	5.0	0.60	ug/kg
8260B	5030A/5035	Soil	Dibromomethane	5.0	0.72	ug/kg
8260B	5030A/5035	Soil	Dichlorodifluoromethane	5.0	0.70	ug/kg
8260B	5030A/5035	Soil	Diisopropyl Ether	10	0.25	ug/kg
8260B	5030A/5035	Soil	Ethyl Acetate	20	4.1	ug/kg
8260B	5030A/5035	Soil	Ethyl Methacrylate	20	3.0	ug/kg
8260B	5030A/5035	Soil	Ethylbenzene	5.0	0.57	ug/kg
8260B	5030A/5035	Soil	Ethylene Oxide	100	18	ug/kg
8260B	5030A/5035	Soil	Hexachlorobutadiene	20	0.75	ug/kg
8260B	5030A/5035	Soil	Iodomethane (Methyl Iodide)	20	4.0	ug/kg
8260B	5030A/5035	Soil	Isobutanol	200	94	ug/kg
8260B	5030A/5035	Soil	Isopropylbenzene	20	0.68	ug/kg
8260B	5030A/5035	Soil	m,p-Xylenes	5.0	1.5	ug/kg
8260B	5030A/5035	Soil	Methacrylonitrile	20	3.4	ug/kg
8260B	5030A/5035	Soil	Methyl Acetate	5.0	0.73	ug/kg
8260B	5030A/5035	Soil	Methyl Methacrylate	20	3.3	ug/kg
8260B	5030A/5035	Soil	Methyl tert-Butyl Ether	5.0	0.64	ug/kg
8260B	5030A/5035	Soil	Methylcyclohexane	5.0	0.71	ug/kg
8260B	5030A/5035	Soil	Methylene Chloride	10	0.96	ug/kg
8260B	5030A/5035	Soil	Naphthalene	20	0.89	ug/kg
8260B	5030A/5035	Soil	n-Butylbenzene	20	0.75	ug/kg
8260B	5030A/5035	Soil	n-Hexane	10	4.0	ug/kg

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5030A/5035	Soil	n-Octane	10	4.0	ug/kg
8260B	5030A/5035	Soil	n-Propylbenzene	20	0.72	ug/kg
8260B	5030A/5035	Soil	o-Xylene	5.0	0.69	ug/kg
8260B	5030A/5035	Soil	Propionitrile	20	3.7	ug/kg
8260B	5030A/5035	Soil	Propylene Oxide	50	10	ug/kg
8260B	5030A/5035	Soil	sec-Butylbenzene	20	0.74	ug/kg
8260B	5030A/5035	Soil	Styrene	5.0	0.73	ug/kg
8260B	5030A/5035	Soil	tert-Amyl Methyl Ether	10	0.15	ug/kg
8260B	5030A/5035	Soil	tert-Butyl Alcohol	50	3.6	ug/kg
8260B	5030A/5035	Soil	tert-Butyl Ethyl Ether	10	0.084	ug/kg
8260B	5030A/5035	Soil	tert-Butylbenzene	20	0.74	ug/kg
8260B	5030A/5035	Soil	Tetrachloroethene (PCE)	5.0	0.31	ug/kg
8260B	5030A/5035	Soil	Toluene	5.0	0.84	ug/kg
8260B	5030A/5035	Soil	trans-1,2-Dichloroethene	5.0	0.73	ug/kg
8260B	5030A/5035	Soil	trans-1,3-Dichloropropene	5.0	0.60	ug/kg
8260B	5030A/5035	Soil	trans-1,4-Dichloro-2-butene	20	1.5	ug/kg
8260B	5030A/5035	Soil	Trichloroethene (TCE)	5.0	0.28	ug/kg
8260B	5030A/5035	Soil	Trichlorofluoromethane	5.0	0.73	ug/kg
8260B	5030A/5035	Soil	Trichlorotrifluoroethane	5.0	0.74	ug/kg
8260B	5030A/5035	Soil	Vinyl Acetate	20	3.6	ug/kg
8260B	5030A/5035	Soil	Vinyl Chloride	5.0	0.62	ug/kg
8260B	5035/5030B	Soil-mid	1,1,1,2-Tetrachloroethane	.05	0.0111	mg/kg
8260B	5035/5030B	Soil-mid	1,1,1-Trichloroethane (TCA)	.05	0.0111	mg/kg
8260B	5035/5030B	Soil-mid	1,1,2,2-Tetrachloroethane	.05	0.0138	mg/kg
8260B	5035/5030B	Soil-mid	1,1,2-Trichloroethane	.05	0.00992	mg/kg
8260B	5035/5030B	Soil-mid	1,1-Dichloroethane	.05	0.00906	mg/kg
8260B	5035/5030B	Soil-mid	1,1-Dichloroethene	.05	0.0119	mg/kg
8260B	5035/5030B	Soil-mid	1,1-Dichloropropene	.05	0.0128	mg/kg
8260B	5035/5030B	Soil-mid	1,2,3-Trichlorobenzene	0.2	0.0326	mg/kg
8260B	5035/5030B	Soil-mid	1,2,3-Trichloropropane	.05	0.0213	mg/kg
8260B	5035/5030B	Soil-mid	1,2,4-Trichlorobenzene	0.2	0.0218	mg/kg
8260B	5035/5030B	Soil-mid	1,2,4-Trimethylbenzene	0.2	0.0141	mg/kg
8260B	5035/5030B	Soil-mid	1,2-Dibromo-3-chloropropane	0.2	0.0991	mg/kg
8260B	5035/5030B	Soil-mid	1,2-Dibromoethane (EDB)	0.2	.00730	mg/kg

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5035/5030B	Soil-mid	1,2-Dichlorobenzene	.05	0.00847	mg/kg
8260B	5035/5030B	Soil-mid	1,2-Dichloroethane (EDC)	.05	0.0114	mg/kg
8260B	5035/5030B	Soil-mid	1,2-Dichloropropane	.05	0.0124	mg/kg
8260B	5035/5030B	Soil-mid	1,3,5-Trichlorobenzene	.2	0.0343	mg/kg
8260B	5035/5030B	Soil-mid	1,3,5-Trimethylbenzene	0.2	.0121	mg/kg
8260B	5035/5030B	Soil-mid	1,3-Dichlorobenzene	.05	0.0102	mg/kg
8260B	5035/5030B	Soil-mid	1,3-Dichloropropane	.05	0.00759	mg/kg
8260B	5035/5030B	Soil-mid	1,4-Dichlorobenzene	.05	.00869	mg/kg
8260B	5035/5030B	Soil-mid	1,4-Dioxane	25	10	mg/kg
8260B	5035/5030B	Soil-mid	1-Chlorohexane	.05	0.0118	mg/kg
8260B	5035/5030B	Soil-mid	2,2-Dichloropropane	.05	0.0174	mg/kg
8260B	5035/5030B	Soil-mid	2-Butanone (MEK)	2.0	0.322	mg/kg
8260B	5035/5030B	Soil-mid	2-Chloroethyl Vinyl Ether	0.5	0.0112	mg/kg
8260B	5035/5030B	Soil-mid	2-Chlorotoluene	0.2	0.0111	mg/kg
8260B	5035/5030B	Soil-mid	2-Hexanone	2.0	0.396	mg/kg
8260B	5035/5030B	Soil-mid	2-Nitropropane	0.5	0.0238	mg/kg
8260B	5035/5030B	Soil-mid	3-Chloro-1-propene	0.5	0.0127	mg/kg
8260B	5035/5030B	Soil-mid	4-Chlorotoluene	0.2	0.00884	mg/kg
8260B	5035/5030B	Soil-mid	4-Isopropyltoluene	0.2	0.0128	mg/kg
8260B	5035/5030B	Soil-mid	4-Methyl-2-pentanone (MIBK)	2.0	0.280	mg/kg
8260B	5035/5030B	Soil-mid	Acetone	2.0	0.229	mg/kg
8260B	5035/5030B	Soil-mid	Acetonitrile	0.5	0.105	mg/kg
8260B	5035/5030B	Soil-mid	Acrolein	2.0	0.142	mg/kg
8260B	5035/5030B	Soil-mid	Acrylonitrile	2.0	0.0161	mg/kg
8260B	5035/5030B	Soil-mid	Benzene	.05	0.0105	mg/kg
8260B	5035/5030B	Soil-mid	Bromobenzene	0.2	0.00972	mg/kg
8260B	5035/5030B	Soil-mid	Bromochloromethane	.05	0.0126	mg/kg
8260B	5035/5030B	Soil-mid	Bromodichloromethane	.05	0.00847	mg/kg
8260B	5035/5030B	Soil-mid	Bromoform	.05	0.0279	mg/kg
8260B	5035/5030B	Soil-mid	Bromomethane	.05	0.0217	mg/kg
8260B	5035/5030B	Soil-mid	Carbon Disulfide	.05	0.0159	mg/kg
8260B	5035/5030B	Soil-mid	Carbon Tetrachloride	.05	0.0123	mg/kg
8260B	5035/5030B	Soil-mid	Chlorobenzene	.05	0.00933	mg/kg
8260B	5035/5030B	Soil-mid	Chloroethane	.05	0.0173	mg/kg

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5035/5030B	Soil-mid	Chloroform	.05	0.00958	mg/kg
8260B	5035/5030B	Soil-mid	Chloromethane	.05	0.0136	mg/kg
8260B	5035/5030B	Soil-mid	Chloroprene	1.0	0.0119	mg/kg
8260B	5035/5030B	Soil-mid	cis-1,2-Dichloroethene	.05	0.0116	mg/kg
8260B	5035/5030B	Soil-mid	cis-1,3-Dichloropropene	.05	0.00808	mg/kg
8260B	5035/5030B	Soil-mid	cis-1,4-Dichloro-2-butene	1.0	0.0562	mg/kg
8260B	5035/5030B	Soil-mid	Cyclohexane	0.10	0.0200	mg/kg
8260B	5035/5030B	Soil-mid	Dibromochloromethane	.05	0.00817	mg/kg
8260B	5035/5030B	Soil-mid	Dibromomethane	.05	0.00974	mg/kg
8260B	5035/5030B	Soil-mid	Dichlorodifluoromethane	.05	0.0166	mg/kg
8260B	5035/5030B	Soil-mid	Dichlorofluoromethane (CFC 21)	.05	0.05	mg/kg
8260B	5035/5030B	Soil-mid	Ethyl Acetate	0.5	0.0484	mg/kg
8260B	5035/5030B	Soil-mid	Ethyl Ether	0.1	0.1	mg/kg
8260B	5035/5030B	Soil-mid	Ethyl Methacrylate	0.2	0.00934	mg/kg
8260B	5035/5030B	Soil-mid	Ethylbenzene	.05	0.00974	mg/kg
8260B	5035/5030B	Soil-mid	Hexachlorobutadiene	0.2	0.0380	mg/kg
8260B	5035/5030B	Soil-mid	Iodomethane	0.5	0.0224	mg/kg
8260B	5035/5030B	Soil-mid	Isobutyl Alcohol	50.	0.427	mg/kg
8260B	5035/5030B	Soil-mid	Isopropylbenzene	0.2	0.00680	mg/kg
8260B	5035/5030B	Soil-mid	m,p-Xylenes	.05	0.0186	mg/kg
8260B	5035/5030B	Soil-mid	Methacrylonitrile	0.5	0.0155	mg/kg
8260B	5035/5030B	Soil-mid	Methyl Acetate	0.10	0.0297	mg/kg
8260B	5035/5030B	Soil-mid	Methyl Methacrylate	0.5	0.0118	mg/kg
8260B	5035/5030B	Soil-mid	Methyl tert-Butyl Ether	.05	0.00734	mg/kg
8260B	5035/5030B	Soil-mid	Methylcyclohexane	0.10	0.0190	mg/kg
8260B	5035/5030B	Soil-mid	Methylene Chloride	0.2	0.0193	mg/kg
8260B	5035/5030B	Soil-mid	Naphthalene	0.2	0.0285	mg/kg
8260B	5035/5030B	Soil-mid	n-Butylbenzene	0.2	0.0221	mg/kg
8260B	5035/5030B	Soil-mid	n-Heptane	0.1	0.1	mg/kg
8260B	5035/5030B	Soil-mid	n-Hexane	0.1	0.0180	mg/kg
8260B	5035/5030B	Soil-mid	n-Octane	0.1	0.1	mg/kg
8260B	5035/5030B	Soil-mid	n-Propylbenzene	0.2	0.00968	mg/kg
8260B	5035/5030B	Soil-mid	o-Xylene	.05	0.00785	mg/kg
8260B	5035/5030B	Soil-mid	Propionitrile	0.5	0.0862	mg/kg

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5035/5030B	Soil-mid	sec-Butylbenzene	0.2	0.0127	mg/kg
8260B	5035/5030B	Soil-mid	Styrene	.05	0.00943	mg/kg
8260B	5035/5030B	Soil-mid	tert-Butyl Alcohol	0.25	0.103	mg/kg
8260B	5035/5030B	Soil-mid	tert-Butyl Ethyl Ether	0.05	0.005	mg/kg
8260B	5035/5030B	Soil-mid	tert-Butylbenzene	0.2	0.0122	mg/kg
8260B	5035/5030B	Soil-mid	Tetrachloroethene (PCE)	.05	0.0109	mg/kg
8260B	5035/5030B	Soil-mid	Tetrahydrofuran	1.0	0.5	mg/kg
8260B	5035/5030B	Soil-mid	Toluene	.05	0.00975	mg/kg
8260B	5035/5030B	Soil-mid	trans-1,2-Dichloroethene	.05	0.0139	mg/kg
8260B	5035/5030B	Soil-mid	trans-1,3-Dichloropropene	.05	0.00863	mg/kg
8260B	5035/5030B	Soil-mid	trans-1,4-Dichloro-2-butene	1.0	0.0597	mg/kg
8260B	5035/5030B	Soil-mid	Trichloroethene (TCE)	.05	0.0188	mg/kg
8260B	5035/5030B	Soil-mid	Trichlorofluoromethane	.05	0.0131	mg/kg
8260B	5035/5030B	Soil-mid	Trichlorotrifluoroethane	.05	0.0121	mg/kg
8260B	5035/5030B	Soil-mid	Vinyl Acetate	0.5	0.0387	mg/kg
8260B	5035/5030B	Soil-mid	Vinyl Chloride	.05	0.0211	mg/kg
8260B	5030B	Water	1,1,1,2-Tetrachloroethane	0.5	0.111	ug/L
8260B	5030B	Water	1,1,1-Trichloroethane (TCA)	0.5	0.116	ug/L
8260B	5030B	Water	1,1,2,2-Tetrachloroethane	0.5	0.138	ug/L
8260B	5030B	Water	1,1,2-Trichloroethane	0.5	0.138	ug/L
8260B	5030B	Water	1,1-Dichloroethane	0.5	0.101	ug/L
8260B	5030B	Water	1,1-Dichloroethene	0.5	0.122	ug/L
8260B	5030B	Water	1,1-Dichloropropene	0.5	0.150	ug/L
8260B	5030B	Water	1,2,3-Trichlorobenzene	2	0.326	ug/L
8260B	5030B	Water	1,2,3-Trichloropropane	0.5	0.213	ug/L
8260B	5030B	Water	1,2,4-Trichlorobenzene	2	0.218	ug/L
8260B	5030B	Water	1,2,4-Trimethylbenzene	2	0.141	ug/L
8260B	5030B	Water	1,2-Dibromo-3-chloropropane	2	0.991	ug/L
8260B	5030B	Water	1,2-Dibromoethane (EDB)	2	0.0981	ug/L
8260B	5030B	Water	1,2-Dichlorobenzene	0.5	0.111	ug/L
8260B	5030B	Water	1,2-Dichloroethane (EDC)	0.5	0.114	ug/L
8260B	5030B	Water	1,2-Dichloropropane	0.5	0.139	ug/L
8260B	5030B	Water	1,3,5-Trichlorobenzene	0.5	0.343	ug/L

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5030B	Water	1,3,5-Trimethylbenzene	0.5	.121	ug/L
8260B	5030B	Water	1,3-Dichlorobenzene	0.5	0.102	ug/L
8260B	5030B	Water	1,3-Dichloropropane	0.5	0.147	ug/L
8260B	5030B	Water	1,4-Dichlorobenzene	0.5	0.114	ug/L
8260B	5030B	Water	1,4-Dioxane	100	23.9	ug/L
8260B	5030B	Water	1-Chlorohexane	0.5	0.118	ug/L
8260B	5030B	Water	2,2-Dichloropropane	0.5	0.174	ug/L
8260B	5030B	Water	2-Butanone (MEK)	20	1.94	ug/L
8260B	5030B	Water	2-Chloroethyl Vinyl Ether	5	0.333	ug/L
8260B	5030B	Water	2-Chlorotoluene	2	0.111	ug/L
8260B	5030B	Water	2-Hexanone	20	3.96	ug/L
8260B	5030B	Water	2-Nitropropane	5	1.99	ug/L
8260B	5030B	Water	3-Chloro-1-propene	5	0.154	ug/L
8260B	5030B	Water	4-Chlorotoluene	2	0.118	ug/L
8260B	5030B	Water	4-Isopropyltoluene	2	0.128	ug/L
8260B	5030B	Water	4-Methyl-2-pentanone (MIBK)	20	2.70	ug/L
8260B	5030B	Water	Acetone	20	4.08	ug/L
8260B	5030B	Water	Acetonitrile	50	7.44	ug/L
8260B	5030B	Water	Acrolein	20	1.42	ug/L
8260B	5030B	Water	Acrylonitrile	5	0.531	ug/L
8260B	5030B	Water	Benzene	0.5	0.136	ug/L
8260B	5030B	Water	Bromobenzene	2	0.172	ug/L
8260B	5030B	Water	Bromochloromethane	0.5	0.164	ug/L
8260B	5030B	Water	Bromodichloromethane	0.5	0.109	ug/L
8260B	5030B	Water	Bromoform	0.5	0.279	ug/L
8260B	5030B	Water	Bromomethane	0.5	0.217	ug/L
8260B	5030B	Water	Carbon Disulfide	0.5	0.159	ug/L
8260B	5030B	Water	Carbon Tetrachloride	0.5	0.139	ug/L
8260B	5030B	Water	Chlorobenzene	0.5	0.134	ug/L
8260B	5030B	Water	Chloroethane	0.5	0.226	ug/L
8260B	5030B	Water	Chloroform	0.5	0.136	ug/L
8260B	5030B	Water	Chloromethane	0.5	0.136	ug/L
8260B	5030B	Water	Chloroprene	10	0.348	ug/L
8260B	5030B	Water	cis-1,2-Dichloroethene	0.5	0.116	ug/L

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5030B	Water	cis-1,3-Dichloropropene	0.5	0.110	ug/L
8260B	5030B	Water	cis-1,4-Dichloro-2-butene	10	0.600	ug/L
8260B	5030B	Water	Cyclohexane	1.0	0.200	ug/L
8260B	5030B	Water	Dibromochloromethane	0.5	0.104	ug/L
8260B	5030B	Water	Dibromomethane	0.5	0.119	ug/L
8260B	5030B	Water	Dichlorodifluoromethane	0.5	0.166	ug/L
8260B	5030B	Water	Dichlorofluoromethane (CFC 21)	0.5	0.400	ug/L
8260B	5030B	Water	Diisopropyl Ether	2.0	0.244	ug/L
8260B	5030B	Water	Ethyl Acetate	5	0.618	ug/L
8260B	5030B	Water	Ethyl Ether	1	0.5	ug/L
8260B	5030B	Water	Ethyl Methacrylate	5	0.0934	ug/L
8260B	5030B	Water	Ethylbenzene	0.5	0.130	ug/L
8260B	5030B	Water	Ethylene Oxide	10	1.1	ug/L
8260B	5030B	Water	Hexachlorobutadiene	2	0.28	ug/L
8260B	5030B	Water	Iodomethane	5	0.375	ug/L
8260B	5030B	Water	Isobutyl Alcohol	100	5.01	ug/L
8260B	5030B	Water	Isopropylbenzene	2	0.105	ug/L
8260B	5030B	Water	m,p-Xylenes	0.5	0.219	ug/L
8260B	5030B	Water	Methacrylonitrile	5	0.444	ug/L
8260B	5030B	Water	Methyl Acetate	1.0	0.354	ug/L
8260B	5030B	Water	Methyl Methacrylate	5	0.354	ug/L
8260B	5030B	Water	Methyl tert-Butyl Ether	0.5	0.197	ug/L
8260B	5030B	Water	Methylcyclohexane	1.0	0.190	ug/L
8260B	5030B	Water	Methylene Chloride	2	0.193	ug/L
8260B	5030B	Water	Naphthalene	2	0.285	ug/L
8260B	5030B	Water	n-Butylbenzene	2	0.221	ug/L
8260B	5030B	Water	n-Hexane	1	0.180	ug/L
8260B	5030B	Water	n-Octane	5	0.29	ug/L
8260B	5030B	Water	n-Propylbenzene	2	0.0980	ug/L
8260B	5030B	Water	o-Xylene	0.5	0.102	ug/L
8260B	5030B	Water	Propionitrile	5	1.27	ug/L
8260B	5030B	Water	sec-Butylbenzene	2	0.127	ug/L
8260B	5030B	Water	Styrene	0.5	0.0943	ug/L
8260B	5030B	Water	tert-Amyl Methyl Ether	2.0	0.143	ug/L

VOLATILE ORGANIC COMPOUNDS (VOCs) ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8260B	5030B	Water	tert-Butyl Alcohol	20	1.031	ug/L
8260B	5030B	Water	tert-Butyl Ethyl Ether	2.0	0.0741	ug/L
8260B	5030B	Water	tert-Butylbenzene	2	0.122	ug/L
8260B	5030B	Water	Tetrachloroethene (PCE)	0.5	0.126	ug/L
8260B	5030B	Water	Tetrahydrofuran	10	0.456	ug/L
8260B	5030B	Water	Toluene	0.5	0.108	ug/L
8260B	5030B	Water	trans-1,2-Dichloroethene	0.5	0.143	ug/L
8260B	5030B	Water	trans-1,3-Dichloropropene	0.5	0.0894	ug/L
8260B	5030B	Water	trans-1,4-Dichloro-2-butene	10	0.597	ug/L
8260B	5030B	Water	Trichloroethene (TCE)	0.5	0.133	ug/L
8260B	5030B	Water	Trichlorofluoromethane	0.5	0.131	ug/L
8260B	5030B	Water	Trichlorotrifluoroethane	0.5	0.132	ug/L
8260B	5030B	Water	Vinyl Acetate	5.0	0.663	ug/L
8260B	5030B	Water	Vinyl Chloride	0.5	0.042	ug/L
AK 101	Method	Soil	Gasoline Range Petroleum Hydrocarbons	20	0.32	mg/kg
8015B/CA-TPH-G	5035/5030B	Soil	Gasoline Range Petroleum Hydrocarbons	5	0.31	mg/kg
NWTPH-Gx	5035/5030B	Soil	Gasoline Range Petroleum Hydrocarbon	5	0.3	mg/kg
AK 101	Method	Water	Gasoline Range Petroleum Hydrocarbons	100	13	ug/L
8015B/CA-TPH-G	5030B	Water	Gasoline Range Petroleum Hydrocarbons	50	13	ug/L
NWTPH-Gx	5030B	Water	Gasoline Range Petroleum Hydrocarbon	250	13	ug/L

a Method Detection Limits are subject to change as new MDL studies are completed.

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
ASTM D4129-82M	Method	Sediment	Total Organic Carbon	0.05	0.02	%
9030M	Method	Sediment	Sulfides	0.5	0.03	mg/kg
PSEP	NA	Sediment	Particle Size	NA	NA	
6010B - ICP	AVS-SEM	Sediment	Cadmium	0.2		mg/kg
6010B - ICP	AVS-SEM	Sediment	Copper	0.4		mg/kg
6010B - ICP	AVS-SEM	Sediment	Lead	3		mg/kg
6010B - ICP	AVS-SEM	Sediment	Nickel	0.5		mg/kg
6010B - ICP	AVS-SEM	Sediment	Zinc	0.4		mg/kg
7470A	AVS-SEM	Sediment	Mercury	0.01		mg/kg
200.8 - ICP/MS	3050B	Sediment	Aluminum	2	2	mg/kg
200.8 - ICP/MS	3050B	Sediment	Antimony	0.05	0.02	mg/kg
200.8 - ICP/MS	3050B	Sediment	Arsenic	0.5	0.07	mg/kg
200.8 - ICP/MS	3050B	Sediment	Barium	0.05	0.03	mg/kg
200.8 - ICP/MS	3050B	Sediment	Beryllium	0.02	0.006	mg/kg
200.8 - ICP/MS	3050B	Sediment	Cadmium	0.05	0.007	mg/kg
6010B - ICP	3050B	Sediment	Chromium	2	0.6	mg/kg
200.8 - ICP/MS	3050B	Sediment	Cobalt	0.02	0.01	mg/kg
200.8 - ICP/MS	3050B	Sediment	Copper	0.1	0.02	mg/kg
200.8 - ICP/MS	3050B	Sediment	Lead	0.05	0.02	mg/kg
200.8 - ICP/MS	3050B	Sediment	Manganese	0.1	0.04	mg/kg
7471A- CVAA	Method	Sediment	Mercury	0.02	0.008	mg/kg
200.8 - ICP/MS	3050B	Sediment	Molybdenum	0.05	0.008	mg/kg
200.8 - ICP/MS	3050B	Sediment	Nickel	0.2	0.04	mg/kg
7740 - GFAA	3050B	Sediment	Selenium	1	0.2	mg/kg
200.8 - ICP/MS	3050B	Sediment	Silver	0.02	0.003	mg/kg
200.8 - ICP/MS	3050B	Sediment	Thallium	0.02	0.002	mg/kg
200.8 - ICP/MS	3050B	Sediment	Vanadium	0.2	0.03	mg/kg
200.8 - ICP/MS	3050B	Sediment	Zinc	0.5	0.2	mg/kg
200.8 - ICP/MS	Reductive Precip.	Seawater	Arsenic	0.5	0.01	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Beryllium	0.02	0.0006	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Cadmium	0.02	0.002	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Chromium	0.2	0.03	ug/L

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
200.8 - ICP/MS	Reductive Precip.	Seawater	Cobalt	0.02	0.002	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Copper	0.1	0.005	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Lead	0.02	0.008	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Nickel	0.2	0.02	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Silver	0.02	0.002	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Thallium	0.02	0.0005	ug/L
200.8 - ICP/MS	Reductive Precip.	Seawater	Zinc	0.5	0.02	ug/L
7742	3010A/BRAA	Seawater	Selenium	1	0.3	ug/L
200.8 - ICP/MS	3050B/PSEP	Tissue	Aluminum	2	0.3	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Antimony	0.05	0.008	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Arsenic	0.5	0.03	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Barium	0.05	0.02	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Beryllium	0.02	0.007	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Cadmium	0.02	0.006	mg/kg
6010B - ICP	3050B/PSEP	Tissue	Chromium	0.5	0.5	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Cobalt	0.02	0.003	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Copper	0.1	0.09	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Lead	0.02	0.007	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Manganese	0.05	0.006	mg/kg
7471A- CVAA	Method	Tissue	Mercury	0.02	0.01	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Molybdenum	0.05	0.005	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Nickel	0.2	0.03	mg/kg
7740 - GFAA	3050B/PSEP	Tissue	Selenium	1	1	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Silver	0.02	0.004	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Thallium	0.02	0.002	mg/kg
200.8 - ICP/MS	3050B/PSEP	Tissue	Zinc	0.5	0.06	mg/kg
8081A	3541	Sed.-Low	2,4'-DDD	1.0	0.12	ug/kg
8081A	3541	Sed.-Low	2,4'-DDE	1.0	0.32	ug/kg
8081A	3541	Sed.-Low	2,4'-DDT	1.0	0.13	ug/kg
8081A	3541	Sed.-Low	4,4'-DDD	1.0	0.12	ug/kg
8081A	3541	Sed.-Low	4,4'-DDE	1.0	0.10	ug/kg
8081A	3541	Sed.-Low	4,4'-DDT	1.0	0.064	ug/kg

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8081A	3541	Sed.-Low	Aldrin	1.0	0.15	ug/kg
8081A	3541	Sed.-Low	alpha-BHC	1.0	0.26	ug/kg
8081A	3541	Sed.-Low	alpha-Chlordane	1.0	0.23	ug/kg
8081A	3541	Sed.-Low	beta-BHC	1.0	0.30	ug/kg
8081A	3541	Sed.-Low	Chlordane	10	1.4	ug/kg
8081A	3541	Sed.-Low	Chlorpyrifos	1.0	0.054	ug/kg
8081A	3541	Sed.-Low	cis-Nonachlor	1.0	0.083	ug/kg
8081A	3541	Sed.-Low	delta-BHC	1.0	0.055	ug/kg
8081A	3541	Sed.-Low	Dieldrin	1.0	0.29	ug/kg
8081A	3541	Sed.-Low	Endosulfan I	1.0	0.17	ug/kg
8081A	3541	Sed.-Low	Endosulfan II	1.0	0.19	ug/kg
8081A	3541	Sed.-Low	Endosulfan Sulfate	1.0	0.079	ug/kg
8081A	3541	Sed.-Low	Endrin	1.0	0.20	ug/kg
8081A	3541	Sed.-Low	Endrin Aldehyde	1.0	0.053	ug/kg
8081A	3541	Sed.-Low	Endrin Ketone	1.0	0.082	ug/kg
8081A	3541	Sed.-Low	gamma-BHC (Lindane)	1.0	0.15	ug/kg
8081A	3541	Sed.-Low	gamma-Chlordane	1.0	0.064	ug/kg
8081A	3541	Sed.-Low	Heptachlor	1.0	0.080	ug/kg
8081A	3541	Sed.-Low	Heptachlor Epoxide	1.0	0.13	ug/kg
8081A	3541	Sed.-Low	Hexachlorobenzene	1.0	0.079	ug/kg
8081A	3541	Sed.-Low	Hexachlorobutadiene	1.0	0.49	ug/kg
8081A	3541	Sed.-Low	Hexachlorocyclopentadiene	1.0	0.39	ug/kg
8081A	3541	Sed.-Low	Hexachloroethane	1.0	0.16	ug/kg
8081A	3541	Sed.-Low	Isodrin	1.0	0.097	ug/kg
8081A	3541	Sed.-Low	Methoxychlor	1.0	0.10	ug/kg
8081A	3541	Sed.-Low	Mirex	1.0	0.10	ug/kg
8081A	3541	Sed.-Low	Oxychlordane	1.0	0.37	ug/kg
8081A	3541	Sed.-Low	Toxaphene	50	4.9	ug/kg
8081A	3541	Sed.-Low	trans-Nonachlor	1.0	0.089	ug/kg
8081A	3540C	Tissue	2,4'-DDD	1.0	0.32	ug/kg
8081A	3540C	Tissue	2,4'-DDE	1.0	0.19	ug/kg
8081A	3540C	Tissue	2,4'-DDT	1.0	0.33	ug/kg
8081A	3540C	Tissue	4,4'-DDD	1.0	0.098	ug/kg

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8081A	3540C	Tissue	4,4'-DDE	1.0	0.12	ug/kg
8081A	3540C	Tissue	4,4'-DDT	1.0	0.17	ug/kg
8081A	3540C	Tissue	Aldrin	1.0	0.11	ug/kg
8081A	3540C	Tissue	alpha-BHC	1.0	0.21	ug/kg
8081A	3540C	Tissue	alpha-Chlordane	1.0	0.18	ug/kg
8081A	3540C	Tissue	beta-BHC	1.0	0.32	ug/kg
8081A	3540C	Tissue	Chlordane	10	1.2	ug/kg
8081A	3540C	Tissue	Chlorpyrifos	1.0	0.15	ug/kg
8081A	3540C	Tissue	cis-Nonachlor	1.0	0.16	ug/kg
8081A	3540C	Tissue	delta-BHC	1.0	0.24	ug/kg
8081A	3540C	Tissue	Dieldrin	1.0	0.081	ug/kg
8081A	3540C	Tissue	Endosulfan I	1.0	0.16	ug/kg
8081A	3540C	Tissue	Endosulfan II	1.0	0.087	ug/kg
8081A	3540C	Tissue	Endosulfan Sulfate	1.0	0.16	ug/kg
8081A	3540C	Tissue	Endrin	1.0	0.088	ug/kg
8081A	3540C	Tissue	Endrin Aldehyde	1.0	0.20	ug/kg
8081A	3540C	Tissue	Endrin Ketone	1.0	0.24	ug/kg
8081A	3540C	Tissue	gamma-BHC (Lindane)	1.0	0.15	ug/kg
8081A	3540C	Tissue	gamma-Chlordane	1.0	0.25	ug/kg
8081A	3540C	Tissue	Heptachlor	1.0	0.13	ug/kg
8081A	3540C	Tissue	Heptachlor Epoxide	1.0	0.25	ug/kg
8081A	3540C	Tissue	Hexachlorobenzene	1.0	0.15	ug/kg
8081A	3540C	Tissue	Hexachlorobutadiene	1.0	0.27	ug/kg
8081A	3540C	Tissue	Hexachloroethane	1.0	0.16	ug/kg
8081A	3540C	Tissue	Isodrin	1.0	0.15	ug/kg
8081A	3540C	Tissue	Methoxychlor	1.0	0.21	ug/kg
8081A	3540C	Tissue	Mirex	1.0	0.20	ug/kg
8081A	3540C	Tissue	Oxychlordane	1.0	0.090	ug/kg
8081A	3540C	Tissue	Toxaphene	50	13	ug/kg
8081A	3540C	Tissue	trans-Nonachlor	1.0	0.082	ug/kg
8082 Aroclors	3541	Sed.-Low	Aroclor 1016	10	1.6	ug/kg
8082 Aroclors	3541	Sed.-Low	Aroclor 1221	20	1.6	ug/kg
8082 Aroclors	3541	Sed.-Low	Aroclor 1232	10	1.6	ug/kg
8082 Aroclors	3541	Sed.-Low	Aroclor 1242	10	1.6	ug/kg

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Aroclors	3541	Sed.-Low	Aroclor 1248	10	1.6	ug/kg
8082 Aroclors	3541	Sed.-Low	Aroclor 1254	10	1.6	ug/kg
8082 Aroclors	3541	Sed.-Low	Aroclor 1260	10	1.6	ug/kg
8082 Aroclors	3541	Sed.-Low	Aroclor 1262	10	1.6	ug/kg
8082 Aroclors	3541	Sed.-Low	Aroclor 1268	10	1.6	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1016	10	1.3	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1221	20	1.6	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1232	10	3	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1242	10	1.4	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1248	10	2.6	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1254	10	0.61	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1260	10	0.79	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1262	10	1.6	ug/kg
8082 Aroclors	3540C	Tissue	Aroclor 1268	10	1.3	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	0.50	.095	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4,4',5,5'-Octachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4,4',5,6-Octachlorobiphenyl	0.50	.134	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4,4',5-Heptachlorobiphenyl	0.50	.062	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4,4'-Hexachlorobiphenyl	0.50	.290	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4,5',6,6'-Octachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4',5,6-Heptachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4,5,6'-Heptachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,3',4,6'-Hexachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4,4',5,5',6-Octachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4,4',5,5'-Heptachlorobiphenyl	0.50	.035	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4,4',5',6-Heptachlorobiphenyl	0.50	.086	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4,4',5'-Hexachlorobiphenyl	0.50	.042	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4,4',6,6'-Heptachlorobiphenyl	0.50	.045	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4',5,5',6-Heptachlorobiphenyl	0.50	.134	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4,5,5'-Hexachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4',5',6-Hexachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3',4,5-Pentachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,4',5-Pentachlorobiphenyl	0.50	.045	ug/kg

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Congeners	3540C	Sediment	2,2',3,4,5'-Pentachlorobiphenyl	0.50	.072	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,5,5',6-Hexachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,5',6-Pentachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',3,5'-Tetrachlorobiphenyl	0.50	.054	ug/kg
8082 Congeners	3540C	Sediment	2,2',4,4',5,5'-Hexachlorobiphenyl	0.50	.104	ug/kg
8082 Congeners	3540C	Sediment	2,2',4,4',5-Pentachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',4,5,5'-Pentachlorobiphenyl	0.50	.034	ug/kg
8082 Congeners	3540C	Sediment	2,2',4,5'-Tetrachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,2',5,5'-Tetrachlorobiphenyl	0.50	.110	ug/kg
8082 Congeners	3540C	Sediment	2,2',5-Trichlorobiphenyl	0.50	.053	ug/kg
8082 Congeners	3540C	Sediment	2,3,3',4,4',5,5'-Heptachlorobiphenyl	0.50	.094	ug/kg
8082 Congeners	3540C	Sediment	2,3,3',4,4',5'-Hexachlorobiphenyl	0.50	.195	ug/kg
8082 Congeners	3540C	Sediment	2,3,3',4,4',5-Hexachlorobiphenyl	0.50	.093	ug/kg
8082 Congeners	3540C	Sediment	2,3,3',4,4',6-Hexachlorobiphenyl	0.50	.041	ug/kg
8082 Congeners	3540C	Sediment	2,3,3',4,4'-Pentachlorobiphenyl	0.50	.093	ug/kg
8082 Congeners	3540C	Sediment	2,3,3',4',6-Pentachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,3,3',4'-Tetrachlorobiphenyl	0.50	.074	ug/kg
8082 Congeners	3540C	Sediment	2,3',4,4',5,5'-Hexachlorobiphenyl	0.70	.328	ug/kg
8082 Congeners	3540C	Sediment	2,3,4,4',5,6-Hexachlorobiphenyl	0.50	.106	ug/kg
8082 Congeners	3540C	Sediment	2,3',4,4',5',6-Hexachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,3,4,4',5-Pentachlorobiphenyl	0.50	.316	ug/kg
8082 Congeners	3540C	Sediment	2',3,4,4',5-Pentachlorobiphenyl	0.50	.080	ug/kg
8082 Congeners	3540C	Sediment	2,3',4,4',5-Pentachlorobiphenyl	0.50	.042	ug/kg
8082 Congeners	3540C	Sediment	2,3',4,4',6-Pentachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,3,4,4'-Tetrachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,3',4,4'-Tetrachlorobiphenyl	0.50	.117	ug/kg
8082 Congeners	3540C	Sediment	2,3',4',5-Tetrachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2',3,4-Trichlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,3-Dichlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,4,4',5-Tetrachlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,4,4'-Trichlorobiphenyl	0.50	.072	ug/kg
8082 Congeners	3540C	Sediment	2,4',5-Trichlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	2,4'-Dichlorobiphenyl	0.50	.110	ug/kg
8082 Congeners	3540C	Sediment	2-Chlorobiphenyl	0.50	.25	ug/kg

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Congeners	3540C	Sediment	3,3',4,4',5,5'-Hexachlorobiphenyl	0.50	.133	ug/kg
8082 Congeners	3540C	Sediment	3,3',4,4',5-Pentachlorobiphenyl	0.50	.140	ug/kg
8082 Congeners	3540C	Sediment	3,3',4,4'-Tetrachlorobiphenyl	0.50	.05	ug/kg
8082 Congeners	3540C	Sediment	3,4,4',5-Tetrachlorobiphenyl	0.50	.096	ug/kg
8082 Congeners	3540C	Sediment	3,4,4'-Trichlorobiphenyl	0.50	.25	ug/kg
8082 Congeners	3540C	Sediment	Decachlorobiphenyl	0.50	.055	ug/kg
8082 Congeners	3540C	Tissue	PCB 1	1.0	0.37	ug/kg
8082 Congeners	3540C	Tissue	PCB 101	0.50	0.095	ug/kg
8082 Congeners	3540C	Tissue	PCB 105	0.50	0.10	ug/kg
8082 Congeners	3540C	Tissue	PCB 110	0.50	0.090	ug/kg
8082 Congeners	3540C	Tissue	PCB 114	0.50	0.090	ug/kg
8082 Congeners	3540C	Tissue	PCB 118	0.50	0.16	ug/kg
8082 Congeners	3540C	Tissue	PCB 119	0.50	0.12	ug/kg
8082 Congeners	3540C	Tissue	PCB 123	0.50	0.30	ug/kg
8082 Congeners	3540C	Tissue	PCB 126	0.50	0.12	ug/kg
8082 Congeners	3540C	Tissue	PCB 128	0.50	0.17	ug/kg
8082 Congeners	3540C	Tissue	PCB 132	0.50	0.081	ug/kg
8082 Congeners	3540C	Tissue	PCB 138	0.50	0.23	ug/kg
8082 Congeners	3540C	Tissue	PCB 141	0.50	0.090	ug/kg
8082 Congeners	3540C	Tissue	PCB 149	0.50	0.14	ug/kg
8082 Congeners	3540C	Tissue	PCB 151	0.50	0.099	ug/kg
8082 Congeners	3540C	Tissue	PCB 153	0.50	0.14	ug/kg
8082 Congeners	3540C	Tissue	PCB 156	0.50	0.31	ug/kg
8082 Congeners	3540C	Tissue	PCB 157	0.50	0.12	ug/kg
8082 Congeners	3540C	Tissue	PCB 158	0.50	0.19	ug/kg
8082 Congeners	3540C	Tissue	PCB 166	0.50	0.12	ug/kg
8082 Congeners	3540C	Tissue	PCB 167	0.50	0.10	ug/kg
8082 Congeners	3540C	Tissue	PCB 168	0.50	0.26	ug/kg
8082 Congeners	3540C	Tissue	PCB 169	0.50	0.36	ug/kg
8082 Congeners	3540C	Tissue	PCB 170	0.50	0.20	ug/kg
8082 Congeners	3540C	Tissue	PCB 174	0.50	0.15	ug/kg
8082 Congeners	3540C	Tissue	PCB 177	0.50	0.18	ug/kg
8082 Congeners	3540C	Tissue	PCB 18	0.50	0.11	ug/kg

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8082 Congeners	3540C	Tissue	PCB 180	0.50	0.084	ug/kg
8082 Congeners	3540C	Tissue	PCB 183	0.50	0.14	ug/kg
8082 Congeners	3540C	Tissue	PCB 184	0.50	0.083	ug/kg
8082 Congeners	3540C	Tissue	PCB 187	0.50	0.20	ug/kg
8082 Congeners	3540C	Tissue	PCB 189	0.50	0.10	ug/kg
8082 Congeners	3540C	Tissue	PCB 194	0.50	0.11	ug/kg
8082 Congeners	3540C	Tissue	PCB 195	0.50	0.21	ug/kg
8082 Congeners	3540C	Tissue	PCB 201	0.50	0.077	ug/kg
8082 Congeners	3540C	Tissue	PCB 203	0.50	0.29	ug/kg
8082 Congeners	3540C	Tissue	PCB 206	0.50	0.14	ug/kg
8082 Congeners	3540C	Tissue	PCB 209	0.50	0.11	ug/kg
8082 Congeners	3540C	Tissue	PCB 28	0.50	0.12	ug/kg
8082 Congeners	3540C	Tissue	PCB 31	0.50	0.12	ug/kg
8082 Congeners	3540C	Tissue	PCB 33	0.50	0.071	ug/kg
8082 Congeners	3540C	Tissue	PCB 37	0.50	0.14	ug/kg
8082 Congeners	3540C	Tissue	PCB 44	0.50	0.11	ug/kg
8082 Congeners	3540C	Tissue	PCB 49	0.50	0.14	ug/kg
8082 Congeners	3540C	Tissue	PCB 5	0.50	0.15	ug/kg
8082 Congeners	3540C	Tissue	PCB 52	0.50	0.082	ug/kg
8082 Congeners	3540C	Tissue	PCB 56	0.50	0.19	ug/kg
8082 Congeners	3540C	Tissue	PCB 60	0.50	0.10	ug/kg
8082 Congeners	3540C	Tissue	PCB 66	0.50	0.094	ug/kg
8082 Congeners	3540C	Tissue	PCB 70	0.50	0.095	ug/kg
8082 Congeners	3540C	Tissue	PCB 74	0.50	0.16	ug/kg
8082 Congeners	3540C	Tissue	PCB 77	0.50	0.11	ug/kg
8082 Congeners	3540C	Tissue	PCB 8	0.50	0.13	ug/kg
8082 Congeners	3540C	Tissue	PCB 81	0.50	0.17	ug/kg
8082 Congeners	3540C	Tissue	PCB 87	0.50	0.11	ug/kg
8082 Congeners	3540C	Tissue	PCB 90	0.50	0.12	ug/kg
8082 Congeners	3540C	Tissue	PCB 90 + PCB 101	1.0	1.0	ug/kg
8082 Congeners	3540C	Tissue	PCB 95	0.50	0.13	ug/kg
8082 Congeners	3540C	Tissue	PCB 97	0.50	0.10	ug/kg
8082 Congeners	3540C	Tissue	PCB 99	0.50	0.089	ug/kg

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C-SIM PAH	3541	Sediment	1-Methylnaphthalene	5	0.25	ug/kg
8270C-SIM PAH	3541	Sediment	1-Methylphenanthrene	5	0.24	ug/kg
8270C-SIM PAH	3541	Sediment	2,3,5-Trimethylnaphthalene	5	0.15	ug/kg
8270C-SIM PAH	3541	Sediment	2,6-Dimethylnaphthalene	5	0.27	ug/kg
8270C-SIM PAH	3541	Sediment	2-Methylnaphthalene	5	0.34	ug/kg
8270C-SIM PAH	3541	Sediment	Acenaphthene	5	0.16	ug/kg
8270C-SIM PAH	3541	Sediment	Acenaphthylene	5	0.22	ug/kg
8270C-SIM PAH	3541	Sediment	Anthracene	5	0.22	ug/kg
8270C-SIM PAH	3541	Sediment	Benz(a)anthracene	5	0.16	ug/kg
8270C-SIM PAH	3541	Sediment	Benzo(a)pyrene	5	0.22	ug/kg
8270C-SIM PAH	3541	Sediment	Benzo(b)fluoranthene	5	0.48	ug/kg
8270C-SIM PAH	3541	Sediment	Benzo(e)pyrene	5	0.39	ug/kg
8270C-SIM PAH	3541	Sediment	Benzo(g,h,i)perylene	5	0.23	ug/kg
8270C-SIM PAH	3541	Sediment	Benzo(k)fluoranthene	5	0.33	ug/kg
8270C-SIM PAH	3541	Sediment	Biphenyl	5	0.43	ug/kg
8270C-SIM PAH	3541	Sediment	Carbazole	5	0.65	ug/kg
8270C-SIM PAH	3541	Sediment	Chrysene	5	0.41	ug/kg
8270C-SIM PAH	3541	Sediment	Dibenz(a,h)anthracene	5	0.26	ug/kg
8270C-SIM PAH	3541	Sediment	Dibenzofuran	5	0.17	ug/kg
8270C-SIM PAH	3541	Sediment	Dibenzothiophene	5	0.23	ug/kg
8270C-SIM PAH	3541	Sediment	Fluoranthene	5	0.34	ug/kg
8270C-SIM PAH	3541	Sediment	Fluorene	5	0.19	ug/kg
8270C-SIM PAH	3541	Sediment	Indeno(1,2,3-cd)pyrene	5	0.24	ug/kg
8270C-SIM PAH	3541	Sediment	Naphthalene	5	0.34	ug/kg
8270C-SIM PAH	3541	Sediment	Pentachlorophenol	200	15	ug/kg
8270C-SIM PAH	3541	Sediment	Perylene	5	0.17	ug/kg
8270C-SIM PAH	3541	Sediment	Phenanthrene	5	0.33	ug/kg
8270C-SIM PAH	3541	Sediment	Pyrene	5	0.36	ug/kg
8270C-SIM PAH	3541	Tissue	1-Methylnaphthalene	0.5	0.11	ug/kg
8270C-SIM PAH	3541	Tissue	1-Methylphenanthrene	0.5	0.085	ug/kg
8270C-SIM PAH	3541	Tissue	2,3,5-Trimethylnaphthalene	0.5	0.077	ug/kg
8270C-SIM PAH	3541	Tissue	2,6-Dimethylnaphthalene	0.5	0.064	ug/kg
8270C-SIM PAH	3541	Tissue	2-Methylnaphthalene	1.0	0.15	ug/kg

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C-SIM PAH	3541	Tissue	Acenaphthene	0.5	0.091	ug/kg
8270C-SIM PAH	3541	Tissue	Acenaphthylene	0.5	0.092	ug/kg
8270C-SIM PAH	3541	Tissue	Anthracene	0.5	0.080	ug/kg
8270C-SIM PAH	3541	Tissue	Benz(a)anthracene	0.5	0.12	ug/kg
8270C-SIM PAH	3541	Tissue	Benzo(a)pyrene	0.5	0.12	ug/kg
8270C-SIM PAH	3541	Tissue	Benzo(b)fluoranthene	0.5	0.15	ug/kg
8270C-SIM PAH	3541	Tissue	Benzo(e)pyrene	0.5	0.12	ug/kg
8270C-SIM PAH	3541	Tissue	Benzo(g,h,i)perylene	0.5	0.17	ug/kg
8270C-SIM PAH	3541	Tissue	Benzo(k)fluoranthene	0.5	0.13	ug/kg
8270C-SIM PAH	3541	Tissue	Biphenyl	0.5	0.14	ug/kg
8270C-SIM PAH	3541	Tissue	Carbazole	0.5	0.063	ug/kg
8270C-SIM PAH	3541	Tissue	Chrysene	0.5	0.19	ug/kg
8270C-SIM PAH	3541	Tissue	Dibenz(a,h)anthracene	0.5	0.11	ug/kg
8270C-SIM PAH	3541	Tissue	Dibenzofuran	0.5	0.071	ug/kg
8270C-SIM PAH	3541	Tissue	Dibenzothiophene	0.5	0.093	ug/kg
8270C-SIM PAH	3541	Tissue	Fluoranthene	0.5	0.36	ug/kg
8270C-SIM PAH	3541	Tissue	Fluorene	0.5	0.088	ug/kg
8270C-SIM PAH	3541	Tissue	Indeno(1,2,3-cd)pyrene	0.5	0.16	ug/kg
8270C-SIM PAH	3541	Tissue	Naphthalene	1.0	0.19	ug/kg
8270C-SIM PAH	3541	Tissue	PAHs, Total	0.5	0.5	ug/kg
8270C-SIM PAH	3541	Tissue	Perylene	0.5	0.16	ug/kg
8270C-SIM PAH	3541	Tissue	Phenanthrene	0.5	0.18	ug/kg
8270C-SIM PAH	3541	Tissue	Pyrene	0.5	0.28	ug/kg
8270C-SIM PAH	3520C	Water	1-Methylnaphthalene	0.02	0.00250	ug/L
8270C-SIM PAH	3520C	Water	1-Methylphenanthrene	0.02	0.00193	ug/L
8270C-SIM PAH	3520C	Water	2,3,5-Trimethylnaphthalene	0.02	0.00110	ug/L
8270C-SIM PAH	3520C	Water	2,6-Dimethylnaphthalene	0.02	0.00237	ug/L
8270C-SIM PAH	3520C	Water	2-Methylnaphthalene	0.02	0.00268	ug/L
8270C-SIM PAH	3520C	Water	Acenaphthene	0.02	0.00198	ug/L
8270C-SIM PAH	3520C	Water	Acenaphthylene	0.02	0.00178	ug/L
8270C-SIM PAH	3520C	Water	Anthracene	0.02	0.00103	ug/L
8270C-SIM PAH	3520C	Water	Benz(a)anthracene	0.02	0.0021	ug/L
8270C-SIM PAH	3520C	Water	Benzo(a)pyrene	0.02	0.00158	ug/L

SELECTED MARINE WATER, SEDIMENT, AND TISSUE ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
8270C-SIM PAH	3520C	Water	Benzo(b)fluoranthene	0.02	0.00194	ug/L
8270C-SIM PAH	3520C	Water	Benzo(e)pyrene	0.02	0.00182	ug/L
8270C-SIM PAH	3520C	Water	Benzo(g,h,i)perylene	0.02	0.00368	ug/L
8270C-SIM PAH	3520C	Water	Benzo(k)fluoranthene	0.02	0.00134	ug/L
8270C-SIM PAH	3520C	Water	Biphenyl	0.02	0.00351	ug/L
8270C-SIM PAH	3520C	Water	Carbazole	0.02	0.019	ug/L
8270C-SIM PAH	3520C	Water	Chrysene	0.02	0.00124	ug/L
8270C-SIM PAH	3520C	Water	Dibenz(a,h)anthracene	0.02	0.00162	ug/L
8270C-SIM PAH	3520C	Water	Dibenzofuran	0.02	0.00705	ug/L
8270C-SIM PAH	3520C	Water	Dibenzothiophene	0.02	0.00401	ug/L
8270C-SIM PAH	3520C	Water	Fluoranthene	0.02	0.00238	ug/L
8270C-SIM PAH	3520C	Water	Fluorene	0.02	0.00258	ug/L
8270C-SIM PAH	3520C	Water	Indeno(1,2,3-cd)pyrene	0.02	0.00208	ug/L
8270C-SIM PAH	3520C	Water	Naphthalene	0.02	0.00316	ug/L
8270C-SIM PAH	3520C	Water	Pentachlorophenol	1	0.095	ug/L
8270C-SIM PAH	3520C	Water	Perylene	0.02	0.00116	ug/L
8270C-SIM PAH	3520C	Water	Phenanthrene	0.02	0.00320	ug/L
8270C-SIM PAH	3520C	Water	Pyrene	0.02	0.00222	ug/L
Organotins	Method	Sediment	Di-n-butyltin	1	0.028	ug/kg
Organotins	Method	Sediment	n-Butyltin	1	0.03	ug/kg
Organotins	Method	Sediment	Tetra-n-butyltin	1	0.07	ug/kg
Organotins	Method	Sediment	Tri-n-butyltin	1	0.056	ug/kg
Organotins	Method	Water	Di-n-butyltin	0.050	0.00055	ug/L
Organotins	Method	Water	n-Butyltin	0.050	0.0017	ug/L
Organotins	Method	Water	Tetra-n-butyltin	0.050	0.0015	ug/L
Organotins	Method	Water	Tri-n-butyltin	0.020	0.0006	ug/L
Organotins	Method	Tissue	Di-n-butyltin	1.0	0.042	ug/kg
Organotins	Method	Tissue	n-Butyltin	1.0	0.061	ug/kg
Organotins	Method	Tissue	Tetra-n-butyltin	1.0	0.067	ug/kg
Organotins	Method	Tissue	Tri-n-butyltin	1.0	0.027	ug/kg

a Method Detection Limits are subject to change as new MDL studies are completed.

ORGANIC COMPOUNDS IN DRINKING WATER ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
504.1	Method	DW	1,2,3-Trichloropropane	0.05	0.0089	ug/L
504.1	Method	DW	1,2-Dibromo-3-chloropropane (DBCP)	0.01	0.0018	ug/L
504.1	Method	DW	Ethylene Dibromide (EDB)	0.01	0.0017	ug/L
508.1	Method	DW	4,4'-DDD	0.01	0.00072	ug/L
508.1	Method	DW	4,4'-DDE	0.01	0.00069	ug/L
508.1	Method	DW	4,4'-DDT	0.01	0.0016	ug/L
508.1	Method	DW	Aldrin	0.01	0.0006	ug/L
508.1	Method	DW	alpha-BHC	0.01	0.005	ug/L
508.1	Method	DW	alpha-Chlordane	0.01	0.0056	ug/L
508.1	Method	DW	beta-BHC	0.01	0.00076	ug/L
508.1	Method	DW	Chlordane	0.1	0.0024	ug/L
508.1	Method	DW	delta-BHC	0.01	0.00069	ug/L
508.1	Method	DW	Dieldrin	0.01	0.00054	ug/L
508.1	Method	DW	Endosulfan I	0.01	0.00078	ug/L
508.1	Method	DW	Endosulfan II	0.01	0.00084	ug/L
508.1	Method	DW	Endosulfan Sulfate	0.01	0.00058	ug/L
508.1	Method	DW	Endrin	0.01	0.0026	ug/L
508.1	Method	DW	Endrin Aldehyde	0.01	0.0009	ug/L
508.1	Method	DW	gamma-BHC (Lindane)	0.01	0.00075	ug/L
508.1	Method	DW	gamma-Chlordane	0.01	0.00073	ug/L
508.1	Method	DW	Heptachlor	0.01	0.00043	ug/L
508.1	Method	DW	Heptachlor Epoxide	0.01	0.00057	ug/L
508.1	Method	DW	Heptachlor Epoxide (Isomer A)	0.01	0.0006	ug/L
508.1	Method	DW	Methoxychlor	0.01	0.0012	ug/L
508.1	Method	DW	Toxaphene	0.1	0.028	ug/L
508.1	Method	DW	Aroclor 1016	0.05	0.037	ug/L
508.1	Method	DW	Aroclor 1221	0.1	0.033	ug/L
508.1	Method	DW	Aroclor 1232	0.1	0.03	ug/L
508.1	Method	DW	Aroclor 1242	0.1	0.037	ug/L
508.1	Method	DW	Aroclor 1248	0.1	0.012	ug/L
508.1	Method	DW	Aroclor 1254	0.1	0.028	ug/L
508.1	Method	DW	Aroclor 1260	0.1	0.039	ug/L
515.4	Method	DW	2,4,5-T	0.2	0.011	ug/L
515.4	Method	DW	2,4,5-TP (Silvex)	0.05	0.012	ug/L

ORGANIC COMPOUNDS IN DRINKING WATER ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
515.4	Method	DW	2,4-D	0.1	0.044	ug/L
515.4	Method	DW	2,4-DB	0.4	0.067	ug/L
515.4	Method	DW	3,5-Dichlorobenzoic Acid	0.2	0.030	ug/L
515.4	Method	DW	4-Nitrophenol	0.4	0.26	ug/L
515.4	Method	DW	Acifluorfen	0.2	0.021	ug/L
515.4	Method	DW	Bentazon	0.4	0.15	ug/L
515.4	Method	DW	Chloramben	0.2	0.072	ug/L
515.4	Method	DW	Dacthal Diacid	0.1	0.034	ug/L
515.4	Method	DW	Dalapon	0.54	0.048	ug/L
515.4	Method	DW	Dicamba	0.2	0.017	ug/L
515.4	Method	DW	Dichlorprop	0.4	0.048	ug/L
515.4	Method	DW	Dinoseb	0.2	0.13	ug/L
515.4	Method	DW	Pentachlorophenol	0.04	0.0032	ug/L
515.4	Method	DW	Picloram	0.1	0.046	ug/L
524.2	Method	DW	1,1,1,2-Tetrachloroethane	0.5	0.19	ug/L
524.2	Method	DW	1,1,1-Trichloroethane	0.5	0.21	ug/L
524.2	Method	DW	1,1,2,2-Tetrachloroethane	0.5	0.26	ug/L
524.2	Method	DW	1,1,2-Trichloroethane	0.5	0.18	ug/L
524.2	Method	DW	1,1-Dichloroethane	0.5	0.16	ug/L
524.2	Method	DW	1,1-Dichloroethene	0.5	0.24	ug/L
524.2	Method	DW	1,1-Dichloropropanone	0.5	0.092	ug/L
524.2	Method	DW	1,1-Dichloropropene	0.5	0.23	ug/L
524.2	Method	DW	1,2,3-Trichlorobenzene	0.5	0.339	ug/L
524.2	Method	DW	1,2,3-Trichloropropane	0.5	0.32	ug/L
524.2	Method	DW	1,2,4-Trichlorobenzene	0.5	0.312	ug/L
524.2	Method	DW	1,2,4-Trimethylbenzene	0.5	0.16	ug/L
524.2	Method	DW	1,2-Dibromo-3-chloropropane (DBCP)	0.5	0.46	ug/L
524.2	Method	DW	1,2-Dibromoethane (EDB)	0.5	0.17	ug/L
524.2	Method	DW	1,2-Dichlorobenzene	0.5	0.21	ug/L
524.2	Method	DW	1,2-Dichloroethane	0.5	0.093	ug/L
524.2	Method	DW	1,2-Dichloropropane	0.5	0.14	ug/L
524.2	Method	DW	1,3,5-Trichlorobenzene	0.5	0.4	ug/L
524.2	Method	DW	1,3,5-Trimethylbenzene	0.5	0.16	ug/L

ORGANIC COMPOUNDS IN DRINKING WATER ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
524.2	Method	DW	1,3-Dichlorobenzene	0.5	0.20	ug/L
524.2	Method	DW	1,3-Dichloropropane	0.5	0.17	ug/L
524.2	Method	DW	1,4-Dichlorobenzene	0.5	0.18	ug/L
524.2	Method	DW	2,2-Dichloropropane	0.5	0.130	ug/L
524.2	Method	DW	2-Butanone (MEK)	20	2.6	ug/L
524.2	Method	DW	2-Chlorotoluene	0.5	0.276	ug/L
524.2	Method	DW	2-Hexanone	20	1.6	ug/L
524.2	Method	DW	2-Nitropropane	2.0	0.34	ug/L
524.2	Method	DW	3-Chloro-1-propene	2.0	0.067	ug/L
524.2	Method	DW	4-Chlorotoluene	0.5	0.17	ug/L
524.2	Method	DW	4-Methyl-2-pentanone (MIBK)	20	2.2	ug/L
524.2	Method	DW	Acetone	20	3	ug/L
524.2	Method	DW	Acrylonitrile	2.0	0.44	ug/L
524.2	Method	DW	Benzene	0.5	0.15	ug/L
524.2	Method	DW	Bromobenzene	0.5	0.18	ug/L
524.2	Method	DW	Bromochloromethane	0.5	0.11	ug/L
524.2	Method	DW	Bromodichloromethane	0.5	0.15	ug/L
524.2	Method	DW	Bromoform	0.5	0.26	ug/L
524.2	Method	DW	Bromomethane	0.5	0.30	ug/L
524.2	Method	DW	Carbon Disulfide	0.5	0.071	ug/L
524.2	Method	DW	Carbon Tetrachloride	0.5	0.24	ug/L
524.2	Method	DW	Chlorobenzene	0.5	0.18	ug/L
524.2	Method	DW	Chloroethane	0.5	0.21	ug/L
524.2	Method	DW	Chloroform	0.5	0.14	ug/L
524.2	Method	DW	Chloromethane	0.5	0.22	ug/L
524.2	Method	DW	cis-1,2-Dichloroethene	0.5	0.13	ug/L
524.2	Method	DW	cis-1,3-Dichloropropene	0.5	0.13	ug/L
524.2	Method	DW	cis-1,4-Dichloro-2-butene	2.0	0.28	ug/L
524.2	Method	DW	Dibromochloromethane	0.5	0.20	ug/L
524.2	Method	DW	Dibromomethane	0.5	0.12	ug/L
524.2	Method	DW	Dichlorodifluoromethane	0.5	0.23	ug/L
524.2	Method	DW	Diisopropyl Ether	0.5	0.034	ug/L

ORGANIC COMPOUNDS IN DRINKING WATER ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
524.2	Method	DW	Ethyl Ether	1.0	0.081	ug/L
524.2	Method	DW	Ethyl Methacrylate	1.0	0.085	ug/L
524.2	Method	DW	Ethylbenzene	0.5	0.15	ug/L
524.2	Method	DW	Hexachlorobutadiene	0.5	0.22	ug/L
524.2	Method	DW	Iodomethane	1.0	0.43	ug/L
524.2	Method	DW	Isopropylbenzene	0.5	0.24	ug/L
524.2	Method	DW	m,p-Xylenes	0.5	0.42	ug/L
524.2	Method	DW	Methacrylonitrile	1.0	0.25	ug/L
524.2	Method	DW	Methyl Methacrylate	1.0	0.19	ug/L
524.2	Method	DW	Methyl tert-Butyl Ether	0.5	0.140	ug/L
524.2	Method	DW	Methylene Chloride	0.5	0.0870	ug/L
524.2	Method	DW	Naphthalene	0.5	0.50	ug/L
524.2	Method	DW	n-Butylbenzene	0.5	0.16	ug/L
524.2	Method	DW	n-Propylbenzene	0.5	0.18	ug/L
524.2	Method	DW	*o-Xylene*	0.5	0.22	ug/L
524.2	Method	DW	p-Isopropyltoluene	0.5	0.161	ug/L
524.2	Method	DW	Propionitrile	20	0.49	ug/L
524.2	Method	DW	sec-Butylbenzene	0.5	0.16	ug/L
524.2	Method	DW	Styrene	0.5	0.20	ug/L
524.2	Method	DW	tert-Amyl Methyl Ether	0.5	0.082	ug/L
524.2	Method	DW	tert-Butyl Alcohol	20	0.97	ug/L
524.2	Method	DW	tert-Butyl Ethyl Ether	0.5	0.055	ug/L
524.2	Method	DW	tert-Butylbenzene	0.5	0.19	ug/L
524.2	Method	DW	Tetrachloroethene	0.5	0.21	ug/L
524.2	Method	DW	Tetrahydrofuran	20	0.93	ug/L
524.2	Method	DW	Toluene	0.5	0.17	ug/L
524.2	Method	DW	trans-1,2-Dichloroethene	0.5	0.17	ug/L
524.2	Method	DW	trans-1,3-Dichloropropene	0.5	0.15	ug/L
524.2	Method	DW	trans-1,4-Dichloro-2-butene	1.0	0.25	ug/L
524.2	Method	DW	Trichloroethene	0.5	0.21	ug/L
524.2	Method	DW	Trichlorofluoromethane	0.5	0.26	ug/L
524.2	Method	DW	Trichlorotrifluoroethane	0.5	0.1	ug/L
524.2	Method	DW	Vinyl Chloride	0.5	0.121	ug/L

ORGANIC COMPOUNDS IN DRINKING WATER ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
525.2	Method	DW	2,4-Dinitrotoluene	0.5	0.0085	ug/L
525.2	Method	DW	2,6-Dinitrotoluene	0.1	0.0097	ug/L
525.2	Method	DW	4,4'-DDD	0.05	0.007	ug/L
525.2	Method	DW	4,4'-DDE	0.05	0.0035	ug/L
525.2	Method	DW	4,4'-DDT	0.050	0.0027	ug/L
525.2	Method	DW	Acenaphthene	0.050	0.0033	ug/L
525.2	Method	DW	Acenaphthylene	0.050	0.0028	ug/L
525.2	Method	DW	Acetochlor	0.060	0.007	ug/L
525.2	Method	DW	Alachlor	0.072	0.0052	ug/L
525.2	Method	DW	Aldrin	0.094	0.0050	ug/L
525.2	Method	DW	alpha-BHC	0.05	0.0039	ug/L
525.2	Method	DW	alpha-Chlordane	0.076	0.0049	ug/L
525.2	Method	DW	Ametryn	.2	0.0040	ug/L
525.2	Method	DW	Anthracene	0.068	0.0044	ug/L
525.2	Method	DW	Atraton	0.05	0.0043	ug/L
525.2	Method	DW	Atrazine	0.10	0.0051	ug/L
525.2	Method	DW	Benz(a)anthracene	0.1	0.011	ug/L
525.2	Method	DW	Benzo(a)pyrene	0.02	0.0085	ug/L
525.2	Method	DW	Benzo(b)fluoranthene	0.1	0.0061	ug/L
525.2	Method	DW	Benzo(g,h,i)perylene	0.1	0.0089	ug/L
525.2	Method	DW	Benzo(k)fluoranthene	0.1	0.012	ug/L
525.2	Method	DW	Benzyl butyl phthalate	0.5	0.013	ug/L
525.2	Method	DW	beta-BHC	0.054	0.0061	ug/L
525.2	Method	DW	Bis(2-ethylhexyl) Adipate	0.5	0.034	ug/L
525.2	Method	DW	Bis(2-ethylhexyl) Phthalate	.5	0.059	ug/L
525.2	Method	DW	Bromacil	0.1	0.0083	ug/L
525.2	Method	DW	Butachlor	0.052	0.0034	ug/L
525.2	Method	DW	Butylate	0.030	0.0027	ug/L
525.2	Method	DW	Caffeine	0.1	0.0094	ug/L
525.2	Method	DW	Carboxin	0.5	0.0078	ug/L
525.2	Method	DW	Chlorobenzilate	0.10		ug/L
525.2	Method	DW	Chloroneb	0.11	0.023	ug/L
525.2	Method	DW	Chlorothalonil	.1	0.011	ug/L
525.2	Method	DW	Chlorpropham	0.070	0.0067	ug/L

ORGANIC COMPOUNDS IN DRINKING WATER ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
525.2	Method	DW	Chlorpyrifos	0.062	0.0056	ug/L
525.2	Method	DW	Chrysene	0.05	0.0032	ug/L
525.2	Method	DW	cis-Permethrin	0.056	0.0042	ug/L
525.2	Method	DW	Cyanazine	0.1	0.011	ug/L
525.2	Method	DW	Cycloate	0.074	0.0038	ug/L
525.2	Method	DW	Dacthal	0.05	0.0031	ug/L
525.2	Method	DW	delta-BHC	0.05	0.0068	ug/L
525.2	Method	DW	Diazinon	0.052	0.015	ug/L
525.2	Method	DW	Dibenz(a,h)anthracene	0.11	0.0081	ug/L
525.2	Method	DW	Dichlorvos	0.20	0.0042	ug/L
525.2	Method	DW	Dieldrin	0.20	0.0058	ug/L
525.2	Method	DW	Diethyl Phthalate	0.5	0.0042	ug/L
525.2	Method	DW	Dimethoate	0.5	0.016	ug/L
525.2	Method	DW	Dimethyl Phthalate	0.5	0.005	ug/L
525.2	Method	DW	Di-n-butyl Phthalate	0.6	0.013	ug/L
525.2	Method	DW	Di-n-octyl Phthalate	0.1	0.005	ug/L
525.2	Method	DW	Diphenamid	0.054	0.0075	ug/L
525.2	Method	DW	Disulfoton	0.2	0.0061	ug/L
525.2	Method	DW	Endosulfan I	0.08	0.015	ug/L
525.2	Method	DW	Endosulfan II	0.084	0.0072	ug/L
525.2	Method	DW	Endosulfan Sulfate	0.076	0.005	ug/L
525.2	Method	DW	Endrin	0.054	0.003	ug/L
525.2	Method	DW	Endrin Aldehyde	0.11	0.0077	ug/L
525.2	Method	DW	Endrin Ketone	0.05	0.0057	ug/L
525.2	Method	DW	EPTC	0.052	0.0056	ug/L
525.2	Method	DW	Ethoprop (Prophos)	0.04	0.0048	ug/L
525.2	Method	DW	Fluoranthene	0.1	0.0031	ug/L
525.2	Method	DW	Fluorene	0.05	0.0034	ug/L
525.2	Method	DW	gamma-BHC (Lindane)	0.05	0.0044	ug/L
525.2	Method	DW	gamma-Chlordane	0.05	0.0029	ug/L
525.2	Method	DW	Heptachlor	0.080	0.0050	ug/L
525.2	Method	DW	Heptachlor Epoxide	0.05	0.0055	ug/L
525.2	Method	DW	Hexachlorobenzene	0.05	0.0043	ug/L
525.2	Method	DW	Hexachlorocyclopentadiene	0.1	0.0055	ug/L

ORGANIC COMPOUNDS IN DRINKING WATER ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
525.2	Method	DW	Indeno(1,2,3-cd)pyrene	0.2	0.0065	ug/L
525.2	Method	DW	Isophorone	0.05	0.013	ug/L
525.2	Method	DW	Malathion	0.10	0.0060	ug/L
525.2	Method	DW	Methoxychlor	0.05	0.0028	ug/L
525.2	Method	DW	Metolachlor	0.090	0.0042	ug/L
525.2	Method	DW	Metribuzin	0.076	0.0055	ug/L
525.2	Method	DW	Mevinphos	0.5	0.0033	ug/L
525.2	Method	DW	Molinate	0.05	0.0049	ug/L
525.2	Method	DW	Parathion	0.10	0.0098	ug/L
525.2	Method	DW	Pebulate	0.05	0.0078	ug/L
525.2	Method	DW	Pentachlorophenol	2.0	0.19	ug/L
525.2	Method	DW	Phenanthrene	0.025	0.0028	ug/L
525.2	Method	DW	Prometon	0.05	0.0076	ug/L
525.2	Method	DW	Prometryn	0.1	0.0043	ug/L
525.2	Method	DW	Pronamide	0.064	0.0033	ug/L
525.2	Method	DW	Propachlor	0.076	0.0045	ug/L
525.2	Method	DW	Propazine	0.05	0.0086	ug/L
525.2	Method	DW	Pyrene	0.025	0.0025	ug/L
525.2	Method	DW	Simazine	0.05	0.0051	ug/L
525.2	Method	DW	Simetryn	0.1	0.0031	ug/L
525.2	Method	DW	Terbacil	0.2	0.0062	ug/L
525.2	Method	DW	Terbufos	0.2	0.0028	ug/L
525.2	Method	DW	Terbutryn	0.05	0.0044	ug/L
525.2	Method	DW	Terrazole	0.040	0.0039	ug/L
525.2	Method	DW	Tetrachlorovinphos	0.2	0.0032	ug/L
525.2	Method	DW	Thiobencarb	.052	0.0061	ug/L
525.2	Method	DW	trans-Nonachlor	0.090	0.0038	ug/L
525.2	Method	DW	trans-Permethrin	0.066	0.0025	ug/L
525.2	Method	DW	Triadimefon	0.05	0.017	ug/L
525.2	Method	DW	Trifluralin	0.054	0.004	ug/L
525.2	Method	DW	Vernolate	0.05	0.0095	ug/L
531.1	Method	DW	3-Hydroxycarbofuran	0.5	0.24	ug/L
531.1	Method	DW	Aldicarb	0.5	0.26	ug/L
531.1	Method	DW	Aldicarb Sulfone	0.5	0.14	ug/L

ORGANIC COMPOUNDS IN DRINKING WATER ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
531.1	Method	DW	Aldicarb Sulfoxide	0.5	0.17	ug/L
531.1	Method	DW	Carbaryl	0.5	0.29	ug/L
531.1	Method	DW	Carbofuran	0.5	0.44	ug/L
531.1	Method	DW	Methiocarb	0.5	0.32	ug/L
531.1	Method	DW	Methomyl	0.5	0.18	ug/L
531.1	Method	DW	Oxamyl	0.5	0.37	ug/L
531.1	Method	DW	Propoxur	0.5	0.32	ug/L
547	Method	DW	Glyphosate	6	2.6	ug/L
548.1	Method	DW	Endothall	5	4.2	ug/L
549.2	Method	DW	Diquat	0.4	0.11	ug/L
549.2	Method	DW	Paraquat	0.8	0.51	ug/L
552.2	Method	DW	Bromoacetic Acid	1.0	0.076	ug/L
552.2	Method	DW	Bromochloroacetic Acid	1.0	0.069	ug/L
552.2	Method	DW	Bromodichloroacetic Acid	1.6	0.11	ug/L
552.2	Method	DW	Chloroacetic Acid	2.0	0.27	ug/L
552.2	Method	DW	Chlorodibromoacetic Acid	2.0	0.37	ug/L
552.2	Method	DW	Dibromoacetic Acid	1.0	0.04	ug/L
552.2	Method	DW	Dichloroacetic Acid	1.0	0.1	ug/L
552.2	Method	DW	Trichloroacetic Acic	1.0	0.088	ug/L

a Method Detection Limits are subject to change as new MDL studies are completed.

MICROBIOLOGICAL ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**Method Reporting Limit**	**Method Detection Limit[a]**	**Units**
SM 9215B			Heterotrophic Plate Count (Pour)	1	NA	CFU/mL
SM 9215C			Heterotrophic Plate Count (Spread)	1	NA	CFU/mL
SM 9221B			Coliform, Total (MPN)	2	NA	MPN/100mL
SM 9221E			Coliform, Fecal (MPN)	2	NA	MPN/100mL
SM 9223B			Coliform (Colilert)	Presence/100mL	NA	NA
SM 9230B			Enterococcus	2	NA	MPN/100mL
SM 9230B			Fecal Streptococcus	2	NA	MPN/100mL
SM 10200H			Chlorophyll A	0.8	0.09	mg/L

a Method Detection Limits are subject to change as new MDL studies are completed.

GENERAL CHEMISTRY/WATER CHEMISTRY ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
110.2	NA	Water	Color	85-115	NA	20
120.1 / *SM* 2510B	NA	Water	Conductivity	85-115	NA	20
130.2 / *SM* 2340C	NA	Water	Hardness as $CaCO_3$	85-115	75-125	20
150.1	NA	Water	pH	85-115	NA	NA
160.1 / *SM* 2540C	NA	Water	Solids, Total Dissolved (Filterable)	85-115	NA	20
160.2	NA	Water	Solids, Total Suspended (Nonfilterable)	85-115	NA	20
160.3	NA	Soil	Solids, Total	NA	NA	20
160.3	NA	Water	Solids, Total	92-106	NA	14
160.4	NA	Soil	Solids, Volatile	85-115	NA	20
160.4	NA	Water	Solids, Volatile	85-115	NA	20
160.5	NA	Water	Solids, Settleable	NA	NA	20
180.1	NA	Water	Turbidity	85-115	NA	20
300.0M	SOP	Soil	Bromide	90-110	80-120	20
300.0M	SOP	Soil	Chloride	90-110	80-120	20
300.0M	SOP	Soil	Fluoride	90-110	80-120	20
300.0M	SOP	Soil	Nitrate as Nitrogen	90-110	80-120	20
300.0M	SOP	Soil	Nitrite as Nitrogen	90-110	80-120	20
300.0M	SOP	Soil	Sulfate	90-110	80-120	20
300.0	NA	Water	Bromide	90-110	80-120	20
300.0	NA	Water	Chloride	90-110	80-120	20
300.0	NA	Water	Fluoride	90-110	80-120	20
300.0	NA	Water	Nitrate as Nitrogen	90-110	80-120	20
300.0	NA	Water	Nitrite as Nitrogen	90-110	80-120	20
300.0	NA	Water	Sulfate	90-110	80-120	20
300.1	NA	Water	Bromate	85-115	75-125	20
300.1	NA	Water	Bromide	85-115	75-125	20
300.1	NA	Water	Chlorite	85-115	75-125	20
300.1	NA	Water	Dichloroacetate (surrogate) 90-115	NA	NA	NA
305.1	NA	Water	Acidity as $CaCO_3$	85-115	NA	20
310.1 / *SM* 2320B	NA	Water	Alkalinity as $CaCO_3$	85-115	NA	20
314.0	NA	Water	Perchlorate	85-115	80-120	20
325.3	NA	Water	Chloride, Titrimetric	85-115	75-125	20
330.4	NA	Water	Chlorine, Total Residual	85-115	NA	20
335.1M	SOP	Soil	Cyanides Amenable to Chlorination	85-115	75-125	20
335.1	NA	Water	Cyanides Amenable to Chlorination	85-115	75-125	20
335.2 / 335.4	SOP	Soil	Cyanide, Total	85-115	75-125	20
335.2 / 335.4	NA	Water	Cyanide, Total	85-115	75-125	20
340.1M	SOP	Soil	Fluoride, Bellack Distillation	85-115	75-125	20
340.1	NA	Water	Fluoride, Bellack Distillation	85-115	75-125	20
340.2M	SOP	Soil	Fluoride	85-115	75-125	20
340.2 / *SM* 4500-F^-C	NA	Water	Fluoride	85-115	75-125	20
350.1M	SOP	Soil	Ammonia as Nitrogen	85-115	75-125	20
350.1	NA	Water	Ammonia as Nitrogen	90-110	90-110	20
350.3M	SOP	Soil	Ammonia as Nitrogen	85-115	75-125	20
350.3	NA	Water	Ammonia as Nitrogen	85-115	75-125	20
351.4M	SOP	Soil	Nitrogen, Total Kjeldahl	85-115	85-115	20
351.4	NA	Water	Nitrogen, Total Kjeldahl	85-115	85-115	20
353.2M	SOP	Soil	Nitrogen, Nitrate + Nitrite as Nitrogen	85-115	75-125	20
353.2	NA	Water	Nitrogen, Nitrate + Nitrite as Nitrogen	90-110	90-110	20
354.1	NA	Water	Nitrite as Nitrogen, Colorimetric	85-115	75-125	20
365.3M	SOP	Soil	Orthophosphate as Phosphorus	85-115	85-115	20
365.3	NA	Water	Orthophosphate as Phosphorus	85-115	75-125	20
SM 4500P-F	NA	Water	Orthophosphate as Phosphorus	85-115	89-110	13
365.3M	SOP	Soil	Phosphorus, Total	94-108	85-115	12
365.3	NA	Water	Phosphorus, Total	85-115	75-125	20
376.1	NA	Water	Sulfide	85-115	75-125	20

GENERAL CHEMISTRY/WATER CHEMISTRY ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
376.2	NA	Water	Sulfide	85-115	75-125	20
377.1	NA	Water	Sulfite	NA	NA	20
SM 5550B	NA	Water	Tannin and Lignin	85-115	75-125	20
405.1	NA	Water	Biological Oxygen Demand	NA	NA	20
410.1 and 410.2M	SOP	Soil	Chemical Oxygen Demand	85-115	75-125	20
410.1	NA	Water	Chemical Oxygen Demand	85-115	75-125	20
410.2	NA	Water	Chemical Oxygen Demand	85-115	75-125	20
ASTM D4129-82M	NA	Soil	Total Organic Carbon	85-115	75-125	20
415.1	NA	Water	Total Organic Carbon	90-109	65-133	20
420.1M	SOP	Soil	Phenolics, Total	85-115	75-125	20
420.1	NA	Water	Phenolics, Total	85-115	75-125	20
425.1	NA	Water	Surfactants (MBAS)	85-115	75-125	20
ASTM D1498	NA	Water	Oxidation-Reduction Potential	NA	NA	20
1020	NA	Soil	Flashpoint, Setaflash	NA	NA	20
1020	NA	Water	Flashpoint, Setaflash	NA	NA	20
1110	NA	Liquid	Corrosivity	NA	NA	20
1650A	NA	Water	Absorbable Organic Halides	78-116	78-116	20
7196A	3060A	Soil	Hexavalent Chromium	85-115	85-115	20
7196A	Method	Water	Hexavalent Chromium	85-115	85-115	20
9010B/9012A		Soil	Cyanide, Total and Amenable	85-115	75-125	20
9010B/9012A		Water	Cyanide, Total and Amenable	85-115	75-125	20
9020	NA	Water	Total Organic Halides	87-113	82-121	20
9030A	Method	Soil	Sulfides	60-130	60-130	20
9030	NA	Water	Sulfides	60-130	60-130	20
9040	NA	Water	Corrosivity (pH)	NA	NA	20
9045C	NA	Soil	pH	NA	NA	20
9060A	NA	Water	Total Organic Carbon	90-109	65-133	20
9095	NA	Soil	Paint Filter Test	85-115	NA	NA
9252	NA	Water	Chloride, Titrimetric	85-115	75-125	20

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
200.7 (ICP)	Method	Soil	Aluminum	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Antimony	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Barium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Beryllium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Boron	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Cadmium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Calcium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Chromium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Cobalt	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Copper	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Iron	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Lead	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Magnesium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Manganese	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Molybdenum	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Nickel	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Potassium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Silver	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Sodium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Tin	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Vanadium	Ref.	70-130	30
200.7 (ICP)	Method	Soil	Zinc	Ref.	70-130	30
200.7 (ICP)	Method	Water	Aluminum	85-115	70-130	20
200.7 (ICP)	Method	Water	Antimony	85-115	70-130	20
200.7 (ICP)	Method	Water	Barium	85-115	70-130	20
200.7 (ICP)	Method	Water	Beryllium	85-115	70-130	20
200.7 (ICP)	Method	Water	Boron	85-115	70-130	20
200.7 (ICP)	Method	Water	Cadmium	85-115	70-130	20
200.7 (ICP)	Method	Water	Calcium	85-115	70-130	20
200.7 (ICP)	Method	Water	Chromium	85-115	70-130	20
200.7 (ICP)	Method	Water	Cobalt	85-115	70-130	20
200.7 (ICP)	Method	Water	Copper	85-115	70-130	20
200.7 (ICP)	Method	Water	Iron	85-115	70-130	20
200.7 (ICP)	Method	Water	Magnesium	85-115	70-130	20
200.7 (ICP)	Method	Water	Manganese	85-115	70-130	20
200.7 (ICP)	Method	Water	Molybdenum	85-115	70-130	20
200.7 (ICP)	Method	Water	Nickel	85-115	70-130	20
200.7 (ICP)	Method	Water	Potassium	85-115	70-130	20
200.7 (ICP)	Method	Water	Silver	85-115	70-130	20
200.7 (ICP)	Method	Water	Sodium	85-115	70-130	20
200.7 (ICP)	Method	Water	Tin	85-115	70-130	20
200.7 (ICP)	Method	Water	Vanadium	85-115	70-130	20
200.7 (ICP)	Method	Water	Zinc	85-115	70-130	20
200.9	Method	Soil	Arsenic	Ref.	70-130	30
200.9	Method	Soil	Lead	Ref.	70-130	30
200.9	Method	Soil	Selenium	Ref.	70-130	30
200.9	Method	Soil	Thallium	Ref.	70-130	30
200.9/206.2	Method	Water	Arsenic	85-115	70-130	20
200.9/239.2	Method	Water	Lead	85-115	70-130	20
245.1	Method	Water	Mercury	85-115	70-131	20
1631	Method	Water	Mercury	77-123	71-125	24
200.9/270.2	Method	Water	Selenium	85-115	70-130	20

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
200.9/279.2	Method	Water	Thallium	85-115	70-130	20
200.8	Method	Soil/Sed.	Aluminum	Ref.	70-130	30
200.8	Method	Soil/Sed.	Antimony	Ref.	70-130	30
200.8	Method	Soil/Sed.	Arsenic	Ref.	70-130	30
200.8	Method	Soil/Sed.	Barium	Ref.	70-130	30
200.8	Method	Soil/Sed.	Beryllium	Ref.	70-130	30
200.8	Method	Soil/Sed.	Cadmium	Ref.	70-130	30
200.8	Method	Soil/Sed.	Chromium	Ref.	70-130	30
200.8	Method	Soil/Sed.	Cobalt	Ref.	70-130	30
200.8	Method	Soil/Sed.	Copper	Ref.	70-130	30
200.8	Method	Soil/Sed.	Lead	Ref.	70-130	30
200.8	Method	Soil/Sed.	Manganese	Ref.	70-130	30
200.8	Method	Soil/Sed.	Molybdenum	Ref.	70-130	30
200.8	Method	Soil/Sed.	Nickel	Ref.	70-130	30
200.8	Method	Soil/Sed.	Selenium	Ref.	70-130	30
200.8	Method	Soil/Sed.	Silver	Ref.	70-130	30
200.8	Method	Soil/Sed.	Thallium	Ref.	70-130	30
200.8	Method	Soil/Sed.	Vanadium	Ref.	70-130	30
200.8	Method	Soil/Sed.	Zinc	Ref.	70-130	30
200.8	Method	Water	Aluminum	85-115	70-130	20
200.8	Method	Water	Antimony	85-115	70-130	20
200.8	Method	Water	Arsenic	85-115	70-130	20
200.8	Method	Water	Barium	85-115	70-130	20
200.8	Method	Water	Beryllium	85-115	70-130	20
200.8	Method	Water	Cadmium	85-115	70-130	20
200.8	Method	Water	Chromium	85-115	70-130	20
200.8	Method	Water	Cobalt	85-115	70-130	20
200.8	Method	Water	Copper	85-115	70-130	20
200.8	Method	Water	Lead	85-115	70-130	20
200.8	Method	Water	Manganese	85-115	70-130	20
200.8	Method	Water	Molybdenum	85-115	70-130	20
200.8	Method	Water	Nickel	85-115	70-130	20
200.8	Method	Water	Selenium	85-115	70-130	20
200.8	Method	Water	Silver	85-115	70-130	20
200.8	Method	Water	Thallium	85-115	70-130	20
200.8	Method	Water	Vanadium	85-115	70-130	20
200.8	Method	Water	Zinc	85-115	70-130	20
200.8	Red.Precip.	Seawater	Arsenic	71-125	50-145	20
200.8	Red.Precip.	Seawater	Beryllium	38-114	50-123	20
200.8	Red.Precip.	Seawater	Cadmium	79-114	64-115	20
200.8	Red.Precip.	Seawater	Chromium	76-119	50-130	20
200.8	Red.Precip.	Seawater	Cobalt	80-112	50-151	20
200.8	Red.Precip.	Seawater	Copper	81-113	50-120	20
200.8	Red.Precip.	Seawater	Lead	81-112	54-118	20
200.8	Red.Precip.	Seawater	Nickel	87-113	59-127	20
200.8	Red.Precip.	Seawater	Silver	78-110	67-104	20
200.8	Red.Precip.	Seawater	Thallium	79-110	63-111	20
200.8	Red.Precip.	Seawater	Zinc	75-136	50-133	20
200.8	3050B	Tissue	Aluminum	Ref.	70-130	30
200.8	3050B	Tissue	Antimony	Ref.	70-130	30
200.8	3050B	Tissue	Arsenic	Ref.	70-130	30
200.8	3050B	Tissue	Barium	Ref.	70-130	30

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
200.8	3050B	Tissue	Beryllium	Ref.	70-130	30
200.8	3050B	Tissue	Cadmium	Ref.	70-130	30
200.8	3050B	Tissue	Cobalt	Ref.	70-130	30
200.8	3050B	Tissue	Copper	Ref.	70-130	30
200.8	3050B	Tissue	Lead	Ref.	70-130	30
200.8	3050B	Tissue	Manganese	Ref.	70-130	30
200.8	3050B	Tissue	Molybdenum	Ref.	70-130	30
200.8	3050B	Tissue	Nickel	Ref.	70-130	30
200.8	3050B	Tissue	Silver	Ref.	70-130	30
200.8	3050B	Tissue	Thallium	Ref.	70-130	30
200.8	3050B	Tissue	Vanadium	Ref.	70-130	30
200.8	3050B	Tissue	Zinc	Ref.	70-130	30
6010B	3050B	Soil	Aluminum	Ref.	75-125	30
6010B	3050B	Soil	Antimony	Ref.	10-132	30
6010B	3050B	Soil	Arsenic	Ref.	46-143	30
6010B	3050B	Soil	Barium	Ref.	77-125	30
6010B	3050B	Soil	Beryllium	Ref.	81-119	30
6010B	3050B	Soil	Boron	Ref.	25-175	30
6010B	3050B	Soil	Cadmium	Ref.	49-151	30
6010B	3050B	Soil	Calcium	Ref.	75-125	30
6010B	3050B	Soil	Chromium	Ref.	60-144	30
6010B	3050B	Soil	Cobalt	Ref.	84-113	30
6010B	3050B	Soil	Copper	Ref.	57-141	30
6010B	3050B	Soil	Iron	Ref.	75-125	30
6010B	3050B	Soil	Lead	Ref.	59-141	30
6010B	3050B	Soil	Magnesium	Ref.	75-125	30
6010B	3050B	Soil	Manganese	Ref.	31-169	30
6010B	3050B	Soil	Molybdenum	Ref.	71-117	30
6010B	3050B	Soil	Nickel	Ref.	74-127	30
6010B	3050B	Soil	Potassium	Ref.	75-125	30
6010B	3050B	Soil	Selenium	Ref.	65-130	30
6010B	3050B	Soil	Silver	Ref.	46-137	30
6010B	3050B	Soil	Sodium	Ref.	75-125	30
6010B	3050B	Soil	Thallium	Ref.	18-166	30
6010B	3050B	Soil	Tin	Ref.	75-125	30
6010B	3050B	Soil	Vanadium	Ref.	77-122	30
6010B	3050B	Soil	Zinc	Ref.	50-149	30
6010B	CLP	Water	Aluminum	92-110	71-128	20
6010B	CLP	Water	Antimony	93-112	82-120	20
6010B	CLP	Water	Arsenic	93-114	83-116	20
6010B	CLP	Water	Barium	78-128	87-115	20
6010B	CLP	Water	Beryllium	89-112	81-115	20
6010B	CLP	Water	Boron	91-117	78-128	20
6010B	CLP	Water	Cadmium	92-112	73-125	20
6010B	CLP	Water	Calcium	94-111	75-125	20
6010B	CLP	Water	Chromium	94-113	79-123	20
6010B	CLP	Water	Cobalt	93-113	86-115	20
6010B	CLP	Water	Copper	92-112	83-116	20
6010B	CLP	Water	Iron	92-112	47-155	20
6010B	CLP	Water	Lead	92-112	79-120	20
6010B	CLP	Water	Magnesium	77-124	75-125	20

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
6010B	CLP	Water	Manganese	93-111	62-140	20
6010B	CLP	Water	Molybdenum	91-111	72-128	20
6010B	CLP	Water	Nickel	92-115	84-119	20
6010B	CLP	Water	Potassium	86-119	75-125	20
6010B	CLP	Water	Selenium	81-122	83-116	20
6010B	CLP	Water	Silver	78-124	77-121	20
6010B	CLP	Water	Sodium	91-117	75-125	20
6010B	CLP	Water	Thallium	75-133	71-128	20
6010B	CLP	Water	Tin	85-115	75-125	20
6010B	CLP	Water	Vanadium	93-113	88-112	20
6010B	CLP	Water	Zinc	93-111	84-115	20
6010B	3050B	Tissue	Chromium	Ref.	70-130	30
6020	3050B	Soil/Sed.	Aluminum	Ref.	70-130	30
6020	3050B	Soil/Sed.	Antimony	Ref.	20-108	30
6020	3050B	Soil/Sed.	Arsenic	Ref.	74-120	30
6020	3050B	Soil/Sed.	Barium	Ref.	79-117	30
6020	3050B	Soil/Sed.	Beryllium	Ref.	78-121	30
6020	3050B	Soil/Sed.	Boron	Ref.	70-130	30
6020	3050B	Soil/Sed.	Cadmium	Ref.	63-136	30
6020	3050B	Soil/Sed.	Chromium	Ref.	53-147	30
6020	3050B	Soil/Sed.	Cobalt	Ref.	77-119	30
6020	3050B	Soil/Sed.	Copper	Ref.	52-153	30
6020	3050B	Soil/Sed.	Lead	Ref.	66-134	30
6020	3050B	Soil/Sed.	Manganese	Ref.	47-169	30
6020	3050B	Soil/Sed.	Molybdenum	Ref.	56-128	30
6020	3050B	Soil/Sed.	Nickel	Ref.	77-128	30
6020	3050B	Soil/Sed.	Selenium	Ref.	74-119	30
6020	3050B	Soil/Sed.	Silver	Ref.	83-107	30
6020	3050B	Soil/Sed.	Thallium	Ref.	79-117	30
6020	3050B	Soil/Sed.	Uranium	Ref.	70-130	30
6020	3050B	Soil/Sed.	Vanadium	Ref.	70-130	30
6020	3050B	Soil/Sed.	Zinc	Ref.	57-156	30
6020	CLP/3020A	Water	Aluminum	66-153	34-161	20
6020	CLP/3020A	Water	Antimony	89-110	81-116	20
6020	CLP/3020A	Water	Arsenic	88-112	73-125	20
6020	CLP/3020A	Water	Barium	88-110	69-131	20
6020	CLP/3020A	Water	Beryllium	83-117	70-120	20
6020	CLP/3020A	Water	Cadmium	91-110	81-113	20
6020	CLP/3020A	Water	Chromium	88-112	72-120	20
6020	CLP/3020A	Water	Cobalt	92-108	63-128	20
6020	CLP/3020A	Water	Copper	89-112	70-116	20
6020	CLP/3020A	Water	Lead	90-110	60-127	20
6020	CLP/3020A	Water	Manganese	87-113	52-152	20
6020	CLP/3020A	Water	Molybdenum	84-115	71-134	20
6020	CLP/3020A	Water	Nickel	88-111	70-118	20
6020	CLP/3020A	Water	Selenium	90-114	67-127	20
6020	CLP/3020A	Water	Silver	85-112	64-122	20
6020	CLP/3020A	Water	Thallium	88-112	72-117	20
6020	CLP/3020A	Water	Vanadium	89-109	85-116	20
6020	CLP/3020A	Water	Zinc	88-115	64-120	20

METALS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
7060A	3050B	Soil	Arsenic	Ref.	41-133	30
7421	3050B	Soil	Lead	Ref.	41-139	30
7471A	Method	Soil	Mercury	Ref.	60-128	30
7740	3050B	Soil	Selenium	Ref.	36-134	30
7742/*SM* 3114B	3050B	Soil	Selenium	Ref.	62-123	30
7841	3050B	Soil	Thallium	Ref.	38-134	30
7060A	CLP/3020A	Water	Arsenic	76-114	62-116	20
7421	CLP/3020A	Water	Lead	77-115	61-133	20
7470A	Method	Water	Mercury	82-114	73-121	20
7740	CLP/3020A	Water	Selenium	79-111	37-119	20
7742/*SM* 3114B	3010A	Water	Selenium	73-120	67-122	20
7841	CLP/3020A	Water	Thallium	82-115	34-132	20
7471A	Method	Tissue	Mercury	Ref.	60-130	30
7740	3050B	Tissue	Selenium	Ref.	60-130	30

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
1664	9071A	Soil	Hexane Extractable Material	78-114	78-114	18
1664	Method	Water	Hexane Extractable Material	78-114	78-114	18
600/4-81-045	Method	Oil	Aroclor 1016	38-94	12-133	40
600/4-81-045	Method	Oil	Aroclor 1260	52-113	32-136	40
600/4-81-045	Method	Oil	Decachlorobiphenyl (Surr.) 49-127	NA	NA	NA
608	3520C	Water	4,4'-DDD	62-132	10-163	30
608	3520C	Water	4,4'-DDE	54-138	10-154	30
608	3520C	Water	4,4'-DDT	72-121	10-160	30
608	3520C	Water	Aldrin	57-109	10-127	30
608	3520C	Water	alpha-BHC	68-114	35-121	30
608	3520C	Water	alpha-Chlordane	63-119	70-130	30
608	3520C	Water	Aroclor 1016	24-134	70-130	30
608	3520C	Water	Aroclor 1260	27-136	70-130	30
608	3520C	Water	beta-BHC	53-154	18-137	30
608	3520C	Water	Chlordane	70-130	70-130	30
608	3520C	Water	delta-BHC	72-122	19-143	30
608	3520C	Water	Dieldrin	68-114	10-152	30
608	3520C	Water	Endosulfan I	47-114	10-133	30
608	3520C	Water	Endosulfan II	51-120	10-136	30
608	3520C	Water	Endosulfan Sulfate	68-120	10-154	30
608	3520C	Water	Endrin	66-121	10-153	30
608	3520C	Water	Endrin Aldehyde	55-123	10-144	30
608	3520C	Water	Endrin Ketone	66-126	70-130	30
608	3520C	Water	gamma-BHC (Lindane)	68-114	10-138	30
608	3520C	Water	gamma-Chlordane	68-112	70-130	30
608	3520C	Water	Heptachlor	56-116	10-131	30
608	3520C	Water	Heptachlor Epoxide	66-119	10-144	30
608	3520C	Water	Methoxychlor	64-144	70-130	30
608	3520C	Water	Toxaphene	70-130	70-130	30
608	3520C	Water	Decachlorobiphenyl (Surr.) 10-168	NA	NA	NA
608	3520C	Water	Tetrachloro-*m*-xylene (Surr.) 25-127	NA	NA	NA
625	3510C/3520C	Water	1,2,4-Trichlorobenzene	63-90	10-180	30
625	3510C/3520C	Water	1,2-Dichlorobenzene	63-93	20-113	30
625	3510C/3520C	Water	1,2-Diphenylhydrazine	67-112	10-140	30
625	3510C/3520C	Water	1,3-Dichlorobenzene	59-92	22-107	30
625	3510C/3520C	Water	1,4-Dichlorobenzene	59-90	21-105	30
625	3510C/3520C	Water	2,3,4,6-Tetrachlorophenol	70-130	70-130	30
625	3510C/3520C	Water	2,4,5-Trichlorophenol	70-130	70-130	30
625	3510C/3520C	Water	2,4,6-Trichlorophenol	72-99	43-117	30
625	3510C/3520C	Water	2,4-Dichlorophenol	69-93	34-112	30
625	3510C/3520C	Water	2,4-Dimethylphenol	58-92	10-178	30
625	3510C/3520C	Water	2,4-Dinitrophenol	54-118	18-141	30
625	3510C/3520C	Water	2,4-Dinitrotoluene	73-116	42-133	30
625	3510C/3520C	Water	2,6-Dinitrotoluene	73-110	43-129	30
625	3510C/3520C	Water	2-Chloronaphthalene	63-100	10-132	30
625	3510C/3520C	Water	2-Chlorophenol	66-97	26-121	30
625	3510C/3520C	Water	2-Methyl-4,6-dinitrophenol	59-121	32-123	30
625	3510C/3520C	Water	2-Methylnaphthalene	70-130	70-130	30
625	3510C/3520C	Water	2-Methylphenol	70-130	70-130	30
625	3510C/3520C	Water	2-Nitroaniline	70-130	70-130	30
625	3510C/3520C	Water	2-Nitrophenol	68-95	29-124	30
625	3510C/3520C	Water	3,3'-Dichlorobenzidine	63-108	10-123	30
625	3510C/3520C	Water	3-Nitroaniline	70-130	70-130	30
625	3510C/3520C	Water	4-Bromophenyl Phenyl Ether	70-104	10-145	30
625	3510C/3520C	Water	4-Chloro-3-methylphenol	68-105	10-165	30

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
625	3510C/3520C	Water	4-Chloroaniline		70-130	70-130	30
625	3510C/3520C	Water	4-Chlorophenyl Phenyl Ether		71-104	10-131	30
625	3510C/3520C	Water	4-Methylphenol		63-103	70-130	30
625	3510C/3520C	Water	4-Nitroaniline		70-130	70-130	30
625	3510C/3520C	Water	4-Nitrophenol		61-122	20-141	30
625	3510C/3520C	Water	Acenaphthene		68-99	11-134	30
625	3510C/3520C	Water	Acenaphthylene		68-109	10-151	30
625	3510C/3520C	Water	Aniline		70-130	70-130	30
625	3510C/3520C	Water	Anthracene		68-107	10-136	30
625	3510C/3520C	Water	Benz(a)anthracene		71-111	10-147	30
625	3510C/3520C	Water	Benzidine		10-179	70-130	30
625	3510C/3520C	Water	Benzo(a)pyrene		68-110	10-140	30
625	3510C/3520C	Water	Benzo(b)fluoranthene		68-111	10-149	30
625	3510C/3520C	Water	Benzo(g,h,i)perylene		71-108	10-137	30
625	3510C/3520C	Water	Benzo(k)fluoranthene		66-118	10-161	30
625	3510C/3520C	Water	Benzoic acid		70-130	70-130	30
625	3510C/3520C	Water	Benzyl alcohol		70-130	70-130	30
625	3510C/3520C	Water	Bis(2-chloroethoxy)methane		60-98	10-179	30
625	3510C/3520C	Water	Bis(2-chloroethyl) Ether		65-98	30-113	30
625	3510C/3520C	Water	Bis(2-chloroisopropyl) Ether		53-108	22-124	30
625	3510C/3520C	Water	Bis(2-ethylhexyl) Phthalate		69-115	10-157	30
625	3510C/3520C	Water	Butyl Benzyl Phthalate		67-114	10-159	30
625	3510C/3520C	Water	Carbazole		70-130	70-130	30
625	3510C/3520C	Water	Chrysene		73-106	10-150	30
625	3510C/3520C	Water	Di-n-butyl Phthalate		64-127	10-157	30
625	3510C/3520C	Water	Di-n-octyl Phthalate		62-129	10-182	30
625	3510C/3520C	Water	Dibenz(a,h)anthracene		67-117	10-143	30
625	3510C/3520C	Water	Dibenzofuran		70-130	70-130	30
625	3510C/3520C	Water	Diethyl Phthalate		72-116	20-142	30
625	3510C/3520C	Water	Dimethyl Phthalate		73-107	12-143	30
625	3510C/3520C	Water	Fluoranthene		64-117	10-138	30
625	3510C/3520C	Water	Fluorene		67-106	16-135	30
625	3510C/3520C	Water	Hexachlorobenzene		70-107	10-148	30
625	3510C/3520C	Water	Hexachlorobutadiene		57-92	10-137	30
625	3510C/3520C	Water	Hexachlorocyclopentadiene		10-73	10-75	30
625	3510C/3520C	Water	Hexachloroethane		58-97	21-108	30
625	3510C/3520C	Water	Indeno(1,2,3-cd)pyrene		70-106	10-142	30
625	3510C/3520C	Water	Isophorone		74-112	33-137	30
625	3510C/3520C	Water	N-Nitrosodi-n-propylamine		68-108	30-136	30
625	3510C/3520C	Water	N-Nitrosodimethylamine		66-104	27-113	30
625	3510C/3520C	Water	N-Nitrosodiphenylamine		73-111	14-149	30
625	3510C/3520C	Water	Naphthalene		64-93	10-149	30
625	3510C/3520C	Water	Nitrobenzene		67-102	10-190	30
625	3510C/3520C	Water	Pentachlorophenol		63-101	39-123	30
625	3510C/3520C	Water	Phenanthrene		67-105	13-137	30
625	3510C/3520C	Water	Phenol		60-98	10-128	30
625	3510C/3520C	Water	Pyrene		64-106	10-147	30
625	3510C/3520C	Water	Pyridine		70-130	70-130	30
625	3510C/3520C	Water	2,4,6-Tribromophenol (Surr.)	46-123	NA	NA	NA
625	3510C/3520C	Water	2-Fluorobiphenyl (Surr.)	50-113	NA	NA	NA
625	3510C/3520C	Water	2-Fluorophenol (Surr.)	45-102	NA	NA	NA
625	3510C/3520C	Water	Nitrobenzene-d5 (Surr.)	53-115	NA	NA	NA
625	3510C/3520C	Water	Phenol-d6 (Surr.)	53-111	NA	NA	NA
625	3510C/3520C	Water	Terphenyl-d14 (Surr.)	33-142	NA	NA	NA
1653	Method	Water	2,4-Dichlorophenol-D3 (Surr.)	27-143	NA	NA	NA
1653	Method	Water	4-Chloroguaiacol-$^{13}C_6$ (Surr.)	43-168	NA	NA	NA

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
1653	Method	Water	3,4,5-Trichlorophenol (Surr.)	24-167	NA	NA	NA
1653	Method	Water	5-Chlorovanillin-$^{13}C_6$ (Surr.)	32-254	NA	NA	NA
1653	Method	Water	4,5-Dichlorocatechol-$^{13}C_6$ (Surr.)	D-190	NA	NA	NA
1653	Method	Water	4,5,6-Trichloroguaiacol-$^{13}C_6$ (Surr.)	51-139	NA	NA	NA
1653	Method	Water	Pentachlorophenol-$^{13}C_6$ (Surr.)	27-167	NA	NA	NA
1653	Method	Water	Tetrachloroguaiacol-$^{13}C_6$ (Surr.)	27-161	NA	NA	NA
1653	Method	Water	Tetrachlorocatechol-$^{13}C_6$ (Surr.)	D-184	NA	NA	NA
8015B	Method	Water	Ethylene Glycol		67-137	74-146	30
8015B	Method	Water	Isopropyl Ether		82-115	81-118	30
8015B	Method	Water	Propylene Glycol		69-135	58-148	30
8015B	Method	Water	Cyclohexanol (Surr.)	34-164	NA	NA	NA
8081A	3540C/3545	Soil	2,4'-DDD		38-149	14-150	40
8081A	3540C/3545	Soil	2,4'-DDE		39-149	14-152	40
8081A	3540C/3545	Soil	2,4'-DDT		38-146	10-149	40
8081A	3540C/3545	Soil	4,4'-DDD		48-145	15-144	40
8081A	3540C/3545	Soil	4,4'-DDE		47-147	11-151	40
8081A	3540C/3545	Soil	4,4'-DDT		47-150	10-163	40
8081A	3540C/3545	Soil	Aldrin		41-137	11-146	40
8081A	3540C/3545	Soil	alpha-BHC		43-144	16-140	40
8081A	3540C/3545	Soil	alpha-Chlordane		47-137	11-149	40
8081A	3540C/3545	Soil	beta-BHC		52-139	18-142	40
8081A	3540C/3545	Soil	Chlordane		53-132	70-130	40
8081A	3540C/3545	Soil	cis-Nonachlor		47-137	31-126	40
8081A	3540C/3545	Soil	delta-BHC		56-154	18-158	40
8081A	3540C/3545	Soil	Dieldrin		46-139	20-139	40
8081A	3540C/3545	Soil	Endosulfan I		32-127	10-135	40
8081A	3540C/3545	Soil	Endosulfan II		41-129	10-130	40
8081A	3540C/3545	Soil	Endosulfan Sulfate		48-139	10-152	40
8081A	3540C/3545	Soil	Endrin		50-145	10-160	40
8081A	3540C/3545	Soil	Endrin Aldehyde		44-137	10-141	40
8081A	3540C/3545	Soil	Endrin Ketone		48-145	10-146	40
8081A	3540C/3545	Soil	gamma-BHC (Lindane)		45-141	14-147	40
8081A	3540C/3545	Soil	gamma-Chlordane		45-137	10-146	40
8081A	3540C/3545	Soil	Heptachlor		43-138	12-147	40
8081A	3540C/3545	Soil	Heptachlor Epoxide		46-139	10-147	40
8081A	3540C/3545	Soil	Hexachlorobenzene		29-133	27-111	40
8081A	3540C/3545	Soil	Isodrin		57-144	70-130	40
8081A	3540C/3545	Soil	Methoxychlor		45-156	14-150	40
8081A	3540C/3545	Soil	Mirex		48-142	23-151	40
8081A	3540C/3545	Soil	Oxychlordane		42-130	10-137	40
8081A	3540C/3545	Soil	Toxaphene		53-128	10-172	40
8081A	3540C/3545	Soil	trans-Nonachlor		50-130	34-125	40
8081A	3540C/3545	Soil	Decachlorobiphenyl (Surr.)	26-144	NA	NA	NA
8081A	3540C/3545	Soil	Tetrachloro-*m*-xylene (Surr.)	19-134	NA	NA	NA
8081A	3520C/3535	Water	2,4'-DDD		31-135	70-130	30
8081A	3520C/3535	Water	2,4'-DDE		33-133	70-130	30
8081A	3520C/3535	Water	2,4'-DDT		33-133	70-130	30
8081A	3520C/3535	Water	4,4'-DDD		34-142	36-132	30
8081A	3520C/3535	Water	4,4'-DDE		31-143	40-128	30
8081A	3520C/3535	Water	4,4'-DDT		32-149	33-144	30
8081A	3520C/3535	Water	Aldrin		24-123	30-114	30
8081A	3520C/3535	Water	alpha-BHC		40-131	43-123	30
8081A	3520C/3535	Water	alpha-Chlordane		44-123	38-123	30
8081A	3520C/3535	Water	beta-BHC		38-134	38-120	30

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8081A	3520C/3535	Water	Chlordane	63-139	70-130	30
8081A	3520C/3535	Water	Chlorpyrifos	10-134	70-130	30
8081A	3520C/3535	Water	cis-Nonachlor	75-113	70-130	30
8081A	3520C/3535	Water	delta-BHC	41-147	43-136	30
8081A	3520C/3535	Water	Dieldrin	42-125	41-118	30
8081A	3520C/3535	Water	Endosulfan I	30-115	28-112	30
8081A	3520C/3535	Water	Endosulfan II	35-121	32-114	30
8081A	3520C/3535	Water	Endosulfan Sulfate	39-129	47-120	30
8081A	3520C/3535	Water	Endrin	45-130	43-129	30
8081A	3520C/3535	Water	Endrin Aldehyde	25-133	23-124	30
8081A	3520C/3535	Water	Endrin Ketone	47-126	45-119	30
8081A	3520C/3535	Water	gamma-BHC (Lindane)	39-130	43-120	30
8081A	3520C/3535	Water	gamma-Chlordane	42-121	39-120	30
8081A	3520C/3535	Water	Heptachlor	35-126	35-117	30
8081A	3520C/3535	Water	Heptachlor Epoxide	43-124	43-116	30
8081A	3520C/3535	Water	Hexachlorobenzene	28-118	30-104	30
8081A	3520C/3535	Water	Hexachlorobutadiene	70-130	70-130	30
8081A	3520C/3535	Water	Hexachloroethane	70-130	70-130	30
8081A	3520C/3535	Water	Isodrin	21-140	70-130	30
8081A	3520C/3535	Water	Methoxychlor	32-151	28-151	30
8081A	3520C/3535	Water	Mirex	73-118	70-130	30
8081A	3520C/3535	Water	Oxychlordane	67-109	70-130	30
8081A	3520C/3535	Water	Toxaphene	51-157	29-164	30
8081A	3520C/3535	Water	trans-Nonachlor	77-107	70-130	30
8081A	3520C/3535	Water	Decachlorobiphenyl (Surr.) 10-145	NA	NA	NA
8081A	3520C/3535	Water	Tetrachloro-*m*-xylene (Surr.) 18-125	NA	NA	NA
8081A	3540C	Tissue	2,4'-DDD	53-135	10-206	40
8081A	3540C	Tissue	2,4'-DDE	53-128	10-210	40
8081A	3540C	Tissue	2,4'-DDT	53-136	10-178	40
8081A	3540C	Tissue	4,4'-DDD	48-119	43-123	40
8081A	3540C	Tissue	4,4'-DDE	40-127	28-133	40
8081A	3540C	Tissue	4,4'-DDT	54-126	47-127	40
8081A	3540C	Tissue	Aldrin	47-118	38-122	40
8081A	3540C	Tissue	alpha-BHC	64-115	46-118	40
8081A	3540C	Tissue	alpha-Chlordane	36-122	42-124	40
8081A	3540C	Tissue	beta-BHC	53-120	13-172	40
8081A	3540C	Tissue	Chlorpyrifos	70-130	70-130	40
8081A	3540C	Tissue	cis-Nonachlor	70-130	70-130	40
8081A	3540C	Tissue	delta-BHC	48-141	27-141	40
8081A	3540C	Tissue	Dieldrin	42-122	38-122	40
8081A	3540C	Tissue	Endosulfan I	30-107	16-127	40
8081A	3540C	Tissue	Endosulfan II	41-106	34-124	40
8081A	3540C	Tissue	Endosulfan Sulfate	42-127	33-133	40
8081A	3540C	Tissue	Endrin	46-128	42-131	40
8081A	3540C	Tissue	Endrin Aldehyde	18-99	10-96	40
8081A	3540C	Tissue	Endrin Ketone	50-118	50-128	40
8081A	3540C	Tissue	gamma-BHC (Lindane)	63-117	41-126	40
8081A	3540C	Tissue	gamma-Chlordane	34-121	30-127	40
8081A	3540C	Tissue	Heptachlor	51-116	42-122	40
8081A	3540C	Tissue	Heptachlor Epoxide	34-126	25-129	40
8081A	3540C	Tissue	Hexachlorobenzene	26-118	46-102	40
8081A	3540C	Tissue	Hexachlorobutadiene	70-130	70-130	40
8081A	3540C	Tissue	Hexachloroethane	70-130	70-130	40
8081A	3540C	Tissue	Isodrin	12-129	70-130	40
8081A	3540C	Tissue	Methoxychlor	48-135	30-156	40
8081A	3540C	Tissue	Mirex	70-130	70-130	40

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8081A	3540C	Tissue	Oxychlordane		70-130	70-130	40
8081A	3540C	Tissue	Toxaphene		70-130	70-130	40
8081A	3540C	Tissue	trans-Nonachlor		70-130	70-130	40
8081A	3540C	Tissue	Decachlorobiphenyl (Surr.)	25-134	NA	NA	NA
8081A	3540C	Tissue	Tetrachloro-*m*-xylene (Surr.)	18-142	NA	NA	NA
8081A	3510C	TCLP	Chlordane		54-108	32-140	30
8081A	3510C	TCLP	Endrin		57-121	68-115	30
8081A	3510C	TCLP	gamma-BHC (Lindane)		56-115	70-109	30
8081A	3510C	TCLP	Heptachlor		37-99	39-108	30
8081A	3510C	TCLP	Heptachlor Epoxide		54-111	64-107	30
8081A	3510C	TCLP	Methoxychlor		53-122	62-118	30
8081A	3510C	TCLP	Toxaphene		70-130	70-130	30
8081A	3510C	TCLP	Decachlorobiphenyl (Surr.)	12-150	NA	NA	NA
8081A	3510C	TCLP	Tetrachloro-*m*-xylene (Surr.)	18-107	NA	NA	NA
8082	3540C/3545	Soil	Aroclor 1016		39-145	26-163	40
8082	3540C/3545	Soil	Aroclor 1260		51-146	24-171	40
8082	3540C/3545	Soil	Decachlorobiphenyl (Surr.)	33-153	NA	NA	NA
8082	3540C/3545	Soil	Tetrachloro-*m*-xylene (Surr.)	21-142	NA	NA	NA
8082	3520C/3535	Water	Aroclor 1016		50-125	37-137	30
8082	3520C/3535	Water	Aroclor 1260		56-122	31-149	30
8082	3520C/3535	Water	Decachlorobiphenyl (Surr.)	10-144	NA	NA	NA
8082	3520C/3535	Water	Tetrachloro-*m*-xylene (Surr.)	27-136	NA	NA	NA
8082	3580A	Oil	Aroclor 1016		38-94	12-133	40
8082	3580A	Oil	Aroclor 1260		52-113	32-136	40
8082	3580A	Oil	Decachlorobiphenyl (Surr.)	49-127	NA	NA	NA
8082	3580A	Oil	Tetrachloro-*m*-xylene (Surr.)	31-111	NA	NA	NA
8082	3540C	Tissue	Aroclor 1016		53-143	28-189	40
8082	3540C	Tissue	Aroclor 1260		58-138	43-153	40
8082	3540C	Tissue	Decachlorobiphenyl (Surr.)	39-136	NA	NA	NA
8082	3540C	Tissue	Tetrachloro-*m*-xylene (Surr.)	38-125	NA	NA	NA
8082	3540C	Soil	PCB 101		57-155	34-188	40
8082	3540C	Soil	PCB 105		51-144	27-183	40
8082	3540C	Soil	PCB 114		47-141	39-153	40
8082	3540C	Soil	PCB 118		58-154	37-174	40
8082	3540C	Soil	PCB 123		50-142	41-148	40
8082	3540C	Soil	PCB 126		53-139	40-148	40
8082	3540C	Soil	PCB 128		33-182	70-130	40
8082	3540C	Soil	PCB 138		44-130	15-167	40
8082	3540C	Soil	PCB 153		51-137	30-151	40
8082	3540C	Soil	PCB 156		50-151	24-183	40
8082	3540C	Soil	PCB 157		25-184	24-167	40
8082	3540C	Soil	PCB 158		45-149	36-176	40
8082	3540C	Soil	PCB 166		70-130	70-130	40
8082	3540C	Soil	PCB 167		26-160	70-130	40
8082	3540C	Soil	PCB 169		52-156	49-159	40
8082	3540C	Soil	PCB 170		49-147	33-168	40
8082	3540C	Soil	PCB 18		44-121	19-156	40
8082	3540C	Soil	PCB 180		52-149	36-175	40
8082	3540C	Soil	PCB 183		49-141	21-175	40
8082	3540C	Soil	PCB 184		55-150	38-171	40
8082	3540C	Soil	PCB 187		32-140	70-130	40
8082	3540C	Soil	PCB 189		48-149	31-161	40
8082	3540C	Soil	PCB 195		47-147	31-172	40
8082	3540C	Soil	PCB 206		48-146	43-153	40
8082	3540C	Soil	PCB 209		47-146	23-173	40
8082	3540C	Soil	PCB 28		46-158	36-187	40

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8082	3540C	Soil	PCB 44	48-137	20-181	40
8082	3540C	Soil	PCB 52	40-127	11-174	40
8082	3540C	Soil	PCB 60	50-150	10-233	40
8082	3540C	Soil	PCB 66	46-127	38-148	40
8082	3540C	Soil	PCB 77	33-150	18-159	40
8082	3540C	Soil	PCB 8	48-140	20-183	40
8082	3540C	Soil	PCB 81	10-189	26-159	40
8082	3540C	Soil	PCB 87	44-130	15-174	40
8082	3540C	Soil	PCB 90	47-141	41-134	40
8082	3540C	Soil	Tetrachloro-*m*-xylene (Surr.) 21-148	NA	NA	NA
8082	3520C	Water	PCB 101	74-171	70-130	30
8082	3520C	Water	PCB 105	73-154	70-130	30
8082	3520C	Water	PCB 114	76-151	70-130	30
8082	3520C	Water	PCB 118	76-167	70-130	30
8082	3520C	Water	PCB 123	64-159	70-130	30
8082	3520C	Water	PCB 126	41-171	70-130	30
8082	3520C	Water	PCB 128	70-130	70-130	30
8082	3520C	Water	PCB 138	34-173	70-130	30
8082	3520C	Water	PCB 153	37-178	70-130	30
8082	3520C	Water	PCB 156	73-167	70-130	30
8082	3520C	Water	PCB 157	66-157	70-130	30
8082	3520C	Water	PCB 158	60-165	70-130	30
8082	3520C	Water	PCB 166	70-130	70-130	30
8082	3520C	Water	PCB 167	70-130	70-130	30
8082	3520C	Water	PCB 169	67-156	70-130	30
8082	3520C	Water	PCB 170	73-150	70-130	30
8082	3520C	Water	PCB 18	23-173	70-130	30
8082	3520C	Water	PCB 180	73-156	70-130	30
8082	3520C	Water	PCB 183	65-148	70-130	30
8082	3520C	Water	PCB 184	73-153	70-130	30
8082	3520C	Water	PCB 187	70-130	70-130	30
8082	3520C	Water	PCB 189	71-159	70-130	30
8082	3520C	Water	PCB 195	64-159	70-130	30
8082	3520C	Water	PCB 206	64-160	70-130	30
8082	3520C	Water	PCB 209	33-189	70-130	30
8082	3520C	Water	PCB 28	79-172	70-130	30
8082	3520C	Water	PCB 44	63-154	70-130	30
8082	3520C	Water	PCB 52	29-172	70-130	30
8082	3520C	Water	PCB 60	75-166	70-130	30
8082	3520C	Water	PCB 66	32-175	70-130	30
8082	3520C	Water	PCB 77	24-180	70-130	30
8082	3520C	Water	PCB 8	53-158	70-130	30
8082	3520C	Water	PCB 81	50-152	70-130	30
8082	3520C	Water	PCB 87	36-174	70-130	30
8082	3520C	Water	PCB 90	50-159	70-130	30
8082	3520C	Water	Tetrachloro-*m*-xylene (Surr.) 15-131	NA	NA	NA
8082	3540C	Tissue	PCB 101	52-156	70-130	40
8082	3540C	Tissue	PCB 105	46-144	29-150	40
8082	3540C	Tissue	PCB 114	45-135	70-130	40
8082	3540C	Tissue	PCB 118	52-154	34-152	40
8082	3540C	Tissue	PCB 123	51-129	70-130	40
8082	3540C	Tissue	PCB 126	52-137	44-135	40
8082	3540C	Tissue	PCB 128	65-114	24-155	40
8082	3540C	Tissue	PCB 138	44-127	26-140	40
8082	3540C	Tissue	PCB 153	50-123	31-124	40
8082	3540C	Tissue	PCB 156	51-143	70-130	40

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8082	3540C	Tissue	PCB 157	48-149	70-130	40
8082	3540C	Tissue	PCB 158	10-210	70-130	40
8082	3540C	Tissue	PCB 166	70-130	70-130	40
8082	3540C	Tissue	PCB 167	70-130	70-130	40
8082	3540C	Tissue	PCB 169	59-138	43-147	40
8082	3540C	Tissue	PCB 170	47-139	37-130	40
8082	3540C	Tissue	PCB 18	50-117	35-122	40
8082	3540C	Tissue	PCB 180	54-137	35-138	40
8082	3540C	Tissue	PCB 183	43-136	58-122	40
8082	3540C	Tissue	PCB 184	10-203	70-130	40
8082	3540C	Tissue	PCB 187	70-130	70-130	40
8082	3540C	Tissue	PCB 189	46-140	59-136	40
8082	3540C	Tissue	PCB 195	51-134	39-138	40
8082	3540C	Tissue	PCB 206	50-140	39-140	40
8082	3540C	Tissue	PCB 209	49-136	35-141	40
8082	3540C	Tissue	PCB 28	50-157	41-148	40
8082	3540C	Tissue	PCB 44	53-132	47-131	40
8082	3540C	Tissue	PCB 52	50-118	48-127	40
8082	3540C	Tissue	PCB 60	10-211	70-130	40
8082	3540C	Tissue	PCB 66	47-128	35-132	40
8082	3540C	Tissue	PCB 77	51-133	17-191	40
8082	3540C	Tissue	PCB 8	51-140	42-138	40
8082	3540C	Tissue	PCB 81	10-184	70-130	40
8082	3540C	Tissue	PCB 87	10-178	70-130	40
8082	3540C	Tissue	PCB 90	10-243	70-130	40
8082	3540C	Tissue	Tetrachloro-*m*-xylene (Surr.) 27-129	NA	NA	NA
8141A	3540C/3545	Soil	Azinphos-methyl (Guthion)	44-151	51-143	40
8141A	3540C/3545	Soil	Bolstar (Sulprofos)	32-137	44-125	40
8141A	3540C/3545	Soil	Chlorpyrifos	43-135	33-148	40
8141A	3540C/3545	Soil	Coumaphos	48-143	51-136	40
8141A	3540C/3545	Soil	Demeton-O, S	10-131	10-116	40
8141A	3540C/3545	Soil	Diazinon	47-128	43-131	40
8141A	3540C/3545	Soil	Dichlorvos	24-137	10-139	40
8141A	3540C/3545	Soil	Dimethoate	45-138	41-134	40
8141A	3540C/3545	Soil	Disulfoton	10-133	16-123	40
8141A	3540C/3545	Soil	EPN	49-126	53-122	40
8141A	3540C/3545	Soil	Ethoprop (Prophos)	40-128	46-123	40
8141A	3540C/3545	Soil	Ethyl Parathion	47-128	48-126	40
8141A	3540C/3545	Soil	Fensulfothion	48-155	47-151	40
8141A	3540C/3545	Soil	Fenthion	34-137	45-127	40
8141A	3540C/3545	Soil	Malathion	49-131	55-124	40
8141A	3540C/3545	Soil	Merphos	11-126	16-129	40
8141A	3540C/3545	Soil	Methyl Parathion	48-127	53-123	40
8141A	3540C/3545	Soil	Mevinphos	43-126	41-128	40
8141A	3540C/3545	Soil	Phorate	18-131	15-127	40
8141A	3540C/3545	Soil	Ronnel	48-123	53-118	40
8141A	3540C/3545	Soil	Stirophos (Tetrachlorovinphos)	45-148	45-143	40
8141A	3540C/3545	Soil	Sulfotep	45-114	47-115	40
8141A	3540C/3545	Soil	Tokuthion (Prothiofos)	48-132	51-126	40
8141A	3540C/3545	Soil	Trichloronate	39-129	33-135	40
8141A	3540C/3545	Soil	Tributyl Phosphate (Surr.) 26-162	NA	NA	NA
8141A	3540C/3545	Soil	Triphenyl Phosphate (Surr.) 34-143	NA	NA	NA
8141A	3520C/3535	Water	Azinphos-methyl (Guthion)	41-151	27-167	30
8141A	3520C/3535	Water	Bolstar (Sulprofos)	22-147	11-153	30
8141A	3520C/3535	Water	Chlorpyrifos	48-141	30-157	30
8141A	3520C/3535	Water	Coumaphos	43-147	36-144	30

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8141A	3520C/3535	Water	Demeton-O, S	10-138	10-138	30
8141A	3520C/3535	Water	Diazinon	54-131	26-149	30
8141A	3520C/3535	Water	Dichlorvos	34-147	10-164	30
8141A	3520C/3535	Water	Dimethoate	38-147	27-172	30
8141A	3520C/3535	Water	Disulfoton	12-144	10-167	30
8141A	3520C/3535	Water	EPN	54-126	34-143	30
8141A	3520C/3535	Water	Ethoprop (Prophos)	52-131	10-164	30
8141A	3520C/3535	Water	Ethyl Parathion	52-126	15-159	30
8141A	3520C/3535	Water	Fensulfothion	53-153	35-171	30
8141A	3520C/3535	Water	Fenthion	25-150	10-171	30
8141A	3520C/3535	Water	Malathion	56-129	35-150	30
8141A	3520C/3535	Water	Merphos	42-115	10-150	30
8141A	3520C/3535	Water	Methyl Parathion	55-127	32-149	30
8141A	3520C/3535	Water	Mevinphos	46-135	49-144	30
8141A	3520C/3535	Water	Phorate	28-138	10-148	30
8141A	3520C/3535	Water	Ronnel	53-124	28-143	30
8141A	3520C/3535	Water	Stirophos (Tetrachlorovinphos)	58-139	34-155	30
8141A	3520C/3535	Water	Sulfotep	49-120	21-142	30
8141A	3520C/3535	Water	Tokuthion (Prothiofos)	54-129	29-144	30
8141A	3520C/3535	Water	Trichloronate	45-138	18-160	30
8141A	3520C/3535	Water	Tributyl Phosphate (Surr.) 14-173	NA	NA	NA
8141A	3520C/3535	Water	Triphenyl Phosphate (Surr.) 38-134	NA	NA	NA
8151A	Method	Soil	2,4,5-T	41-133	28-138	40
8151A	Method	Soil	2,4,5-TP (Silvex)	40-131	20-137	40
8151A	Method	Soil	2,4-D	41-115	19-129	40
8151A	Method	Soil	2,4-DB	31-147	10-171	40
8151A	Method	Soil	Dalapon	18-112	10-137	40
8151A	Method	Soil	Dicamba	43-124	17-138	40
8151A	Method	Soil	Dichlorprop	38-113	22-121	40
8151A	Method	Soil	Dinoseb	10-112	10-108	40
8151A	Method	Soil	MCPA	31-125	10-145	40
8151A	Method	Soil	MCPP	24-137	13-129	40
8151A	Method	Soil	2,4-Dichlorophenylacetic Acid (Surr.) 22-132	NA	NA	NA
8151A	Method	Water	2,4,5-T	24-128	27-122	30
8151A	Method	Water	2,4,5-TP (Silvex)	19-132	10-166	30
8151A	Method	Water	2,4-D	24-112	10-134	30
8151A	Method	Water	2,4-DB	10-127	10-148	30
8151A	Method	Water	Dalapon	11-109	10-115	30
8151A	Method	Water	Dicamba	28-111	31-107	30
8151A	Method	Water	Dichlorprop	26-112	21-109	30
8151A	Method	Water	Dinoseb	14-99	18-91	30
8151A	Method	Water	MCPA	13-110	10-114	30
8151A	Method	Water	MCPP	10-115	10-98	30
8151A	Method	Water	2,4-Dichlorophenylacetic Acid (Surr.) 10-121	NA	NA	NA
8151M	Method	Soil	2,3,4,5-Tetrachlorophenol	51-119	59-160	40
8151M	Method	Soil	2,3,5,6-Tetrachlorophenol	53-132	68-146	40
8151M	Method	Soil	2,4,5-Trichlorophenol	38-116	47-157	40
8151M	Method	Soil	2,4,6-Trichlorophenol	54-112	60-127	40
8151M	Method	Soil	3,4,5-Trichlorophenol	13-88	70-130	40
8151M	Method	Soil	3,4-Dichlorophenol	10-158	70-130	40
8151M	Method	Soil	3,5-Dichlorophenol	10-127	70-130	40
8151M	Method	Soil	Pentachlorophenol	63-137	57-166	40
8151M	Method	Soil	4-Bromo-2,6-dichlorophenol (Surr.) 51-141	NA	NA	NA
8151M	Method	Water	2,3,4,5-Tetrachlorophenol	41-132	20-149	30
8151M	Method	Water	2,3,5,6-Tetrachlorophenol	41-133	41-140	30
8151M	Method	Water	2,4,5-Trichlorophenol	20-120	39-101	30

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8151M	Method	Water	2,4,6-Trichlorophenol	52-108	31-135	30
8151M	Method	Water	3,4,5-Trichlorophenol	10-78	70-130	30
8151M	Method	Water	3,4-Dichlorophenol	10-123	70-130	30
8151M	Method	Water	3,5-Dichlorophenol	10-68	70-130	30
8151M	Method	Water	Pentachlorophenol	45-140	43-139	30
8151M	Method	Water	4-Bromo-2,6-dichlorophenol (Surr.) 41-152	NA	NA	NA
8270C	3541	Soil	1,2,4,5-Tetrachlorobenzene	70-130	70-130	40
8270C	3541	Soil	1,2,4-Trichlorobenzene	43-89	10-102	40
8270C	3541	Soil	1,2-Dichlorobenzene	45-89	10-96	40
8270C	3541	Soil	1,2-Diphenylhydrazine	53-104	70-130	40
8270C	3541	Soil	1,3,5-Trinitrobenzene	70-130	70-130	40
8270C	3541	Soil	1,3-Dichlorobenzene	42-86	10-92	40
8270C	3541	Soil	1,3-Dinitrobenzene	70-130	70-130	40
8270C	3541	Soil	1,4-Dichlorobenzene	42-84	10-91	40
8270C	3541	Soil	1,4-Dioxane	70-130	70-130	40
8270C	3541	Soil	1,4-Naphthoquinone	70-130	70-130	40
8270C	3541	Soil	1-Naphthylamine	70-130	70-130	40
8270C	3541	Soil	2,3,4,6-Tetrachlorophenol	39-124	70-130	40
8270C	3541	Soil	2,4,5-Trichlorophenol	40-100	21-107	40
8270C	3541	Soil	2,4,6-Trichlorophenol	40-97	17-106	40
8270C	3541	Soil	2,4-Dichlorophenol	42-90	11-107	40
8270C	3541	Soil	2,4-Dimethylphenol	10-92	10-91	40
8270C	3541	Soil	2,4-Dinitrophenol	13-119	10-134	40
8270C	3541	Soil	2,4-Dinitrotoluene	50-114	16-127	40
8270C	3541	Soil	2,6-Dichlorophenol	70-130	70-130	40
8270C	3541	Soil	2,6-Diisopropylnaphthalene	70-130	70-130	40
8270C	3541	Soil	2,6-Dinitrotoluene	50-105	22-117	40
8270C	3541	Soil	2-Acetylaminofluorene	70-130	70-130	40
8270C	3541	Soil	2-Chloronaphthalene	46-95	10-113	40
8270C	3541	Soil	2-Chlorophenol	40-89	16-92	40
8270C	3541	Soil	2-Methyl-4,6-dinitrophenol	30-116	10-114	40
8270C	3541	Soil	2-Methylnaphthalene	43-91	10-106	40
8270C	3541	Soil	2-Methylphenol	34-90	10-98	40
8270C	3541	Soil	2-Naphthylamine	70-130	70-130	40
8270C	3541	Soil	2-Nitroaniline	42-104	20-116	40
8270C	3541	Soil	2-Nitrophenol	42-91	13-99	40
8270C	3541	Soil	2-Picoline	70-130	70-130	40
8270C	3541	Soil	3,3'-Dichlorobenzidine	10-109	10-98	40
8270C	3541	Soil	3,3'-Dimethylbenzidine	70-130	70-130	40
8270C	3541	Soil	3-Methylcholanthrene	70-130	70-130	40
8270C	3541	Soil	3-Nitroaniline	38-103	10-105	40
8270C	3541	Soil	4-Aminobiphenyl	70-130	70-130	40
8270C	3541	Soil	4-Bromophenyl Phenyl Ether	46-101	10-121	40
8270C	3541	Soil	4-Chloro-3-methylphenol	40-98	18-104	40
8270C	3541	Soil	4-Chloroaniline	17-95	10-83	40
8270C	3541	Soil	4-Chlorophenyl Phenyl Ether	45-101	10-118	40
8270C	3541	Soil	4-Methylphenol	34-93	10-103	40
8270C	3541	Soil	4-Nitroaniline	38-107	10-109	40
8270C	3541	Soil	4-Nitrophenol	40-113	10-129	40
8270C	3541	Soil	4-Nitroquinoline N-Oxide	70-130	70-130	40
8270C	3541	Soil	5-Nitro-o-toluidine	70-130	70-130	40
8270C	3541	Soil	7,12-Dimethylbenz(a)anthracene	70-130	70-130	40
8270C	3541	Soil	a,a-Dimethylphenethylamine	70-130	70-130	40

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C	3541	Soil	Acenaphthene	47-94	10-115	40
8270C	3541	Soil	Acenaphthylene	51-105	10-140	40
8270C	3541	Soil	Acetophenone	45-105	10-127	40
8270C	3541	Soil	Aniline	10-80	10-73	40
8270C	3541	Soil	Anthracene	52-102	10-131	40
8270C	3541	Soil	Aramite, Total	70-130	70-130	40
8270C	3541	Soil	Atrazine	37-132	23-133	40
8270C	3541	Soil	Azobenzene	42-97	23-95	40
8270C	3541	Soil	Benz(a)anthracene	53-111	10-142	40
8270C	3541	Soil	Benzaldehyde	22-111	13-96	40
8270C	3541	Soil	Benzidine	10-69	70-130	40
8270C	3541	Soil	Benzo(a)pyrene	52-110	10-128	40
8270C	3541	Soil	Benzo(b)fluoranthene	52-111	10-145	40
8270C	3541	Soil	Benzo(g,h,i)perylene	36-126	10-129	40
8270C	3541	Soil	Benzo(k)fluoranthene	54-112	13-127	40
8270C	3541	Soil	Benzoic Acid	10-100	10-127	40
8270C	3541	Soil	Benzophenone	70-130	70-130	40
8270C	3541	Soil	Benzyl Alcohol	41-93	26-93	40
8270C	3541	Soil	Biphenyl	48-98	14-109	40
8270C	3541	Soil	Bis(2-chloroethoxy)methane	44-90	14-103	40
8270C	3541	Soil	Bis(2-chloroethyl) Ether	44-89	10-106	40
8270C	3541	Soil	Bis(2-chloroisopropyl) Ether	39-91	10-105	40
8270C	3541	Soil	Bis(2-ethylhexyl) Phthalate	37-133	10-138	40
8270C	3541	Soil	Butyl Benzyl Phthalate	50-111	10-128	40
8270C	3541	Soil	Caprolactam	25-110	10-132	40
8270C	3541	Soil	Carbazole	51-108	13-133	40
8270C	3541	Soil	Chlorobenzilate	70-130	70-130	40
8270C	3541	Soil	Chrysene	52-108	10-146	40
8270C	3541	Soil	Di-n-butyl Phthalate	52-116	10-132	40
8270C	3541	Soil	Di-n-octyl Phthalate	50-119	10-133	40
8270C	3541	Soil	Diallate	70-130	70-130	40
8270C	3541	Soil	Diazinon	34-74	70-130	40
8270C	3541	Soil	Dibenz(a,h)anthracene	45-124	16-129	40
8270C	3541	Soil	Dibenzofuran	45-96	10-115	40
8270C	3541	Soil	Diethyl Phthalate	48-112	10-126	40
8270C	3541	Soil	Diethylene Glycol Dibenzoate	70-130	70-130	40
8270C	3541	Soil	Dimethoate	70-130	70-130	40
8270C	3541	Soil	Dimethyl Phthalate	49-102	21-114	40
8270C	3541	Soil	Dinoseb	70-130	70-130	40
8270C	3541	Soil	Diphenylamine	70-130	70-130	40
8270C	3541	Soil	Disulfoton	70-130	70-130	40
8270C	3541	Soil	Ethyl Methanesulfonate	70-130	70-130	40
8270C	3541	Soil	Ethylene Glycol Butyl Ether (EGBE)	70-130	70-130	40
8270C	3541	Soil	Famphur	70-130	70-130	40
8270C	3541	Soil	Fluoranthene	50-108	10-156	40
8270C	3541	Soil	Fluorene	47-100	10-123	40
8270C	3541	Soil	Hexachlorobenzene	49-104	15-120	40
8270C	3541	Soil	Hexachlorobutadiene	41-88	10-123	40
8270C	3541	Soil	Hexachlorocyclopentadiene	23-92	10-80	40
8270C	3541	Soil	Hexachloroethane	43-89	10-107	40
8270C	3541	Soil	Hexachlorophene	70-130	70-130	40
8270C	3541	Soil	Hexachloropropene	70-130	70-130	40
8270C	3541	Soil	Indeno(1,2,3-cd)pyrene	44-123	10-138	40

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C	3541	Soil	Isodrin	70-130	70-130	40
8270C	3541	Soil	Isophorone	49-106	23-113	40
8270C	3541	Soil	Isosafrole	70-130	70-130	40
8270C	3541	Soil	Kepone	70-130	70-130	40
8270C	3541	Soil	Methapyrilene	70-130	70-130	40
8270C	3541	Soil	Methyl Methanesulfonate	70-130	70-130	40
8270C	3541	Soil	Methyl Parathion	70-130	70-130	40
8270C	3541	Soil	n-Dodecane	70-130	70-130	40
8270C	3541	Soil	N-Nitrosodi-n-butylamine	70-130	70-130	40
8270C	3541	Soil	N-Nitrosodi-n-propylamine	42-103	12-116	40
8270C	3541	Soil	N-Nitrosodiethylamine	70-130	70-130	40
8270C	3541	Soil	N-Nitrosodimethylamine	34-96	10-91	40
8270C	3541	Soil	N-Nitrosodiphenylamine	49-112	11-131	40
8270C	3541	Soil	N-Nitrosomethylethylamine	70-130	70-130	40
8270C	3541	Soil	N-Nitrosomorpholine	70-130	70-130	40
8270C	3541	Soil	N-Nitrosopiperidine	70-130	70-130	40
8270C	3541	Soil	N-Nitrosopyrrolidine	70-130	70-130	40
8270C	3541	Soil	Naphthalene	45-89	10-111	40
8270C	3541	Soil	Nitrobenzene	44-92	10-103	40
8270C	3541	Soil	O,O,O-Triethyl Phosphorothioate	70-130	70-130	40
8270C	3541	Soil	o-Toluidine	70-130	70-130	40
8270C	3541	Soil	p-Dimethylaminoazobenzene	70-130	70-130	40
8270C	3541	Soil	p-Phenylenediamine	70-130	70-130	40
8270C	3541	Soil	Parathion	70-130	70-130	40
8270C	3541	Soil	Pentachlorobenzene	70-130	70-130	40
8270C	3541	Soil	Pentachloroethane	70-130	70-130	40
8270C	3541	Soil	Pentachloronitrobenzene	70-130	70-130	40
8270C	3541	Soil	Pentachlorophenol	32-104	10-138	40
8270C	3541	Soil	Phenacetin	70-130	70-130	40
8270C	3541	Soil	Phenanthrene	51-99	10-155	40
8270C	3541	Soil	Phenol	43-90	21-92	40
8270C	3541	Soil	Phorate	70-130	70-130	40
8270C	3541	Soil	Pronamide	70-130	70-130	40
8270C	3541	Soil	Pyrene	48-107	10-157	40
8270C	3541	Soil	Pyridine	10-110	70-130	40
8270C	3541	Soil	Quinoline	70-130	70-130	40
8270C	3541	Soil	Safrole	70-130	70-130	40
8270C	3541	Soil	Sulfotep	70-130	70-130	40
8270C	3541	Soil	Thionazin	70-130	70-130	40
8270C	3541	Soil	2,4,6-Tribromophenol (Surr.) 12-111	NA	NA	NA
8270C	3541	Soil	2-Fluorobiphenyl (Surr.) 10-109	NA	NA	NA
8270C	3541	Soil	2-Fluorophenol (Surr.) 10-85	NA	NA	NA
8270C	3541	Soil	Nitrobenzene-d5 (Surr.) 10-100	NA	NA	NA
8270C	3541	Soil	Phenol-d6 (Surr.) 17-96	NA	NA	NA
8270C	3541	Soil	Terphenyl-d14 (Surr.) 21-122	NA	NA	NA
8270C	3520C	Water	1,2,4,5-Tetrachlorobenzene	70-130	70-130	30
8270C	3520C	Water	1,2,4-Trichlorobenzene	41-103	43-98	30
8270C	3520C	Water	1,2-Dichlorobenzene	39-108	39-98	30
8270C	3520C	Water	1,2-Diphenylhydrazine	66-115	70-130	30
8270C	3520C	Water	1,3,5-Trinitrobenzene	70-130	70-130	30
8270C	3520C	Water	1,3-Dichlorobenzene	30-108	29-100	30
8270C	3520C	Water	1,3-Dinitrobenzene	70-130	70-130	30
8270C	3520C	Water	1,4-Dichlorobenzene	32-105	30-99	30

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C	3520C	Water	1,4-Dioxane	70-130	70-130	30
8270C	3520C	Water	1,4-Naphthoquinone	70-130	70-130	30
8270C	3520C	Water	1-Naphthylamine	70-130	70-130	30
8270C	3520C	Water	2,3,4,6-Tetrachlorophenol	70-130	70-130	30
8270C	3520C	Water	2,4,5-Trichlorophenol	65-115	60-121	30
8270C	3520C	Water	2,4,6-Trichlorophenol	64-112	60-118	30
8270C	3520C	Water	2,4-Dichlorophenol	59-110	56-116	30
8270C	3520C	Water	2,4-Dimethylphenol	17-116	10-157	30
8270C	3520C	Water	2,4-Dinitrophenol	22-132	14-194	30
8270C	3520C	Water	2,4-Dinitrotoluene	75-120	67-128	30
8270C	3520C	Water	2,6-Dichlorophenol	70-130	70-130	30
8270C	3520C	Water	2,6-Dinitrotoluene	73-115	69-121	30
8270C	3520C	Water	2-Acetylaminofluorene	70-130	70-130	30
8270C	3520C	Water	2-Chloronaphthalene	55-110	54-106	30
8270C	3520C	Water	2-Chlorophenol	59-110	50-113	30
8270C	3520C	Water	2-Methyl-4,6-dinitrophenol	50-122	37-147	30
8270C	3520C	Water	2-Methylnaphthalene	50-104	49-100	30
8270C	3520C	Water	2-Methylphenol	55-109	39-118	30
8270C	3520C	Water	2-Naphthylamine	70-130	70-130	30
8270C	3520C	Water	2-Nitroaniline	64-117	18-140	30
8270C	3520C	Water	2-Nitrophenol	59-112	51-118	30
8270C	3520C	Water	2-Picoline	70-130	70-130	30
8270C	3520C	Water	3,3'-Dichlorobenzidine	30-122	10-160	30
8270C	3520C	Water	3,3'-Dimethylbenzidine	70-130	70-130	30
8270C	3520C	Water	3-Methylcholanthrene	70-130	70-130	30
8270C	3520C	Water	3-Nitroaniline	52-123	10-145	30
8270C	3520C	Water	4-Aminobiphenyl	70-130	70-130	30
8270C	3520C	Water	4-Bromophenyl Phenyl Ether	65-114	65-107	30
8270C	3520C	Water	4-Chloro-3-methylphenol	61-114	58-126	30
8270C	3520C	Water	4-Chloroaniline	27-125	10-137	30
8270C	3520C	Water	4-Chlorophenyl Phenyl Ether	66-111	62-109	30
8270C	3520C	Water	4-Methylphenol	55-111	42-123	30
8270C	3520C	Water	4-Nitroaniline	58-118	10-135	30
8270C	3520C	Water	4-Nitrophenol	56-126	29-167	30
8270C	3520C	Water	4-Nitroquinoline N-Oxide	70-130	70-130	30
8270C	3520C	Water	5-Nitro-o-toluidine	70-130	70-130	30
8270C	3520C	Water	7,12-Dimethylbenz(a)anthracene	70-130	70-130	30
8270C	3520C	Water	a,a-Dimethylphenethylamine	70-130	70-130	30
8270C	3520C	Water	Acenaphthene	63-109	58-105	30
8270C	3520C	Water	Acenaphthylene	68-119	57-116	30
8270C	3520C	Water	Acetophenone	56-137	70-130	30
8270C	3520C	Water	Aniline	10-123	12-106	30
8270C	3520C	Water	Anthracene	66-112	43-117	30
8270C	3520C	Water	Aramite, Total	70-130	70-130	30
8270C	3520C	Water	Atrazine	11-169	70-130	30
8270C	3520C	Water	Azobenzene	61-117	70-130	30
8270C	3520C	Water	Benz(a)anthracene	71-116	53-118	30
8270C	3520C	Water	Benzaldehyde	70-130	70-130	30
8270C	3520C	Water	Benzidine	10-144	70-130	30
8270C	3520C	Water	Benzo(a)pyrene	64-116	44-120	30
8270C	3520C	Water	Benzo(b)fluoranthene	64-122	43-134	30
8270C	3520C	Water	Benzo(g,h,i)perylene	62-127	45-126	30
8270C	3520C	Water	Benzo(k)fluoranthene	66-125	44-132	30

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C	3520C	Water	Benzoic Acid	10-120	26-162	30
8270C	3520C	Water	Benzyl alcohol	56-115	48-120	30
8270C	3520C	Water	Biphenyl	70-130	70-130	30
8270C	3520C	Water	Bis(2-chloroethoxy)methane	60-111	35-136	30
8270C	3520C	Water	Bis(2-chloroethyl) Ether	60-112	47-121	30
8270C	3520C	Water	Bis(2-chloroisopropyl) Ether	52-115	37-121	30
8270C	3520C	Water	Bis(2-ethylhexyl) Phthalate	71-119	48-132	30
8270C	3520C	Water	Butyl Benzyl Phthalate	71-114	59-122	30
8270C	3520C	Water	Caprolactam	70-130	70-130	30
8270C	3520C	Water	Carbazole	70-117	55-119	30
8270C	3520C	Water	Chlorobenzilate	70-130	70-130	30
8270C	3520C	Water	Chrysene	71-112	53-120	30
8270C	3520C	Water	Di-n-butyl Phthalate	67-126	59-123	30
8270C	3520C	Water	Di-n-octyl Phthalate	68-127	58-130	30
8270C	3520C	Water	Diallate	70-130	70-130	30
8270C	3520C	Water	Dibenz(a,h)anthracene	65-127	46-127	30
8270C	3520C	Water	Dibenzofuran	63-109	60-106	30
8270C	3520C	Water	Diethyl Phthalate	71-123	65-125	30
8270C	3520C	Water	Dimethoate	70-130	70-130	30
8270C	3520C	Water	Dimethyl Phthalate	72-114	69-116	30
8270C	3520C	Water	Dinoseb	70-130	70-130	30
8270C	3520C	Water	Diphenylamine	70-130	70-130	30
8270C	3520C	Water	Disulfoton	70-130	70-130	30
8270C	3520C	Water	Ethyl Methanesulfonate	70-130	70-130	30
8270C	3520C	Water	Famphur	70-130	70-130	30
8270C	3520C	Water	Fluoranthene	64-118	50-123	30
8270C	3520C	Water	Fluorene	66-112	61-112	30
8270C	3520C	Water	Hexachlorobenzene	67-116	58-113	30
8270C	3520C	Water	Hexachlorobutadiene	22-108	20-97	30
8270C	3520C	Water	Hexachlorocyclopentadiene	10-68	10-67	30
8270C	3520C	Water	Hexachloroethane	19-118	12-111	30
8270C	3520C	Water	Hexachlorophene	70-130	70-130	30
8270C	3520C	Water	Hexachloropropene	70-130	70-130	30
8270C	3520C	Water	Indeno(1,2,3-cd)pyrene	61-125	45-127	30
8270C	3520C	Water	Isodrin	70-130	70-130	30
8270C	3520C	Water	Isophorone	70-129	63-125	30
8270C	3520C	Water	Isosafrole	70-130	70-130	30
8270C	3520C	Water	Kepone	70-130	70-130	30
8270C	3520C	Water	Methapyrilene	70-130	70-130	30
8270C	3520C	Water	Methyl Methanesulfonate	70-130	70-130	30
8270C	3520C	Water	Methyl Parathion	70-130	70-130	30
8270C	3520C	Water	N-Nitrosodi-n-butylamine	70-130	70-130	30
8270C	3520C	Water	N-Nitrosodi-n-propylamine	57-126	48-133	30
8270C	3520C	Water	N-Nitrosodiethylamine	70-130	70-130	30
8270C	3520C	Water	N-Nitrosodimethylamine	54-120	32-118	30
8270C	3520C	Water	N-Nitrosodiphenylamine	71-120	12-148	30
8270C	3520C	Water	N-Nitrosomethylethylamine	70-130	70-130	30
8270C	3520C	Water	N-Nitrosomorpholine	70-130	70-130	30
8270C	3520C	Water	N-Nitrosopiperidine	70-130	70-130	30
8270C	3520C	Water	N-Nitrosopyrrolidine	70-130	70-130	30
8270C	3520C	Water	Naphthalene	54-103	51-98	30
8270C	3520C	Water	Nitrobenzene	58-116	22-163	30
8270C	3520C	Water	O,O,O-Triethyl Phosphorothioate	70-130	70-130	30
8270C	3520C	Water	o-Toluidine	70-130	70-130	30

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C	3520C	Water	p-Dimethylaminoazobenzene		70-130	70-130	30
8270C	3520C	Water	p-Phenylenediamine		70-130	70-130	30
8270C	3520C	Water	Parathion		70-130	70-130	30
8270C	3520C	Water	Pentachlorobenzene		70-130	70-130	30
8270C	3520C	Water	Pentachloroethane		70-130	70-130	30
8270C	3520C	Water	Pentachloronitrobenzene		70-130	70-130	30
8270C	3520C	Water	Pentachlorophenol		42-123	26-166	30
8270C	3520C	Water	Phenacetin		70-130	70-130	30
8270C	3520C	Water	Phenanthrene		68-109	59-111	30
8270C	3520C	Water	Phenol		56-110	35-131	30
8270C	3520C	Water	Phorate		70-130	70-130	30
8270C	3520C	Water	Pronamide		70-130	70-130	30
8270C	3520C	Water	Pyrene		66-111	52-117	30
8270C	3520C	Water	Pyridine		39-103	43-103	30
8270C	3520C	Water	Quinoline		70-130	70-130	30
8270C	3520C	Water	Safrole		70-130	70-130	30
8270C	3520C	Water	Sulfotep		70-130	70-130	30
8270C	3520C	Water	Thionazin		70-130	70-130	30
8270C	3520C	Water	2,4,6-Tribromophenol (Surr.)	44-124	NA	NA	NA
8270C	3520C	Water	2-Fluorobiphenyl (Surr.)	49-105	NA	NA	NA
8270C	3520C	Water	2-Fluorophenol (Surr.)	42-104	NA	NA	NA
8270C	3520C	Water	Nitrobenzene-d5 (Surr.)	51-113	NA	NA	NA
8270C	3520C	Water	Phenol-d6 (Surr.)	49-113	NA	NA	NA
8270C	3520C	Water	Terphenyl-d14 (Surr.)	27-136	NA	NA	NA
8270C	3510C	TCLP	1,2,4-Trichlorobenzene		44-102	NA	30
8270C	3510C	TCLP	1,2-Dichlorobenzene		45-100	NA	30
8270C	3510C	TCLP	1,3-Dichlorobenzene		44-98	NA	30
8270C	3510C	TCLP	1,4-Dichlorobenzene		43-96	NA	30
8270C	3510C	TCLP	2,4,5-Trichlorophenol		68-108	60-119	30
8270C	3510C	TCLP	2,4,6-Trichlorophenol		67-106	58-119	30
8270C	3510C	TCLP	2,4-Dichlorophenol		54-108	NA	30
8270C	3510C	TCLP	2,4-Dimethylphenol		45-110	NA	30
8270C	3510C	TCLP	2,4-Dinitrophenol		14-128	NA	30
8270C	3510C	TCLP	2,4-Dinitrotoluene		67-121	56-126	30
8270C	3510C	TCLP	2,6-Dinitrotoluene		60-122	NA	30
8270C	3510C	TCLP	2-Chloronaphthalene		50-105	NA	30
8270C	3510C	TCLP	2-Chlorophenol		55-107	NA	30
8270C	3510C	TCLP	2-Methyl-4,6-dinitrophenol		46-123	NA	30
8270C	3510C	TCLP	2-Methylnaphthalene		48-100	NA	30
8270C	3510C	TCLP	2-Methylphenol		61-101	53-106	30
8270C	3510C	TCLP	2-Nitroaniline		55-125	NA	30
8270C	3510C	TCLP	2-Nitrophenol		53-111	NA	30
8270C	3510C	TCLP	3,3'-Dichlorobenzidine		41-134	NA	30
8270C	3510C	TCLP	3-Nitroaniline		55-126	NA	30
8270C	3510C	TCLP	4-Bromophenyl Phenyl Ether		52-117	NA	30
8270C	3510C	TCLP	4-Chloro-3-methylphenol		59-113	NA	30
8270C	3510C	TCLP	4-Chloroaniline		53-111	NA	30
8270C	3510C	TCLP	4-Chlorophenyl Phenyl Ether		54-114	NA	30
8270C	3510C	TCLP	4-Methylphenol		56-103	52-107	30
8270C	3510C	TCLP	4-Nitroaniline		52-125	NA	30
8270C	3510C	TCLP	4-Nitrophenol		33-120	NA	30
8270C	3510C	TCLP	Acenaphthene		55-108	NA	30
8270C	3510C	TCLP	Acenaphthylene		59-115	NA	30
8270C	3510C	TCLP	Aniline		15-109	NA	30
8270C	3510C	TCLP	Anthracene		57-117	NA	30
8270C	3510C	TCLP	Benz(a)anthracene		60-121	NA	30

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C	3510C	TCLP	Benzo(a)pyrene	62-123	NA	30
8270C	3510C	TCLP	Benzo(b)fluoranthene	58-120	NA	30
8270C	3510C	TCLP	Benzo(g,h,i)perylene	56-120	NA	30
8270C	3510C	TCLP	Benzo(k)fluoranthene	59-121	NA	30
8270C	3510C	TCLP	Benzoic acid	10-103	NA	30
8270C	3510C	TCLP	Benzyl alcohol	52-106	NA	30
8270C	3510C	TCLP	bis(2-Chloroethoxy)methane	52-106	NA	30
8270C	3510C	TCLP	Bis(2-chloroethyl) Ether	52-108	NA	30
8270C	3510C	TCLP	Bis(2-chloroisopropyl) Ether	42-113	NA	30
8270C	3510C	TCLP	Bis(2-ethylhexyl) Phthalate	56-128	NA	30
8270C	3510C	TCLP	Butyl Benzyl Phthalate	56-124	NA	30
8270C	3510C	TCLP	Carbazole	60-117	NA	30
8270C	3510C	TCLP	Chrysene	61-117	NA	30
8270C	3510C	TCLP	Di-n-butyl Phthalate	55-126	NA	30
8270C	3510C	TCLP	Di-n-octyl Phthalate	57-130	NA	30
8270C	3510C	TCLP	Dibenz(a,h)anthracene	55-124	NA	30
8270C	3510C	TCLP	Dibenzofuran	55-111	NA	30
8270C	3510C	TCLP	Diethyl Phthalate	57-127	NA	30
8270C	3510C	TCLP	Dimethyl Phthalate	58-118	NA	30
8270C	3510C	TCLP	Fluoranthene	52-121	NA	30
8270C	3510C	TCLP	Fluorene	55-112	NA	30
8270C	3510C	TCLP	Hexachlorobenzene	62-112	61-112	30
8270C	3510C	TCLP	Hexachlorobutadiene	52-93	43-107	30
8270C	3510C	TCLP	Hexachlorocyclopentadiene	24-119	NA	30
8270C	3510C	TCLP	Hexachloroethane	54-94	43-106	30
8270C	3510C	TCLP	Indeno(1,2,3-cd)pyrene	55-124	NA	30
8270C	3510C	TCLP	Isophorone	59-123	NA	30
8270C	3510C	TCLP	N-Nitrosodi-n-propylamine	56-116	NA	30
8270C	3510C	TCLP	N-Nitrosodimethylamine	48-117	NA	30
8270C	3510C	TCLP	N-Nitrosodiphenylamine	59-127	NA	30
8270C	3510C	TCLP	Naphthalene	48-100	NA	30
8270C	3510C	TCLP	Nitrobenzene	62-102	43-131	30
8270C	3510C	TCLP	Pentachlorophenol	54-110	49-122	30
8270C	3510C	TCLP	Phenanthrene	55-112	NA	30
8270C	3510C	TCLP	Phenol	41-100	NA	30
8270C	3510C	TCLP	Pyrene	51-116	NA	30
8270C	3510C	TCLP	Pyridine	10-98	10-105	30
8270C	3510C	TCLP	2,4,6-Tribromophenol (Surr.) 56-117	NA	NA	NA
8270C	3510C	TCLP	2-Fluorobiphenyl (Surr.) 54-104	NA	NA	NA
8270C	3510C	TCLP	2-Fluorophenol (Surr.) 55-99	NA	NA	NA
8270C	3510C	TCLP	Nitrobenzene-d5 (Surr.) 66-106	NA	NA	NA
8270C	3510C	TCLP	Phenol-d6 (Surr.) 55-99	NA	NA	NA
8270C	3510C	TCLP	Terphenyl-d14 (Surr.) 60-123	NA	NA	NA
8270C-LL	3541	Soil-LL	1,2,4,5-Tetrachlorobenzene	47-95	33-119	40
8270C-LL	3541	Soil-LL	1,2,4-Trichlorobenzene	40-91	10-80	40
8270C-LL	3541	Soil-LL	1,2-Dichlorobenzene	39-91	10-75	40
8270C-LL	3541	Soil-LL	1,3-Dichlorobenzene	36-89	10-70	40
8270C-LL	3541	Soil-LL	1,4-Dichlorobenzene	37-87	10-72	40
8270C-LL	3541	Soil-LL	2,4,5-Trichlorophenol	37-103	17-133	40
8270C-LL	3541	Soil-LL	2,4,6-Trichlorophenol	37-100	14-132	40
8270C-LL	3541	Soil-LL	2,4-Dichlorophenol	36-100	19-109	40
8270C-LL	3541	Soil-LL	2,4-Dimethylphenol	10-63	10-92	40
8270C-LL	3541	Soil-LL	2,4-Dinitrophenol	14-111	10-166	40
8270C-LL	3541	Soil-LL	2,4-Dinitrotoluene	52-107	30-120	40
8270C-LL	3541	Soil-LL	2,6-Dinitrotoluene	50-98	28-116	40
8270C-LL	3541	Soil-LL	2-Chloronaphthalene	40-94	16-105	40

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C-LL	3541	Soil-LL	2-Chlorophenol	35-98	10-116	40
8270C-LL	3541	Soil-LL	2-Methyl-4,6-dinitrophenol	30-114	10-119	40
8270C-LL	3541	Soil-LL	2-Methylnaphthalene	41-87	10-109	40
8270C-LL	3541	Soil-LL	2-Methylphenol	30-91	10-105	40
8270C-LL	3541	Soil-LL	2-Nitroaniline	44-96	24-117	40
8270C-LL	3541	Soil-LL	2-Nitrophenol	37-100	18-101	40
8270C-LL	3541	Soil-LL	3,3'-Dichlorobenzidine	22-94	10-62	40
8270C-LL	3541	Soil-LL	3-Nitroaniline	43-93	10-91	40
8270C-LL	3541	Soil-LL	4-Bromophenyl Phenyl Ether	47-96	21-117	40
8270C-LL	3541	Soil-LL	4-Chloro-3-methylphenol	36-102	17-120	40
8270C-LL	3541	Soil-LL	4-Chloroaniline	26-78	10-62	40
8270C-LL	3541	Soil-LL	4-Chlorophenyl Phenyl Ether	44-97	23-111	40
8270C-LL	3541	Soil-LL	4-Methylphenol	28-94	10-114	40
8270C-LL	3541	Soil-LL	4-Nitroaniline	40-100	10-104	40
8270C-LL	3541	Soil-LL	4-Nitrophenol	35-120	22-128	40
8270C-LL	3541	Soil-LL	Acenaphthene	44-92	10-132	40
8270C-LL	3541	Soil-LL	Acenaphthylene	49-100	11-130	40
8270C-LL	3541	Soil-LL	Acetophenone	49-96	11-140	40
8270C-LL	3541	Soil-LL	Aniline	10-70	10-47	40
8270C-LL	3541	Soil-LL	Anthracene	51-97	10-135	40
8270C-LL	3541	Soil-LL	Atrazine	43-126	18-153	40
8270C-LL	3541	Soil-LL	Azobenzene	40-101	31-96	40
8270C-LL	3541	Soil-LL	Benz(a)anthracene	58-106	10-136	40
8270C-LL	3541	Soil-LL	Benzaldehyde	20-95	10-105	40
8270C-LL	3541	Soil-LL	Benzo(a)pyrene	56-107	10-152	40
8270C-LL	3541	Soil-LL	Benzo(b)fluoranthene	56-104	10-156	40
8270C-LL	3541	Soil-LL	Benzo(g,h,i)perylene	27-121	10-146	40
8270C-LL	3541	Soil-LL	Benzo(k)fluoranthene	58-106	19-131	40
8270C-LL	3541	Soil-LL	Benzoic Acid	10-88	10-124	40
8270C-LL	3541	Soil-LL	Benzyl Alcohol	35-88	21-95	40
8270C-LL	3541	Soil-LL	Biphenyl	44-98	13-133	40
8270C-LL	3541	Soil-LL	Bis(2-chloroethoxy)methane	42-89	24-95	40
8270C-LL	3541	Soil-LL	Bis(2-chloroethyl) Ether	41-89	10-122	40
8270C-LL	3541	Soil-LL	Bis(2-chloroisopropyl) Ether	35-90	10-91	40
8270C-LL	3541	Soil-LL	Bis(2-ethylhexyl) Phthalate	47-124	10-150	40
8270C-LL	3541	Soil-LL	Butyl Benzyl Phthalate	48-119	21-130	40
8270C-LL	3541	Soil-LL	Caprolactam	23-113	10-197	40
8270C-LL	3541	Soil-LL	Carbazole	53-104	25-119	40
8270C-LL	3541	Soil-LL	Chrysene	57-111	10-139	40
8270C-LL	3541	Soil-LL	Di-n-butyl Phthalate	51-111	15-133	40
8270C-LL	3541	Soil-LL	Di-n-octyl Phthalate	41-123	28-122	40
8270C-LL	3541	Soil-LL	Dibenz(a,h)anthracene	55-107	10-148	40
8270C-LL	3541	Soil-LL	Dibenzofuran	44-91	10-129	40
8270C-LL	3541	Soil-LL	Diethyl Phthalate	48-107	23-123	40
8270C-LL	3541	Soil-LL	Dimethyl Phthalate	48-99	24-118	40
8270C-LL	3541	Soil-LL	Fluoranthene	53-108	10-150	40
8270C-LL	3541	Soil-LL	Fluorene	46-97	10-172	40
8270C-LL	3541	Soil-LL	Hexachlorobenzene	46-103	31-111	40
8270C-LL	3541	Soil-LL	Hexachlorobutadiene	37-92	10-93	40
8270C-LL	3541	Soil-LL	Hexachlorocyclopentadiene	21-98	10-75	40
8270C-LL	3541	Soil-LL	Hexachloroethane	37-90	10-89	40
8270C-LL	3541	Soil-LL	Indeno(1,2,3-cd)pyrene	55-107	10-130	40
8270C-LL	3541	Soil-LL	Isophorone	47-101	29-108	40
8270C-LL	3541	Soil-LL	N-Nitrosodi-n-propylamine	40-100	18-111	40
8270C-LL	3541	Soil-LL	N-Nitrosodimethylamine	31-103	21-101	40
8270C-LL	3541	Soil-LL	N-Nitrosodiphenylamine	47-108	22-130	40

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C-LL	3541	Soil-LL	Naphthalene		41-90	10-113	40
8270C-LL	3541	Soil-LL	Nitrobenzene		40-91	20-92	40
8270C-LL	3541	Soil-LL	Pentachlorophenol		22-100	10-145	40
8270C-LL	3541	Soil-LL	Phenanthrene		50-96	10-147	40
8270C-LL	3541	Soil-LL	Phenol		35-102	14-114	40
8270C-LL	3541	Soil-LL	Pyrene		50-108	10-136	40
8270C-LL	3541	Soil-LL	Pyridine		10-68	70-130	40
8270C-LL	3541	Soil-LL	2,4,6-Tribromophenol (Surr.)	16-122	NA	NA	NA
8270C-LL	3541	Soil-LL	2-Fluorobiphenyl (Surr.)	10-107	NA	NA	NA
8270C-LL	3541	Soil-LL	2-Fluorophenol (Surr.)	12-88	NA	NA	NA
8270C-LL	3541	Soil-LL	Nitrobenzene-d5 (Surr.)	10-97	NA	NA	NA
8270C-LL	3541	Soil-LL	Phenol-d6 (Surr.)	20-101	NA	NA	NA
8270C-LL	3541	Soil-LL	Terphenyl-d14 (Surr.)	28-135	NA	NA	NA
8270C-LL	3520C	Water-LL	1,2,4,5-Tetrachlorobenzene		70-130	70-130	30
8270C-LL	3520C	Water-LL	1,2,4-Trichlorobenzene		38-94	26-96	30
8270C-LL	3520C	Water-LL	1,2-Dichlorobenzene		40-91	24-96	30
8270C-LL	3520C	Water-LL	1,3-Dichlorobenzene		34-84	19-87	30
8270C-LL	3520C	Water-LL	1,4-Dichlorobenzene		35-84	21-87	30
8270C-LL	3520C	Water-LL	2,4,5-Trichlorophenol		64-129	56-135	30
8270C-LL	3520C	Water-LL	2,4,6-Trichlorophenol		65-127	48-139	30
8270C-LL	3520C	Water-LL	2,4-Dichlorophenol		57-134	43-134	30
8270C-LL	3520C	Water-LL	2,4-Dimethylphenol		14-116	10-181	30
8270C-LL	3520C	Water-LL	2,4-Dinitrophenol		10-125	20-203	30
8270C-LL	3520C	Water-LL	2,4-Dinitrotoluene		71-130	56-149	30
8270C-LL	3520C	Water-LL	2,6-Dinitrotoluene		70-121	63-138	30
8270C-LL	3520C	Water-LL	2-Chloronaphthalene		48-106	47-111	30
8270C-LL	3520C	Water-LL	2-Chlorophenol		64-130	46-129	30
8270C-LL	3520C	Water-LL	2-Methyl-4,6-dinitrophenol		22-149	26-165	30
8270C-LL	3520C	Water-LL	2-Methylnaphthalene		47-101	42-101	30
8270C-LL	3520C	Water-LL	2-Methylphenol		54-125	27-151	30
8270C-LL	3520C	Water-LL	2-Nitroaniline		64-118	10-160	30
8270C-LL	3520C	Water-LL	2-Nitrophenol		57-139	52-141	30
8270C-LL	3520C	Water-LL	3,3'-Dichlorobenzidine		37-121	70-130	30
8270C-LL	3520C	Water-LL	3-Nitroaniline		52-129	10-146	30
8270C-LL	3520C	Water-LL	4-Bromophenyl Phenyl Ether		64-110	47-122	30
8270C-LL	3520C	Water-LL	4-Chloro-3-methylphenol		59-133	17-166	30
8270C-LL	3520C	Water-LL	4-Chloroaniline		46-102	10-110	30
8270C-LL	3520C	Water-LL	4-Chlorophenyl Phenyl Ether		60-114	48-118	30
8270C-LL	3520C	Water-LL	4-Methylphenol		52-129	24-155	30
8270C-LL	3520C	Water-LL	4-Nitroaniline		56-122	10-127	30
8270C-LL	3520C	Water-LL	4-Nitrophenol		65-135	45-185	30
8270C-LL	3520C	Water-LL	Acenaphthene		62-107	38-118	30
8270C-LL	3520C	Water-LL	Acenaphthylene		66-119	43-130	30
8270C-LL	3520C	Water-LL	Acetophenone		53-123	65-135	30
8270C-LL	3520C	Water-LL	Aniline		10-103	70-130	30
8270C-LL	3520C	Water-LL	Anthracene		65-105	11-143	30
8270C-LL	3520C	Water-LL	Atrazine		70-130	70-130	30
8270C-LL	3520C	Water-LL	Azobenzene		66-112	70-130	30
8270C-LL	3520C	Water-LL	Benz(a)anthracene		73-111	32-130	30
8270C-LL	3520C	Water-LL	Benzaldehyde		70-130	58-121	30
8270C-LL	3520C	Water-LL	Benzo(a)pyrene		67-111	25-131	30
8270C-LL	3520C	Water-LL	Benzo(b)fluoranthene		68-112	29-136	30
8270C-LL	3520C	Water-LL	Benzo(g,h,i)perylene		71-116	24-145	30
8270C-LL	3520C	Water-LL	Benzo(k)fluoranthene		70-115	31-133	30
8270C-LL	3520C	Water-LL	Benzoic Acid		10-74	10-177	30
8270C-LL	3520C	Water-LL	Benzyl Alcohol		59-109	28-145	30

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270C-LL	3520C	Water-LL	Biphenyl	70-130	70-130	30
8270C-LL	3520C	Water-LL	Bis(2-chloroethoxy)methane	62-116	57-119	30
8270C-LL	3520C	Water-LL	Bis(2-chloroethyl) Ether	65-118	54-120	30
8270C-LL	3520C	Water-LL	Bis(2-chloroisopropyl) Ether	55-118	20-154	30
8270C-LL	3520C	Water-LL	Bis(2-ethylhexyl) Phthalate	65-124	26-167	30
8270C-LL	3520C	Water-LL	Butyl Benzyl Phthalate	69-121	48-136	30
8270C-LL	3520C	Water-LL	Caprolactam	70-130	70-130	30
8270C-LL	3520C	Water-LL	Carbazole	72-115	48-131	30
8270C-LL	3520C	Water-LL	Chrysene	70-115	42-135	30
8270C-LL	3520C	Water-LL	Di-n-butyl Phthalate	76-114	52-132	30
8270C-LL	3520C	Water-LL	Di-n-octyl Phthalate	66-122	49-130	30
8270C-LL	3520C	Water-LL	Dibenz(a,h)anthracene	72-114	27-142	30
8270C-LL	3520C	Water-LL	Dibenzofuran	59-109	50-120	30
8270C-LL	3520C	Water-LL	Diethyl Phthalate	72-120	42-146	30
8270C-LL	3520C	Water-LL	Dimethyl Phthalate	72-115	52-141	30
8270C-LL	3520C	Water-LL	Fluoranthene	69-117	33-151	30
8270C-LL	3520C	Water-LL	Fluorene	64-113	46-132	30
8270C-LL	3520C	Water-LL	Hexachlorobenzene	61-118	45-122	30
8270C-LL	3520C	Water-LL	Hexachlorobutadiene	17-85	10-79	30
8270C-LL	3520C	Water-LL	Hexachlorocyclopentadiene	10-67	10-65	30
8270C-LL	3520C	Water-LL	Hexachloroethane	24-80	10-93	30
8270C-LL	3520C	Water-LL	Indeno(1,2,3-cd)pyrene	74-113	26-143	30
8270C-LL	3520C	Water-LL	Isophorone	68-131	50-146	30
8270C-LL	3520C	Water-LL	N-Nitrosodi-n-propylamine	61-124	44-149	30
8270C-LL	3520C	Water-LL	N-Nitrosodimethylamine	44-151	70-130	30
8270C-LL	3520C	Water-LL	N-Nitrosodiphenylamine	69-125	10-143	30
8270C-LL	3520C	Water-LL	Naphthalene	55-103	44-107	30
8270C-LL	3520C	Water-LL	Nitrobenzene	65-113	44-152	30
8270C-LL	3520C	Water-LL	Pentachlorophenol	23-130	38-150	30
8270C-LL	3520C	Water-LL	Phenanthrene	67-107	53-120	30
8270C-LL	3520C	Water-LL	Phenol	61-134	22-158	30
8270C-LL	3520C	Water-LL	Pyrene	67-114	24-144	30
8270C-LL	3520C	Water-LL	Pyridine	32-100	70-130	30
8270C-LL	3520C	Water-LL	2,4,6-Tribromophenol (Surr.) 43-144	NA	NA	NA
8270C-LL	3520C	Water-LL	2-Fluorobiphenyl (Surr.) 45-120	NA	NA	NA
8270C-LL	3520C	Water-LL	2-Fluorophenol (Surr.) 41-118	NA	NA	NA
8270C-LL	3520C	Water-LL	Nitrobenzene-d5 (Surr.) 46-130	NA	NA	NA
8270C-LL	3520C	Water-LL	Phenol-d6 (Surr.) 47-132	NA	NA	NA
8270C-LL	3520C	Water-LL	Terphenyl-d14 (Surr.) 43-150	NA	NA	NA
8270-SIM	3541	Soil	1,2,4-Trichlorobenzene	70-130	70-130	40
8270-SIM	3541	Soil	1,2-Dichlorobenzene	70-130	70-130	40
8270-SIM	3541	Soil	1,3-Dichlorobenzene	70-130	70-130	40
8270-SIM	3541	Soil	1,4-Dichlorobenzene	70-130	70-130	40
8270-SIM	3541	Soil	1-Methylnaphthalene	46-119	23-121	40
8270-SIM	3541	Soil	1-Methylphenanthrene	59-118	52-114	40
8270-SIM	3541	Soil	2,3,4,5-Tetrachlorophenol	44-134	48-141	40
8270-SIM	3541	Soil	2,3,4,6-Tetrachlorophenol	46-121	70-130	40
8270-SIM	3541	Soil	2,3,4-Trichlorophenol	49-131	35-155	40
8270-SIM	3541	Soil	2,3,5,6-Tetrachlorophenol	40-135	27-168	40
8270-SIM	3541	Soil	2,3,5-Trichlorophenol	45-134	26-166	40
8270-SIM	3541	Soil	2,3,5-Trimethylnaphthalene	53-116	47-105	40
8270-SIM	3541	Soil	2,3,6-Trichlorophenol	46-134	25-165	40
8270-SIM	3541	Soil	2,4,5-Trichlorophenol	39-131	59-118	40
8270-SIM	3541	Soil	2,4,6-Trichlorophenol	39-132	53-121	40
8270-SIM	3541	Soil	2,4-Dichlorophenol	70-130	70-130	40
8270-SIM	3541	Soil	2,4-Dimethylphenol	70-130	70-130	40

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270-SIM	3541	Soil	2,4-Dinitrophenol	70-130	70-130	40
8270-SIM	3541	Soil	2,4-Dinitrotoluene	70-130	70-130	40
8270-SIM	3541	Soil	2,6-Dimethylnaphthalene	36-136	36-107	40
8270-SIM	3541	Soil	2,6-Dinitrotoluene	70-130	70-130	40
8270-SIM	3541	Soil	2-Chloronaphthalene	70-130	70-130	40
8270-SIM	3541	Soil	2-Chlorophenol	70-130	70-130	40
8270-SIM	3541	Soil	2-Methyl-4,6-dinitrophenol	70-130	70-130	40
8270-SIM	3541	Soil	2-Methylnaphthalene	42-121	13-126	40
8270-SIM	3541	Soil	2-Methylphenol	70-130	70-130	40
8270-SIM	3541	Soil	2-Nitroaniline	70-130	70-130	40
8270-SIM	3541	Soil	2-Nitrophenol	70-130	70-130	40
8270-SIM	3541	Soil	3,3'-Dichlorobenzidine	70-130	70-130	40
8270-SIM	3541	Soil	3,4,5-Trichlorophenol	10-155	10-182	40
8270-SIM	3541	Soil	3-Nitroaniline	70-130	70-130	40
8270-SIM	3541	Soil	4-Bromophenyl Phenyl Ether	70-130	70-130	40
8270-SIM	3541	Soil	4-Chloro-3-methylphenol	70-130	70-130	40
8270-SIM	3541	Soil	4-Chloroaniline	70-130	70-130	40
8270-SIM	3541	Soil	4-Chlorophenyl Phenyl Ether	70-130	70-130	40
8270-SIM	3541	Soil	4-Methylphenol	70-130	70-130	40
8270-SIM	3541	Soil	4-Nitroaniline	70-130	70-130	40
8270-SIM	3541	Soil	4-Nitrophenol	70-130	70-130	40
8270-SIM	3541	Soil	Acenaphthene	50-110	18-125	40
8270-SIM	3541	Soil	Acenaphthylene	50-111	21-121	40
8270-SIM	3541	Soil	Aniline	70-130	70-130	40
8270-SIM	3541	Soil	Anthracene	52-115	19-133	40
8270-SIM	3541	Soil	Benz(a)anthracene	51-118	12-139	40
8270-SIM	3541	Soil	Benzo(a)pyrene	56-122	10-148	40
8270-SIM	3541	Soil	Benzo(b)fluoranthene	55-125	12-144	40
8270-SIM	3541	Soil	Benzo(e)pyrene	61-117	22-131	40
8270-SIM	3541	Soil	Benzo(g,h,i)perylene	49-125	10-148	40
8270-SIM	3541	Soil	Benzo(k)fluoranthene	55-124	11-145	40
8270-SIM	3541	Soil	Biphenyl	40-130	18-131	40
8270-SIM	3541	Soil	Bis(2-chloroethoxy)methane	70-130	70-130	40
8270-SIM	3541	Soil	Bis(2-chloroethyl) Ether	70-130	70-130	40
8270-SIM	3541	Soil	Bis(2-chloroisopropyl) Ether	70-130	70-130	40
8270-SIM	3541	Soil	Bis(2-ethylhexyl) Phthalate	70-130	70-130	40
8270-SIM	3541	Soil	Butyl Benzyl Phthalate	70-130	70-130	40
8270-SIM	3541	Soil	Carbazole	10-138	14-177	40
8270-SIM	3541	Soil	Chrysene	54-120	12-145	40
8270-SIM	3541	Soil	Di-n-butyl Phthalate	70-130	70-130	40
8270-SIM	3541	Soil	Di-n-octyl Phthalate	70-130	70-130	40
8270-SIM	3541	Soil	Dibenz(a,h)anthracene	37-135	12-143	40
8270-SIM	3541	Soil	Dibenzofuran	50-115	21-126	40
8270-SIM	3541	Soil	Dibenzothiophene	34-113	10-127	40
8270-SIM	3541	Soil	Diethyl Phthalate	70-130	70-130	40
8270-SIM	3541	Soil	Dimethyl Phthalate	70-130	70-130	40
8270-SIM	3541	Soil	Fluoranthene	55-121	10-149	40
8270-SIM	3541	Soil	Fluorene	52-112	22-125	40
8270-SIM	3541	Soil	Hexachlorobenzene	70-130	70-130	40
8270-SIM	3541	Soil	Hexachlorobutadiene	70-130	70-130	40
8270-SIM	3541	Soil	Hexachlorocyclopentadiene	70-130	70-130	40
8270-SIM	3541	Soil	Hexachloroethane	70-130	70-130	40
8270-SIM	3541	Soil	Indeno(1,2,3-cd)pyrene	42-133	10-151	40
8270-SIM	3541	Soil	Isophorone	70-130	70-130	40
8270-SIM	3541	Soil	N-Nitrosodi-n-propylamine	70-130	70-130	40
8270-SIM	3541	Soil	N-Nitrosodimethylamine	70-130	70-130	40

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270-SIM	3541	Soil	N-Nitrosodiphenylamine		70-130	70-130	40
8270-SIM	3541	Soil	Naphthalene		48-107	10-121	40
8270-SIM	3541	Soil	Nitrobenzene		70-130	70-130	40
8270-SIM	3541	Soil	Pentachlorophenol		10-126	10-144	40
8270-SIM	3541	Soil	Perylene		62-118	25-129	40
8270-SIM	3541	Soil	Phenanthrene		53-112	10-143	40
8270-SIM	3541	Soil	Phenol		70-130	70-130	40
8270-SIM	3541	Soil	Pyrene		47-129	10-150	40
8270-SIM	3541	Soil	2,4,6-Tribromophenol (Surr.)	10-181	NA	NA	NA
8270-SIM	3541	Soil	2-Fluorobiphenyl (Surr.)	23-127	NA	NA	NA
8270-SIM	3541	Soil	2-Fluorophenol (Surr.)	10-94	NA	NA	NA
8270-SIM	3541	Soil	Fluoranthene-d10 (Surr.)	10-136	NA	NA	NA
8270-SIM	3541	Soil	Fluorene-d10 (Surr.)	10-123	NA	NA	NA
8270-SIM	3541	Soil	Nitrobenzene-d5 (Surr.)	10-130	NA	NA	NA
8270-SIM	3541	Soil	Phenol-d6 (Surr.)	21-130	NA	NA	NA
8270-SIM	3541	Soil	Terphenyl-d14 (Surr.)	32-123	NA	NA	NA
8270-SIM	3510C/20C/35	Water	1,4-Dioxane		45-103	40-104	30
8270-SIM	3510C/20C/35	Water	1-Methylnaphthalene		28-135	27-154	30
8270-SIM	3510C/20C/35	Water	1-Methylphenanthrene		24-161	19-172	30
8270-SIM	3510C/20C/35	Water	2,3,4,5-Tetrachlorophenol		39-152	70-130	30
8270-SIM	3510C/20C/35	Water	2,3,4,6-Tetrachlorophenol		10-251	70-130	30
8270-SIM	3510C/20C/35	Water	2,3,4-Trichlorophenol		66-120	70-130	30
8270-SIM	3510C/20C/35	Water	2,3,5,6-Tetrachlorophenol		31-128	70-130	30
8270-SIM	3510C/20C/35	Water	2,3,5-Trichlorophenol		65-119	70-130	30
8270-SIM	3510C/20C/35	Water	2,3,5-Trimethylnaphthalene		23-155	34-149	30
8270-SIM	3510C/20C/35	Water	2,3,6-Trichlorophenol		63-122	70-130	30
8270-SIM	3510C/20C/35	Water	2,4,5-Trichlorophenol		53-135	70-130	30
8270-SIM	3510C/20C/35	Water	2,4,6-Trichlorophenol		54-132	70-130	30
8270-SIM	3510C/20C/35	Water	2,4-Dichlorophenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	2,4-Dimethylphenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	2,4-Dinitrophenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	2,6-Dimethylnaphthalene		10-154	22-165	30
8270-SIM	3510C/20C/35	Water	2-Chlorophenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	2-Methyl-4,6-dinitrophenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	2-Methylnaphthalene		23-141	28-134	30
8270-SIM	3510C/20C/35	Water	2-Methylphenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	2-Nitrophenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	3,4,5-Trichlorophenol		66-125	70-130	30
8270-SIM	3510C/20C/35	Water	3-Methylcholanthrene		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	4-Chloro-3-methylphenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	4-Methylphenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	4-Nitrophenol		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	7,12-Dimethylbenz(a)anthracene		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	Acenaphthene		41-135	33-135	30
8270-SIM	3510C/20C/35	Water	Acenaphthylene		40-138	28-143	30
8270-SIM	3510C/20C/35	Water	Anthracene		36-139	24-139	30
8270-SIM	3510C/20C/35	Water	Benz(a)anthracene		46-136	24-142	30
8270-SIM	3510C/20C/35	Water	Benzo(a)pyrene		43-138	10-153	30
8270-SIM	3510C/20C/35	Water	Benzo(b)fluoranthene		53-139	15-156	30
8270-SIM	3510C/20C/35	Water	Benzo(e)pyrene		28-160	16-152	30
8270-SIM	3510C/20C/35	Water	Benzo(g,h,i)perylene		42-146	19-150	30
8270-SIM	3510C/20C/35	Water	Benzo(k)fluoranthene		53-140	14-153	30
8270-SIM	3510C/20C/35	Water	Benzoic Acid		70-130	70-130	30
8270-SIM	3510C/20C/35	Water	Biphenyl		10-178	10-180	30
8270-SIM	3510C/20C/35	Water	Bis(2-ethylhexyl) Phthalate		10-255	70-130	30
8270-SIM	3510C/20C/35	Water	Carbazole		10-213	44-153	30

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270-SIM	3510C/20C/35	Water	Chrysene		51-134	23-144	30
8270-SIM	3510C/20C/35	Water	Dibenz(a,h)anthracene		37-148	12-162	30
8270-SIM	3510C/20C/35	Water	Dibenzofuran		10-183	30-150	30
8270-SIM	3510C/20C/35	Water	Dibenzothiophene		10-206	70-130	30
8270-SIM	3510C/20C/35	Water	Diphenyl Ether		58-130	70-130	30
8270-SIM	3510C/20C/35	Water	Fluoranthene		43-148	16-161	30
8270-SIM	3510C/20C/35	Water	Fluorene		43-139	31-151	30
8270-SIM	3510C/20C/35	Water	Indeno(1,2,3-cd)pyrene		40-146	10-167	30
8270-SIM	3510C/20C/35	Water	N-Nitrosodimethylamine		30-182	70-130	30
8270-SIM	3510C/20C/35	Water	Naphthalene		35-133	26-132	30
8270-SIM	3510C/20C/35	Water	Pentachlorophenol		10-151	10-203	30
8270-SIM	3510C/20C/35	Water	Perylene		17-161	70-130	30
8270-SIM	3510C/20C/35	Water	Phenanthrene		45-138	38-137	30
8270-SIM	3510C/20C/35	Water	Phenol		19-171	70-130	30
8270-SIM	3510C/20C/35	Water	Pyrene		37-154	18-155	30
8270-SIM	3510C/20C/35	Water	Quinoline		53-124	69-133	30
8270-SIM	3510C/20C/35	Water	1,4-Dioxine-d8 (Surr.)	40-124	NA	NA	NA
8270-SIM	3510C/20C/35	Water	2,4,6-Tribromophenol (Surr.)	10-189	NA	NA	NA
8270-SIM	3510C/20C/35	Water	2-Fluorobiphenyl (Surr.)	32-151	NA	NA	NA
8270-SIM	3510C/20C/35	Water	2-Fluorophenol (Surr.)	10-138	NA	NA	NA
8270-SIM	3510C/20C/35	Water	Fluoranthene-d10 (Surr.)	28-150	NA	NA	NA
8270-SIM	3510C/20C/35	Water	Fluorene-d10 (Surr.)	26-131	NA	NA	NA
8270-SIM	3510C/20C/35	Water	Nitrobenzene-d5 (Surr.)	36-174	NA	NA	NA
8270-SIM	3510C/20C/35	Water	Phenol-d6 (Surr.)	28-183	NA	NA	NA
8270-SIM	3510C/20C/35	Water	Terphenyl-d14 (Surr.)	32-157	NA	NA	NA
8270-SIM	3541	Tissue	1,2,4-Trichlorobenzene		41-114	59-109	40
8270-SIM	3541	Tissue	1,2-Dichlorobenzene		41-117	51-106	40
8270-SIM	3541	Tissue	1,3-Dichlorobenzene		41-112	43-104	40
8270-SIM	3541	Tissue	1,4-Dichlorobenzene		41-109	45-101	40
8270-SIM	3541	Tissue	1-Methylnaphthalene		10-174	46-104	40
8270-SIM	3541	Tissue	1-Methylphenanthrene		12-187	70-130	40
8270-SIM	3541	Tissue	2,3,5-Trimethylnaphthalene		10-184	70-130	40
8270-SIM	3541	Tissue	2,4,5-Trichlorophenol		25-159	81-132	40
8270-SIM	3541	Tissue	2,4,6-Trichlorophenol		30-154	72-137	40
8270-SIM	3541	Tissue	2,4-Dichlorophenol		50-124	73-140	40
8270-SIM	3541	Tissue	2,4-Dimethylphenol		10-107	56-145	40
8270-SIM	3541	Tissue	2,4-Dinitrophenol		40-166	10-197	40
8270-SIM	3541	Tissue	2,4-Dinitrotoluene		54-136	73-137	40
8270-SIM	3541	Tissue	2,6-Dimethylnaphthalene		10-186	70-130	40
8270-SIM	3541	Tissue	2,6-Dinitrotoluene		48-138	71-138	40
8270-SIM	3541	Tissue	2-Chloronaphthalene		39-133	37-137	40
8270-SIM	3541	Tissue	2-Chlorophenol		47-118	71-115	40
8270-SIM	3541	Tissue	2-Methyl-4,6-dinitrophenol		42-156	49-148	40
8270-SIM	3541	Tissue	2-Methylnaphthalene		12-159	39-116	40
8270-SIM	3541	Tissue	2-Methylphenol		45-113	66-123	40
8270-SIM	3541	Tissue	2-Nitroaniline		47-122	62-131	40
8270-SIM	3541	Tissue	2-Nitrophenol		46-125	52-163	40
8270-SIM	3541	Tissue	3,3'-Dichlorobenzidine		35-135	70-130	40
8270-SIM	3541	Tissue	3-Nitroaniline		50-121	10-122	40
8270-SIM	3541	Tissue	4-Bromophenyl Phenyl Ether		57-123	66-119	40
8270-SIM	3541	Tissue	4-Chloro-3-methylphenol		54-124	68-161	40
8270-SIM	3541	Tissue	4-Chloroaniline		39-95	10-104	40
8270-SIM	3541	Tissue	4-Chlorophenyl Phenyl Ether		58-115	63-123	40
8270-SIM	3541	Tissue	4-Methylphenol		45-115	60-134	40
8270-SIM	3541	Tissue	4-Nitroaniline		51-134	10-122	40
8270-SIM	3541	Tissue	4-Nitrophenol		48-139	49-161	40

SEMIVOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270-SIM	3541	Tissue	Acenaphthene	44-120	52-112	40
8270-SIM	3541	Tissue	Acenaphthylene	44-124	44-126	40
8270-SIM	3541	Tissue	Acetophenone	10-137	70-130	40
8270-SIM	3541	Tissue	Aniline	10-78	70-130	40
8270-SIM	3541	Tissue	Anthracene	47-128	51-121	40
8270-SIM	3541	Tissue	Atrazine	48-143	70-130	40
8270-SIM	3541	Tissue	Azobenzene	13-143	70-130	40
8270-SIM	3541	Tissue	Benz(a)anthracene	51-135	49-127	40
8270-SIM	3541	Tissue	Benzaldehyde	10-113	70-130	40
8270-SIM	3541	Tissue	Benzo(a)pyrene	49-144	50-126	40
8270-SIM	3541	Tissue	Benzo(b)fluoranthene	54-138	46-124	40
8270-SIM	3541	Tissue	Benzo(e)pyrene	23-184	70-130	40
8270-SIM	3541	Tissue	Benzo(g,h,i)perylene	45-138	46-124	40
8270-SIM	3541	Tissue	Benzo(k)fluoranthene	55-141	51-126	40
8270-SIM	3541	Tissue	Benzoic Acid	10-214	10-214	40
8270-SIM	3541	Tissue	Benzyl Alcohol	30-122	46-133	40
8270-SIM	3541	Tissue	Biphenyl	12-172	70-130	40
8270-SIM	3541	Tissue	Bis(2-chloroethoxy)methane	46-116	56-124	40
8270-SIM	3541	Tissue	Bis(2-chloroethyl) Ether	52-109	56-112	40
8270-SIM	3541	Tissue	Bis(2-chloroisopropyl) Ether	46-112	42-118	40
8270-SIM	3541	Tissue	Bis(2-ethylhexyl) Phthalate	39-174	53-172	40
8270-SIM	3541	Tissue	Butyl Benzyl Phthalate	56-145	39-171	40
8270-SIM	3541	Tissue	Caprolactam	31-156	70-130	40
8270-SIM	3541	Tissue	Carbazole	10-171	61-127	40
8270-SIM	3541	Tissue	Chrysene	59-132	59-123	40
8270-SIM	3541	Tissue	Di-n-butyl Phthalate	60-146	47-161	40
8270-SIM	3541	Tissue	Di-n-octyl Phthalate	49-156	35-184	40
8270-SIM	3541	Tissue	Dibenz(a,h)anthracene	36-155	42-144	40
8270-SIM	3541	Tissue	Dibenzofuran	11-168	57-115	40
8270-SIM	3541	Tissue	Dibenzothiophene	10-168	70-130	40
8270-SIM	3541	Tissue	Diethyl Phthalate	61-133	60-139	40
8270-SIM	3541	Tissue	Dimethyl Phthalate	60-120	68-124	40
8270-SIM	3541	Tissue	Fluoranthene	47-139	49-130	40
8270-SIM	3541	Tissue	Fluorene	49-120	53-120	40
8270-SIM	3541	Tissue	Hexachlorobenzene	59-124	62-121	40
8270-SIM	3541	Tissue	Hexachlorobutadiene	51-105	43-114	40
8270-SIM	3541	Tissue	Hexachlorocyclopentadiene	19-123	10-105	40
8270-SIM	3541	Tissue	Hexachloroethane	51-110	29-116	40
8270-SIM	3541	Tissue	Indeno(1,2,3-cd)pyrene	37-148	30-148	40
8270-SIM	3541	Tissue	Isophorone	54-127	61-147	40
8270-SIM	3541	Tissue	N-Nitrosodi-n-propylamine	42-132	48-139	40
8270-SIM	3541	Tissue	N-Nitrosodimethylamine	24-115	55-111	40
8270-SIM	3541	Tissue	N-Nitrosodiphenylamine	58-132	71-132	40
8270-SIM	3541	Tissue	Naphthalene	42-116	30-112	40
8270-SIM	3541	Tissue	Nitrobenzene	48-117	54-119	40
8270-SIM	3541	Tissue	Pentachlorophenol	27-160	10-181	40
8270-SIM	3541	Tissue	Perylene	19-189	70-130	40
8270-SIM	3541	Tissue	Phenanthrene	49-121	58-108	40
8270-SIM	3541	Tissue	Phenol	52-118	55-130	40
8270-SIM	3541	Tissue	Pyrene	52-129	58-110	40
8270-SIM	3541	Tissue	Pyridine	12-90	70-130	40
8270-SIM	3541	Tissue	2,4,6-Tribromophenol (Surr.) 47-152	NA	NA	NA
8270-SIM	3541	Tissue	2-Fluorobiphenyl (Surr.) 43-133	NA	NA	NA
8270-SIM	3541	Tissue	2-Fluorophenol (Surr.) 41-112	NA	NA	NA

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8270-SIM	3541	Tissue	Fluoranthene-d10 (Surr.)	48-108	NA	NA	NA
8270-SIM	3541	Tissue	Fluorene-d10 (Surr.)	40-97	NA	NA	NA
8270-SIM	3541	Tissue	Nitrobenzene-d5 (Surr.)	35-128	NA	NA	NA
8270-SIM	3541	Tissue	Phenol-d6 (Surr.)	43-133	NA	NA	NA
8270-SIM	3541	Tissue	Terphenyl-d14 (Surr.)	49-137	NA	NA	NA
8310	3550B	Soil	2-Methylnaphthalene		10-170	70-130	40
8310	3550B	Soil	Acenaphthene		47-96	30-101	40
8310	3550B	Soil	Acenaphthylene		54-97	10-148	40
8310	3550B	Soil	Anthracene		50-93	29-119	40
8310	3550B	Soil	Benz(a)anthracene		70-103	14-146	40
8310	3550B	Soil	Benzo(a)pyrene		45-103	10-156	40
8310	3550B	Soil	Benzo(b)fluoranthene		75-105	10-157	40
8310	3550B	Soil	Benzo(g,h,i)perylene		71-109	10-173	40
8310	3550B	Soil	Benzo(k)fluoranthene		79-102	10-163	40
8310	3550B	Soil	Chrysene		75-103	10-193	40
8310	3550B	Soil	Dibenz(a,h)anthracene		61-123	10-178	40
8310	3550B	Soil	Fluoranthene		54-118	10-173	40
8310	3550B	Soil	Fluorene		48-96	20-124	40
8310	3550B	Soil	Indeno(1,2,3-cd)pyrene		73-106	10-173	40
8310	3550B	Soil	Naphthalene		42-98	10-127	40
8310	3550B	Soil	Phenanthrene		41-118	31-130	40
8310	3550B	Soil	Pyrene		43-129	10-153	40
8310	3550B	Soil	*p* -Terphenyl (Surr.)	42-139	NA	NA	NA
8310	3510C	Water	2-Methylnaphthalene/Dibenzofuran		65-100	70-130	30
8310	3510C	Water	Acenaphthene		70-100	54-105	30
8310	3510C	Water	Acenaphthylene		70-96	41-112	30
8310	3510C	Water	Anthracene		74-107	61-113	30
8310	3510C	Water	Benz(a)anthracene		77-109	62-119	30
8310	3510C	Water	Benzo(a)pyrene		73-106	61-116	30
8310	3510C	Water	Benzo(b)fluoranthene		77-109	48-135	30
8310	3510C	Water	Benzo(g,h,i)perylene		55-130	59-121	30
8310	3510C	Water	Benzo(k)fluoranthene		78-110	66-113	30
8310	3510C	Water	Chrysene		74-108	55-122	30
8310	3510C	Water	Dibenz(a,h)anthracene		52-129	54-130	30
8310	3510C	Water	Fluoranthene		74-104	47-135	30
8310	3510C	Water	Fluorene		70-100	36-132	30
8310	3510C	Water	Indeno(1,2,3-cd)pyrene		43-137	54-116	30
8310	3510C	Water	Naphthalene		65-101	53-109	30
8310	3510C	Water	Phenanthrene		74-106	58-116	30
8310	3510C	Water	Pyrene		69-117	34-150	30
8310	3510C	Water	p-Terphenyl (Surr.)	42-137	NA	NA	NA
8315	Method	Soil	Acetaldehyde		46-125	34-148	40
8315	Method	Soil	Formaldehyde		39-153	39-153	40
8315	Method	Water	Acetaldehyde		10-168	17-165	30
8315	Method	Water	Formaldehyde		39-153	39-153	30
8330	Method	Soil	1,3,5-Trinitrobenzene		75-116	64-122	11
8330	Method	Soil	1,3-Dinitrobenzene		73-119	65-124	11
8330	Method	Soil	2,4,6-Trinitrotoluene		74-118	67-122	12
8330	Method	Soil	2,4-Dinitrotoluene		72-121	62-129	12
8330	Method	Soil	2,6-Dinitrotoluene		69-115	64-121	13
8330	Method	Soil	2-Amino-4,6-dinitrotoluene		50-147	55-138	12
8330	Method	Soil	2-Nitrotoluene		73-116	63-123	11
8330	Method	Soil	3-Nitrotoluene		71-118	61-125	17
8330	Method	Soil	4-Amino-2,6-dinitrotoluene		53-142	60-129	12
8330	Method	Soil	4-Nitrotoluene		77-110	67-119	11
8330	Method	Soil	HMX		74-119	62-125	14

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8330	Method	Soil	Nitrobenzene		70-119	62-124	12
8330	Method	Soil	RDX		69-121	57-127	13
8330	Method	Soil	Tetryl		37-150	14-156	29
8330	Method	Soil	1-Chloro-3-nitrobenzene (Surr.)	61-124	NA	NA	NA
8330	Method	Water	1,3,5-Trinitrobenzene		71-108	56-125	14
8330	Method	Water	1,3-Dinitrobenzene		72-110	51-140	11
8330	Method	Water	2,4,6-Trinitrotoluene		73-111	57-134	12
8330	Method	Water	2,4-Dinitrotoluene		72-113	53-143	13
8330	Method	Water	2,6-Dinitrotoluene		69-111	43-145	14
8330	Method	Water	2-Amino-4,6-dinitrotoluene		68-114	49-142	14
8330	Method	Water	2-Nitrotoluene		49-112	40-144	52
8330	Method	Water	3-Nitrotoluene		52-114	43-142	45
8330	Method	Water	4-Amino-2,6-dinitrotoluene		72-111	48-142	12
8330	Method	Water	4-Nitrotoluene		57-113	43-144	37
8330	Method	Water	HMX		66-109	47-128	13
8330	Method	Water	Nitrobenzene		53-115	42-145	44
8330	Method	Water	RDX		60-117	42-143	11
8330	Method	Water	Tetryl		55-134	49-138	14
8330	Method	Water	1-Chloro-3-nitrobenzene (Surr.)	55-112	NA	NA	NA
8330	Method	Tissue	1,3,5-Trinitrobenzene		70-130	70-130	40
8330	Method	Tissue	1,3-Dinitrobenzene		70-130	70-130	40
8330	Method	Tissue	2,4,6-Trinitrotoluene		70-130	70-130	40
8330	Method	Tissue	2,4-Dinitrotoluene		70-130	70-130	40
8330	Method	Tissue	2,6-Dinitrotoluene		70-130	70-130	40
8330	Method	Tissue	2-Amino-4,6-dinitrotoluene		70-130	70-130	40
8330	Method	Tissue	2-Nitrotoluene		70-130	70-130	40
8330	Method	Tissue	3-Nitrotoluene		70-130	70-130	40
8330	Method	Tissue	4-Amino-2,6-dinitrotoluene		70-130	70-130	40
8330	Method	Tissue	4-Nitrotoluene		70-130	70-130	40
8330	Method	Tissue	HMX		70-130	70-130	40
8330	Method	Tissue	Nitrobenzene		70-130	70-130	40
8330	Method	Tissue	RDX		70-130	70-130	40
8330	Method	Tissue	Tetryl		70-130	70-130	40
8330	Method	Tissue	1-Chloro-3-nitrobenzene (Surr.)	83-112	NA	NA	NA
8330M	Method	Soil	Picric Acid		70-130	70-130	40
8330M	Method	Soil	2,6-Dinitro-4-methylphenol (Surr.)	51-126	NA	NA	NA
8330M	Method	Water	Picric Acid		70-130	70-130	30
8330M	Method	Water	2,6-Dinitro-4-methylphenol (Surr.)	64-125	NA	NA	NA
8332	Method	Soil	Nitroglycerine		78-112	49-134	40
8332	Method	Soil	PETN		81-111	78-113	40
8332	Method	Soil	1-Chloro-3-nitrobenzene (Surr.)	79-105	NA	NA	NA
8332	Method	Water	Nitroglycerine		32-131	70-130	30
8332	Method	Water	PETN		44-127	70-130	30
8332	Method	Water	2,3-Dimethyl-2,3-dinitrobutane (Surr.)	48-109	NA	NA	NA
Organotin	Method	Soil	Dibutyltin		27-163	10-150	40
Organotin	Method	Soil	Monobutyltin		10-101	10-78	40
Organotin	Method	Soil	Tetrabutyltin		17-135	11-151	40
Organotin	Method	Soil	Tributyltin		26-131	10-146	40
Organotin	Method	Soil	Tripropyltin (Surr.)	20-121	NA	NA	NA
Organotin	Method	Water	Dibutyltin		39-127	34-127	30
Organotin	Method	Water	Monobutyltin		41-163	26-151	30
Organotin	Method	Water	Tetrabutyltin		32-112	10-99	30
Organotin	Method	Water	Tributyltin		51-119	50-120	30
Organotin	Method	Water	Tripropyltin (Surr.)	47-136	NA	NA	NA
Organotin	Method	Tissue	Dibutyltin		10-94	10-121	40
Organotin	Method	Tissue	Monobutyltin		10-115	10-113	40

SEMIVOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
Organotin	Method	Tissue	Tetrabutyltin		10-110	10-125	40
Organotin	Method	Tissue	Tributyltin		10-97	10-113	40
Organotin	Method	Tissue	Tripropyltin (Surr.)	10-114	NA	NA	NA
8015M	3550B	Soil	Diesel Range Petroleum Hydrocarbons		76-131	64-141	40
8015M	3550B	Soil	Residual Range Petroleum Hydrocarbons		66-136	49-144	40
8015M	3550B	Soil	Bromofluorobenzene (Surr.)	10-154	NA	NA	NA
8015M	3550B	Soil	o-Terphenyl (Surr.)	56-135	NA	NA	NA
8015M	3510C	Water	Diesel Range Petroleum Hydrocarbons		67-151	47-166	30
8015M	3510C	Water	Residual Range Petroleum Hydrocarbons		60-145	54-153	30
8015M	3510C	Water	Bromofluorobenzene (Surr.)	35-145	NA	NA	NA
8015M	3510C	Water	o-Terphenyl (Surr.)	39-152	NA	NA	NA
AK 102	Method	Soil	Diesel Range Petroleum Hydrocarbons		75-125	60-140	20
AK 102	Method	Soil	o-Terphenyl (Surr.)	50-150	60-120	NA	NA
AK 102	Method	Water	Diesel Range Petroleum Hydrocarbons		75-125	75-125	20
AK 102	Method	Water	o-Terphenyl (Surr.)	50-150	60-120	NA	NA
AK 103	Method	Soil	Residual Range Petroleum Hydrocarbons		60-120	60-140	20
AK 103	Method	Soil	n-Triacontane (Surr.)	50-150	60-120	NA	NA
NWTPH-Dx	Method	Soil	Diesel Range Petroleum Hydrocarbons		62-158	50-168	40
NWTPH-Dx	Method	Soil	o-Terphenyl (Surr.)	50-150	NA	NA	NA
NWTPH-Dx	Method	Water	Diesel Range Petroleum Hydrocarbons		53-161	40-164	30
NWTPH-Dx	Method	Water	o-Terphenyl (Surr.)	50-150	NA	NA	NA
NCASI 94.03	Method	Water	Methanol		70-132	49-141	30
NCASI 99.01	Method	Water	Acetaldehyde		59-127	53-125	30
NCASI 99.01	Method	Water	Methanol		74-124	48-136	30
NCASI 99.01	Method	Water	Methyl Ethyl Ketone		52-137	37-146	30
NCASI 99.01	Method	Water	Propionitrile		46-138	43-126	30
NCASI 99.02	Method	Water	Acrolein		80-120	80-120	30
NCASI 99.02	Method	Water	Acetaldehyde		80-120	80-120	30
NCASI 99.02	Method	Water	Methanol		80-120	80-120	30
NCASI 99.02	Method	Water	Methyl Ethyl Ketone		80-120	80-120	30
NCASI 99.02	Method	Water	Propionitrile		80-120	80-120	30

VOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
524.2	Method	Water	Dichlorodifluoromethane (CFC 12)	70-130	NA	
524.2	Method	Water	Chloromethane	70-130	NA	
524.2	Method	Water	Vinyl Chloride	70-130	NA	
524.2	Method	Water	Bromomethane	70-130	NA	
524.2	Method	Water	Chloroethane	70-130	NA	
524.2	Method	Water	Trichlorofluoromethane (CFC 11)	70-130	NA	NA
524.2	Method	Water	1,1-Dichloroethene	70-130	NA	NA
524.2	Method	Water	Methylene Chloride	70-130	NA	NA
524.2	Method	Water	trans-1,2-Dichloroethene	70-130	NA	NA
524.2	Method	Water	2,2-Dichloropropane	70-130	NA	NA
524.2	Method	Water	cis-1,2-Dichloroethene	70-130	NA	NA
524.2	Method	Water	1,1-Dichloroethane	70-130	NA	NA
524.2	Method	Water	Chloroform	70-130	NA	NA
524.2	Method	Water	Bromochloromethane	70-130	NA	NA
524.2	Method	Water	1,1,1-Trichloroethane (TCA)	70-130	NA	NA
524.2	Method	Water	1,1-Dichloropropene	70-130	NA	NA
524.2	Method	Water	Carbon Tetrachloride	70-130	NA	NA
524.2	Method	Water	Benzene	70-130	NA	NA
524.2	Method	Water	1,2-Dichloroethane	70-130	NA	NA
524.2	Method	Water	Trichloroethene (TCE)	70-130	NA	NA
524.2	Method	Water	1,2-Dichloropropane	70-130	NA	NA
524.2	Method	Water	Bromodichloromethane	70-130	NA	NA
524.2	Method	Water	Dibromomethane	70-130	NA	NA
524.2	Method	Water	cis-1,3-Dichloropropene	70-130	NA	NA
524.2	Method	Water	Toluene	70-130	NA	NA
524.2	Method	Water	trans-1,3-Dichloropropene	70-130	NA	NA
524.2	Method	Water	1,1,2-Trichloroethane	70-130	NA	NA
524.2	Method	Water	Tetrachloroethene (PCE)	70-130	NA	NA
524.2	Method	Water	1,3-Dichloropropane	70-130	NA	NA
524.2	Method	Water	1,2,3-Trichlorobenzene	70-130	NA	NA
524.2	Method	Water	Dibromochloromethane	70-130	NA	NA
524.2	Method	Water	1,2-Dibromoethane (EDB)	70-130	NA	NA
524.2	Method	Water	Chlorobenzene	70-130	NA	NA
524.2	Method	Water	Ethylbenzene	70-130	NA	NA
524.2	Method	Water	1,1,1,2-Tetrachloroethane	70-130	NA	NA
524.2	Method	Water	Styrene	70-130	NA	NA
524.2	Method	Water	Total Xylenes	70-130	NA	NA
524.2	Method	Water	Bromoform	70-130	NA	NA
524.2	Method	Water	Isopropylbenzene	70-130	NA	NA
524.2	Method	Water	1,1,2,2-Tetrachloroethane	70-130	NA	NA
524.2	Method	Water	1,2,3-Trichloropropane	70-130	NA	NA
524.2	Method	Water	Bromobenzene	70-130	NA	NA
524.2	Method	Water	n-Propylbenzene	70-130	NA	NA
524.2	Method	Water	1,3,5-Trimethylbenzene	70-130	NA	NA
524.2	Method	Water	2-Chlorotoluene	70-130	NA	NA
524.2	Method	Water	4-Chlorotoluene	70-130	NA	NA
524.2	Method	Water	tert-Butylbenzene	70-130	NA	NA
524.2	Method	Water	1,2,4-Trimethylbenzene	70-130	NA	NA
524.2	Method	Water	sec-Butylbenzene	70-130	NA	NA
524.2	Method	Water	4-Isopropyltoluene	70-130	NA	NA
524.2	Method	Water	1,3-Dichlorobenzene	70-130	NA	NA
524.2	Method	Water	1,4-Dichlorobenzene	70-130	NA	NA
524.2	Method	Water	n-Butylbenzene	70-130	NA	NA
524.2	Method	Water	1,2-Dichlorobenzene	70-130	NA	NA
524.2	Method	Water	1,2-Dibromo-3-chloropropane (DBCP)	70-130	NA	NA

VOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
524.2	Method	Water	1,2,4-Trichlorobenzene		70-130	NA	NA
524.2	Method	Water	Hexachlorobutadiene		70-130	NA	NA
524.2	Method	Water	Naphthalene		70-130	NA	NA
524.2	Method	Water	4-Bromofluorobenzene (Surr.)	82-110	NA	NA	NA
524.2	Method	Water	Dibromofluoromethane (Surr.)	83-121	NA	NA	NA
524.2	Method	Water	Toluene-D8 (Surr.)	89-117	NA	NA	NA
602	Method	Water	Benzene		39-150	39-150	30
602	Method	Water	Toluene		46-148	46-148	30
602	Method	Water	Ethylbenzene		32-160	32-160	30
602	Method	Water	Xylenes		32-160	32-160	30
602	Method	Water	1,4-Difluorobenzene (Surr.)	82-120	NA	NA	NA
624	Method	Water	1,1,1-Trichloroethane (TCA)		78-122	79-129	30
624	Method	Water	1,1,2,2-Tetrachloroethane		70-114	65-124	30
624	Method	Water	1,1,2-Trichloroethane		73-114	66-120	30
624	Method	Water	1,1-Dichloroethane		70-131	71-136	30
624	Method	Water	1,1-Dichloroethene		71-140	62-156	30
624	Method	Water	1,2-Dichlorobenzene		64-125	68-122	30
624	Method	Water	1,2-Dichloroethane (EDC)		63-138	59-141	30
624	Method	Water	1,2-Dichloropropane		71-119	68-128	30
624	Method	Water	1,3-Dichlorobenzene		72-118	69-125	30
624	Method	Water	1,4-Dichlorobenzene		74-115	71-122	30
624	Method	Water	2-Chloroethyl Vinyl Ether		24-130	10-129	30
624	Method	Water	Acrolein		25-166	10-156	30
624	Method	Water	Acrylonitrile		50-150	46-152	30
624	Method	Water	Benzene		79-119	79-124	30
624	Method	Water	Bromodichloromethane		71-133	78-129	30
624	Method	Water	Bromoform		53-145	52-147	30
624	Method	Water	Bromomethane		10-187	10-167	30
624	Method	Water	Carbon Disulfide		66-133	56-156	30
624	Method	Water	Carbon Tetrachloride		72-138	74-145	30
624	Method	Water	Chlorobenzene		74-117	73-124	30
624	Method	Water	Chloroethane		55-153	51-165	30
624	Method	Water	Chloroform		63-129	46-136	30
624	Method	Water	Chloromethane		49-140	46-151	30
624	Method	Water	cis-1,2-Dichloroethene		70-125	70-128	30
624	Method	Water	cis-1,3-Dichloropropene		67-122	43-131	30
624	Method	Water	Dibromochloromethane		50-140	55-137	30
624	Method	Water	Dichlorodifluoromethane		41-147	59-135	30
624	Method	Water	Ethylbenzene		68-126	69-132	30
624	Method	Water	m,p-Xylenes		74-124	74-129	30
624	Method	Water	Methylene Chloride		69-123	63-127	30
624	Method	Water	o-Xylene		61-126	64-128	30
624	Method	Water	Styrene		55-133	65-125	30
624	Method	Water	Tetrachloroethene (PCE)		65-129	66-138	30
624	Method	Water	Toluene		74-123	74-128	30
624	Method	Water	trans-1,2-Dichloroethene		75-120	76-128	30
624	Method	Water	trans-1,3-Dichloropropene		47-124	40-125	30
624	Method	Water	Trichloroethene (TCE)		74-119	43-164	30
624	Method	Water	Trichlorofluoromethane		55-131	58-136	30
624	Method	Water	Trichlorotrifluoroethane		42-185	37-196	30
624	Method	Water	Vinyl Acetate		41-163	70-130	30
624	Method	Water	Vinyl Chloride		54-134	54-146	30
624	Method	Water	Dibromofluoromethane (Surr.)	75-142	NA	NA	NA
624	Method	Water	Toluene-D8 (Surr.)	72-142	NA	NA	NA
624	Method	Water	4-Bromofluorobenzene (Surr.)	72-125	NA	NA	NA
8021BTEX	5035/5030B	Soil-mid	Benzene		75-121	53-135	40

VOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8021BTEX	5035/5030B	Soil-mid	Toluene	77-118	52-134	40
8021BTEX	5035/5030B	Soil-mid	Ethylbenzene	78-118	44-145	40
8021BTEX	5035/5030B	Soil-mid	m,p-Xylenes	80-118	44-147	40
8021BTEX	5035/5030B	Soil-mid	o-Xylene	78-117	39-147	40
8021BTEX	5035/5030B	Soil-mic	4-Bromofluorobenzene (Surr.) 43-142	NA	NA	
8021BTEX	5030B	Water	Benzene	84-116	84-123	30
8021BTEX	5030B	Water	Toluene	84-116	46-160	30
8021BTEX	5030B	Water	Ethylbenzene	83-119	63-145	30
8021BTEX	5030B	Water	m,p-Xylenes	84-120	73-132	30
8021BTEX	5030B	Water	o-Xylene	82-118	69-138	30
8021BTEX	5030B	Water	1,4-Difluorobenzene (Surr.) 87-126	NA	NA	30
8260B	5030A/5035	Soil-low	1,1,1,2-Tetrachloroethane	65-129	10-136	40
8260B	5030A/5035	Soil-low	1,1,1-Trichloroethane (TCA)	63-140	13-145	40
8260B	5030A/5035	Soil-low	1,1,2,2-Tetrachloroethane	56-136	10-138	40
8260B	5030A/5035	Soil-low	1,1,2-Trichloroethane	62-138	10-140	40
8260B	5030A/5035	Soil-low	1,1-Dichloroethane	64-132	17-140	40
8260B	5030A/5035	Soil-low	1,1-Dichloroethene	64-142	22-142	40
8260B	5030A/5035	Soil-low	1,1-Dichloropropene	63-129	10-123	40
8260B	5030A/5035	Soil-low	1,2,3-Trichlorobenzene	67-132	10-127	40
8260B	5030A/5035	Soil-low	1,2,3-Trichloropropane	57-135	10-142	40
8260B	5030A/5035	Soil-low	1,2,4-Trichlorobenzene	65-136	10-124	40
8260B	5030A/5035	Soil-low	1,2,4-Trimethylbenzene	61-128	10-140	40
8260B	5030A/5035	Soil-low	1,2-Dibromo-3-chloropropane	62-128	10-126	40
8260B	5030A/5035	Soil-low	1,2-Dibromoethane (EDB)	65-131	10-134	40
8260B	5030A/5035	Soil-low	1,2-Dichlorobenzene	67-121	10-128	40
8260B	5030A/5035	Soil-low	1,2-Dichloroethane (EDC)	67-134	18-138	40
8260B	5030A/5035	Soil-low	1,2-Dichloropropane	68-130	17-135	40
8260B	5030A/5035	Soil-low	1,3,5-Trimethylbenzene	62-129	10-139	40
8260B	5030A/5035	Soil-low	1,3-Dichlorobenzene	66-127	10-128	40
8260B	5030A/5035	Soil-low	1,3-Dichloropropane	61-136	10-139	40
8260B	5030A/5035	Soil-low	1,4-Dichlorobenzene	67-126	10-131	40
8260B	5030A/5035	Soil-low	1,4-Dioxane	10-81	70-130	40
8260B	5030A/5035	Soil-low	1-Chlorohexane	50-158	10-119	40
8260B	5030A/5035	Soil-low	2,2-Dichloropropane	65-138	11-135	40
8260B	5030A/5035	Soil-low	2-Butanone (MEK)	61-145	21-126	40
8260B	5030A/5035	Soil-low	2-Chloroethyl Vinyl Ether	43-145	10-147	40
8260B	5030A/5035	Soil-low	2-Chlorotoluene	60-129	10-137	40
8260B	5030A/5035	Soil-low	2-Hexanone	49-149	10-143	40
8260B	5030A/5035	Soil-low	2-Nitropropane	10-196	70-130	40
8260B	5030A/5035	Soil-low	3-Chloro-1-propene	29-142	70-130	40
8260B	5030A/5035	Soil-low	4-Chlorotoluene	60-127	10-134	40
8260B	5030A/5035	Soil-low	4-Isopropyltoluene	59-125	10-135	40
8260B	5030A/5035	Soil-low	4-Methyl-2-pentanone (MIBK)	58-144	12-138	40
8260B	5030A/5035	Soil-low	Acetone	54-128	16-116	40
8260B	5030A/5035	Soil-low	Acetonitrile	45-121	70-130	40
8260B	5030A/5035	Soil-low	Acrolein	10-211	10-138	40
8260B	5030A/5035	Soil-low	Acrylonitrile	36-204	10-144	40
8260B	5030A/5035	Soil-low	Benzene	68-127	16-134	40
8260B	5030A/5035	Soil-low	Bromobenzene	66-127	10-129	40
8260B	5030A/5035	Soil-low	Bromochloromethane	70-131	18-135	40
8260B	5030A/5035	Soil-low	Bromodichloromethane	72-137	10-151	40
8260B	5030A/5035	Soil-low	Bromoethane	70-130	70-130	40
8260B	5030A/5035	Soil-low	Bromoform	67-136	10-139	40
8260B	5030A/5035	Soil-low	Bromomethane	37-181	10-159	40
8260B	5030A/5035	Soil-low	Carbon Disulfide	58-141	10-142	40
8260B	5030A/5035	Soil-low	Carbon Tetrachloride	63-140	10-144	40

VOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8260B	5030A/5035	Soil-low	Chlorobenzene		66-126	10-133	40
8260B	5030A/5035	Soil-low	Chloroethane		59-132	29-131	40
8260B	5030A/5035	Soil-low	Chloroform		65-129	18-136	40
8260B	5030A/5035	Soil-low	Chloromethane		49-141	21-136	40
8260B	5030A/5035	Soil-low	Chloroprene		28-140	70-130	40
8260B	5030A/5035	Soil-low	cis-1,2-Dichloroethene		68-127	21-132	40
8260B	5030A/5035	Soil-low	cis-1,3-Dichloropropene		71-132	10-133	40
8260B	5030A/5035	Soil-low	cis-1,4-Dichloro-2-butene		15-158	52-78	40
8260B	5030A/5035	Soil-low	Cyclohexane		56-154	15-173	40
8260B	5030A/5035	Soil-low	Dibromochloromethane		65-135	10-142	40
8260B	5030A/5035	Soil-low	Dibromomethane		69-126	12-133	40
8260B	5030A/5035	Soil-low	Dichlorodifluoromethane		32-164	10-155	40
8260B	5030A/5035	Soil-low	Diisopropyl Ether		41-146	24-113	40
8260B	5030A/5035	Soil-low	Ethyl Acetate		26-151	70-130	40
8260B	5030A/5035	Soil-low	Ethyl Acrylate		50-135	70-130	40
8260B	5030A/5035	Soil-low	Ethyl Methacrylate		26-144	70-130	40
8260B	5030A/5035	Soil-low	Ethylbenzene		68-129	10-134	40
8260B	5030A/5035	Soil-low	Ethylene Oxide		70-130	70-130	40
8260B	5030A/5035	Soil-low	Hexachlorobutadiene		62-137	10-115	40
8260B	5030A/5035	Soil-low	Iodomethane		15-197	17-134	40
8260B	5030A/5035	Soil-low	Isobutanol		41-136	70-130	40
8260B	5030A/5035	Soil-low	Isopropylbenzene		58-115	10-121	40
8260B	5030A/5035	Soil-low	m,p-Xylenes		70-124	10-137	40
8260B	5030A/5035	Soil-low	Methacrylonitrile		28-137	70-130	40
8260B	5030A/5035	Soil-low	Methyl Acetate		10-177	10-205	40
8260B	5030A/5035	Soil-low	Methyl Methacrylate		16-151	70-130	40
8260B	5030A/5035	Soil-low	Methyl tert-Butyl Ether		69-137	33-135	40
8260B	5030A/5035	Soil-low	Methylcyclohexane		63-146	10-159	40
8260B	5030A/5035	Soil-low	Methylene Chloride		51-133	15-127	40
8260B	5030A/5035	Soil-low	n-Butylbenzene		59-132	10-142	40
8260B	5030A/5035	Soil-low	n-Hexane		70-130	70-130	40
8260B	5030A/5035	Soil-low	n-Propylbenzene		58-132	10-140	40
8260B	5030A/5035	Soil-low	Naphthalene		62-130	10-138	40
8260B	5030A/5035	Soil-low	o-Xylene		68-124	10-141	40
8260B	5030A/5035	Soil-low	Propionitrile		10-145	70-130	40
8260B	5030A/5035	Soil-low	Propylene Oxide		70-130	70-130	40
8260B	5030A/5035	Soil-low	sec-Butylbenzene		63-135	10-137	40
8260B	5030A/5035	Soil-low	Styrene		68-125	10-139	40
8260B	5030A/5035	Soil-low	tert-Amyl Methyl Ether		34-164	70-130	40
8260B	5030A/5035	Soil-low	tert-Butyl Alcohol		16-173	70-130	40
8260B	5030A/5035	Soil-low	tert-Butyl Ethyl Ether		45-147	70-130	40
8260B	5030A/5035	Soil-low	tert-Butylbenzene		60-128	10-133	40
8260B	5030A/5035	Soil-low	Tetrachloroethene (PCE)		62-135	10-138	40
8260B	5030A/5035	Soil-low	Toluene		66-126	14-129	40
8260B	5030A/5035	Soil-low	trans-1,2-Dichloroethene		63-129	18-129	40
8260B	5030A/5035	Soil-low	trans-1,3-Dichloropropene		56-133	10-128	40
8260B	5030A/5035	Soil-low	trans-1,4-Dichloro-2-butene		10-248	10-166	40
8260B	5030A/5035	Soil-low	Trichloroethene (TCE)		69-131	10-138	40
8260B	5030A/5035	Soil-low	Trichlorofluoromethane		48-140	10-142	40
8260B	5030A/5035	Soil-low	Trichlorotrifluoroethane		64-151	10-159	40
8260B	5030A/5035	Soil-low	Vinyl Acetate		10-201	10-132	40
8260B	5030A/5035	Soil-low	Vinyl Chloride		56-136	27-132	40
8260B	5030A/5035	Soil-low	1,2-Dichloroethane-D4 (Surr.)	71-138	NA	NA	NA
8260B	5030A/5035	Soil-low	4-Bromofluorobenzene (Surr.)	76-133	NA	NA	NA
8260B	5030A/5035	Soil-low	Dibromofluoromethane (Surr.)	77-132	NA	NA	NA
8260B	5030A/5035	Soil-low	Toluene-D8 (Surr.)	75-137	NA	NA	NA

VOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8260B	5035/5030B	Soil-mid	1,1,1,2-Tetrachloroethane	45-149	55-136	40
8260B	5035/5030B	Soil-mid	1,1,1-Trichloroethane (TCA)	48-151	65-127	40
8260B	5035/5030B	Soil-mid	1,1,2,2-Tetrachloroethane	54-138	49-143	40
8260B	5035/5030B	Soil-mid	1,1,2-Trichloroethane	54-138	58-131	40
8260B	5035/5030B	Soil-mid	1,1-Dichloroethane	55-142	74-121	40
8260B	5035/5030B	Soil-mid	1,1-Dichloroethene	58-143	75-125	40
8260B	5035/5030B	Soil-mid	1,1-Dichloropropene	53-131	62-119	40
8260B	5035/5030B	Soil-mid	1,2,3-Trichlorobenzene	48-140	42-138	40
8260B	5035/5030B	Soil-mid	1,2,3-Trichloropropane	56-141	63-137	40
8260B	5035/5030B	Soil-mid	1,2,4-Trichlorobenzene	46-140	50-132	40
8260B	5035/5030B	Soil-mid	1,2,4-Trimethylbenzene	57-143	67-136	40
8260B	5035/5030B	Soil-mid	1,2-Dibromo-3-chloropropane	34-145	55-136	40
8260B	5035/5030B	Soil-mid	1,2-Dibromoethane (EDB)	51-134	62-118	40
8260B	5035/5030B	Soil-mid	1,2-Dichlorobenzene	56-132	64-118	40
8260B	5035/5030B	Soil-mid	1,2-Dichloroethane (EDC)	58-142	55-140	40
8260B	5035/5030B	Soil-mid	1,2-Dichloropropane	53-144	69-127	40
8260B	5035/5030B	Soil-mid	1,3,5-Trichlorobenzene	54-131	70-130	40
8260B	5035/5030B	Soil-mid	1,3,5-Trimethylbenzene	66-134	54-148	40
8260B	5035/5030B	Soil-mid	1,3-Dichlorobenzene	58-133	64-121	40
8260B	5035/5030B	Soil-mid	1,3-Dichloropropane	54-138	66-120	40
8260B	5035/5030B	Soil-mid	1,4-Dichlorobenzene	56-133	65-120	40
8260B	5035/5030B	Soil-mid	1,4-Dioxane	33-169	70-130	40
8260B	5035/5030B	Soil-mid	1-Chlorohexane	64-132	70-130	40
8260B	5035/5030B	Soil-mid	2,2-Dichloropropane	26-157	47-132	40
8260B	5035/5030B	Soil-mid	2-Butanone (MEK)	58-137	62-138	40
8260B	5035/5030B	Soil-mid	2-Chloroethyl Vinyl Ether	10-174	70-130	40
8260B	5035/5030B	Soil-mid	2-Chlorotoluene	77-121	55-146	40
8260B	5035/5030B	Soil-mid	2-Hexanone	41-142	33-148	40
8260B	5035/5030B	Soil-mid	2-Nitropropane	10-156	70-130	40
8260B	5035/5030B	Soil-mid	3-Chloro-1-propene	33-97	70-130	40
8260B	5035/5030B	Soil-mid	4-Chlorotoluene	57-142	59-141	40
8260B	5035/5030B	Soil-mid	4-Isopropyltoluene	53-135	33-155	40
8260B	5035/5030B	Soil-mid	4-Methyl-2-pentanone (MIBK)	66-124	55-134	40
8260B	5035/5030B	Soil-mid	Acetone	47-147	51-139	40
8260B	5035/5030B	Soil-mid	Acetonitrile	70-130	70-130	40
8260B	5035/5030B	Soil-mid	Acrolein	70-130	70-130	40
8260B	5035/5030B	Soil-mid	Acrylonitrile	10-142	70-130	40
8260B	5035/5030B	Soil-mid	Benzene	57-138	79-114	40
8260B	5035/5030B	Soil-mid	Bromobenzene	57-139	70-124	40
8260B	5035/5030B	Soil-mid	Bromochloromethane	59-138	78-117	40
8260B	5035/5030B	Soil-mid	Bromodichloromethane	57-145	67-128	40
8260B	5035/5030B	Soil-mid	Bromoform	42-157	49-138	40
8260B	5035/5030B	Soil-mid	Bromomethane	10-225	10-184	40
8260B	5035/5030B	Soil-mid	Carbon Disulfide	47-137	55-125	40
8260B	5035/5030B	Soil-mid	Carbon Tetrachloride	35-167	46-146	40
8260B	5035/5030B	Soil-mid	Chlorobenzene	57-134	71-113	40
8260B	5035/5030B	Soil-mid	Chloroethane	18-155	59-127	40
8260B	5035/5030B	Soil-mid	Chloroform	55-132	61-123	40
8260B	5035/5030B	Soil-mid	Chloromethane	35-139	60-122	40
8260B	5035/5030B	Soil-mid	Chloroprene	47-88	70-130	40
8260B	5035/5030B	Soil-mid	cis-1,2-Dichloroethene	58-135	77-112	40
8260B	5035/5030B	Soil-mid	cis-1,3-Dichloropropene	55-141	69-125	40
8260B	5035/5030B	Soil-mid	cis-1,4-Dichloro-2-butene	30-150	70-130	40
8260B	5035/5030B	Soil-mid	Cyclohexane	70-130	70-130	40
8260B	5035/5030B	Soil-mid	Dibromochloromethane	47-147	55-127	40
8260B	5035/5030B	Soil-mid	Dibromomethane	60-133	74-116	40

VOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8260B	5035/5030B	Soil-mid	Dichlorodifluoromethane		13-150	57-133	40
8260B	5035/5030B	Soil-mid	Diisopropyl Ether		70-130	70-130	40
8260B	5035/5030B	Soil-mid	Ethyl Acetate		43-76	70-130	40
8260B	5035/5030B	Soil-mid	Ethyl Ether		51-125	70-130	40
8260B	5035/5030B	Soil-mid	Ethyl Methacrylate		27-80	70-130	40
8260B	5035/5030B	Soil-mid	Ethylbenzene		57-143	58-135	40
8260B	5035/5030B	Soil-mid	Ethylene Oxide		70-130	70-130	40
8260B	5035/5030B	Soil-mid	Hexachlorobutadiene		53-143	35-162	40
8260B	5035/5030B	Soil-mid	Iodomethane		10-204	70-130	40
8260B	5035/5030B	Soil-mid	Isobutanol		47-165	70-130	40
8260B	5035/5030B	Soil-mid	Isopropylbenzene		51-129	51-125	40
8260B	5035/5030B	Soil-mid	m,p-Xylenes		57-143	63-129	40
8260B	5035/5030B	Soil-mid	Methacrylonitrile		44-87	70-130	40
8260B	5035/5030B	Soil-mid	Methyl Acetate		70-130	70-130	40
8260B	5035/5030B	Soil-mid	Methyl Methacrylate		28-97	70-130	40
8260B	5035/5030B	Soil-mid	Methyl tert-Butyl Ether		40-146	41-153	40
8260B	5035/5030B	Soil-mid	Methylcyclohexane		70-130	70-130	40
8260B	5035/5030B	Soil-mid	Methylene Chloride		56-138	76-116	40
8260B	5035/5030B	Soil-mid	n-Butylbenzene		48-142	37-169	40
8260B	5035/5030B	Soil-mid	n-Hexane		71-121	70-130	40
8260B	5035/5030B	Soil-mid	n-Propylbenzene		56-142	58-145	40
8260B	5035/5030B	Soil-mid	Naphthalene		46-161	10-211	40
8260B	5035/5030B	Soil-mid	o-Xylene		57-141	66-127	40
8260B	5035/5030B	Soil-mid	Propionitrile		39-89	70-130	40
8260B	5035/5030B	Soil-mid	sec-Butylbenzene		65-137	56-157	40
8260B	5035/5030B	Soil-mid	Styrene		55-139	63-123	40
8260B	5035/5030B	Soil-mid	tert-Amyl Methyl Ether		70-130	70-130	40
8260B	5035/5030B	Soil-mid	tert-Butyl Alcohol		70-130	70-130	40
8260B	5035/5030B	Soil-mid	tert-Butyl Ethyl Ether		70-130	70-130	40
8260B	5035/5030B	Soil-mid	tert-Butylbenzene		55-140	45-153	40
8260B	5035/5030B	Soil-mid	Tetrachloroethene (PCE)		53-132	56-120	40
8260B	5035/5030B	Soil-mid	Toluene		58-141	60-138	40
8260B	5035/5030B	Soil-mid	trans-1,2-Dichloroethene		57-135	69-121	40
8260B	5035/5030B	Soil-mid	trans-1,3-Dichloropropene		34-144	45-131	40
8260B	5035/5030B	Soil-mid	trans-1,4-Dichloro-2-butene		66-152	59-179	40
8260B	5035/5030B	Soil-mid	Trichloroethene (TCE)		65-133	73-126	40
8260B	5035/5030B	Soil-mid	Trichlorofluoromethane		38-137	53-126	40
8260B	5035/5030B	Soil-mid	Trichlorotrifluoroethane		54-140	56-122	40
8260B	5035/5030B	Soil-mid	Vinyl Acetate		10-148	70-130	40
8260B	5035/5030B	Soil-mid	Vinyl Chloride		42-145	69-127	40
8260B	5035/5030B	Soil-mid	1,2-Dichloroethane-D4[g]	54-132	NA	NA	NA
8260B	5035/5030B	Soil-mid	4-Bromofluorobenzene[g]	58-128	NA	NA	NA
8260B	5035/5030B	Soil-mid	Dibromofluoromethane[g]	58-121	NA	NA	NA
8260B	5035/5030B	Soil-mic	Toluene-D8[g]	63-132	NA	NA	NA
8260B	5030B	Water	1,1,1,2-Tetrachloroethane		70-128	69-132	30
8260B	5030B	Water	1,1,1-Trichloroethane (TCA)		68-133	71-143	30
8260B	5030B	Water	1,1,2,2-Tetrachloroethane		64-128	70-126	30
8260B	5030B	Water	1,1,2-Trichloroethane		76-118	73-122	30
8260B	5030B	Water	1,1-Dichloroethane		66-126	63-134	30
8260B	5030B	Water	1,1-Dichloroethene		74-128	75-139	30
8260B	5030B	Water	1,1-Dichloropropene		68-115	68-124	30
8260B	5030B	Water	1,2,3-Trichlorobenzene		59-127	60-123	30
8260B	5030B	Water	1,2,3-Trichloropropane		70-123	67-127	30
8260B	5030B	Water	1,2,4-Trichlorobenzene		59-128	58-127	30
8260B	5030B	Water	1,2,4-Trimethylbenzene		68-124	69-128	30
8260B	5030B	Water	1,2-Dibromo-3-chloropropane		58-127	55-130	30

VOLATILE ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8260B	5030B	Water	1,2-Dibromoethane (EDB)	73-116	70-118	30
8260B	5030B	Water	1,2-Dichlorobenzene	73-110	72-113	30
8260B	5030B	Water	1,2-Dichloroethane (EDC)	70-129	70-133	30
8260B	5030B	Water	1,2-Dichloropropane	68-122	67-127	30
8260B	5030B	Water	1,3,5-Trichlorobenzene	47-137	67-129	30
8260B	5030B	Water	1,3,5-Trimethylbenzene	70-123	71-128	30
8260B	5030B	Water	1,3-Dichlorobenzene	73-113	70-119	30
8260B	5030B	Water	1,3-Dichloropropane	74-117	73-118	30
8260B	5030B	Water	1,4-Dichlorobenzene	72-115	73-115	30
8260B	5030B	Water	1,4-Dioxane	14-205	60-136	30
8260B	5030B	Water	1-Chlorohexane	66-126	70-142	30
8260B	5030B	Water	2,2-Dichloropropane	49-145	51-149	30
8260B	5030B	Water	2-Butanone (MEK)	60-143	54-142	30
8260B	5030B	Water	2-Chloroethyl Vinyl Ether	10-180	10-146	30
8260B	5030B	Water	2-Chlorotoluene	70-123	73-126	30
8260B	5030B	Water	2-Hexanone	58-129	50-133	30
8260B	5030B	Water	2-Nitropropane	11-187	79-171	30
8260B	5030B	Water	3-Chloro-1-propene	47-154	79-151	30
8260B	5030B	Water	4-Chlorotoluene	71-119	72-122	30
8260B	5030B	Water	4-Isopropyltoluene	62-118	62-123	30
8260B	5030B	Water	4-Methyl-2-pentanone (MIBK)	62-131	56-137	30
8260B	5030B	Water	Acetone	65-136	58-136	30
8260B	5030B	Water	Acetonitrile	54-156	58-135	30
8260B	5030B	Water	Acrolein	16-178	10-186	30
8260B	5030B	Water	Acrylonitrile	49-146	66-133	30
8260B	5030B	Water	Benzene	70-121	71-126	30
8260B	5030B	Water	Bromobenzene	74-116	73-119	30
8260B	5030B	Water	Bromochloromethane	74-122	73-126	30
8260B	5030B	Water	Bromodichloromethane	77-129	76-136	30
8260B	5030B	Water	Bromoform	61-141	56-146	30
8260B	5030B	Water	Bromomethane	25-163	27-173	30
8260B	5030B	Water	Carbon Disulfide	59-130	58-142	30
8260B	5030B	Water	Carbon Tetrachloride	59-147	63-158	30
8260B	5030B	Water	Chlorobenzene	75-112	74-115	30
8260B	5030B	Water	Chloroethane	61-126	58-137	30
8260B	5030B	Water	Chloroform	70-121	69-126	30
8260B	5030B	Water	Chloromethane	39-134	39-145	30
8260B	5030B	Water	Chloroprene	44-165	78-162	30
8260B	5030B	Water	cis-1,2-Dichloroethene	74-119	69-129	30
8260B	5030B	Water	cis-1,3-Dichloropropene	70-129	69-130	30
8260B	5030B	Water	cis-1,4-Dichloro-2-butene	20-177	51-152	30
8260B	5030B	Water	Dibromochloromethane	71-129	67-135	30
8260B	5030B	Water	Dibromomethane	74-118	73-121	30
8260B	5030B	Water	Dichlorodifluoromethane	40-149	44-158	30
8260B	5030B	Water	Dichlorofluoromethane (CFC 21)	69-136	70-130	30
8260B	5030B	Water	Diisopropyl Ether	64-135	48-148	30
8260B	5030B	Water	Ethyl Acetate	44-153	47-150	30
8260B	5030B	Water	Ethyl Ether	32-145	68-120	30
8260B	5030B	Water	Ethyl Methacrylate	36-144	61-138	30
8260B	5030B	Water	Ethylbenzene	75-118	74-124	30
8260B	5030B	Water	Hexachlorobutadiene	59-130	54-136	30
8260B	5030B	Water	Iodomethane	16-177	29-172	30
8260B	5030B	Water	Isobutanol	19-184	45-145	30
8260B	5030B	Water	Isopropylbenzene	65-106	63-113	30
8260B	5030B	Water	m,p-Xylenes	73-118	72-124	30
8260B	5030B	Water	Methacrylonitrile	43-150	70-130	30

VOLATILE ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
8260B	5030B	Water	Methyl Methacrylate		41-144	75-125	30
8260B	5030B	Water	Methyl tert-Butyl Ether		57-134	58-143	30
8260B	5030B	Water	Methylene Chloride		62-122	60-125	30
8260B	5030B	Water	n-Butylbenzene		57-127	55-133	30
8260B	5030B	Water	n-Hexane		50-142	60-152	30
8260B	5030B	Water	n-Propylbenzene		69-121	71-126	30
8260B	5030B	Water	Naphthalene		48-150	49-152	30
8260B	5030B	Water	o-Xylene		73-116	73-120	30
8260B	5030B	Water	Propionitrile		37-159	65-132	30
8260B	5030B	Water	sec-Butylbenzene		68-126	68-133	30
8260B	5030B	Water	Styrene		71-119	63-128	30
8260B	5030B	Water	tert-Amyl Methyl Ether		55-137	60-136	30
8260B	5030B	Water	tert-Butyl Alcohol		18-163	23-161	30
8260B	5030B	Water	tert-Butyl Ethyl Ether		51-145	58-140	30
8260B	5030B	Water	tert-Butylbenzene		68-119	69-125	30
8260B	5030B	Water	Tetrachloroethene (PCE)		71-117	64-127	30
8260B	5030B	Water	Tetrahydrofuran		15-161	40-137	30
8260B	5030B	Water	Toluene		72-117	71-124	30
8260B	5030B	Water	trans-1,2-Dichloroethene		72-119	69-130	30
8260B	5030B	Water	trans-1,3-Dichloropropene		62-123	61-123	30
8260B	5030B	Water	trans-1,4-Dichloro-2-butene		19-177	49-167	30
8260B	5030B	Water	Trichloroethene (TCE)		73-121	61-134	30
8260B	5030B	Water	Trichlorofluoromethane		60-122	60-133	30
8260B	5030B	Water	Trichlorotrifluoroethane		67-135	65-146	30
8260B	5030B	Water	Vinyl Acetate		10-202	55-160	30
8260B	5030B	Water	Vinyl Chloride		60-125	53-141	30
8260B	5030B	Water	1,2-Dichloroethane-D4 (Surr.)	70-124	NA	NA	NA
8260B	5030B	Water	4-Bromofluorobenzene (Surr.)	73-116	NA	NA	NA
8260B	5030B	Water	Dibromofluoromethane (Surr.)	80-120	NA	NA	NA
8260B	5030B	Water	Toluene-D8 (Surr.)	80-122	NA	NA	NA
8015B	5035/5030B	Soil	Gasoline Range Petroleum Hydrocarbons		51-139	51-127	40
8015B	5035/5030B	Soil	4-Bromofluorobenzene (Surr.)	50-136	NA	NA	NA
8015B	5030B	Water	Gasoline Range Petroleum Hydrocarbons		70-130	41-147	30
8015B	5030B	Water	1,4-Difluorobenzene (Surr.)	81-122	NA	NA	NA
AK 101	Method	Soil	Gasoline Range Petroleum Hydrocarbons		60-120	41-157	40
AK 101	Method	Soil	4-Bromofluorobenzene (Surr.)	50-150	60-120	NA	NA
AK 101	Method	Water	Gasoline Range Petroleum Hydrocarbons		60-120	67-127	30
AK 101	Method	Water	1,4-Difluorobenzene (Surr.)	50-150	60-120	NA	NA
NWTPH-Gx	Method	Soil	Gasoline Range Petroleum Hydrocarbons		63-116	42-139	40
NWTPH-Gx	Method	Soil	4-Bromofluorobenzene (Surr.)	50-150	NA	NA	NA
NWTPH-Gx	Method	Water	Gasoline Range Petroleum Hydrocarbons		61-132	67-127	30
NWTPH-Gx	Method	Water	1,4-Difluorobenzene (Surr.)	50-150	NA	NA	NA

DRINKING WATER ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
504.1	Method	Water	1,2-Dibromoethane	70-130	65-135	NA
504.1	Method	Water	1,2-Dibromo-3-chloropropane	70-130	65-135	NA
504.1	Method	Water	1,2,3-Trichloropropane	70-130	65-135	NA
508.1	Method	Water	Aldrin	70-130	65-135	NA
508.1	Method	Water	Alpha-BHC	70-130	65-135	NA
508.1	Method	Water	Alpha-Chlordane	70-130	65-135	NA
508.1	Method	Water	Beta-BHC	70-130	65-135	NA
508.1	Method	Water	Chlordane	70-130	65-135	NA
508.1	Method	Water	4,4'-DDD	70-130	65-135	NA
508.1	Method	Water	4,4'-DDE	70-130	65-135	NA
508.1	Method	Water	4,4'-DDT	70-130	65-135	NA
508.1	Method	Water	Delta-BHC	70-130	65-135	NA
508.1	Method	Water	Dieldrin	70-130	65-135	NA
508.1	Method	Water	Endosulfan I	70-130	65-135	NA
508.1	Method	Water	Endosulfan II	70-130	65-135	NA
508.1	Method	Water	Endosulfan Sulfate	70-130	65-135	NA
508.1	Method	Water	Endrin	70-130	65-135	NA
508.1	Method	Water	Endrin Aldehyde	70-130	65-135	NA
508.1	Method	Water	Gamma-BHC(Lindane)	70-130	65-135	NA
508.1	Method	Water	Gamma-Chlordane	70-130	65-135	NA
508.1	Method	Water	Heptachlor	70-130	65-135	NA
508.1	Method	Water	Heptachlor Epoxide	70-130	65-135	NA
508.1	Method	Water	Heptachlor Epoxide (isomer A)	70-130	65-135	NA
508.1	Method	Water	Methoxychlor	70-130	65-135	NA
508.1	Method	Water	Toxaphene	70-130	65-135	NA
508.1	Method	Water	Aroclor 1016	70-130	65-135	NA
508.1	Method	Water	Aroclor 1221	70-130	65-135	NA
508.1	Method	Water	Aroclor 1232	70-130	65-135	NA
508.1	Method	Water	Aroclor 1242	70-130	65-135	NA
508.1	Method	Water	Aroclor 1248	70-130	65-135	NA
508.1	Method	Water	Aroclor 1254	70-130	65-135	NA
508.1	Method	Water	Aroclor 1260	70-130	65-135	NA
508.1	Method	Water	4,4'-Dibromooctafluorobiphenyl (Surr.) 70-130	NA	NA	NA
515.4	Method	Water	Aciflurofen	70-130	70-130	30
515.4	Method	Water	Bentazon	70-130	70-130	30
515.4	Method	Water	Chloramben	70-130	70-130	30
515.4	Method	Water	2,4-D	70-130	70-130	30
515.4	Method	Water	Dalapon	70-130	70-130	30
515.4	Method	Water	2,4-DB	70-130	70-130	30
515.4	Method	Water	Dacthal Diacid	70-130	70-130	30
515.4	Method	Water	Dicamba	70-130	70-130	30
515.4	Method	Water	3,5-Dichlorobenzoic acid	70-130	70-130	30
515.4	Method	Water	Dichlorprop	70-130	70-130	30
515.4	Method	Water	Dinoseb	70-130	70-130	30
515.4	Method	Water	Pentachlorophenol	70-130	70-130	30
515.4	Method	Water	Picloram	70-130	70-130	30
515.4	Method	Water	2,4,5-T	70-130	70-130	30
515.4	Method	Water	2,4,5-TP (Silvex)	70-130	70-130	30
515.4	Method	Water	4-Nitrophenol	70-130	70-130	30
515.4	Method	Water	2,4-Dichlorophenylacetic acid (Surr.) 70-130	NA	NA	30
525.2	Method	Water	2,4-Dinitrotoluene	70-130	70-130	NA
525.2	Method	Water	2,6-Dinitrotoluene	70-130	70-130	NA
525.2	Method	Water	4,4'-DDD	70-130	70-130	NA
525.2	Method	Water	4,4'-DDE	70-130	70-130	NA
525.2	Method	Water	4,4'-DDT	70-130	70-130	NA
525.2	Method	Water	Acenaphthene	70-130	70-130	NA

DRINKING WATER ORGANICS ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
525.2	Method	Water	Acenaphthylene	70-130	70-130	NA
525.2	Method	Water	Acetochlor	70-130	70-130	NA
525.2	Method	Water	Alachlor	70-130	70-130	NA
525.2	Method	Water	Aldrin	70-130	70-130	NA
525.2	Method	Water	alpha-BHC	70-130	70-130	NA
525.2	Method	Water	Ametryn	70-130	70-130	NA
525.2	Method	Water	Anthracene	70-130	70-130	NA
525.2	Method	Water	Atraton	70-130	70-130	NA
525.2	Method	Water	Atrazine	70-130	70-130	NA
525.2	Method	Water	Benz(a)anthracene	70-130	70-130	NA
525.2	Method	Water	Benzo(a)pyrene	70-130	70-130	NA
525.2	Method	Water	Benzo(b)fluoranthene	70-130	70-130	NA
525.2	Method	Water	Benzo(g,h,i)perylene	70-130	70-130	NA
525.2	Method	Water	Benzo(k)fluoranthene	70-130	70-130	NA
525.2	Method	Water	Benzyl butyl phthalate	70-130	70-130	NA
525.2	Method	Water	Beta-BHC	70-130	70-130	NA
525.2	Method	Water	Bis(2-ethylhexyl)adipate	70-130	70-130	NA
525.2	Method	Water	Bis(2-ethylhexyl)phthalate	70-130	70-130	NA
525.2	Method	Water	Bromacil	70-130	70-130	NA
525.2	Method	Water	Butachlor	70-130	70-130	NA
525.2	Method	Water	Butylate	70-130	70-130	NA
525.2	Method	Water	Caffeine	70-130	70-130	NA
525.2	Method	Water	Carboxin	70-130	70-130	NA
525.2	Method	Water	Chlorobenzilate	70-130	70-130	NA
525.2	Method	Water	Chloroneb	70-130	70-130	NA
525.2	Method	Water	Chlorothalonil	70-130	70-130	NA
525.2	Method	Water	Chlorpropham	70-130	70-130	NA
525.2	Method	Water	Chorpyrifos	70-130	70-130	NA
525.2	Method	Water	Chrysene	70-130	70-130	NA
525.2	Method	Water	alpha-Chlordane	70-130	70-130	NA
525.2	Method	Water	cis-Permethrin	70-130	70-130	NA
525.2	Method	Water	Cyanazine	70-130	70-130	NA
525.2	Method	Water	Cycloate	70-130	70-130	NA
525.2	Method	Water	Dacthal	70-130	70-130	NA
525.2	Method	Water	delta-BHC	70-130	70-130	NA
525.2	Method	Water	Diazinon	70-130	70-130	NA
525.2	Method	Water	Dibenz(a,h)anthracene	70-130	70-130	NA
525.2	Method	Water	Dibutyl phthalate	70-130	70-130	NA
525.2	Method	Water	Dichlorvos	70-130	70-130	NA
525.2	Method	Water	Dieldrin	70-130	70-130	NA
525.2	Method	Water	Diethyl Phthalate	70-130	70-130	NA
525.2	Method	Water	Dimethoate	70-130	70-130	NA
525.2	Method	Water	Dimethyl phthalate	70-130	70-130	NA
525.2	Method	Water	Di-n-octyl phthalate	70-130	70-130	NA
525.2	Method	Water	Diphenamide	70-130	70-130	NA
525.2	Method	Water	Disulfoton	70-130	70-130	NA
525.2	Method	Water	Endosulfan I	70-130	70-130	NA
525.2	Method	Water	Endosulfan II	70-130	70-130	NA
525.2	Method	Water	Endosulfan Sulfate	70-130	70-130	NA
525.2	Method	Water	Endrin	70-130	70-130	NA
525.2	Method	Water	Endrin Aldehyde	70-130	70-130	NA
525.2	Method	Water	Endrin Ketone	70-130	70-130	NA
525.2	Method	Water	EPTC	70-130	70-130	NA
525.2	Method	Water	Ethoprophos	70-130	70-130	NA
525.2	Method	Water	Fenamiphos	70-130	70-130	NA
525.2	Method	Water	Fenarimol	70-130	70-130	NA

DRINKING WATER ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
525.2	Method	Water	Fluoranthene		70-130	70-130	NA
525.2	Method	Water	Fluorene		70-130	70-130	NA
525.2	Method	Water	Heptachlor		70-130	70-130	NA
525.2	Method	Water	Heptachlor Epoxide		70-130	70-130	NA
525.2	Method	Water	Hexachlorobenzene		70-130	70-130	NA
525.2	Method	Water	Hexachlorocyclopentadiene		70-130	70-130	NA
525.2	Method	Water	Indeno(1,2,3-cd)pyrene		70-130	70-130	NA
525.2	Method	Water	Isophorone		70-130	70-130	NA
525.2	Method	Water	Lindane (gamma-BHC)		70-130	70-130	NA
525.2	Method	Water	Malathion		70-130	70-130	NA
525.2	Method	Water	Merphos		70-130	70-130	NA
525.2	Method	Water	Methoxychlor		70-130	70-130	NA
525.2	Method	Water	Metolachlor		70-130	70-130	NA
525.2	Method	Water	Metribuzin		70-130	70-130	NA
525.2	Method	Water	Mevinphos		70-130	70-130	NA
525.2	Method	Water	Molinate		70-130	70-130	NA
525.2	Method	Water	Napropamide		70-130	70-130	NA
525.2	Method	Water	Nitrobenzene		70-130	70-130	NA
525.2	Method	Water	Norflurazon		70-130	70-130	NA
525.2	Method	Water	Parathion		70-130	70-130	NA
525.2	Method	Water	Pebulate		70-130	70-130	NA
525.2	Method	Water	Pentachlorophenol		70-130	70-130	NA
525.2	Method	Water	Phenanthrene		70-130	70-130	NA
525.2	Method	Water	Prometon		70-130	70-130	NA
525.2	Method	Water	Prometryn		70-130	70-130	NA
525.2	Method	Water	Propachlor		70-130	70-130	NA
525.2	Method	Water	Propazine		70-130	70-130	NA
525.2	Method	Water	Propyzamide (Pronamide)		70-130	70-130	NA
525.2	Method	Water	Pyrene		70-130	70-130	NA
525.2	Method	Water	Simazine		70-130	70-130	NA
525.2	Method	Water	Simetryn		70-130	70-130	NA
525.2	Method	Water	Tebuthiurun		70-130	70-130	NA
525.2	Method	Water	Terbutryn		70-130	70-130	NA
525.2	Method	Water	Terbacil		70-130	70-130	NA
525.2	Method	Water	Terbufos		70-130	70-130	NA
525.2	Method	Water	Terrazole		70-130	70-130	NA
525.2	Method	Water	Tetrachlorvinphos		70-130	70-130	NA
525.2	Method	Water	Thiobencarb		70-130	70-130	NA
525.2	Method	Water	gamma-Chlordane		70-130	70-130	NA
525.2	Method	Water	trans-Nonachlor		70-130	70-130	NA
525.2	Method	Water	trans-Permethrin		70-130	70-130	NA
525.2	Method	Water	Triadimefon		70-130	70-130	NA
525.2	Method	Water	Tricyclazole		70-130	70-130	NA
525.2	Method	Water	Trifluralin		70-130	70-130	NA
525.2	Method	Water	Velpar		70-130	70-130	NA
525.2	Method	Water	Vernolate		70-130	70-130	NA
525.2	Method	Water	1,3-dimethyl-2-nitrobenzene (Surr.)	70-130	NA	NA	NA
525.2	Method	Water	Perylene-D12 (Surr.)	70-130	NA	NA	NA
525.2	Method	Water	Triphenylphosphate (Surr.)	70-130	NA	NA	NA
531.1	Method	Water	Aldicarb		80-120	65-135	NA
531.1	Method	Water	Aldicarb Sulfone		80-120	65-135	NA
531.1	Method	Water	Aldicarb Sulfoxide		80-120	65-135	NA
531.1	Method	Water	Baygon(Propoxur)		80-120	65-135	NA
531.1	Method	Water	Carbaryl		80-120	65-135	NA
531.1	Method	Water	Carbofuran		80-120	65-135	NA
531.1	Method	Water	3-Hydroxycarbofuran		80-120	65-135	NA

DRINKING WATER ORGANICS ANALYSES							
Method	**Prep Method**	**Matrix**	**Analyte**		**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
531.1	Method	Water	Methiocarb		80-120	65-135	NA
531.1	Method	Water	Methomyl		80-120	65-135	NA
531.1	Method	Water	Oxamyl		80-120	65-135	NA
547	Method	Water	Glyphosate		70-130	70-130	NA
548.1	Method	Water	Endothall		80-120	80-120	NA
549.2	Method	Water	Diquat		70-130	70-130	NA
549.2	Method	Water	Paraquat		70-130	70-130	NA
552.2	Method	Water	Bromochloroacetic Acid		70-130	70-130	NA
552.2	Method	Water	Bromodichloroacetic Acid		70-130	70-130	NA
552.2	Method	Water	Chlorodibromoacetic Acid		70-130	70-130	NA
552.2	Method	Water	Dibromoacetic Acid		70-130	70-130	NA
552.2	Method	Water	Dichloroacetic Acid		70-130	70-130	NA
552.2	Method	Water	Monobromoacetic Acid		70-130	70-130	NA
552.2	Method	Water	Monochloroacetic Acid		70-130	70-130	NA
552.2	Method	Water	Trichloroacetic Acid		70-130	70-130	NA
552.2	Method	Water	2,3-Dibromopropionic acid (Surr.)	70-130	NA	NA	NA

MICROBIOLOGICAL ANALYSES						
Method	**Prep Method**	**Matrix**	**Analyte**	**LCS Accuracy (% Rec.)**	**Matrix Spike (% Rec.)**	**Precision (RPD)**
SM 9215B	Method	Water	Heterotrophic Plate Count (Pour)	NA	NA	NA
SM 9215C	Method	Water	Heterotrophic Plate Count (Spread)	NA	NA	NA
SM 9221B	Method	Water	Coliform, Total (MPN)	NA	NA	NA
SM 9221E	Method	Water	Coliform, Fecal (MPN)	NA	NA	NA
SM 9223B	Method	Water	Coliform (Colilert)	NA	NA	NA
SM 9230B	Method	Water	Enterococcus	NA	NA	NA
SM 9230B	Method	Water	Fecal Streptococcus	NA	NA	NA
SM 10200H	Method	Water	Chlorophyll A	NA	NA	20

APPENDIX E

HEALTH AND SAFETY PLAN

(on CD)

APPENDIX E

LOCKHEED WEST SEATTLE SUPERFUND SITE

DRAFT

HEALTH AND SAFETY PLAN

Prepared by

TETRA TECH

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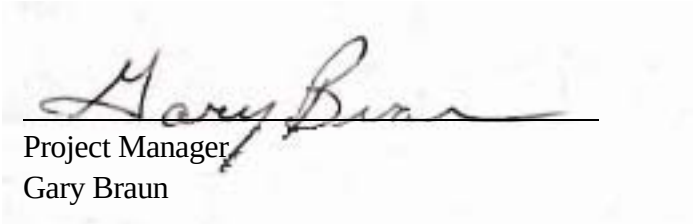
Prepared for

Lockheed Martin Corporation

August 2006
Revision 0

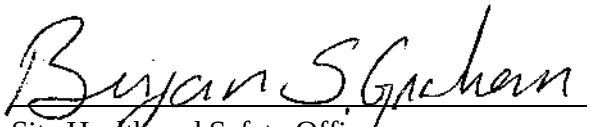
APPROVALS

This Health and Safety Plan (HASP) was prepared for the Remedial Investigation/Feasibility Study (RI/FS) field activities at the Lockheed West Seattle Superfund Site, Seattle, Washington. The purpose of this HASP to identify the scope of work, personnel, and health and safety requirements for the successful and safe completion of the project. By their signature, the undersigned certify that this HASP will be utilized for the protection of the health and safety of personnel during fieldwork conducted at the Lockheed West Seattle Superfund Site, Seattle, Washington.



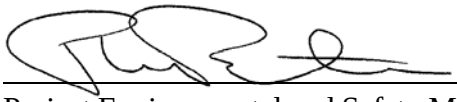
Project Manager
Gary Braun

January 4, 2007
Date



Site Health and Safety Officer
Bryan Graham

January 4, 2007
Date



Project Environmental and Safety Manager
Phil Bartley

January 4, 2007
Date

TETRA TECH EC, INCORPORATED, TETRA TECH EC SUBCONTRACTORS, AND THE CLIENT DO NOT GUARANTEE THE HEALTH OR SAFETY OF ANY PERSON ENTERING THIS SITE. DUE TO THE NATURE OF THIS SITE AND THE ACTIVITY OCCURRING THEREON, IT IS NOT POSSIBLE TO DISCOVER, EVALUATE, AND PROVIDE PROTECTION FOR ALL POSSIBLE HAZARDS THAT MAY BE ENCOUNTERED. STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THIS SITE. THE HEALTH AND SAFETY GUIDELINES IN THIS PLAN WERE PREPARED SPECIFICALLY FOR THIS SITE AND SHOULD NOT BE USED ON ANY OTHER SITE WITHOUT PRIOR RESEARCH AND EVALUATION BY TRAINED HEALTH AND SAFETY SPECIALISTS

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ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
CFR	Code of Federal Regulations
Coast Guard	U.S. Coast Guard
CRZ	contamination reduction zone
dBA	A-weighted decibel
DNR	Washington Department of Natural Resources
EPA	U.S. Environmental Protection Agency
EZ	exclusion zone
FOL	Field Operations Leader
HASP	Health and Safety Plan
LMC	Lockheed Martin Corporation
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	permissible exposure limit
PHSM	Project Health and Safety Manager
PM	Project Manager
Port	Port of Seattle
PPE	personal protective equipment
ppm	parts per million
Site	Lockheed West Seattle Superfund Site
STEL	short-term exposure limit
TBT	Tributyltin
TWA	time-weighted average
USFDA	U.S. Food and Drug Administration

1. BACKGROUND AND INTRODUCTION

This Health and Safety Plan (HASP) addresses health and safety practices and controls that will be implemented by Tetra Tech, Inc. (Tetra Tech) and its subcontractors during the environmental sampling (water and sediment) associated with field activities at the Lockheed West Seattle Superfund Site, Seattle, Washington (the Site).

Activities performed under this HASP will comply with applicable sections of 29 Code of Federal Regulations (CFR) 1910 and 1926. Any modifications to the HASP will be reviewed and approved by the Project Health and Safety Manager (PHSM) and the client's project manager (PM). The HASP and its attachments provide the minimum health and safety requirements for on-site personnel. Each company that participates in the field activities has the responsibility to review the original HASP, the HASP addendum, any modification, and adhere to the requirements therein.

1.1 DISTRIBUTION AND APPROVAL

The HASP and HASP addendum will be made available to all Tetra Tech personnel involved in fieldwork on this project. It will also be made available to subcontractors and other non-employees who may need to work on the Site. For non-employees, it must be made clear the plan represents minimum safety procedures. They must also understand they are responsible for their own safety while present on the Site. The plan has been approved by the Tetra Tech EC, Inc.'s Corporate Health and Safety Manager. By signing the documentation form provided with this plan (Section 12 located at the end of plan), project workers also certify their approval and agreement to comply with the plan.

2. DESCRIPTION OF PROJECT

The following sections briefly describe the project history, location, and scope of work to be completed at the Site.

2.1 PROJECT HISTORY AND SUMMARY

The Site is located in the southwest corner of Elliott Bay, and consists of the aerial extent of sediment contamination and sources thereto from the former shipyard facility also known as Lockheed Shipyard Number 2, which was located at 2330 Southwest Florida Street in West Seattle, Washington.

The Site is bounded by Elliott Bay on the north, Harbor Island West Waterway on the east, and Pacific Sound Resources Superfund Site on the west. It includes approximately 7 acres of aquatic land now owned by the Port of Seattle (Port) (formerly owned by Lockheed Martin Corporation [LMC]) and approximately 20 acres owned by Washington Department of Natural Resources (DNR) and leased to LMC.

LMC discontinued operations at Lockheed Shipyard Number 2 in 1987 after approximately 41 years of continuous operations that included shipbuilding, ship repair, and ship maintenance. Past industrial practices at or adjacent to the facility have resulted in contamination of upland soils and adjacent aquatic sediments. The contaminants found in the aquatic area include hazardous substances commonly associated with shipbuilding, repair, and maintenance activities, consistent with the historical uses of the facility. Contaminants of concern at the Site include, but are not limited to, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), mercury, other metals, and organic compounds.

2.1 ENVIRONMENTAL SETTING

The aquatic area associated with the Site is located along the southwestern shoreline of Elliot Bay, adjacent to the Port's container shipping operations at Terminal 5 (Figure 2-1). A portion of the aquatic area also borders the West Waterway of the Duwamish River. For the purposes of this HASP, off-shore areas of the former shipyard include:

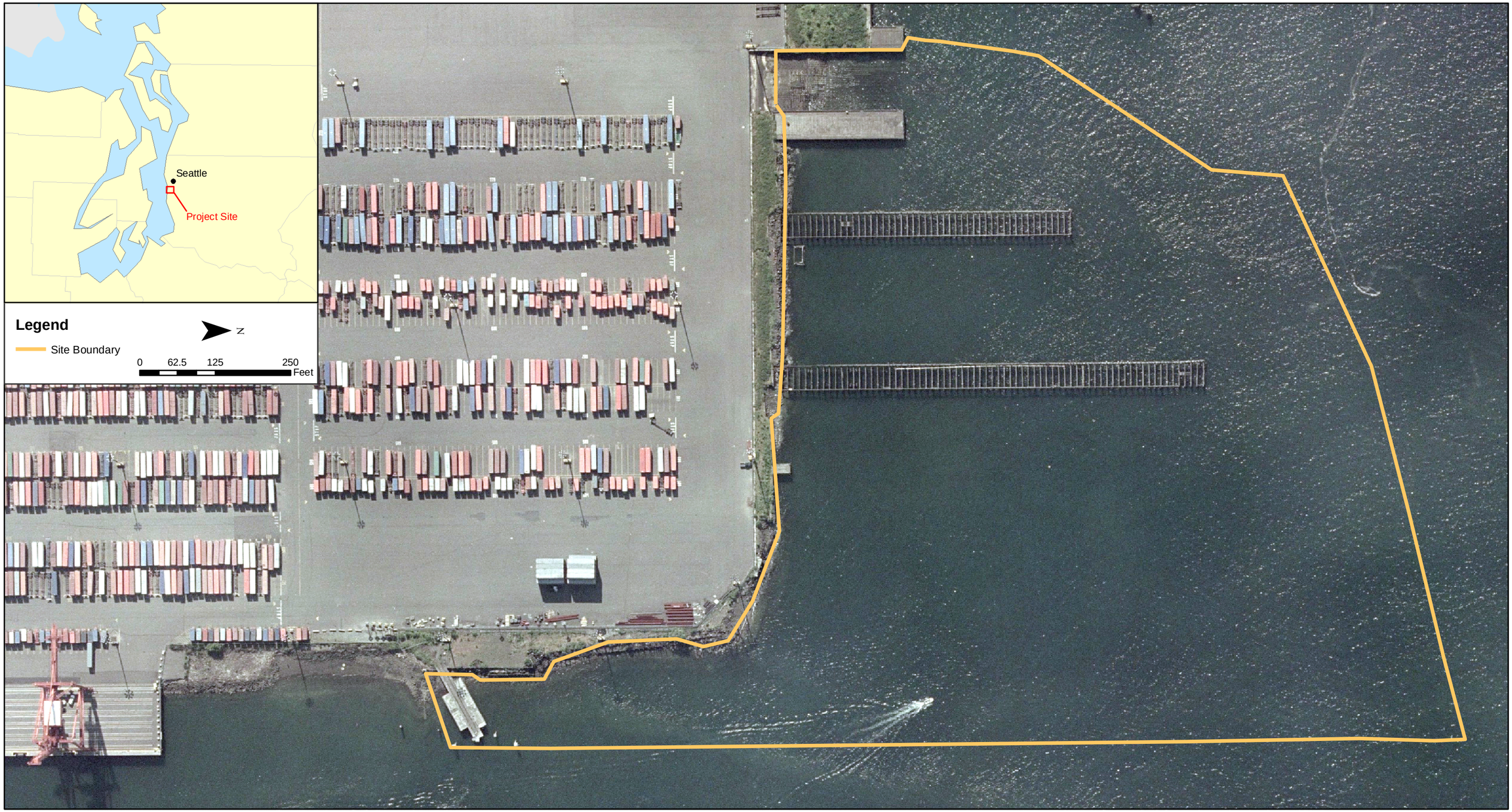
- Approximately 20 acres of land previously leased from DNR, and
- Approximately 7 acres of aquatic land south of the DNR lease areas that are owned by the Port.

The southern edge of the Site is defined for this report as the top of the bank along the shoreline adjacent to Terminal 5. The Port completed extensive redevelopment and environmental remediation of upland areas at Terminal 5 in the late 1990s. Terminal 5 is currently used for container shipping. The eastern and northern boundaries of the Site are defined by the outer limits of the DNR aquatic lease areas (Outer Harbor Line).

2.2 SCOPE OF WORK

The scope of work to be conducted in the field is discussed in detail in Section 4 and includes the following:

- Mobilization to the Site,
- Surface and subsurface sediment sampling to confirm and further delineate the nature and extend of sediment contamination,
- Soil borings off shore using a vibracore system or barge mounted hollow-stem auger drill rig,
- Surface sediment sampling in inter-tidal area using hand held equipment,
- Surface water sampling off shore using a peristaltic pump, and
- Demobilization from the Site.



TETRA TECH EC, INC.	**Lockheed West Shipyard No. 2 Seattle, WA**	**Figure 2-1 Location of Lockheed West Seattle, WA**

3. ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

The following sections specify Tetra Tech's project organization and chain of command for health and safety on this project.

3.1 PROJECT MANAGER

Mr. Gary Braun is the Project Manager (PM) for this project. His responsibilities include the following:

- Ensures implementation of this program and coordinates with the responsible PHSM,
- Participates in major incident investigations,
- Ensures the HASP has all of the required approvals before any site work is conducted,
- Ensures the PHSM and Site Health and Safety Officer (SHSO) are informed of project changes that require modifications of the site safety plan,
- Has overall project responsibility for project health and safety, and
- Ensures adequate personnel and equipment are available to safely complete the project.

3.2 FIELD OPERATIONS LEADER

Ms. Jennifer Hawkins is the Field Operations Leader (FOL) for this project. Her responsibilities include the following:

- Ensures the HASP is implemented,
- Ensures field work is scheduled with adequate personnel and equipment resources to complete the job safely,
- Enforces site health and safety rules,
- Investigates incidents,
- Ensures the PHSM and SHSO are informed of project changes that require modifications to the HASP,
- Ensures proper personal protective equipment is utilized,
- Ensures project personnel have appropriate training and experience to do the work,

- Assigns work and monitors performance, and
- Communicates all pertinent health and safety and regulatory compliance issues to the client.

3.3 SITE HEALTH AND SAFETY OFFICER

Mr. Bryan Graham is the SHSO for this project. His responsibilities include the following:

- Monitors compliance with the HASP,
- Evaluates the adequacy of personnel and equipment resources to complete the job safely,
- Helps enforce site health and safety rules,
- Investigates incidents,
- Assists FOL in incident investigations,
- Ensures the PHSM is informed of project changes that require modifications to the HASP,
- Conducts site safety briefings,
- Ensures proper personal protective equipment is utilized,
- Inspects personal protective equipment (PPE) to ensure PPE is adequate and not resulting in employee exposure,
- Notifies PHSM of all accidents/incidents,
- Reports to PHSM to provide summaries of field operations and progress, and
- Acts as Emergency Coordinator.

3.4 PROJECT HEALTH AND SAFETY MANAGER

Mr. Phil Bartley is the PHSM for this project. His responsibilities include the following:

- Provides for the development and approval of the HASP,
- Serves as the primary contact to review health and safety matters that may arise,
- Approves revised or new safety protocols for field operations,
- Approves individuals who are assigned site safety responsibilities,
- Coordinates revisions of this HASP with field personnel,

- Coordinates upgrading or downgrading of PPE with the FOL/SHSO, and
- Assists in the investigation of high loss incidents, including near misses.

3.5 SITE PERSONNEL

The following responsibilities pertain to all site personnel:

- Report any unsafe or potentially hazardous conditions to the FOL/SHSO,
- Maintain knowledge of the information, instructions, and emergency response actions contained in the HASP,
- Comply with rules, regulations, and procedures as set forth in this HASP and any revisions,
- Prevent admittance to work sites by unauthorized personnel, and
- Prior to use, daily inspect all tools and equipment, including PPE.

4. COMPREHENSIVE WORK PLAN

The scope of work to be conducted includes the following activities:

- Site mobilization,
- Surface sediment sampling using a Van Veen sampler,
- Sediment coring (vibracore or barge mounted drill rig),
- Surface sediment sampling in the inter-tidal zone, and
- Surface water sampling.

In general, sediment samples will be collected from the back of the vessel using a Van Veen sampler (clam shell), vibracore, or barge mounted drill rig. Samples collected with the Van Veen sampler will be processed on the deck of the boat and the required sample containers will be filled immediately. Core samples will be capped and transported to an on-shore processing facility, where the cores will be cut and sent off for analyses. Surface sediment samples from the inter-tidal zone will be collected and processed at each sample location. Surface water samples will be collected from the deck of the boat and processed on the boat. These activities are described in greater detail in the following sections.

4.1 SITE MOBILIZATION

Mobilization includes moving and removing necessary heavy equipment and personnel to and from the Site to perform the scope of work. Physical hazards associated with mobilization and demobilization activities are typically limited to general construction hazards such as slips, trips, and falls; material lifting and handing; and use of heavy equipment.

The exact location of the on-shore processing area is not known at this time as an agreement has not been reached with the client and the current tenant at the Site. It is anticipated that the processing area will be near one of the docks on the north side of the Site. The risks associated with site mobilization will be re-evaluated if the processing area is located in a different area.

4.2 SEDIMENT SURFACE SAMPLING

Near-surface sediment samples will be collected from the vessel using a Van Veen sampler. The sampler is a clam-shell device that is lowered through the water column into the sediment. The sampler closes and collects sediment that is brought to the surface where it is visually characterized and samples are collected. Physical hazards associated with sediment surface

sampling include those associated with boating safety, lifting of heavy equipment, and operation of equipment that presents pinch-point hazards. Chemical hazards include those associated with sampling of potentially impacted surface sediment.

4.3 SEDIMENT CORING

Sediment cores are collected using a vibracore sampler. A vibracore consists of an aluminum tube connected to an oscillating vibratory head that is lowered through the water column into the sediment. If possible, the aluminum tube is lowered directly through the sediment under its own weight. If necessary, the electronic vibratory head is activated and sends a vibration through the aluminum tube aiding it in passing through the sediment. A catcher at the bottom of the tube causes the sediment to be retained within, and the tube is brought back to the deck of the vessel where it is characterized, processed, and sampled. Physical hazards associated with sediment surface sampling include those associated with boating safety, lifting of heavy equipment, and operation of electrical equipment. Chemical hazards include those associated with sampling of potentially impacted surface sediment.

In the event the vibracore system does not provide an adequate sample volume, a barge mounted hollow-stem auger drill rig will be used for coring. If necessary, this approach will consist of driving the hollow-stem auger drill rig onto a barge and drilling through a “moon hole” on the deck of the barge. The barge will be driven to the sample location and secured using spuds driven into the sediment. The drill rig will then be used to collect the sediment cores in the same manner as the drill rig would be used on shore. Physical hazards include those typically associated with drill rigs, such as overhead hazards, contact with moving/rotating machinery, lifting of heavy objects, and increased noise levels. Chemical hazards are the same as those associated with sediment coring.

4.4 SUFACE SEDIMENT SAMPLING – INTER-TIDAL ZONE

Surface sediment samples will be collected from the inter-tidal zone using hand-held equipment during low tide conditions. Sampling equipment will include stainless steel bowls and spoons. Physical hazards associated with sediment surface sampling include slips, trips, and falls associated with work done on slick surfaces with potential unsure footings. Chemical hazards include those associated with sampling of potentially impacted surface sediment.

4.5 SUFACE WATER SAMPLING

Surface water samples will be collected from the vessel using a peristaltic pump. High-density polyethylene tubing is lowered into the water column and the wrapped around the peristaltic

pump used to apply pressure and draw water to the surface. The surface water samples will be placed into laboratory-supplied glassware or plastic containers. Physical hazards associated with sediment surface sampling include those associated with boating safety. Chemical hazards include those associated with sampling of potentially impacted surface sediment that may have also impacted the surface water.

5. HAZARD EVALUATION – SITE CONTAMINANTS

The following sections describe the potential exposure routes for workers at the Site, chemical and physical hazard assessments, and activity hazard assessments for activities to be conducted at the Site.

5.1 POTENTIAL EXPOSURE ROUTES

Field activities at the Site include the collection of potentially contaminated sediment and groundwater. The extent of impacted sediment at the Site is not defined; therefore, there is the potential for impacted material to be brought to the surface where workers are conducting routine sampling activities. Exposures will be managed by the proper use of PPE and safe work practices designed to minimize contact with potentially contaminated material.

Sediment samples have been collected during previous investigations at the Site. The concentrations detected include the following:

- PAHs (Pyrene) at 17,000 micrograms per kilogram (µg/kg)
- Arsenic at 1,420 milligrams per kilogram (mg/kg)
- Lead at 2,179 mg/kg
- Zinc at 4,810 mg/kg
- PCBs at 6,560 µg/kg
- Tributyltin (TBT) at 272 µg/kg

5.2 HAZARD ASSESSMENTS

Based on previous site information and knowledge of the types of activities conducted at these locations, PAHs, metals, PCBs, and TBT may exceed screening levels. Health hazards of potential chemicals are discussed below. This information covers potential toxic effects that might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean such effects will occur from the planned site activities. In general, the chemicals that may be encountered at this Site are not expected to be present at concentrations that could produce significant exposures. The types of planned work activities and use of monitoring procedures and protective measures will limit potential exposures at this Site.

These standards are presented using the following abbreviations:

- PEL Permissible exposure limit.
- TWA Time-weighted average exposure limit for any 8-hour work shift.
- STEL Short-term exposure limit expressed as a 15-minute, time-weighted average and not to be exceeded at any time during a work day.

5.2.1 Polycyclic Aromatic Hydrocarbons

Exposure to PAHs can occur via inhalation of vapors, ingestion, and skin and eye contact. Skin contact can result in reddening or corrosion. Ingestion can cause nausea, vomiting, blood pressure fall, abdominal pain, convulsions, and coma. Damage to the central nervous system can also occur. The U.S. Department of Health and Human Services (1989) has classified 15 PAHs as having sufficient evidence for carcinogenicity, while the U.S. Environmental Protection Agency (EPA) (1990) has classified at least 5 of the identified PAHs as human carcinogens. Currently there is no assigned PEL-TWA for PAHs, but the closely related material coal tar is listed as coal tar pitch volatiles with a PEL-TWA of 0.2 milligrams per cubic meters (mg/m^3).

5.2.2 Arsenic

Arsenic is toxic by inhalation and ingestion of dusts and fumes or by inhalation of arsine gas. Trivalent arsenic compounds are the most toxic to humans, with significant corrosive effects on the skin, eyes, and mucous membranes. Dermatitis also frequently occurs, and skin sensitization and contact dermatitis may result from arsenic trioxide or pentoxide. Trivalent arsenic interacts with a number of sulfhydryl proteins and enzymes, altering their normal biological function. Ingestion of arsenic can result in fever, anorexia, cardiac abnormalities, and neurological damage. Liver injury can accompany chronic exposure. Skin and inhalation exposure to arsenic has been associated with cancer in humans, particularly among workers in the arsenical-pesticide industry or copper smelters. EPA currently classifies arsenic as a Class A, or confirmed, human carcinogen. Arsine is a highly toxic gaseous arsenical, causing nausea, vomiting, and hemolysis. The current PEL-TWA for organic and inorganic forms of arsenic is 0.01 mg/m^3.

5.2.3 Inorganic Lead

Inorganic lead exposure can occur via inhalation of dusts or metal fumes, ingestion of dusts, and skin and eye contact. The principal target organs of lead toxicity include the nervous system, kidneys, blood, gastrointestinal, and reproductive systems. Generalized symptoms of lead exposure include decreased physical fitness, fatigue, sleep disturbances, headaches, bone and

muscle pain, constipation, abdominal pain, and decreased appetite. More severe exposure can result in anemia, severe gastrointestinal disturbance, a "lead-line" on the gums, neurological symptoms, convulsions, and death.

Neurological effects are among the most severe of inorganic lead's toxic effects and vary depending on the age of individual exposed. Effects observed in adults occur primarily in the peripheral nervous system, resulting in nerve destruction and degeneration. Wrist-drop and foot-drop are two characteristic manifestations of this toxicity.

EPA also currently lists inorganic lead as a Group B2 probable human carcinogen via the oral route. This conclusion is based on feeding studies conducted in laboratory animals. The current PEL-TWA for inorganic lead is 0.05 mg/m^3. Occupational exposure to lead is also specifically regulated under WAC 296-62-07521, with an action level established at 0.03 mg/m^3 that triggers monitoring and other requirements.

5.2.4 Zinc

Zinc compounds can be hazardous by inhalation of dust and fumes, ingestion, and skin and eye contact. Zinc chloride is corrosive to skin and mucous membranes, and sensitization can occur resulting in dermatitis. Eye contact can produce inflammation and corneal ulceration. Ingestion can result in corrosive damage to the digestive tract. The current PEL-TWA for exposure to zinc chloride fumes is 1 mg/m^3. Zinc chromate exhibits potential carcinogenic effects and is currently limited with a PEL-TWA of 0.05 mg/m^3. Zinc oxide is toxic via inhalation of fumes and dusts and may cause dermatitis. The current PEL-TWA for zinc oxide is 10 mg/m^3 as total dust and 5 mg/m^3 as the respirable fraction.

5.2.5 Polychlorinated Biphenyls

PCB is a generic term for a range of PCB compounds used commercially in heat transfer media and in the chemical/coatings industry. PCBs have been marketed commercially under the trade names Askarel® and Aroclor®, with a designation referring to the percent weight of chlorine. Prolonged skin contact with PCBs may cause acne-like symptoms, known as chloracne. Irritation to eyes, nose, and throat may also occur. Acute and chronic exposure can cause liver damage, and symptoms of edema, jaundice, anorexia, nausea, abdominal pains, and fatigue. If pregnant women accidentally ingest PCBs, stillbirth or infant skin and eye problems may occur. PCBs are a suspect carcinogen. EPA currently classifies PCBs as a Class B2, probable human carcinogen. The PEL-TWA for PCBs with 54 percent chlorine content is 0.5 mg/m^3, while the PEL-TWA for PCBs with 42 percent chlorine is 1 mg/m^3. Skin exposure may contribute significantly to uptake of these chemicals; therefore, all skin exposure should be strictly avoided.

5.2.6 Tributyltin

TBT (organotin) is a man-made chemical used in marine antifouling paints and occurs in a solid or liquid state. In pure form (DOT guidelines), organotins are poisonous and may be fatal if inhaled, swallowed, or absorbed through skin. Contact to the pure material may cause burns to the skin and eyes. Generalized symptoms of exposure are skin and eye irritation. The toxicity of organotin compounds is the result of their lipid solubility, allowing penetration into the brain and central nervous system; however, possible contact with TBT will be diluted for sediment sampling. According to the U.S. Food and Drug Administration (USFDA), the symptoms of acute tin toxicity from ingestion to humans are nausea, abdominal cramping, diarrhea, and vomiting. These symptoms have often followed consumption of canned fruit juices and salmon containing 650 to 1,400 parts per million (ppm) tin. Because of low intestinal absorption of tin (a breakdown product of organotins), the acute toxic symptoms are probably caused primarily by local irritation of the gastrointestinal tract.

The current PEL-TWA for organotin compounds, as tin, is 0.1 mg/m^3 (skin contact). The STEL is 0.2 mg/m^3.

5.3 OTHER PHYSICAL HAZARDS

A variety of physical hazards may be present during site activities, both on shore and while working on the boat. The most common hazards are struck by/or against hazards during sampling operations. These may include slips, trips, and falls, and temperature extremes. Other physical hazards are due to the use of hand and power tools, and material handlings. These hazards are not unique and are generally familiar to hazardous waste workers. Additional specific safety requirements working on or near water will be covered during safety briefings at the Site.

5.3.1 Slips, Trips, and Falls

Working in and around the Site will pose slip, trip, and fall hazards due to wet terrain, slippery surfaces, or surfaces that are muddy. Potential adverse health effects include falling to the ground and becoming injured or twisting knees/ankles. These hazards will be controlled by keeping the work area free of debris and other litter. Specifically, the core processing area will be managed in such a manner that liners are not placed in high traffic areas, core material is collected in buckets or equivalent, and all workers will be aware of potential hazards associated with the walking surface. The deck of the boat will be organized in such a manner to minimize the amount of equipment and material laying on the deck that may pose a trip hazard. Site workers will wear high traction, steel-toed safety boots and pay careful attention to surface

conditions to prevent trip and fall injuries. The work area will be inspected before the start of work each day to identify hazards that could cause injury. The results of these inspections will be communicated to site personnel during the daily tailgate and safety meetings.

5.3.2 Noise

Federal Occupational Safety and Health Administration's (OSHA's) 85-decibel A-weighted (dBA) noise exposure limit could be exceeded for those project personnel working on the boat while operating the vibracore drilling equipment, hollow-stem auger drilling, or working with power tools in the processing area. To control this exposure hazard, all personnel working near excessively noisy equipment will be required to wear hearing protection.

5.3.3 Boat Operations

Operating boats or vessels on the water carries the risk of having a crew member fall overboard and possibly drown, striking or being struck by other vessels operating in the area, losing power or steering and drifting into hazardous areas, and encountering severe weather, to name a few. The risk of a boating accident can be reduced by ensuring the boat operators are experienced, and when applicable, licensed; operating the vessel in compliance with U.S. Coast Guard (Coast Guard) rules and regulations; maintaining the vessel in good mechanical order; avoiding bad weather and dangerous seas; and ensuring emergency equipment is available on board (i.e., life vests, life rings, safety skiffs, fire extinguishers, communication equipment, etc.).

To address these concerns, all work conducted from small vessels will comply with Tetra Tech's Boating Safety Procedure (EHS 6-6, see Attachment A), and applicable Coast Guard regulations. Vessels will be operated by experience crewmembers, and all equipment will be inspected prior to use to ensure that it is in proper working order. This inspection will be conducted by the SHSO for each vessel used on a daily basis. Ultimately, the boat operator will be responsible for the safety of all personnel on the boat and for the integrity of the vessel and its safety equipment.

Prior to the start of field activities, the boat operator will give a detailed health and safety briefing on the location and use of all vessel safety equipment and the procedures for addressing an on-board emergency (i.e., fire, mechanical failure, man overboard situation, etc.). The maximum number of passengers and weight that can safely be transported shall be posted. The number of passengers shall not exceed the number of personal floatation devices (PFDs). Boat operators and passengers will be required to wear Type III, Type V, or better Coast Guard-approved international orange PFDs. If any work is done at night, the PFDs will be equipped with a Coast Guard-approved automatically activated light.

Vessels operated by Tetra Tech personnel will have at least one sound signaling device and a radio to communicate with support services on shore. Boating operations will be suspended during severe weather or rough seas.

5.3.4 Fire and Explosion Hazard

A gasoline powered generator and/or air compressor may be used at the Site to power the vibracore sampler and various other power tools. There is a risk of fire during refueling of the generator, particularly if fuel is spilled in the process. To prevent ignition of this fuel, the generator will be staged and operated outside, away from all ignition sources. Refueling will not be done while the generator is running. Smoking will be prohibited within 100 feet of the generator and fuel storage area. The gasoline will be stored in a safety can and will be bonded to the generator during transfer of fuel. Fuel will not be dispensed from the bed of plastic-lined pickup trucks. The generator will be grounded to a conducting rod driven into the ground, if necessary, and if such grounding is recommended by the manufacturer. A 10-pound portable dry chemical fire extinguisher and sorbent pads will be staged at the Site in the event of fuel spillage or fire.

5.3.5 Manual Lifting

Collecting coring samples, handling coring equipment, and unloading materials will involve heavy lifting. Such activities carry the risk of back and muscle strain. To control this hazard, workers will be instructed to use proper lifting techniques when moving heavy loads, particularly when unloading cores, deploying boats, stowing gear, and moving material weighing more than 50 pounds or awkwardly shaped. When engaged in such activities, workers will maintain ergonomically safe lifting postures and have others help them if mechanical lifting devices cannot be used.

5.3.6 Hand and Power Tools

Several different portable power tools, including a vibracore sampler, skill saws, and drills, may be used during the project. Power tools can cause injury if their wiring is defective, guards are missing, kill switches are broken, metal fatigue or cracks are present in reciprocating cutting and drilling appliances, or if the tools are used in a manner other than what they are designed for. To control these hazards, all power tools will be inspected before and after each use. Any defects noted during these inspections will be immediately repaired or the tool will be taken out of service. Under no circumstances will power tools be used in an inappropriate (non-specified) manner. Tool operators will be trained in the use of each type of tool they will be required to

use. All electrically powered tools, as well as all electrical equipment used on site, will be connected to power sources equipped with ground fault circuit interrupters. In addition, extension cords used with the power tools will be quipped with water poof couplings to prevent electrocution wherever wet conditions may be. Portable tools will be stored in a clean, secure area after each day's use.

5.3.7 Sediment Coring Equipment

A vibracore will be used to collect sediment samples. This consists of a long (up to 10 feet) aluminum tube attached to a vibrating hammer (vibracore), which is all supported by an A-frame on the back of the boat. Working with and near this equipment poses many potential hazards that can result in serious physical harm. This can include being struck by or against the equipment or pinched or caught by equipment. These hazards will be avoided by ensuring that all rotating or reciprocation parts of the vibracore are guarded or shielded and operators keep their hands away from any coring or cutting surfaces.

5.3.8 Temperature Extremes

Because most planned work activities will be conducted outside where temperature conditions are unpredictable, there is a risk that site workers could develop heat or cold stress. The likelihood of this occurring is dependent on environmental conditions, the level of work activity, and the personal control measures that are used to manage heat loads (work/rest regimes, use of clothing, hydration, etc.). Appropriate control measures will be taken to manage these thermal stress concerns. The SHSO will monitor ambient temperatures in the work area, track work loads, and determine the need for personal protective and administrative controls. In addition, all site workers will be instructed in the recognition and control of thermal stress symptoms and in the treatment procedures identified below.

5.3.9 Signs of Hypothermia

Hypothermia can result from abnormal cooling of the core body temperature. It is caused by exposure to a cold environment, and wind-chill as well as wetness or water immersion can play a significant role. The following discusses signs and symptoms as well as treatment for hypothermia.

Typical warning signs of hypothermia include fatigue, weakness, incardination, apathy, and drowsiness. A confused state is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink. Body temperatures below 90°F require immediate treatment to restore temperature to normal.

5.3.10 Treatment of Hypothermia

Current medical practice recommends slow rewarming as treatment for hypothermia, followed by professional medical care. This can be accomplished by moving the person into a sheltered area and wrapping with blankets in a warm room. In emergency situations where body temperature falls below 90°F and heated shelter is not available, use a sleeping bag, blankets and/or body heat from another individual to help restore normal body temperature.

5.4 ACTIVITY HAZARD ANALYSIS

The Activity Hazard Analysis (AHA) is a systematic way of identifying the potential health and safety hazards associated with major phases of work on the project and the methods to avoid, control, and mitigate those hazards. AHAs are developed for all activities as necessary, prior to start-up. The AHAs will be used to train work crews in proper safety procedures during preparatory meetings and before the beginning of each new task.

AHAs are included in Attachment B of this HASP. AHAs have been developed for the following phases of work:

- Mobilization/demobilization,
- Surface sediment sampling,
- Sediment coring operations,
- Working on or over water,
- Equipment decontamination,
- Core sample preparation, and
- Drilling.

6. SITE ACCESS AND CONTROL

Access to the Site will be limited to those personnel engaged in the work under the Lockheed West Seattle Superfund Site project. Site control will be maintained by Tetra Tech by establishing clearly identified work zones, whenever possible.

6.1 WORK ZONES

Where there is the potential for workers to come into contact with soils and materials with chemical concentrations greater than typical background concentrations, the Site will be divided into an exclusion zone (EZ), a contamination reduction zone, and a clean zone. The exclusion zone is defined as the area where contamination and other site hazards are either known or are likely to be present. The contamination reduction zone is where hazardous substances are removed from site personnel and their equipment as they exit the EZ. The clean zone is a non-contaminated area where support services, storage of non-hazardous materials, and administrative activities may occur. There will be no smoking, eating, or drinking within the exclusion or contaminant reduction zones. The zone locations will be based upon current knowledge of proposed site activities. It is possible that the zone configurations may be changed due to work plan revisions. Because most of the work with the sampling equipment will occur on the deck of the vessel and the working space will be limited, the zone boundaries will be marked as necessary. Due to the small size of some areas, there may be activities performed in the EZ that are normally performed in the contamination reduction zone (CRZ). The FOL and SHSO shall monitor these activities to ensure no cross contamination, particularly for the support zone.

6.1.1 Exclusion Zone

The EZ will include the vibracore floating work platform and core sample examination and preparation area. These areas will be identified and isolated in such a way as to avoid interference with operations by outside personnel. Isolation protocols may include use of ropes, barricades, temporary fencing, boundary tape, warning signs, or other distinguishable markers. All personnel entering the EZ will use the buddy system to maintain vigilance over each other and will wear the personal protective equipment specified in this plan. EZ workers will also have copies of their medical clearance and training records on file at the Site.

6.1.2 Contamination Reduction Zone

A CRZ will be established between the support zone and the EZ and will be used for EZ entry and egress of personnel and emergency support services. The CRZ will contain a contamination reduction corridor that includes an area for decontamination of personnel and portable hand-held equipment, tools, and heavy equipment. All personnel and equipment must pass through the contamination reduction corridor when exiting the exclusion zone. Decontamination of personnel and equipment will be accomplished as described below. Decontamination activities to be conducted in the CRZ will require personal protection as deemed necessary by the SHSO. Due to the small areas on some vessels, the CRZ may be a simple step off/wash area or similar that is moved, as necessary, when not in use.

6.1.3 Support Zone

The support zone (SZ) is located in an uncontaminated area of the site adjacent to the EZ and CRZ. Site access and the majority of site operations will be controlled from this location. The SZ will contain provisions for team communications and serve as a staging area for equipment, office facilities, and emergency response resources. Safety equipment such as emergency eyewash, fire extinguisher, first aid kit, air horns and other equipment will be stored in the SZ and transported to work areas as necessary. No contaminated personnel or contaminated materials will be allowed in this zone except appropriately packaged and decontaminated environmental samples.

6.2 CONTAMINATION CONTROL

The following sections describe the measure that will be taken to control contamination of workers and equipment during the execution of the field activities.

6.2.1 Personnel Decontamination Station

Good personal hygiene, coupled with diligent decontamination, will significantly reduce the potential for exposure.

6.2.2 Minimization of Contact with Contaminants

During completion of all site activities, personnel should attempt to minimize the degree of contact with contaminated materials. This involves a conscientious effort to keep “clean” during site activities. All personnel should minimize kneeling, splash generation, and other physical

contact with contamination. This may ultimately minimize the degree of decontamination required and the generation of waste materials from site operations.

Field procedures will be developed to control overspray and runoff and to ensure that unprotected personnel working nearby are not affected.

6.2.3 Personnel Decontamination Sequence

Consideration will be given to prevailing wind directions so that the decontamination line, the support zone, and contamination reduction zone exit is upwind from the exclusion zone and the first station of the decontamination line. Personnel who are performing decontamination will remove all PPE used in the EZ and place the waste in drums/trash cans in the CRZ. Hand sanitizer or baby wipes shall be available for wiping hands and face.

Decontamination for site personnel wearing Level D PPE will consist of having each worker remove their hard hats, safety glasses, leather gloves, hearing protection, PFDs, and outer protective garments prior to leaving the Site and storing them in a clean area for reuse the next day.

Site personnel engaged in sediment coring and core sample preparation work while wearing Modified Level D PPE will be required to have their boots and gloves washed, rinsed, and removed before leaving the Site. They will also remove their Poly-Tyvek coveralls and place them in a plastic bag for disposal. Re-usable PVC raingear, if worn, will be rinsed clean with water, removed, and stored on site for later use.

Personnel decontamination will be conducted in a CRZ situated adjacent to and contiguous with the EZ. A large wash tub will be placed in the CRZ for workers to stand in while their outer protective clothing is washed and rinsed. Scrub brushes and soap solution may be used to remove mud and soil from clothing.

The SHSO will ensure that the above-mentioned decontamination procedures are effectively controlling the spread of contamination in the work area by periodically inspecting the recently cleaned clothing and equipment for evidence of residual contamination. The work area will also be examined to detect any sign of contamination outside of the work zones. Should it become apparent that contamination is being dispersed into clean areas of the Site, work activities will cease until more effective decon methods can be devised.

6.2.4 Emergency Decontamination

Emergency decontamination is discussed in the Emergency Plan, Section 10.8.

6.2.5 Hand-held Equipment Decontamination

Hand-held equipment includes all monitoring instruments, samples, hand tools, and notebooks. The hand-held equipment is dropped at the first decontamination station to be decontaminated by one of the decontamination team members. These items must be decontaminated or discarded as waste prior to removal from the EZ.

To aid in decontamination and to the extent feasible, monitoring instruments can be sealed in plastic bags or wrapped in polyethylene. This will also protect the instruments against contaminants. The instruments will be wiped clean using wipes or paper towels if contamination is visually evident. Decontamination procedures for sampling equipment, hand tools, etc., shall include the use of steam cleaning or a detergent wash, as appropriate for the site conditions.

6.3 COMMUNICATIONS

The following communications equipment shall be specified as appropriate:

- Telephones – A cellular telephone will be located in the SZ for communication with emergency support services/facilities and the home office.
- Radio – A radio capable of receiving marine channels will be kept on the boat and in the processing area
- Hand Signals – Field teams shall use hand signals along with the buddy system. The entire field team shall know them before operations commence and their use covered during site-specific training. Typical hand signals include the following:

Signal	Meaning
Hand gripping throat	Out of air, can't breathe
Grip on a partner's wrist or placement of both hands around a partner's waist	Leave area immediately, no debate
Hands on top of head	Need assistance
Thumbs up	Okay, I'm all right, I understand
Thumbs down	No, negative

7. HAZWOPER TRAINING AND RECORDKEEPING

The following sections describe the training and recordkeeping requirements for the project.

7.1 HAZWOPER TRAINING

In accordance with Tetra Tech's corporate policy, and pursuant to 29 CFR 1910.120, site personnel shall have had 40-hour General Site Worker training, 3-day supervised on-the-job training, and 8-hour refresher training (if it has been at least 1 year since the initial 40-hour training of HAZWOPER). Personnel who have not met the requirements for initial training shall not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical).

7.2 SITE-SPECIFIC TRAINING

Prior to commencement of field activities, all field personnel assigned to the project will be provided training that will specifically address the activities, procedures, monitoring, and equipment for the site operations. It will include site and facility layout, hazards, and emergency services at the Site, and will highlight all provisions contained within this Plan. This training will also allow field worker, to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity. Boat operators will have demonstrated skills, experience, and/or appropriate training in operating the vessels (work boats and drilling platform) used on this project. The FOL will also have 8-hour Supervisor training.

7.3 ON-SITE SAFETY BRIEFINGS

Project personnel and visitors will be given daily on-site health and safety briefings by the FOL/SHSO to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices, or the Site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

7.4 FIRST AID AND CPR

The SHSO and at least one other site worker shall have First Aid and CPR training in order to ensure that emergency medical treatment is available during field activities. A list of first aid

qualified personnel will be posted at the Site. The training will be consistent with the requirements of the American Red Cross Association.

7.5 HAZARD COMMUNICATION

Hazard communication training will be provided in accordance with the requirements contained in the Tetra Tech's Health and Safety Program EHS 4-2. Material Safety Data Sheets (MSDS) will be readily available for all chemicals brought on site as well as lists of all chemicals monitored. All secondary containers will be clearly labeled as to their contents.

7.6 GENERAL SITE RULES

Attachment C presents Tetra Tech's general site rules that will apply to all Tetra Tech employees and subcontractors associated with this project.

8. MEDICAL SURVEILLANCE

All contractor and subcontractor personnel performing field work where potential exposure to contaminants exists at the Site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120(f).

The Medical Surveillance Program is described in detail in Tetra Tech's Health and Safety Program EHS 4-5. The Corporate Medical Consultant is Work Care in California.

8.1 MEDICAL SURVEILLANCE REQUIREMENTS

A physician's medical release for work will be confirmed by the SHSO before an employee can work in the EZ. The examination will be taken annually or biennially (with physician approval) and upon termination of hazardous waste site work if the last examination was not taken within the previous 6 months. Additional medical testing may be required by the PHSM in consultation with the Corporate Medical Consultant and the SHSO if an over-exposure or accident occurs, if an employee exhibits symptoms of exposure, or if other site conditions warrant further medical surveillance.

8.2 MEDICAL DATA SHEET

A medical data sheet is provided in Attachment D. This medical data sheet is voluntary and should be completed by all on-site personnel and will be maintained at the Site. Where possible, this medical data sheet will accompany the personnel needing medical assistance. The medical data sheet will be maintained in a secure location, treated as confidential, and used only on a need-to-know basis.

9. PERSONAL PROTECTIVE EQUIPMENT

The PPE specified in Table 9-1 represents the hazard analysis and PPE selection required by 29 CFR 1910.132. Specific information on the selection rationale for each activity can be found under Section 4.0 and Attachment B for AHAs. For the purposes of PPE selection, the PHSM and SHSO are considered competent persons.

Modifications for initial PPE selection may also be made by the SHSO in consultation with the PHSM. A written justification for downgrades will be provided to the PHSM for approval as a field change request.

PPE ABBREVIATIONS

HEAD PROTECTION
HH = hard hat

HEARING PROTECTION
EP = ear plugs

EYE/FACE PROTECTION
GOG = goggles
PFS = plastic face shield
SG = ANSI approved safety glasses with side shields

FOOT PROTECTION
OB = overboot
Rub = rubber slush boots
STB = leather work boots with steel toe

HAND PROTECTION
LWG = leather work gloves
Nit = nitrile
Sur = surgical

BODY PROTECTION
WC = work clothes
Cot Cov = Cotton Coveralls
Poly = polyethylene coated Tyvek® coveralls
Saran = saranex coated Tyvek® coveralls

RESPIRATORY PROTECTION
Level D = No respiratory protection required
Level C = Full face air purifying respirator with N-99 cartridges
Level B = Full face air supplied respirator with escape bottle

Because volatile organic compounds are not on the list of contaminants of concern, and given that the material will be saturated and not prone to volatize, air monitoring will not be conducted during the field program. Table 9-1 summarizes the PPE required for each task.

Table 9-1. Personal Protective Equipment Selection

Task	Head	Eye	Feet	Hands	Body	Hearing	Respirator
Mobilization/ Demobilization	HH, if overhead hazard	SG	STB	LWG	WC	EP as determined necessary by the SHSO	Level D
Sediment Surface Sampling	HH, if overhead hazard	SG	STB + OB or Rub	Nit	WC and/or Poly/Saran as determined by SHSO	EP as determined necessary by the SHSO	Level D initially, Modified Level D as indicated by SHSO and when needed to prevent dermal contact with sediments.
Sediment Core Sampling (vibracore and drill rig)	HH, if overhead hazard	SG	STB + OB or Rub	Nit	WC and/or Poly/Saran as determined by SHSO	EP as determined necessary by the SHSO	Level D initially, Modified Level D as indicated by SHSO and when needed to prevent dermal contact with sediments.
Core Sample Preparation	HH, if overhead hazard	SG	STB + OB or Rub	Nit	WC and/or Poly/Saran as determined by SHSO	EP as determined necessary by the SHSO	Level D initially, Modified Level D as indicated by SHSO and when needed to prevent dermal contact with sediments.
Equipment Decontamination	N/A	GOG + PFS	STB + OB or Rub	Nit	WC and/or Poly/Saran as determined by SHSO	EP as determined necessary by the SHSO	Level D initially, Modified Level D as indicated by SHSO and when needed to prevent dermal contact with sediments.

HH = hard hat
GOG = goggles
PFS = plastic face shield
STB = leather work boots with steel toe
OB = overboot
Nit = nitrile
LWG = leather work gloves
WC = work cloths
SHSO = Site Health and Safety Officer
Rub = rubber slush boots

9.1 OSHA REQUIREMENTS FOR PERSONAL PROTECTIVE EQUIPMENT

All PPE used during the course of this field activity must meet the following OSHA standards:

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1
Respiratory	29 CFR 1910.134	ANSI Z88.1
Head	29 CFR 1910.135	ANSI Z89.1
Foot	29 CFR 1910.136	ANSI Z41.1
Hand	29 CFR 1910.138	
Hearing	29 CFR 1910.95	
Protective Clothing	29 CFR 1910.132	

ANSI = American National Standards Institute

Under worst-case dry conditions and contaminate concentrations at the maximum level identified, it is possible for airborne levels to exceed lowest allowed exposure levels (see Table 9-2). In that sampling will be performed wet, and samples will be promptly sealed, exposures significantly less than the levels identified below will be encountered.

To help ensure this, the SHSO shall monitor work conditions. If samples are not kept wet, and visible emissions occur, the SHSO can require the use of personal dust monitoring or compound-specific air monitoring. If dust monitoring is used, an action level of 2 mg/m^3 shall be used to ensure an appropriate safety factor.

Table 9-2. Contaminate Concentrations

	Maximum Soil Concentration (mg/kg)	Percent of Contaminate in Soil	Lowest Air Action Level (mg/m^3)	Maximum Air Contaminate Concentration for 10 mg/m^3 Dust Concentration (mg/m^3)	Maximum Air Contaminate Concentration > Lowest Air Action Level (yes/no)
Arsenic	1420	0.142	0.01	0.0142	yes
Lead	2179	0.2179	0.03	0.02179	no
Zinc (assumed Zinc Chromate)	4810	0.481	0.05	0.0481	no
PCBs	6560	0.656	0.5	0.0656	no
TBT	0.172	0.0000172	0.1	0.00000172	no

Due to the nature of the tasks involved and the size of the Site, the SHSO will choose PPE on a daily basis depending on the operation, location, and the hazards involved in each task. The level of PPE protection will be upgraded or downgraded based on changes in site conditions.

Several factors that may indicate the need to re-evaluate site conditions and PPE selection include the following:

- Encountering or handling contaminants other than those previously identified,
- Commencement of a new work phase,
- Change in job tasks during a work phase,
- Change of season/weather,
- Change in work scope that affects the degrees of contact with contaminants, and
- Change of ambient levels of contaminants.

All major PPE changes that deviate from this plan must be approved in advance by the PHSM.

The various levels of PPE referenced in this plan (Level D, Modified Level D, and Level C) are described below.

Level D

If the potential for direct chemical contact is minimal (such as mobilizing equipment and surveying site), or if workers are going to be outside the exclusion and contamination reduction zones, then Level D PPE will be prescribed as follows:

- Cotton coveralls, leather gloves, hard hat, and safety glasses with side shields;
- Chemical-resistant boots or leather work boots with steel toe;
- High-intensity road vests when working near heavy equipment;
- Optional disposable boot covers and chemical-protective gloves;
- Hearing protection as required; and
- PFDs while on the water.

Modified Level D

Modified Level D will be worn by those site workers who may come into direct skin contact with the contaminated sediments (such as when collecting core samples and examining and preparing core samples for laboratory analysis and shipment) without significant inhalation exposure.

Modified Level D will consist of the following items:

- Disposable PolyTyvek coveralls or equivalent, or lightweight reusable raingear,
- Nitrile gloves and PVC steel-toe boots with optional latex booties,
- Hard hats,
- Safety glasses with side shields,
- High-intensity road vests when working around heavy equipment,
- Hearing protection as required, and
- PFDs while on the water.

Level C

Level C PPE, which includes the use of respiratory protection, is not authorized under this plan.

10. EMERGENCY RESPONSE PLAN

This section establishes procedures and provides information for use during a project emergency. Emergencies happen unexpectedly and quickly and require an immediate response; therefore, contingency planning and advanced training of staff is essential. Specific elements of emergency support procedures that are addressed in the following subsections include communications, local emergency support units, preparation for medical emergencies, first aid for injuries incurred on site, record keeping, and emergency site evacuation procedures.

10.1 RESPONSIBILITIES

The following sections describe the responsibilities of the PHSM, Emergency Coordinator, and Site Personnel, as well as emergency response activities.

10.1.1 Project Health and Safety Manager

The PHSM oversees and approves the Emergency Response/Contingency Plan and performs audits to determine that the plan is in effect and that all pre-emergency requirements are met. The PHSM acts as a liaison to applicable regulatory agencies and notifies OSHA of reportable accidents.

10.1.2 Emergency Coordinator

The Emergency Coordinator is the FOL. In the event of an emergency, the Emergency Coordinator shall make contact with local emergency response personnel. In these contacts, the Emergency Coordinator will inform response personnel about the nature of work on the Site, the type of contaminants and associated health or safety effects, and the nature of the emergency, particularly if it is related to exposure to contaminants.

The Emergency Coordinator shall review this plan, verify the emergency phone numbers on Table 9-1, and review the hospital route prior to beginning work on site. The Emergency Coordinator shall make necessary arrangements to be prepared for any emergencies that could occur.

The Emergency Coordinator shall implement the Emergency Response/Contingency Plan whenever conditions at the Site warrant such action.

10.1.3 Site Personnel

Site personnel are responsible for knowing the Emergency Response/Contingency Plan and the procedures contained herein. Personnel are expected to notify the Emergency Coordinator of situations that could constitute a site emergency.

10.2 COMMUNICATIONS

A variety of communication systems may be utilized during emergency situations. These are discussed in the following sections.

During an emergency, the primary form of communication between field groups in the EZ and the Emergency Coordinator will be verbal communications. During an emergency situation, the lines will be kept clear so that all field teams can receive instructions. A cellular telephone will be available on site.

Air horns will be used to alert site personnel of emergencies. The following signals will be used:

- Two short blasts = shut down equipment, await instructions
- Three short blasts = injured employee, first-aid providers respond
- One continuous blast = site evacuation

The procedure to activate the air horns consists of depressing the air horn button or switch while pointing it in the direction of the area to be signaled. Air horns should be tested at least monthly to ensure that they are working properly.

Field teams will employ hand signals when necessary for communication during emergency situations. Hand signals are found in Section 6.3.

10.3 PRE-EMERGENCY PLANNING

Emergency telephone numbers should be readily available in the immediate work area and in the SZ in order to deal with any emergency that might occur during remedial activities at the Site. These telephone numbers are presented in Table 10-1. A hospital route map is provided in Attachment E. The emergency phone numbers listed are preliminary. Upon mobilization, the SHSO shall verify all numbers and document any changes in the site logbook. Any changes shall also be documented with a field change request form. It is not possible to determine the emergency evacuation routes until the Site is set up. Prior to the commencement of field activities, the evacuation routes for potential emergencies in the processing area and from the vessel will be clearly identified, posted, and communicated to all site personnel.

Table 10-1. Emergency Telephone Numbers

Emergency Service	Telephone Number
Police	911
Fire	911
Ambulance	911
Virginia Mason Hospital	206-624-1144
EPA National Response Center	800-424-8802
Poison Control Center	800-252-5655
Gary Braun, Project Manager	425-482-7600
Phil Barley, PHSM	509-521-4898
U.S. Coast Guard	206-217-6000 or VHF chnl 16

Each person who will be working on the Site or observing the operations will be asked to complete a medical data sheet before fieldwork commences. These data sheets will be filled out during the initial site safety-training meeting and will be kept on the Site. In the event of an incident where a team member has to be taken to a hospital, a copy of his/her medical data sheet will be presented to the attending physician.

10.4 EMERGENCY MEDICAL TREATMENT

The procedures and rules in this Plan are designed to prevent employee injury. However, should an injury occur, no matter how slight, it will be reported to the FOL/SHSO immediately. First-aid equipment will be available on site (see Zip Bulletin No. 108 in Attachment D).

During the site safety briefing, project personnel will be informed of the location of the first aid station(s) that has been set up. Unless they are in immediate danger, severely injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the Site or before the injured person can be transported to the hospital, will be followed closely.

If personnel are transported to the hospital, the FOL/SHSO will provide a copy of the Medical Data Sheet to the paramedics and treating physician. Only in **non-emergency** situations will an injured person be transported to the hospital by means other than an ambulance.

10.5 EMERGENCY SITE EVACUATION ROUTES AND PROCEDURES

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting. If an emergency occurs at the work area, including but not limited to fire, explosion, or significant release of toxic gas into the atmosphere, immediate evacuation of all personnel is necessary due to an immediate or

impending danger. All heavy equipment will be shut down and all personnel will evacuate the work areas and assemble at a pre-determined location.

As field activities at this location are anticipated to be limited to several weeks, evacuation drills may be performed.

10.6 FIRE PREVENTION AND PROTECTION

In the event of a fire or explosion, procedures will include immediately evacuating the work area, the Emergency Coordinator will immediately notify the local fire and police departments. No personnel will fight a fire beyond the stage where it can be put out with a portable extinguisher (incipient stage).

Adhering to the following precautions will help to prevent fires:

- Good housekeeping and storage of materials,
- Storage of flammable liquids and gases away from oxidizers,
- No smoking in the exclusion zone or any work area,
- No hot work without a properly executed hot work permit,
- Shutting off engines to refuel,
- Grounding and bonding metal containers during transfer of flammable liquids,
- Use of Underwriters Laboratory approved flammable storage cans,
- Fire extinguishers rated at least 10 pounds ABC located on all heavy equipment, in all trailers, and near all hot work activities, and
- Monthly inspections of all fire extinguishers.

10.7 OVERT CHEMICAL EXPOSURE

The following are standard procedures to treat chemical exposures. Other specific procedures detailed on the MSDS or recommended by the Corporate Medical Consultant will be followed, when necessary. If first aid or emergency medical treatment is necessary, the Emergency Coordinator will contact the emergency facilities.

Skin and Eye Contact:	Use copious amounts of soap and water. Wash/rinse affected areas thoroughly, then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination. Skin should also be rinsed for 15 minutes if contact with caustic or acid chemical should occur.
Inhalation:	Move to fresh air. Decontaminate and transport to hospital or local medical provider.
Ingestion:	Decontaminate and transport to emergency medical facility.
Puncture Wound or Laceration:	Decontaminate and transport to emergency medical facility.

10.8 DECONTAMINATION DURING MEDICAL EMERGENCIES

If emergency life-saving first aid and/or medical treatment are required, normal decontamination procedures may need to be abbreviated or postponed. The SHSO or designee will accompany contaminated victims to the medical facility to advise on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed on site, a plastic barrier between the injured individual and clean surfaces should be used to help prevent contamination of the inside of ambulances and/or medical personnel. Outer garments may then be removed at the medical facility. No attempt will be made to wash or rinse the victim if his/her injuries are life threatening, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material, which could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed.

10.9 ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

- Project Health and Safety Manager, Phil Bartley, 509-521-4898
- Project Manager, Gary Braun, 425-482-7600
- The employer of any injured worker who is not a Tetra Tech employee.

Written confirmation of verbal reports are to be submitted within 24 hours. The accident/incident report is provided in Attachment D, Field Forms. If the employee involved is not a Tetra Tech employee, his/her employer shall receive a copy of the report.

10.10 ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SHSO in conjunction with the FOL, will determine if work can continue without potentially risking the safety of all field workers.

Some of the items to be considered prior to determining if work should continue include the following:

- Potential for cold, stress, and cold-related injuries;
- Treacherous weather-related working conditions (hail, rain, snow, ice, and/or high winds);
- Limited visibility (fog);
- Potential for floods or high current conditions;
- Potential for electrical storms; and
- Small craft boat advisories.

Site activities will be limited to daylight hours, or when suitable artificial light is provided, and acceptable weather conditions prevail. The SHSO will determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

10.11 SPILL CONTROL AND RESPONSE

All small hazardous spills/environmental releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining the best means of containment and cleanup. For small spills, sorbent materials such as sand, sawdust, or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Any acid spills should be diluted or neutralized carefully prior to attempting recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas should be blocked. All spill containment materials will be properly

disposed as hazardous waste. An exclusion zone of 50 to 100 feet around the spill area should be established depending on the size of the spill. The FOL/SHSO should take the following steps:

1. Determine the nature, identity, and amounts of major spill components.
2. Make sure all unnecessary persons are removed from the spill area.
3. Notify appropriate response teams and authorities.
4. Use proper PPE in consultation with the SHSO.
5. If a flammable liquid, gas, or vapor is involved, remove all ignition sources and use non-sparking and/or explosive proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.).
6. If possible, try to stop the leak with appropriate material.
7. Remove all surrounding materials that can react or compound with the spill.
8. Notify the Project Manager, Gary Braun, 425-482-7600.

10.12 EMERGENCY EQUIPMENT

The following minimum emergency equipment shall be kept and maintained on site.

- Industrial first aid kit (including a CPR kit),
- Bloodborne pathogen kit,
- Portable eye washes (15 minute),
- Fire extinguishers (one per vehicle and heavy equipment), and
- Absorbent material.

10.13 POSTINGS

The following information shall be posted or readily visible and available at conspicuous locations throughout the Site.

- Emergency telephone numbers, and
- Hospital Route Map (see original HASP for Hospital route).

11. LOGS, REPORTS, AND RECORDKEEPING

The following sections provide a summary of required health and safety logs, reports, and recordkeeping for the Project.

11.1 ON-SITE LOG

A log of personnel on site each day will be kept by the SHSO. Originals will be kept in the project file.

11.2 HEALTH AND SAFETY REPORTS

The SHSO shall complete and submit Weekly Health and Safety Reports to the PHSM. These reports are provided in Attachment D.

11.3 ACCIDENT/INCIDENT REPORTS

A Tetra Tech accident/incident report must be completed following procedures given in Section 9.9 of this HASP. The originals will be sent to the Regional Records Coordinator for maintenance by Tetra Tech. Copies will be distributed as stated. A copy of the forms will be kept in the project file.

11.4 MATERIAL SAFETY DATA SHEETS

MSDSs will be obtained and kept on file at the Site for each hazardous chemical brought to, used, or stored at the Site. The MSDS will be kept in the project file.

12. FIELD TEAM REVIEW

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the HASP and the HASP Addendum for site activities conducted on the Lockheed West Seattle Superfund Site, Seattle, Washington. It is maintained on site by the FOL/SHSO as a project record.

Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, the HASP and HASP Addendum and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	Date

ATTACHMENT A

BOATING OPERATIONS

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6.0 REFERENCES

1.0 PURPOSE

The purpose of this program is to establish minimum requirements for boating safety.

2.0 SCOPE

This procedure applies to all Tetra Tech EC, Inc. (TtEC) projects.

3.0 MAINTENANCE

The Director, Environmental, Safety and Quality (ESQ) Programs is responsible for updating this procedure. Approval authority rests with TtEC's President and Chief Executive Officer. Suggestions for revision shall be submitted to both the department responsible for updating the procedure and the Executive Director Compliance and Corporate Counsel.

4.0 DEFINITIONS

4.1 Boat

Any powered or nonpowered watercraft utilized for the transport of personnel on a body of water.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Line Management

The Project Manager (PM) is responsible for coordinating with the appropriate TtEC Project Environmental and Safety Manager (PESM) to implement the requirements of this procedure. The PM shall provide the necessary management support and allocate sufficient project resources to permit project personnel to operate boats in a safe manner.

Site managers and supervisors are responsible for implementation of this boating safety program in the field.

5.1.2 Environmental, Health and Safety Personnel

The PESM shall ensure that the requirements of this program are incorporated into site Environmental Health and Safety (EHS) plans.

5.2 General Requirements

5.2.1 Boat Operators

TtEC personnel who will operate a boat during the course of a project shall first demonstrate to the site manager that they are experienced in operating boats similar to those used for the project and that they are knowledgeable of the U.S. Coast Guard Boating Safety requirements (33 CFR Subchapter S). **Project boats shall be operated by experienced boat operators only.** Boat operators shall also possess basic mechanical knowledge necessary to troubleshoot common mechanical problems that can

and do occur. The boat operator shall be responsible for the safety of all personnel on board the boat he or she is operating and for the integrity of all boat and safety equipment.

Each designated boat operator shall give a safety briefing to all occupants of the boat prior to leaving the shore. **Boats are to be occupied during use by not less than one qualified operator plus one additional person.**

5.2.2 Boat Passengers

Project personnel riding as passengers in a boat shall comply with U.S. Coast Guard requirements presented below.

5.3 Float Plan

The Environmental and Safety Supervisor (ESS) or SM/FOL shall be aware of the location of all project boats and personnel using them at all times. If several boats and crews are involved or are traveling to remote areas, each designated boat operator shall file a written float plan with the ESS or SM/FOL. The float plan shall include the following:

- The names of the boat operator and passengers;
- A description and registration numbers of the boat;
- Radio call sign or cellular telephone number if boat is so equipped;
- A trip itinerary with expected time of return; and
- Steps the ESS or SM/FOL will take to initiate a search response if the expected time of return is exceeded.

5.4 Boat Registration and Numbering

The ESS or SM/FOL shall ensure that all project boats meet U.S. Coast Guard or state boat registration and numbering requirements. The US Coast Guard requires that all motorized boats be numbered in the state of principal use. Many states also require that certain non-motorized boats be numbered (sailboats, rafts, and dinghies). A valid certificate of number showing the numbers issued to the boat is required to be on board the boat whenever the boat is in use. Boat registration numbers are required to be painted or permanently attached to each side of the forward half of the boat. Boat registration must be updated annually.

5.5 U.S. Coast Guard-Approved Equipment

All TtEC project boats will meet or exceed U.S. Coast Guard requirements for safety equipment. These requirements are summarized below for small craft (less than 12 meters in length). The ESS or SM/FOL shall consult with the PESM if larger craft are required.

5.5.1 Flame Arresters

All gasoline engines, except outboard motors, installed in a boat must have an approved flame arrestor (backfire preventer) fitted to the carburetor.

5.5.2 Sound Signaling Devices

Although not required for small craft, all TtEC boats shall carry at least one air horn or similar sound-signaling device.

5.5.3 Personal Flotation Devices

All TtEC personnel and passengers shall wear an approved personal flotation device (PFD) at all times when operating or being transported in a boat. A positively buoyant wet suit or dry suit may be substituted for a PFD. PFDs shall be Type II or higher (capable of turning its wearer in a vertical or slightly backward position in the water). In addition, each boat shall be equipped with at least one Type IV PFD, designed to be thrown to a person in the water and grasped and held by the user until rescued. A buoyant boat cushion equipped with straps and a float ring are two common examples of a Type IV PFD.

5.5.4 Fire Extinguishers

Each boat used by TtEC personnel shall carry at least one Type B-I or B-II fire extinguisher (for use in gasoline, oil and grease fires) approved by Underwriters Laboratories (UL). Each fire extinguisher shall be inspected by the ESS or SM/FOL at least every 6 months to ensure that it is sufficiently charged and that the nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately.

5.5.5 Navigation Lights

Each boat operated at night shall be equipped with navigation lights and these lights shall be utilized at all times when operating between sunset and sunrise. Navigational lighting shall be in compliance with U.S. Coast Guard requirements. Boats shall be operated at reduced speeds at night and when visibility is reduced.

5.5.6 Visual Distress Signals

All TtEC boats shall carry a selection of pyrotechnic and nonpyrotechnic visual distress signals. Pyrotechnic visual distress signals include red flares, orange smoke, and aerial red meteor or parachute flares. Nonpyrotechnic visual distress signals include an orange distress flag and a flashlight or other electric distress light. No single signaling device is ideal under all conditions and for all purposes. Pyrotechnic visual distress signals shall not be used past the expiration date stamped on them.

5.5.7 Pollution Control

The Refuse Act of 1989 prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil, and other liquid pollutants) into the waters of the United States. The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances in quantities that may be harmful into U.S. navigable waters. No person may intentionally drain oil or oily wastes from any source into the bilge of any vessel. Larger vessels equipped with toilet facilities must be equipped with a U.S. Coast Guard-approved marine sanitation device.

TtEC employees shall report any significant oil spills to water to the PESM who must report the spill to the U.S. Coast Guard or other applicable regulatory agency. The procedure for incident reporting and investigation shall be followed when reporting the spill. (See EHS 1-7, Incident Reporting and Investigation).

5.6 Load Capacity

Boats shall not be loaded (passengers and gear) beyond the weight capacity printed on the U.S. Coast Guard information plate attached to the stern. In addition, several factors must be considered when loading a boat: distribute the load evenly, keep the load low, do not stand up in a small boat or canoe, and do not overload the boat.

5.7 Tool Kit

All TtEC motorized boats shall carry a tool kit sufficient for the boat operator to troubleshoot common mechanical problems such as fouled spark plugs, flooded carburetor, electrical shorts, etc. Boats operated in remote areas shall also carry appropriate spare parts (propellers, shear pins, patch kits, air pumps, etc). The tool kit shall be maintained by the boat operator and supplies used up shall be replaced immediately.

5.8 Survival Kit

All TtEC boats utilized in remote areas shall carry a survival kit. The survival kit shall contains, at a minimum, a first aid kit, high-energy canned or preserved foods, drinking water, blankets, a heat source, signaling devices, waterproof matches, and other items as necessary to ensure survival for a minimum of 24 hours for the entire crew. Survival suits may be required by the EHS plans for operations in cold environments.

5.9 Communications

All TtEC boats operated in remote areas shall carry a two-way radio or cellular telephone that enables communication back to the field camp or other pre-established location. Exceptions to this requirement must be negotiated with the PESM.

5.10 Boating Accident Report

The U.S. Coast Guard requires filing of a boating accident report within 24 hours of an accident. TtEC personnel involved in a boating accident shall follow the procedure outlined in EHS plans and EHS 1-7, Incident Reporting and Investigating for accident and injury reporting. This procedure will provide for proper notification of the U.S. Coast Guard.

5.11 Good Housekeeping

TtEC personnel using a boat shall properly stow and secure all gear and equipment against unexpected shifts when underway. Decks and open spaces must be kept clear and free from clutter and trash to minimize slip, trip, and fall hazards.

5.12 Fuel Management

TtEC personnel shall utilize the "one-third rule" in boating fuel management. Use one-third of the fuel to get to the destination, one-third to return, and keep one-third in reserve.

5.13 Training

Boat operators shall be trained on and knowledgeable of U.S. Coast Guard boating safety requirements.

All operators and passengers shall be trained on the requirements of this program. Training records shall be maintained in accordance with EHS 1-9, Recordkeeping.

6.0 REFERENCES

33 CFR Subchapter S, Boating Safety
Environmental, Health & Safety - Programs Procedure EHS 1-7, Incident Reporting and Investigation
Environmental, Health & Safety - Programs Procedure EHS 1-9, Recordkeeping
U.S. Department of Transportation, U.S. Coast Guard

ATTACHMENT B

ACTIVITY HAZARD ANALYSIS

ACTIVITY HAZARD ANALYSIS

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: SITE MOBILIZATION/DEMOBILIZATION — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Mobilization/demobilization of equipment and supplies	1. Back Injuries	1. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
2. Establish Site security, work zones and staging areas	2. Slips/Trips/Falls	2. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
	3. Overhead Hazards	3. Personnel will be required to wear hard hats that meet ANSI Standard Z89.1.
	4. Dropped Objects	4. Steel toe boots meeting ANSI Standard Z41 will be worn during all site activities.
	5. Noise	5. Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs); SHSO will determine the need for hearing protection; all equipment will be equipped with manufacturer's required mufflers.
	6. Heavy Equipment Movement	6. Only trained personnel will operate equipment. A spotter will be used at all times during movement. The operator shall perform the operational safety check prior to the commencement of activities.
	7. Pinch/Cut/Slash	7. Use hand tools properly and wear appropriate protective equipment, cut resistant work gloves will be worn when dealing with sharp objects; all hand and power tools will be maintained in safe condition; guards will be kept in place while using hand and power tools.
	8. Overhead Utilities	8. All overhead utilities will be identified prior to equipment operations; no equipment or personnel closer than 10 feet to energized electrical lines or unprotected/ unshielded circuits or similar structures.
	9. Temperature Extremes	9. Drink plenty of fluids; train personnel of signs/symptoms of heat/cold stress; monitor air temperatures when extreme weather conditions are present; stay in visual and verbal contact with your buddy; and use Temperature Extremes program EHS 4-6.
	10. Hand and Power Tools	10. Daily inspections will be performed; remove broken or damaged tools from service; use the tool for its intended purpose; and use in accordance with manufacturer's instructions.
	11. Inclement Weather	11. Monitor weather conditions daily.

ACTIVITY HAZARD ANALYSIS

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: SAMPLING OPERATIONS — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Collect subsurface soil samples using Vibracore	1. Slips/Trips/Falls	1. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
	2. Chemical Hazards	2. Appropriate protective clothing will be worn during drilling and sampling operations; skin will be rinsed with water if contact with hazardous material occurs; a portable eye wash station will be located by work area; conduct hazard communication training for decontamination and sample preservation chemicals. Follow good personal hygiene practices.
	3. Overhead Hazards	3. All overhead utilities will be identified prior to equipment operations; no equipment or personnel closer than 10 feet to energized electrical lines or unprotected/ unshielded circuits or similar structures.
	4. Dropped Objects	4. Steel toe boots meeting ANSI Standard Z41 will be worn during all site activities.
	5. Noise	5. Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs); SHSO will determine the need for hearing protection; all equipment will have manufacturer's required mufflers.
	6. Heavy Equipment Operation	6. Only trained personnel will operate equipment. A spotter will be used at all times during movement. Operator shall perform operational safety prior to the commencement of activities.
	7. Pinch/Cut/Slash	7. Use hand tools properly and wear appropriate protective equipment, cut resistant work gloves will be worn when dealing with sharp objects; all hand and power tools will be maintained in safe condition; guards will be kept in place while using hand and power tools.
	8. Fire/ Explosion	8. ABC type fire extinguishers shall be readily available. No smoking in work area. Bond and ground portable generator and gasoline can when refilling generator with fuel.
	9. Temperature Extremes	9. Drink plenty of fluids; train personnel of signs/symptoms of heat/cold stress; monitor air temperatures when extreme weather conditions are present; stay in visual and verbal contact with your buddy; and use Temperature Extremes program EHS 4-6.
	10. Hand and Power Tools	10. Daily inspections will be performed; remove broken or damaged tools from service. Use the tool for its intended purpose; and use in accordance with manufacturer's instructions. Ensure water-proof extension cords are used to power equipment.
	11. Inclement Weather	11. Monitor weather conditions daily.

ACTIVITY HAZARD ANALYSIS

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: WORKING ON OR NEAR WATER — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Sampling Operations over water (for hazards related to Vibracore operations, see Vibracore AHA)	1. Chemical hazards.	1. Wear the appropriate PPE. Practice contamination avoidance. Conduct real-time air monitoring. Follow proper decontamination procedures. Ensure sample containers are properly decontaminated before handling them. Wash hands/face before eating, drinking or smoking.
2. Sampling over water	2. Slips/Trips/Falls	2. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
3. Sample handling	3. Drowning	3. A buddy/ rescue person shall be on shore during all activities when personnel are in the water. A throwable flotation device shall be available. Wear PFD when working on or near water deeper than 1 foot.

ACTIVITY HAZARD ANALYSIS

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: DECONTAMINATION — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Decontaminate personnel	1. Chemical Hazards.	1. Wear the appropriate PPE. Practice contamination avoidance. Conduct real-time air monitoring. Follow proper decontamination procedures. Ensure sample containers are properly decontaminated before handling them. Wash hands/face before eating, drinking, or smoking.
2. Decontaminate equipment	2. Slips/Trips/Falls	2. Maintain work areas safe and orderly; unloading areas should be on even terrain; mark and repair if possible tripping hazards.
	3. Overhead Hazards	3. Personnel will be required to wear hard hats that meet ANSI Standard Z89.1.
	4. Dropped Objects	4. Steel toe boots meeting ANSI Standard Z41 will be work during all Site activities.
	5. Noise	5. Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs); SHSO will determine the need for hearing protection; all equipment will be equipped with manufacturer's required mufflers.
	6. Back Injuries	6. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	7. Splashing	7. Wear safety goggles when collecting and handling samples and during well development.
	8. Temperature Extremes	8. Drink plenty of fluids; train personnel of signs/symptoms of heat/cold stress; monitor air temperatures when extreme weather conditions are present; stay in visual and verbal contact with your buddy; and use Temperature Extremes program EHS 4-6.
	9. Inclement Weather	9. Monitor weather conditions daily.
	10. Manual Lifting	10. Use proper lifting techniques. Team lifting will be used for heavy loads or use mechanical lifting devices.

ACTIVITY HAZARD ANALYSIS

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: SAMPLE PREPARATION — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Removing core sample from core tubes	1. Back Injuries from heavy lifting	1. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	2. Contact with contaminated sediments	2. Wear modified Level D PPE. Undergo PPE decontamination. Establish work zones.
2. Examining and preparing core samples for laboratory analysis.	1. Contact with contaminated sediment	1. Wear modified Level D PPE. Undergo PPE decontamination. Establish work zones.

ACTIVITY HAZARD ANALYSIS

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: BARGE MOUNTED DRILLING — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
1. Drilling operations - Inspection of Drill Rig	1. Improper inspection of rig could cause workers to be exposed to hazards associated with operating and mechanical device.	1. The rig and all associate equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. 2. Equipment will be inspected before use and the beginning of each shift. 3. Faulty or unsafe equipment will be tagged and removed from service. No faulty equipment or damaged items will be allowed in the work area. 4. Verify the emergency shutdown system that consists of trip wire located at the right and left rear of the drill. (located on each side – one for the driller and one for the driller's helper). Assure that each wire shuts down the system when the trip wire is pulled or pushed. 5. Inspect the brakes and tire pressure on the drill rig. 6. Inspect all cables on the rig. 7. Inspect all hydraulic and pneumatic hoses.
2. Drilling operations – Set up work area and move rig into position	1. Failure to review site layout plan could cause exposure to potential hazards such as electrocution, damaging of underground utilities, tip over of rig in unstable soil conditions.	1. The site layout plan will become part of this hazard analysis as soon as it is completed. 2. The drilling rig will not be moved into any work area until the site layout plan has been completed and the route of travel to any work site has been assessed for hazards (overhead lines, stability of roads and ground). 3. The site layout plan and the analysis of the route of travel will be covered at the pre-activity safety briefing along with this activity hazard analysis.
	2. Damage to existing utilities.	1. Personnel will contact service facilities engineer before working near utilities. 2. Site access to be provided by client (Invenergy) 3. Assure that weight of rig on ground is evenly distributed and is not so heavy as to damage any underground lines that may be near the surface.
	3. Vehicle may move if not properly set up.	1. Use spotter to properly position vehicle. 2. Set brakes and place wheel chocks under front wheels of mobile rig. 3. Extend stabilizer jacks and ensure that footing is sound. 4. Vehicle must be level to the vertical and horizontal planes.

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: BARGE MOUNTED DRILLING — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
	4. When raising rig, rig may not install properly due to the condition of rig and connecting cables.	1. Inspect all components of rig to determine condition. 2. Make all repairs before raising rig.
	5. When raising rig, mast could come in contact with or close proximity to overhead power lines causing electrocution of workers.	1. Mast and other equipment must be at least 15 feet from any overhead utility lines. 2. Verify the voltage of any overhead power lines. If any lines are above 50kV, the clearance distance must be greater. Refer to the EEM 385-1-1, Section 11, Table 11-3 for clearance required for voltages above 50kV.
	6. Worker may become pinned between rig and other truck components or worker could be pinned under truck rig if servicing of rig from under the truck is required.	1. When any part of the rig or equipment is in motion, workers will stand a sufficient distance from the moving parts so that the worker is not pinned between the moving parts. 2. Workers will not manually "guide" any moving part of the rig when it is raised up. 3. Workers will not work under the rig or the truck. If work must be done under the truck or rig, the drill crew supervisor will contact the SHSS to ascertain a safe method for lockout of the equipment to ensure that adequate blocking is installed.
	7. High winds could destabilize rig. Mast could act as a conductor during a thunderstorm.	1. Check weather conditions and forecasts to determine if conditions are acceptable for use of rig. 2. Do not operate the rig if winds exceed manufacturer's recommended tolerances. 3. Never raise a mast in an area where lightning is within 3 miles of rig.
	8. Noise.	1. Earplugs will be worn whenever drill rig is in operation.
	9. Pinch points.	1. Avoid placing hands in places close to moving machinery. 2. Wear gloves, as appropriate.
3. Drilling operations- start up drill and perform drilling	1. Pressurized hydraulic lines could rupture causing release of hot hydraulic fluid. Hot fluid can ignite if contact is made with engine. Hot fluid can burn workers. Fluid can cause environmental contamination.	1. Personnel will have been trained in the use of drilling equipment. 2. Inspect all hydraulic lines before placing rig in service. Any damaged hoses or connections must be replaced before unit is used. 3. Immediately shut down the equipment. 4. Ensure that first aid kit is readily available to treat injured workers.. 5. A spill control kit consisting of shovel, absorbent material and disposal drum must be available at the drilling location. 6. As quickly as possible, berm the liquid to minimize the area over which the liquid spreads. 7. Loose protective clothing will be restrained with duct tape to prevent entanglement in moving parts.

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: BARGE MOUNTED DRILLING — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
		8. Hands will not be put in areas where parts are moving except as required for drill operation. 9. Drill rig will be moved with the boom down. 10. Refer to EHS Procedure 6-2 "Drill Rigs" for added safety information.
	2. Air hoses or hydraulic hoses under pressure could suddenly release, whip and hit workers causing severe injury.	1. Do not disconnect air hoses and compressors until hose line has been bled. 2. Visually inspect all connection of any lines under pressure. Use safety clamps to connect each side of connection to the other in the event the connection breaks. (the safety clamps will keep the hoses from whipping under the sudden release of pressure) 3. Tie back or attach hoses wherever possible to minimize the length of hose that could whip around in the event that there is a sudden release of pressure.
	3. Strains from manually moving materials, equipment, and drums.	1. Personnel will be directed to use proper lifting techniques such as keeping back straight, lifting with legs, limiting twisting, and getting help in moving bulky/heavy materials and equipment. 2. Mechanical equipment will be used as much as possible. 3. Use care when handling augers or drill rods. 4. Avoid standing under any load. 5. Get help for lifting any item that weighs 50-pounds or more. 6. Follow EHS Program 3-5 "Ergonomics"
	4. The mast could be used to lift other objects as it is being raised causing potential failure of the mast.	1. Masts shall be used in a manner specified by the manufacturer and should never be loaded beyond their capacity.
	5. Workers could climb drill mast and expose themselves to a fall hazard.	1. Climbing on the mast is not allowed.

Project: Lockheed West Seattle — Location: Seattle, Washington

Activity: BARGE MOUNTED DRILLING — Analysis approved by: P. Bartley

MAJOR STEPS	POTENTIAL HAZARDS	PROTECTIVE MEASURES/CONTROLS
	6. Workers could place hands into moving parts of the rig or loose clothing could become entangled in moving machine parts either of which could injure a worker.	1. Chains, sprockets and moving parts will be guarded. 2. Workers will not wear loose clothing, or any jewelry. 3. Workers will not place their hands or any part of their body between the drill auger or rod and the drill plate. Workers should never place themselves in a position where they can come in contact with the moving drill rods or augers. 4. The operator will verbally alert all workers and visually ensure that all workers are clear from dangerous parts of equipment before starting or engaging equipment. 5. Workers will avoid contact with any moving auger. Means will be provided to guard against employee contact with auger. (For example, use barricade of perimeter of auger or electronic brake activated by a presence-sensing device.)
	7. Workers could injure themselves by cleaning the augers while they are rotating.	1. Augers will be cleaned only when they are stopped and in neutral. They will not be restarted until the worker has given a verbal all clear to the operator and the operator has visually determined that the worker is clear of the auger.. 2. Only long handled shovels will be used to move cutting from the auger.
	8. Workers could trip or fall while working on the vessel.	1. All personnel on the vessel will wear Coast Guard approved PFDs 2. The moon hole on the vessel will be clearly identified and not left uncovered when not drilling.
	9. Pinch points.	1. Avoid placing hands in places close to moving machinery. 2. Wear gloves, as appropriate. 3. Keep constantly alert.
4. Removing core sample from core tubes	1. Back Injuries from heavy lifting	1. Site personnel will be instructed on proper lifting techniques; mechanical devices should be used to reduce manual handling of materials; team lifting should be utilized if mechanical devices are not available.
	2. Contact with contaminated sediments	2. Wear modified Level D PPE. Undergo PPE decontamination. Establish work zones.
5. Examining and preparing core samples for laboratory analysis.	1. Contact with contaminated sediment	1. Wear modified Level D PPE. Undergo PPE decontamination. Establish work zones.

ATTACHMENT C

TETRA TECH EC WORK RULES

Tetra Tech EC

GENERAL HEALTH AND SAFETY RULES

1. All site personnel must attend each day's Daily Briefing.
2. Any individual taking prescribed drugs shall inform the FOL/SHSO of the type of medication. The FOL/SHSO will review the matter with the PHSM and the Corporate Medical Consultant (CMC), who will decide if the employee can safely work on-site while taking the medication.
3. All site personnel shall wear the personal protective equipment specified by the FOL/SHSO and in the EHS Plan(s). This includes hard hats and safety glasses that must be worn at all times in active work areas.
4. Facial hair (beards, long sideburns or mustaches) which may interfere with a satisfactory fit of a respirator mask is not allowed on any person who may be required to wear a respirator.
5. All personnel must sign the site log and the exclusion zone log when used at the site.
6. Personnel must follow proper decontamination procedures
7. Eating, drinking, chewing tobacco or gum, smoking and any other practice that may increase the possibility of hand-to-mouth contact is prohibited in the exclusion zone or the contamination reduction zone. (Exceptions may be permitted by the PHSM to allow fluid intake during heat stress conditions.)
8. All lighters, matches, cigarettes and other forms of tobacco are prohibited in the Exclusion Zone.
9. All signs and demarcations shall be followed. Such signs and demarcation shall not be removed, except as authorized by the FOL/SHSO.
10. No one shall enter a permit-required confined space without a permit. Confined space entry permits shall be implemented as issued.
11. All personnel must follow Hot Work Permits as issued.
12. All personnel must use the Buddy System in the Exclusion Zone.
13. All personnel must follow the work-rest regimens and other practices required by the heat stress program.

14. All personnel must follow lockout/tagout procedures when working on equipment involving moving parts or hazardous energy sources.

15. No person shall operate equipment unless trained and authorized.

16. No one may enter an excavation greater than four feet deep unless authorized by the Competent Person. Excavations must be sloped or shored properly. Safe means of access and egress from excavations must be maintained.

17. Ladders and scaffolds shall be solidly constructed, in good working condition, and inspected prior to use. No one may use defective ladders or scaffolds.

18. Fall protection or fall arrest systems must be in place when working at elevations greater than six feet for temporary working surfaces and four feet for fixed platforms.

19. The Supervisor must select safety belts, harnesses and lanyards. The user must inspect the equipment prior to use. No defective personal fall-protection equipment shall be used. Personal fall protection that has been shock loaded must be discarded.

20. Hand and portable power tools must be inspected prior to use. Defective tools and equipment shall not be used.

21. Ground fault interrupters shall be used for cord and plug equipment used outdoors or in damp locations. Electrical cords shall be kept out walkways and puddles unless protected and rated for the service.

22. Improper use, mishandling, or tampering with health and safety equipment and samples is prohibited.

23. Horseplay of any kind is prohibited.

24. Possession or use of alcoholic beverages, controlled substances, or firearms on any site is forbidden.

25. All incidents, no matter how minor, must be reported immediately to the Supervisor.

26. All personnel shall be familiar with the Site Emergency Response Plan.

The above Health and Safety Rules are not all inclusive and it is your responsibility to comply with all regulations set forth by OSHA, TtECs Health and Safety Programs, the EHS Plan(s), the client, TtECs Supervisors, and the FOL/SHSO.

ATTACHMENT D

FIELD FORMS

Tetra Tech EC

MEDICAL DATA SHEET

This brief medical data sheet shall be completed by all on-site personnel and will be kept in the Support Zone by the FOL/SHSO as a project record during the conduct of site operations. It accompanies any personnel when medical assistance is needed or if transport to a hospital is required.

Project:_____

Name: _____ Home Telephone:_____

Address:_____

Age: _____ Height: _____ Weight: _____ Blood Type: _____

Name and Telephone Number of Emergency Contact:_____

_____

Drug or Other Allergies: _____

Particular Sensitivities: _____

Do You Wear Contacts? _____

Provide a Checklist of Previous Illnesses:_____

_____

What Medications are you presently using?_____

_____

Do You Have Any Medical Restrictions? _____

_____

Name, Address, and Phone Number of Personal Physician:_____

_____

ATTACHMENT E

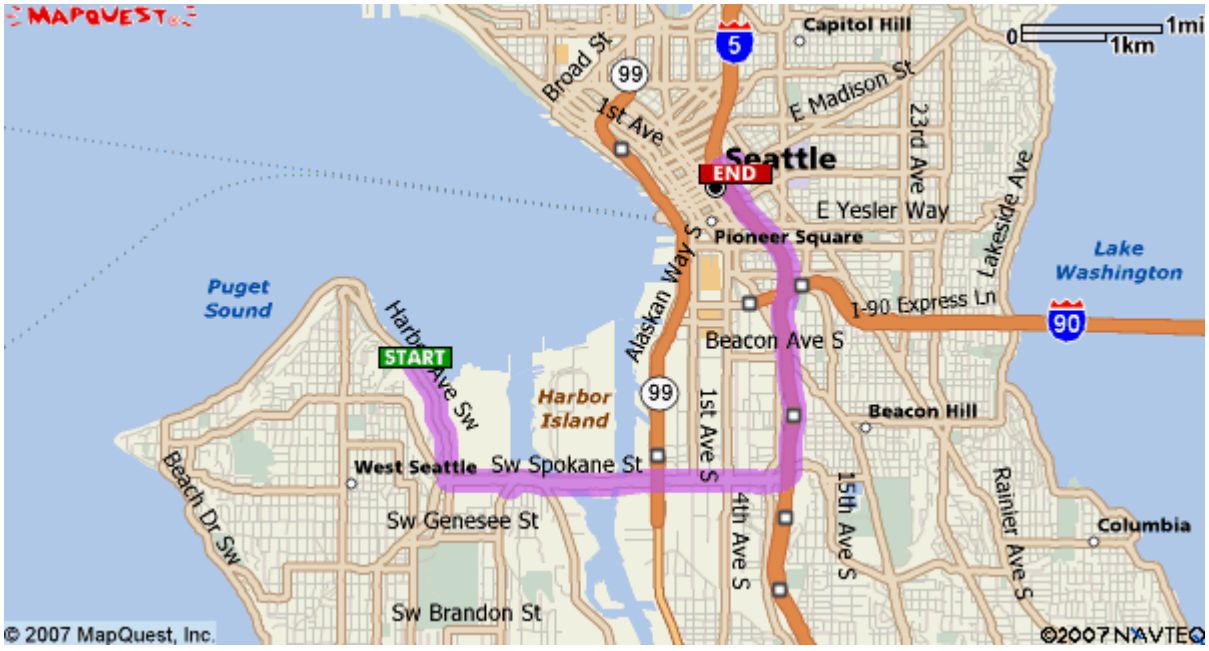
HOSPITAL ROUTE MAP AND LOCATION MAP

Directions from Jack Block Shoreline Access to Virginia Mason Hospital

Start:
2130 Harbor Ave Sw
Seattle, WA 98126-2033, US

End:
Virginia Mason Hospital: 206-624-1144
1100 9th Ave, Seattle, WA 98101, US

Directions			Distance
Total Est. Time: 12 minutes **Total Est. Distance:** 6.21 miles			
	**1:**	Start out going SOUTH on HARBOR AVE SW toward LOTUS AVE SW.	0.9 miles
	**2:**	HARBOR AVE SW becomes SW AVALON WAY.	<0.1 miles
	**3:**	Turn LEFT onto SW SPOKANE ST.	0.3 miles
	**4:**	Take the ramp toward I-5 / WA-99 N.	0.2 miles
	**5:**	Merge onto WEST SEATTLE BRIDGE.	1.7 miles
	**6:**	Merge onto I-5 N via the ramp on the LEFT toward VANCOUVER BC.	1.1 miles
	**7:**	Take the DEARBORN ST. / JAMES ST. exit- EXIT 164A- toward MADISON ST..	1.0 miles
	**8:**	Take the I-5 N exit on the LEFT toward MADISON ST / CONVENTION CENTER / VANCOUVER BC.	0.2 miles
	**9:**	Take the exit toward MADISON ST. / CONVENTION PLACE.	0.2 miles
	**10:**	Stay STRAIGHT to go onto 7TH AVE.	<0.1 miles
	**11:**	Turn RIGHT onto SPRING ST.	0.1 miles
	**12:**	End at **Virginia Mason Hospital:** 1100 9th Ave, Seattle, WA 98101, US	
Total Est. Time: 12 minutes**Total Est. Distance:** 6.21 miles			



Start:
2130 Harbor Ave Sw
Seattle, WA 98126-2033, US

End:
Virginia Mason Hospital: 206-624-1144
1100 9th Ave, Seattle, WA 98101, US

APPENDIX F

RESPONSE TO COMMENTS

RESPONSE TO COMMENTS (dated June 2, 2008) ON THE DRAFT FINAL REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN FOR LOCKHEED WEST SEATTLE SUPERFUND SITE

1. Figure 1-1: It is not clear from this figure when additional data collection will be considered. Currently, the figure indicates this would happen before the RI. Additional text on the data evaluation process should be added to text (Section 8?) and included in Figure 1-1 and Figure 2-2.

Response: Added arrow from RI back to Additional sampling box. Data evaluation discussion was added to the 3rd sentence of Section 13.1: "…assessment of data adequacy to meet the DQOs (including the rationale and basis for any additional data collection needs, if necessary),".

2. Page 2-2, 4th bullet on the page: Specifically identify Tribes.

Response: Edit made as follows:

Background concentrations for COCs (to be determined in coordination with EPA, Muckleshoot and Suquamish tribes, and other stakeholders) will be considered as cleanup criteria if risk-based cleanup criteria are lower and, therefore, not practically achievable; and

3. Page 2-5, 2.5.2 Data Collection Report:
As noted subsequently, identify that that data will be submitted in an MS Access database using a format similar to that employed for the LDW project.

The last bullet in this section might be interpreted to imply that the ability of the data to answer site characterization/risk assessment needs will be evaluated and the need for further samples determined.

Response: Added to the 9th bullet: "in a format compatible with software currently available within EPA Region 10 (MS Access format)." Last bullet was deleted to make description consistent with Section 10.

4. Page 2-9, 2.5.4.5 Feasibility Study: Include state and community acceptance as part of evaluation of FS alternatives.

Response: Modified text to be consistent with Section 13.4:

…2) an assessment of each alternative against each of the CERCLA criteria except Criteria 8 (state acceptance) and 9 (community acceptance) which will be addressed by EPA after the RI/FS report has been released to the public.

5. Page 4-33, 4.6.5 CSM Summary: Bullet one, add dioxins/furans

Response: Edit made.

6. Page 5-2, 5.1.1 Preliminary Remedial Action Objective: "The primary focus of the preliminary RAO development is the impact of the contaminated sediments on benthic invertebrate communities." Clarify this to note that human health risk RAOs are as important as protecting benthic invertebrates.

Response: Edit made. Modified the first sentence as follows:

The focus of the preliminary RAO development is the impact of the contaminated sediments on human health and the benthic invertebrate communities.

7. Page 6-1, 6 Preliminary Remediation Goals and Cleanup Levels: A distinction should be made here between PRGs and RBCs. PRGs are screening values and utilize an HQ of 0.1. This distinction should be made clear in the subsequent text.

Response: The introductory text of Section 6 on Page 6-1 provides a generic definition of PRGs; a more specific definition of PRGs in their use as screening levels is presented in Section 11. In Section 6.2.1, Page 6-2, the concept of risk-based cleanup goals is developed, and RBCs are defined at that point. The concept of PRGs specifically used as screening levels for human health and based on an HQ of 0.1 is introduced in the human health risk assessment text of Section 11 where they are actually used as screening values. However, PRGs are not always based on an HQ of 0.1; for example, sediment management criteria are considered numerical PRGs for sediment benthos, and are not based on an HQ of 0.1. In addition, PRGs can include non-risk-based numerical values, such as ARARs. For that reason, the introduction of PRGs that utilize an HQ of 0.1 is more appropriately done in Section 11 where they are used as screening values for human health risk assessment.

8. Page 6-3, 6.2 Risk-Based Concentrations and Cleanup Levels: 3rd bullet, "Background concentrations for COCs with risk-based levels ~~exceeding~~ **less than** background."

Response: Edit made.

- ***Background concentrations for COCs with risk-based levels less than background.***

9. Page 6-4, 6.2.1.1 Approach: Edit as follows: "The LDW RI did not develop ~~RBTCs in~~ sediment **associated seafood consumption** RBTCs…

Response: Edit made as follows:

For those reasons, the LDW RI did not develop sediment RBTCs that consider bioaccumulation and consequent seafood consumption risks of CPAHs, arsenic, or dioxin/furans.

10. Page 6-5, 6.2.1.2: Sources of Risk-Based Concentration Values:

Edit as follows: "Not all the COCs for the different seafood ingestion scenarios were assigned **sediment** RBTCs…"

Edit as follows: Consquently, sediment RBTCs **that consider bioaccumulation of** arsenic and **c**PAHs and subsequent ~~for~~ seafood consumption ~~scenarios~~ risks were not developed.

Response: Edits made.

Not all the COCs for the different seafood ingestion scenarios were assigned sediment RBTCs due to lack of quantifiable relationships between tissue and sediment concentrations.

Consequently, sediment RBTCs that consider bioaccumulation of arsenic and cPAHs and seafood consumption were not developed.

11. Page 6-6, 6.2.1.2: Sources of Risk-Based Concentration Values:

Please add: "Tissue dioxin/furan results were not available for the LDW project, but it was noted that if tissue dioxin/furan data had been available, that seafood consumption risks would likely have been unacceptable. For the LDW site, sediment dioxin/furan remediation will be based on background levels of these contaminants."

Consultation with Burt Shephard and Larry Burkhard indicates that a BSAF approach is generally unsuitable for mercury. Likely mercury remediation would be based on consideration of background with subsequent monitoring.

Response: Text is added to the end of the paragraph that mentions the LDW seafood consumption pathway:

The draft RI for the LDW Site recognizes that the driving risk scenario for deriving risk-based cleanup levels for the LDW is tribal consumption of seafood, which as mentioned above is also assumed to be the risk driver pathway for the Lockheed West Site. For the tribal seafood consumption scenario at the LDW Site, the COCs driving the cancer risks are total PCBs and arsenic, with contribution from cPAHs. Because it is the driving risk scenario for setting cleanup levels at the LDW site, the procedure for developing RBTCs based on the tribal seafood consumption scenario is described in more detail below. Tissue dioxin/furan results were not available for the LDW project, but it was noted that if tissue dioxin/furan data had been available, that seafood consumption risks would likely have been unacceptable. For the LDW site, sediment dioxin/furan remediation will be based on background levels of these contaminants.

Comment noted. Because of the difficulty in modeling mercury in the biotic environment, EPA documents and guidance generally recommends collection of site-specific data (e.g., mercury report to congress; hazardous waste combustion risk assessment guidance). The use of a BSAF developed from the site-collected data on mercury in clams and sediment would be consistent with that recommendation, at least for shellfish.

12. Page 6-7, 6.2.1.3 RBCs for Indirect Sediment Exposures: Seafood Consumption: It is appropriate to note that PCBs, cPAHs, and arsenic were the primary risk drivers at the LDW site and that these may be the risk drivers for LW. However, the application of the methodology should not be limited to these chemicals, as other contaminants will be evaluated at LW. In addition, the approach taken to address dioxin risks. See comment on 6-6, should be noted here.

Response: Agreed; the second paragraph of the referenced section acknowledges that for any other COCs identified at the LW site other than arsenic, PCBs, and cPAHs, RBTCs will be developed. The following is edited text from the second paragraph of the referenced section:

The above procedures were explored in the draft LDW RI to develop the RBTCs for carcinogenic risk drivers for the indirect exposure pathway of seafood consumption. As mentioned above, BSAFs or regression relationships may be used to develop RBTCs for any risk driver COCs at the Lockheed West Site for which RBTCs have not been developed in the LDW RI, if data are or become available. For dioxins and furans, RBTCs will not be developed in the LDW RI due to the lack of of suitable data, and hence sediment dioxin/furan remediation will be based on background levels of these contaminants.

13. Page 6-8, 6.2.1.4 Approach to Applying Sediment-to-Tissue Relationship Data to the Lockheed West Site:

It should be noted here that BSAFs for the LDW were deemed to be of limited reliability given the decrease in tissue PCB levels that occurred following 2004 tissue sampling. This comment also has applicability to section 6.2.1.5.

Response: Comment noted; text will be edited as follows, in the middle of the second paragraph of Section 6.2.1.4:

Thus the use of any existing LDW data to derive BSAFs would add a high level of uncertainty to risk estimates and cleanup levels. In addition, BSAFs for the LDW were deemed to be of limited reliability given the decrease in tissue PCB levels that occurred following 2004 tissue sampling.

14. Page 6-10, 6.2.1.5 Sediment to Tissue Relationships for COCs, Biota-sediment accumulation factors: Note that the LDW data also support more limited home ranges for shiner surf perch and a larger home range for crab.

Response: The end of the last paragraph in Section 6.2.1.5 Sediment to Tissue Relationships for COCs, Biota-sediment accumulation factors, will be edited as follows:

The LDW ERA and RI present analyses of relationships between chemicals in sediment and those in tissue collected from the LDW that tend to support smaller

home ranges for sculpin and shiner surf perch on an area basis, and larger home ranges for English sole and crab on a site-wide basis.

15. Page 6-11, 6.2.2 Identify Sediment Cleanup Levels: Note that this chapter still needs to discuss whether RME tribal exposure will be parameterized using Tulalip or Suquamish data. If Tulalip data are identified as RME, then the tribes still have the right to request an additional tribal scenario based on Suquamish data.

Response: The end of the first paragraph of 6.2.2 Identify Sediment Cleanup Levels will be edited with an additional sentence identifying the Tulalip survey as the basis for the RME for the tribal scenario, as follows:

The RBCs for the tribal seafood scenario will be developed from the RME exposure parameters, including tribal seafood consumption rates that are documented for RBTC development in the LDW draft RI, which follow from the EPA Region 10 Framework, which includes consultation with the affected tribes. The RME tribal exposure for the Lockheed West site will be parameterized using Tulalip survey data. Selection of whether Tulalip or Suquamish consumption rates constitute RME will be made in consultation with the tribes.

16. Page 6-12, 6.3 Determination of Background Concentrations: Edit as follows: "…based on data collected from the Puget Sound area, **intra site data,** and upstream of the site."

Response: Edit made.

17. Page 6-13, 6.3.1 Existing background data: These background data may be ~~considered~~ **used** for development **of area or** natural background.

Response: Edit made.

18. Page 11-3, 11.2 Scope:

In comments prepared on 11/15/07, EPA noted:

> "It should also be noted that the Lockheed West site is one of many cleanup sites within the Duwamish and Elliott Bay and that these sites must be considered holistically in addressing contamination in the system as a whole. Dividing a larger contaminated area into small cleanup sites and then declaring that exposure assumptions suitable for the larger contaminated area are not applicable to small cleanup sites is not appropriate."

Response: This comment will be added as a quote from EPA in a third bullet on Page 11-3:

- ***Furthermore, EPA notes that "The Lockheed West site is one of many cleanup sites within the Duwamish and Elliott Bay and that these sites must be considered holistically in addressing contamination in the system as a whole. Dividing a larger contaminated area into small cleanup sites and then declaring that exposure assumptions suitable for the larger contaminated area are not applicable to small cleanup sites is not appropriate."***

In comments prepared on 2/25/08 EPA noted:

19. Page 11-3, 11.2 Scope: The point should be made that though the LW site is smaller than the LDW, that it is contiguous with the LDW and the entire system should be remediated in a similar way.

Please strike text utilizing site area as a basis for considering exposure parameters to be unrealistically high.

Response: As per discussion with EPA, the text will not be struck entirely but will be edited, with additional text highlighted below:

An important consideration under this streamlined approach is that no assumptions are made that the exposure parameter values in the LDW risk assessments are directly applicable to the Lockheed West site, and no site-specific exposure parameters are developed. Only exposure concentration data for sediment will be site-specific. Use of the LDW exposure scenarios and all inherent assumptions and exposure parameters for the Lockheed West site is not considered to reflect all site-specific exposures, particularly with the smaller size of the exposure area, limited access to the Site, and limited available ecological habitat under present conditions. Instead, use of LDW exposure scenarios and assumptions is intended to help ensure consistency in site cleanup approaches between the Lockheed West and LDW sites.

20. Page 11-6, 11.3.1.2 Screening Steps, 3rd Item in Outline: It is unclear whether LDW metals background concentrations will be appropriate for LW. Text describing a screening comparison should be struck. Further, in preparing a risk analysis, EPA looks at the risk associated with a contaminant and then identifies the site and background related components of risk. It is premature to implement a background screen at this point.

Response: Edit made. Deleted "for the screening step" at the end of the 2nd sentence. Note that the text specifically states that the background comparison is not a screening step, but only a comparison. EPA guidance allows for a comparison with background in the initial steps, and then evaluates site risks in context with background risks, as the comment indicates. As the work plan text states, no chemicals will be screened for background. The comparison with background is mentioned here only as a potential activity in the risk assessment (consistent with standard HHRA methodology), which will be decided during the actual development of the risk assessment.

21. Page 11-18, 11.3.2.4 Exposure Point Concentrations: Note issues previously expressed regarding instability of PCB tissue concentrations over time and hence uncertainty in BSAFs.

Response: The text will be edited to state that literature BSAFs will be used in the HHRA to develop tissue RBCs, with the use of site-specific data if they become available. LDW site data would only be used if they became available and were approved by EPA.

Add new sentence before last sentence in paragraph:
As described earlier in Sections 6 and 8, BSAFs for developing EPCs in tissue will be taken from the literature, and site-specific data that are presently planned for collection on sediment and clam tissue chemical concentrations may also be used to develop BSAFs.

———

Previous comment 8. Figure 1-1: Site Investigation heading should include potential tissue analysis, not just clam reconnaissance.

Response: Edit made to Figure.

"A clam reconnaissance survey and potential tissue analysis will be completed to identify the presence or absence of deposit feeding clams at the site and for BSAF calculations."

Previous comment 17 and 18: Figure 2-2: Need to see revised Gant chart prior to approving WP. This has not been provided to date.

Response: Figure 2-2 was provided to EPA as part of the review package on 5/14/08.

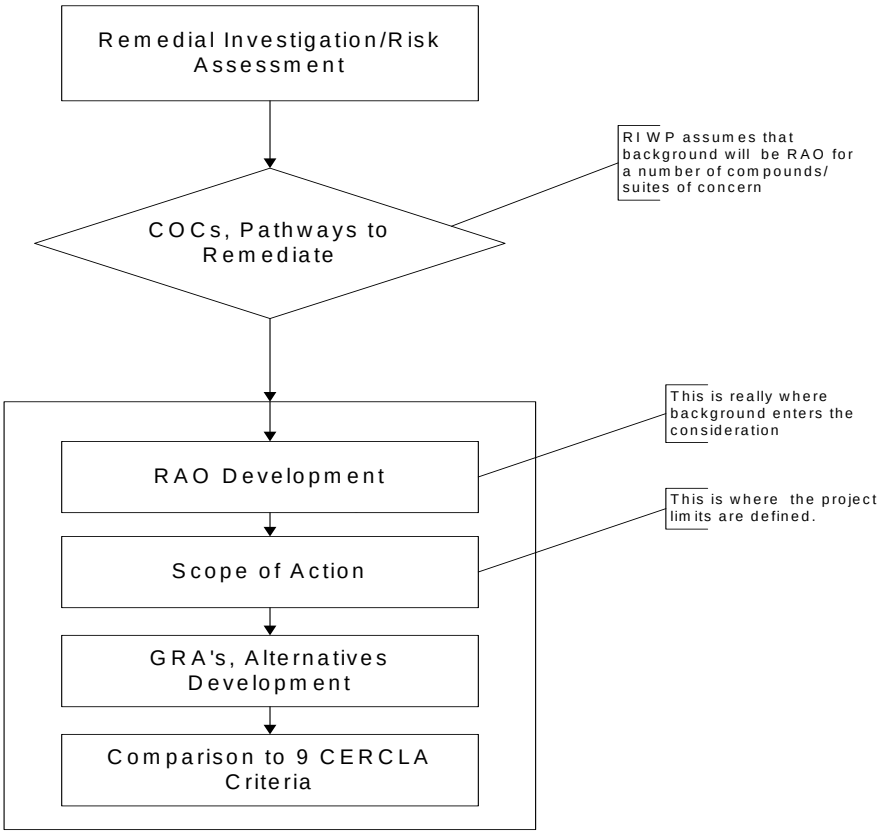
Previous comment 37: Add cPAHs and dioxins to the first bullet as potential COIs entering from other sites.

Response: This comment does not refer to previous comment 37, however reference to cPAHs and dioxin/furans has been included in the first bullet of Section 4.6.5.

RESPONSE TO COMMENTS (dated April 8, 2008) ON THE DRAFT FINAL REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK PLAN FOR LOCKHEED WEST SEATTLE SUPERFUND SITE

General Comments

1. **Comment: Cleanup Boundary Development:** As written, this document refers only to the property boundary of the site and remains silent on the site study boundary and the future development of cleanup boundaries. This may be an artifact of the compression in the streamlining process, which tries to jump ahead of the normal sequence (see figure). Please add an additional paragraph in the Introduction that explains the study boundary will be defined to determine extent of releases from the Lockheed site and extends beyond the property boundary. Following the completion of the RI/FS, the cleanup boundary will then be developed.



Response: The following text has been added to Section 1.2, paragraph 1: "For purposes of illustration, the historical property boundaries are shown on the figures. The property boundaries are not intended to represent the site boundary or the cleanup boundary. These will be determined following the completion of the RI/FS based on extent of historical shipyard contamination."

2. **Comment: Source Control Evaluation.** Add the source control evaluation on to the project schedule. In addition, considering that source control evaluation can be time

intensive and subject to potential data gaps, consider the development of milestones or other deliverables related to source control that may be added to the schedule. At a minimum, a milestone for reviewing current source information and identified data gaps should be added. In this manner, EPA can continue to track the progress of this evaluation in light of the overall project schedule.

1. ***Response: A source control evaluation has been added to the project schedule. The schedule lists selected milestones as per EPA request. Additionally, Section 2.5.3. has been revised to clarify that the Source Control Evaluation approach will be further refined through technical workshops with EPA and the project stakeholders. Details of the Source Control Evaluation approach stemming from the technical workshops will be documented and submitted for review and approval.***

3. **Comment: Uncertainty Management.** Several of the steps in the process outlined in the Work Plan depend upon "external" management of uncertainty, such as relying on the LDW RI BSAFs or trophic models. In some instances, this may not be justified, whereas in other it may be. This comment requests that Lockheed explicitly document uncertainty within the RI/FS report.

   Response: Sources of uncertainty will be documented in the RI and risk assessment reports. The following statement was added to Section 13.1 (Remedial Investigation reporting): Sources of uncertainty, including internal and external sources, will be documented in the RI report and associated risk assessments.

   Comment: In our view, assurance of a marine benthic community that has acceptable levels of tissue-related chemistry is the focus of managing uncertainty. The streamlined approach is not explicitly managing uncertainty or out-referencing to other sites' management. The sediment→tissue linkage is incompletely addressed by the LDW RI because tissue, in particular benthic infauna or deposit feeding bivalves, are the key element in the trophic transfer and thus the risk of several of the site COI. The "adopted BSAF" approach appears to have flaws (areas of incomparable coverage or no coverage in the LDW), and also may be trumped by the sediment background for some key COI. In the FS, we believe it is going to be very difficult to establish a confident relationship that removal or capping of X area will reduce concentrations in tissue to Y. Site delineation may have to address this uncertainty either with conservative factors or with an explicit acknowledgement of the uncertainty and a post-remedy monitoring program to assure that the best estimate in the FS achieves a tissue-based goal. Both the BSAF and the background approaches for sediment should acknowledge this, and include an uncertainty assessment.

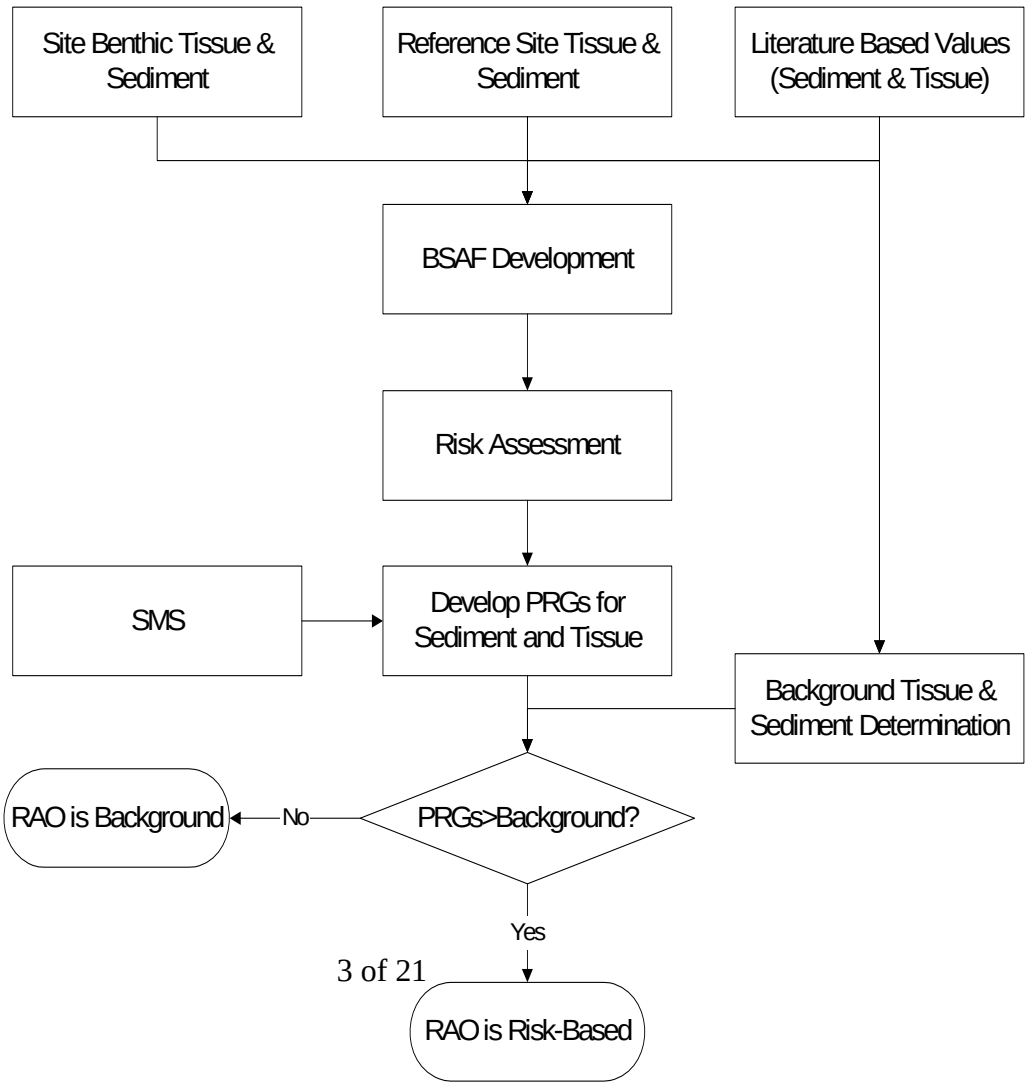
   Response: Section 6.2.1.4 has been revised to more clearly describe the use of LDW data, literature values, and site specific values in the estimating the relationship between sediment and tissue concentrations. Notwithstanding this change, we agree that it will be difficult to establish a confident relationship between sediment and tissue concentrations at the site because sediment may be insignificant relative to other

sources in determining tissue concentrations. There was a low correlation between sediment and tissue concentrations in the LDW evaluations, which strongly suggests that non-sediment sources are the most significant influence on tissue concentrations. As noted above, Section 6.2.1.4 proposes how these evaluations will be performed in the Lockheed West RI, and sources of uncertainty will be discussed in the RI and risk assessment reports.

Comment: As an alternative, tissue background would most precisely measure the biotic component that is likely to be key to the understanding of exposure patterns for trophic level 2 and above receptors. Tissue concentrations at stations with relatively low levels of contamination (along preliminary borders, or in the intertidal) would be useful to confirm protective BSAFs for COC.

Response: We agree that collecting BSAF data from areas of low contamination will provide more conservative estimates of BSAFs. The work plan for clam tissue sampling reconnaissance that was submitted to EPA under separate cover and approved on April 10, 2008 includes this rationale by targeting areas of low as well as high COPC concentrations in Lockheed West site sediments.

Comment: This flow chart shows our preferred approach, which <u>also</u> includes tissue samples.



Response: As agreed with EPA, BSAFs will be developed using the literature-based approach established for the LDW. Tissue sampling would be performed to evaluate the conservativeness of the literature-based approach. The EPA-approved clam sampling reconnaissance Work Plan lists conditions under which site-specific tissue sampling will be completed.

Comment: The sediment RAO may be sufficient for determining the boundary of the actionable area, but not the final completion of the remedy. Tissue RAOs (including a restored benthic community) would be desirable, and may be essential for the long-term monitoring of effectiveness.

Response: Bullets 2 and 3 in Section 5.1.1 already list the RAOs requested in EPA's comment.

4. **Comment:** NRC (2007) [1] stated that "an adaptive management plan is essential to the selection and implementation of remedies at contaminated megasites where there is a high degree of uncertainty about the effectiveness of the remedy." This is not a megasite, but it is certainly embedded within a series of other contaminated sites, some of which are megasites; and can be considered a megasite in terms of the associated complex relationships.

   The components of an adaptive management plan include somewhat flexible performance standards and listing of contingent actions if performance is not met. Some contingent actions may be to better understand the source if recontamination occurs, and then, if recontamination is site-related, to lead to a further action. For illustration that seems relevant to this Work Plan, if a reference (background) tissue data set were the comparison for remedy effectiveness, that would control for systematic changes such as dredging-related suspended solids from other remedial activities in the LDW. Selection of a deposit feeder and a suspension feeder would presumably help understand whether sediment or water were the reason.

   Response: LMC generally agrees with the concept of adaptive management and has included reduction of tissue concentrations as an RAO. The need to establish a reference tissue data set will be evaluated after selection of the remedial action.

5. **Comment:** Should any unconfined, open-water disposal be intended as part of the remedy, based on proximity of upland sources, characterization of prospective dredged material management units for polychlorinated dioxins and furans will very likely be required for this site,. For information, the current interim approach (which will likely be supplanted by another one in a few months) is shown on page 5 of this presentation-- http://www.nws.usace.army.mil/PublicMenu/documents/DMMO/Dioxin_Pub_Meeting_Posters_092407.pdf

[1] National Resource Council of the National Academy of Sciences (NRC). 2007. *Sediment Dredging at Superfund Megasites: Assessing the Effectiveness.* National Academies Press, www.nap.edu

Response: Comment is acknowledged.

Specific Comments

6. **Comment: Figure 1-1, Work Planning, 3rd bullet:** Qualify this statement to note that though all data will be used to identify data gaps, only a subset of the existing data will be used in the RI/FS.

   Response: Text added, "Only validated, existing sediment quality data will be utilized for the RI/FS."

7. **Comment: Figure 1-1, Work Planning, 4th and 5th bullets.** Note that other efforts to characterize background may be required.

   Response: Text added to 5th bullet, "…other efforts to characterize background may be required."

8. **Comment: Figure 1-1, Site Investigation, 1st bullet**. Note that tissue samples may be required.

   Response: See responses to General Comments #3 and #4, above. In addition, bullets were added to Figure 1-1, "Shoreline survey will be completed to identify near shore site features," and "A clam reconnaissance survey will be completed to identify the presence or absence of deposit-feeding clams at the site."

9. **Comment: Page 2-2, Section 2.1, Streamlining the RI/FS Process, third line on page.** Delete the word "cancer," so that the sentence refers to EPA human health risk thresholds, not just cancer risk thresholds.

   Response: Suggested edit made.

10. **Comment: Page 2-2, Section 2.1, Streamlining the RI/FS Process, second paragraph, second line**. Edit the clause "of human health risk based-thresholds" to state "of human health or ecologically based thresholds." The *in-situ* sediments at the site currently exceed both threshold classes.

    Response: Suggested edit made.

11. **Comment: Page 2-2, 2.1 Streamlining the RI/FS Process, 1st text block.** Strike "guidance" here and in all other references to the Framework and just refer to the Framework document as "the Framework." The Framework provides a consistent starting point for EPA in assessing tribal seafood consumption risks, but is not binding on other parties.

Response: Text referring to the Framework "guidance" is removed and referred to as "the Framework" throughout report.

12. **Comment:** P**age 2-2, 2.1 Streamlining the RI/FS Process, 4th bullet.** State how Tribes and other stakeholders figure into the process.

    Response: Text has been revised to state that background concentrations will be determined in coordination with the EPA and stakeholders.

13. **Comment: Page 2-3, 2.2 Lockheed West RI/FS Scope of Work, 1st bullet.** Add "Characterize nature and extent of contamination and consequent ecological and human health risks."

    Response: Clarification has been added to bullets #3 and #6 to address comment.

14. **Comment: Page 2-5, 2.5.2 Data Collection Report.** It is important that data be reviewed and a discussed with regards to whether or not the data collected meet risk based reporting limits.

    Response: This step is implied in the data validation process described in bullet #6

    The work plan provides risk-based analytical concentration goals (RBACGs); these values were used in the data report in a comparison with detection limits to evaluate whether the data met risk assessment needs. The RBACGs were taken from the LDW QAPPs for sediment and benthic tissue sampling.

15. **Comment: Page 2-7, 2.5.4.2 Baseline Ecological and Human Health Risk Assessments, final paragraph of section.** Edit as follows. "…by ~~following~~ utilizing relevant material from the LDW HHRA and applying the tribal Framework ~~guidance~~ (August 2007)…"

    Response: This requests edits very similar to comment #16. The edit suggested in comment #16 was incorporated into Section 2.5.4.2.

16. **Comment:** P**age 2-7, Section 2.5.4.2, Baseline Ecological and Human Health Risk Assessments, Last Paragraph in Section, Last Sentence**. Edit the last sentence to read as follows, "It will address risks to seafood-consuming individuals by following the LDW HHRA, as appropriate, and applying the tribal framework guidance on seafood consumption." It is important to qualify the use of the LDW risk assessments with "as appropriate" in order to allow for consideration of whether all of the assumptions/ conclusions in those studies are appropriate to this site.

    Response: Suggested edits made, except consistent with EPA comment #11, "tribal framework guidance" was abbreviated to "Framework."

17. **Comment: Figure 2-2 Representative Project Schedule.** Add the Source Control Evaluation submittal(s) to the schedule.

Response: See response made to General Comment #2.

18. **Comment: Figure 2-2.** Change the terminology in lines 130-132 from "Preferred" to "Proposed" and add in the legend whether the green shading for "water work window" is that this period is open or closed for in-water work.

Response: Suggested edits made. Clarification has been added for in-water work.

19. **Comment: Page 3-9, Table 3-1, Potential Chemical-Specific ARARs for Lockheed West.** The Toxic Substance Control Act table entry is truncated. Other entries should be checked for truncation as well.

Response: Table formatting reviewed for truncation.

20. **Comment: Page 4-1, Section 4. Summary of Existing Information, Preliminary Conceptual Site Model, and Identification of Data Gaps.** This section should briefly summarize the data that have been collected for the RI/FS to date.

Response: The following paragraph has been added to the Section 4 introduction, "Note: at the time of approval of this Work Plan, the proposed site surveying and sediment quality surveying has been completed. These data are however, not considered to be preexisting information and are therefore not discussed in this section."

21. **Comment: Page 4-4, Section 4.1.4 Ecology Designation for Lockheed West, second paragraph.** Reference the figure showing the area that the Port agreed to remediation (the upland portion of the Site and also the aquatic areas where remedial actions were necessary for constructing new Terminal 5 facilities.)

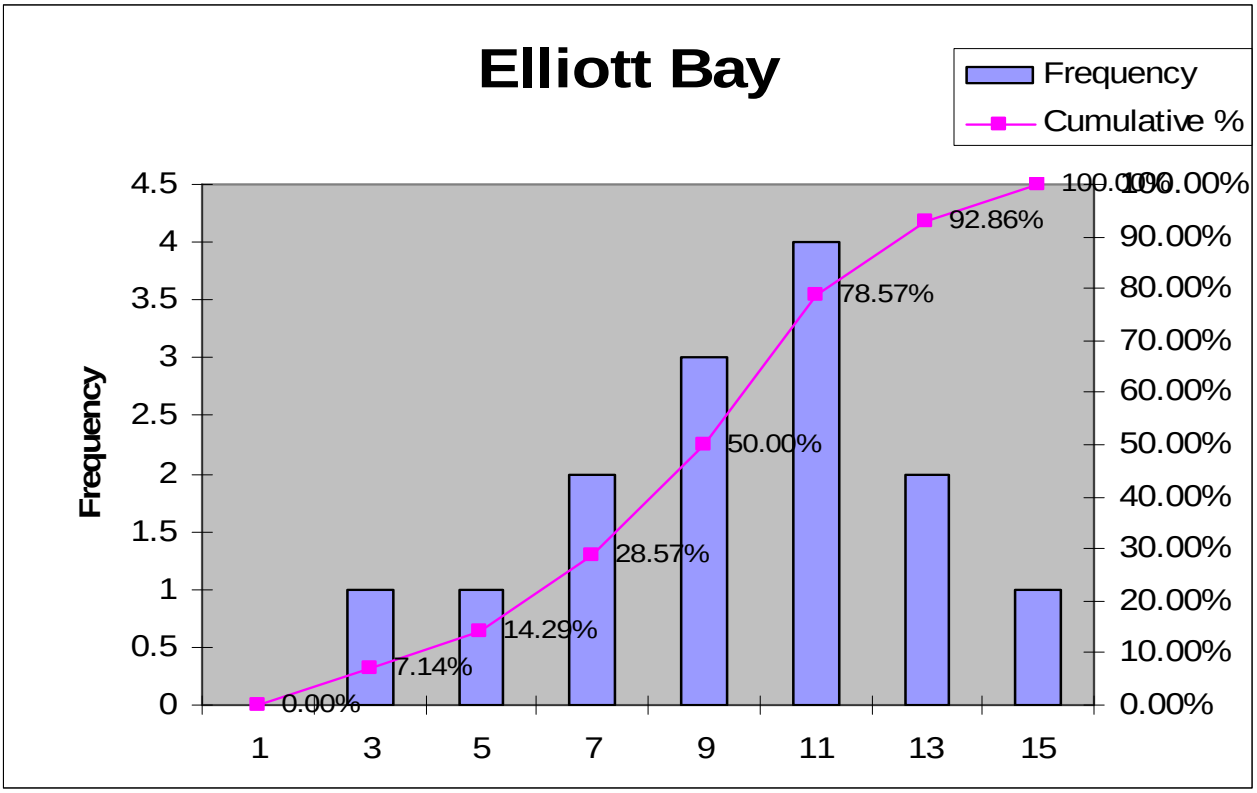
Response: Added reference to Figure 4-8 in text.

22. **Comment: Page 4-10, 4.1.8 Pacific Sound Resources Cleanup Areas.** This section should discuss the contaminants present at PSR, in particular dioxin. Dioxin concentrations at the adjacent capped PSR site should be discussed.

Response: Added reference to dioxin/furan.

23. **Comment:** Historic current patterns may have moved dioxins from PSR to the Lockheed site. Prior to the cleanup there, the sediment ranged from 1-156 ng/kg 2,3,7,8-TCDD Toxicity Equivalents (TEQ). The ongoing PSR monitoring program does not measure dioxins, but the following information is provided with regard to dioxin in the surface surroundings of the nearby Elliott Bay PSDDA site, based on a sample size of 13.

This may reflect input from the PSR site prior to capping. It is not provided as an example of background, but may reflect something of the system-wide dioxin concentrations at a location removed from, and possibly affected by PSR before the remediation there. The x-axis is ng/kg TEQ. The display shows both a histogram (numbers of samples in the range indicated) and a cumulative distribution (line showing the percentage of samples below that interval).



Response: The data referenced in EPA's comment will be considered in the source control evaluation described in Section 12 of the Work Plan.

24. **Comment: Page 4-13, Section 4.2, Site Description including geographic and property boundaries, 4th paragraph.** Define top of bank with an elevation.

Response: Top of bank defined by mean higher high water mark (+11.35 ft MLLW) in text.

25. **Comment: Page 4-13, second to last paragraph.** Reference the figure showing the location of the "sheet pile bulkhead across the apron of the former shipway in the western portion of the Site" or include this on an existing figure and reference it.

Response: Reference made to Figure 4-7 in text and modified Figure 4-7 to include sheet pile bulkhead.

26. **Comment: Page 4-14, Section 4.3 Identification of Potential Historical and Ongoing Sources of Contamination to the Lockheed West Site, Bullets.** Add bank erosion.

Response: Suggested edit made.

27. **Comment: Page 4-14.** Existing and/or historic storm drain locations should be included on maps. Although they have been abandoned, it is important for reviewers of this project to know where the historic lines and outfalls were with respect to the Lockheed West Superfund site.

Response: Abandoned storm drains referenced on Figure 4-10.

28. **Comment: Page 4-17, 4.3.4 Completed Source Control Activities.** See comment on page 4-10

Response: Reference to dioxin/furan added.

29. **Comment: Page 4-18, 4.4.2 Shoreline Characteristics and Vicinity Land Use.** Include a map identifying features/areas cited the text.

Response: Added reference to Figure 1-2 in text. Modified Figure 1-2 to include features/areas cited in text.

30. **Comment: Page 4-19, Section 4.4.2, Shoreline Characteristics and Vicinity Land Use.** Add a general description of bank conditions and presence of armoring or state where this information is already located.

Response: Text added to end of 5th paragraph, "The shoreline of the former shipyard is generally characterized by heavy armoring or bulkheads with the exception of the small intertidal beach located on West Waterway."

31. **Comment: Page 4-19, Section 4.4.2, Shoreline Characteristics and Vicinity Land Use, Last Paragraph in Section, Last Sentence in Paragraph.** Change "southern Elliott Bay" to "Elliott Bay."

Response: Suggested edit made.

32. **Comment: Page 4-26, 4.5.1 Existing Groundwater Monitoring Data.** State the general findings of these ground water studies or indicated where this information is already located.

Response: Made additional reference to Appendix A.

33. **Comment: Page 4-29, Section 4.5.5, Summaries of Previous Risk Assessments, first full paragraph.** This paragraph states that risk assessments "for the West Waterway and downstream areas of the LDW are considered appropriate for comparison in the development of plans for the Lockheed West focused ERA and HHRA." The West Waterway risk assessments may not be appropriate to use for comparisons to the Lockheed West Seattle Superfund Site as the pre-date the Framework. These risk assessments did not incorporate exposure parameters consistent with it or current guidance

Response: Language has been added to this section that the PSR and West Waterway RAs pre-dated the Framework.

34. **Comment: Page 4-31, Section 4.6.2, Types of Contamination and Affected Media, first paragraph in Section.** This paragraph incorrectly states that contaminated sediments are the only affected media of concern at the site. At a minimum, groundwater, fish and shellfish tissue, and, potentially, surface water and soils are additional affected media of concern at the site.

Response: The following text has been added to the work plan: "Sediments are the primary affected media at the site; other potentially affected media include marine organisms that may contact contaminated sediment, surface waters of West Waterway and Elliott Bay that overlie contaminated sediment, and possibly upland sources such as groundwater and upland soils that may contribute to sediment or sediment porewater contamination."

35. **Comment: Page 4-31, 4.6.2 Types of Contamination and Affected Media.** As has been noted in past comments on previous LW RI/FS work plan drafts, the SMS contaminant list does not cover a number of substances that are of human health concern (e.g. cPAHs, dioxins/furans). Add these contaminants. Additionally, SQS/CSL levels of concern for ecological receptors may not be health protective for bioaccumulative contaminants in fish and shellfish consumed by humans.

Response: The text has been revised to include chemicals that have been previously detected at the site or are suspected of contaminating site sediments based on findings of contamination at nearby sites such as the upstream LDW site. Other non-SMS COIs that may be present at Lockheed West based on their known presence in sediments in the upstream LDW site include carcinogenic PAHs and dioxins/furans.

36. **Comment: Page 4-32, 4.6.5 CSM summary, 4th bullet.** Confirm that upland groundwater does not appear to be a contamination source.

Response: The potential for discharge of contaminated groundwater was added to the 3rd bullet. The 4th bullet was deleted.

37. **Comment: Page 4-32, 4.6.5 CSM Summary, 1st bullet.** COIs may also have entered the site from other areas (e.g. PSR dioxins).

Response: Edit has been made to address the comment.

38. **Comment: Page 4-32, 4.6.5 CSM Summary, 4th bullet.** Note that the recent Port Sampling and Analysis Plan is being reviewed by Ecology and when groundwater data is available, it will be evaluated for potential sources to the Lockheed West site.

Response: Comment acknowledged. See Response to Comment #36.

39. **Comment: Page 4-32, 4.6.5 CSM Summary, 5th bullet.** State why a snapshot of bathymetry indicates that the site was stable. EPA believes that repeated bathymetric measurements over time would be required to determine this.

Response: The intent was to show on a gross level that the site is stable because all of the historical features are still visible, meaning they haven't been altered over the decades by erosion or sloughing. The 5th bullet was modified as such, "There is no evidence of mass sediment redistribution at the site as shown by the presence of historically contoured bottom features, such as drydock areas and former pier areas, in the recent hydrographic survey."

40. **Comment: Page 4-35, 4.7.5.2 Sediment Stability.** Expand on the data supporting deposition based on contaminant concentration trends and high resolution multibeam bathymetry.

Response: Clarification was made to better describe the high resolution bathymetry and statements on the data supporting deposition based on contaminant concentration trends were removed.

41. **Comment: Page 4-57, Figure 4-11**. Include the color code for bathymetry depths. The grey text in the figure is hard to make out and the text's relevance is unclear.

Response: Enhanced all figures with bathymetry by changing the contour lines to black and increased contour interval number size.

42. **Comment: P**ag**e 4-59, Figure 4-12.** Superimpose the sampling locations on a bathymetry map with storm drain locations identified as well.

Response: Figure edited as suggested.

43. **Comment: Figure 4-9.** Add text in Chapter 4, that although the Port of Seattle owns a portion (indicated by green) of the contaminated off-shore sediments, that this area will all be remediated by Lockheed Martin.

Response: Section 5.2 describes LMC's cleanup requirements as a minimum, remediation of the Site will consist of placing caps over contaminated sediments identified by the Remedial Investigation as being the result of historical shipyard activities. Other remediation approaches, such as dredging, may also be implemented if site conditions warrant their use.

44. **Comment: P**ag**e 6-2, Section 6.1, Benthic PRGs—Washington Sediment Management Standards, First Line on Page.** Replace "no acute or chronic adverse effects on marine organisms" with "no acute or chronic adverse effects on benthic marine organisms."

Response: Edit has been made as per the comment.

45. **Comment: Page 6-3, Section 6.2.1.1. Approach.** The draft LDW RI did not develop RBTCs for COCs for all exposure pathways for both human health and ecological receptors. State the RBTCs will be developed for contaminants such as arsenic, cPAHs and dioxin/furans for human health seafood consumption. Issues associated with arsenic will be discussed. Include a discussion in the risk assessment.

Response: Text has been added to clarify that the approach to the development of cleanup levels will borrow RBTCs from the LDW RI. The text acknowledges that RBTCs were not developed for all pathways for both human health and ecological receptors. The RBTCs that get developed from the LDW final RI will be incorporated into the Lockheed West cleanup levels, including RBTCs for arsenic. The approach to setting risk-based cleanup levels for the LDW will be incorporated into the approach for the Lockheed West site. This will be mentioned in the risk assessment.

46. **Comment: P**ag**e 6-3, Section 6.2, Risk-Based Concentrations and Cleanup**

Levels, second full paragraph. Add a bullet identifying the Washington State Sediment Management Standards as an additional basis for developing sediment cleanup levels at the Site.

Response: Bullet has been added as per the comment.

47. **Comment: Page 6-5, Section 6.2.1.2, Sources of Risk-Based Concentration Values, first paragraph.** This section states that the LDW RI develops risk-based threshold concentrations (RBTCs) for Chemicals of Concern (COCs) for all exposure pathways for both human and ecological receptors at the LDW. This statement is false. RBTCs were only developed for some risk driver chemicals for certain exposure pathways. Correct this statement in the Work Plan, or else make it more general and address the specific issues in this comment during the Tier 2 process.

Response: The text has been edited to read: "The draft LDW RI evaluates risk-based threshold concentrations (RBTCs) for COCs for all exposure pathways for both human and ecological receptors at the LDW (Windward 2007c), and develops RBTCs for some COCs for some of the exposure pathways and ecological receptors. Not all the COCs for the different seafood ingestion scenarios at the LDW site were assigned RBTCs due to lack of quantifiable relationships between tissue and sediment concentrations."

Additionally, text has been modified where appropriate throughout section.

48. **Comment: Page 6-5, Section 6.2.1.2, Sources of Risk-Based Concentration Values, last paragraph.** This paragraph refers to "risk drivers" several times, when the appropriate term should be "Chemicals of Concern." Revise.

Response: Text has been revised as suggested.

49. **Comment: Page 6-6, Section 6.2.1.2, Sources of Risk-Based Concentration Values, First Full Paragraph.** This paragraph states that for the Tribal seafood consumption scenario at the LDW Site, the COC driving the cancer risk is total PCBs. This is not entirely true. Additional risk drivers may include carcinogenic PAHs and arsenic. Also, dioxin risk from this pathway was never quantified, but was assumed to be significant. Correct or delete this statement.

Response: The statement has been modified to include the additional risk drivers. Since risk-based concentrations were not developed for dioxins, they are not mentioned in this section.

50. **Comment: Page 6-6, 6.2.1.2 Sources of Risk-Based Concentration Values.** The LDW surface sediment QAPP provides RBACGs for cPAHs that could be applicable here. Again, the fact that a filter feeding, rather than a deposit feeding bivalve was used

may account for the lack of a good BSAF relationship between PAHs in bivalves and sediment.

Response: Mention of the lack of a good BSAF relationship for PAHs at the LDW site has been added.

51. **Comment: Page 6-8, 6.2.1.5**. "sit" should be spelled "site."

Response: Edit has been made.

52. **Comment: Page 6-10, 6.2.2 Identify Sediment Cleanup Levels.** MTCA generally uses "natural," as opposed to "area" background for use in establishing cleanup levels that when met, will allow Ecology to consider a site remediated. Again, describe how background will be derived when needed to justify RAOs.

Response: The approach to deriving background concentrations is provided in Section 6.3.

53. **Comment: Page 6-10, 6.2.2 Identify Sediment Cleanup Levels.** There should be some discussion about the process by which tribal consumption rates will be considered RME and suitable for establishing cleanup levels. RBTCs/RBCs based on Suquamish Tribe rates would also be included to characterize difference in cleanup levels that would result from application of higher tribal seafood consumption.

Response: Discussion has been added to the text as requested. The process will follow the EPA Region 10 Framework, which specifies consultation with the affected tribes. The following text has been added, "As described above, the risk-based RGs as developed from RBCs will be based on the RME risk driver scenarios for the Site. The primary risk driver scenario for sediment cleanup is expected to be the tribal consumption of seafood, as it has been identified for the LDW site. The RBCs for the tribal seafood scenario will be developed from the RME exposure parameters, including tribal seafood consumption rates, that are documented for RBTC development in the LDW draft RI, which follow from the EPA Region 10 Framework, which includes consultation with the affected tribes."

54. **Comment: Page 6-11, 6.3 Determination of Background Concentrations.** EPA uses 95% UCLs for determination of background. The Work Plan describes the MTCA approach, which is not applicable to this site. Therefore, delete the references to MTCA.

Response: The discussion of the method that Ecology uses to define background has been deleted. Text has been added to indicate that the approach to background will be based on EPA guidance and will be determined during performance of the RI, and may occur after the background approach to the LDW site has been determined.

55. **Comment: Page 6-12, 6.3.3 Background Concentration Data from the LDW Site.** Modify this section and delete the MTCA background section. Include the EPA 2002 reference for determining background.

Response: Comment applies to Section 6.3. The discussion on the MTCA background approach has been deleted. Mention of the EPA 2002 guidance has been added to the text. Additionally, Section 6.3 has been revised to clarify that the approach to identification of background concentrations will be further refined through technical workshops with EPA and the project stakeholders. Details of the approach stemming from the technical workshops will be documented and submitted for review and approval.

56. **Comment: Page 7-1, 7 Sediment Stability.** State the criteria that will be used to determine the need to progress from Tiers 1 through 3. Or, is it assumed that all three tiers will be implemented?

Response: Clarification has been added, however, it is assumed that all three tiers will be implemented.

57. **Comment: Page 8-7, 8.2.1 Surface Sediment Samples.** Editorial. "In the event a given sample location did not yield…"

Response: Editorial made.

58. **Comment: Page 8-11, 8.3.4 Physical Testing.** Would grain size data also be useful for characterizing sediment transport?

Response: Text has been added to evaluate sediment transport.

59. **Comment: Page 8-11, 8.3.5 Sediment Stability.** Expand on how the multibeam bathymetry results indicate sediment stability. State why Lockheed West is similar to the West Waterway and what specific types of data were collected and what were the results to support this conclusion.

Response: The following text has been added to address sediment stability, "…results of high resolution multibeam bathymetry data do not indicate significant erosional features at the Site. There is no evidence of mass sediment redistribution at the site as shown by the presence of historically contoured bottom features, such as drydock areas and former pier areas."

Additional text has been added to clarify similarities between LW and WW.

60. **Comment: Page 8-12, 8.3.5 Sediment Stability.** Discuss storm events.

Response: Storm event noted discussion has been added.

61. **Comment: Page 8-19/8-21, Figures 8-2/8-3.** Since the proposed samples were taken, the legend text should be modified to reflect this. Figure 8-2 should contain the outline of the work areas to facilitate comparison with Table 8-2.

Response: Figure 8-2 title has been changed to "Historical and Current Sediment Sampling Locations" and legend text edited. Work area boundaries (as shown in Figure 8-1) were added to figure. Figure 8-3—legend text edited.

62. **Comment: Page 8-23, first page of Table 8-1.** Revise wording on Steps 5 and 6 to state that sediment data will be compared to human health and ecological PRGs, and background levels determined as appropriate. No agreement has been reached about using the Elliot Bay samples as background. You may wish to briefly describe the process by which background is to be selected.

Response: Text in the table has been edited as suggested.

63. **Comment: Page 8-25, third page of Table 8-1.** Revise to include clam reconnaissance.

Response: Clam reconnaissance survey added to Table 8-1 (Page 8-25) steps where appropriate.

64. **Comment: Page 8-26, fourth page of Table 8-1.** Revise the problem statement to include refinement of the CSM. Revise Step 3 to include review of West Waterway and LDW information. State the decision rules, or how will they be developed when considering West Waterway and LDW data. In other words, what action(s) will be taken if the West Waterway or LDW are found to be sources of contamination for the Lockheed West site?

Response: Table 8-1 (Page 8-26) modified as appropriate.

65. **Comment: Page 8-28, Table 8-2, Proposed Sampling Stations Rationale.** Remove adjective "proposed" as appropriate. This table should cross reference Maps in Appendix A that would allow for an understanding of historic contamination and how it has reflected selection of new samples.

Response: "Proposed" text deleted from table. Note added to "Rationale" header of table "(Note: Historical sample information is described in Appendix A)".

66. **Comment: P**a**ge 8-30, Table 8-3, Proposed Sampling Locations and Analyses Summary.** Remove "proposed" as appropriate.

Response: "Proposed" text deleted from table.

67. **Comment: Page 9-1, Data Management.** The structure of the database containing site data should be specified. EPA favors a Microsoft Access readable database. A data dictionary and entity relationship diagram should be part of the data deliverable, and it

should be compatible with EIM. EPA and LM should discuss the schedule for incorporation of data into the database. Additionally, EPA should receive all relevant GIS files needed to interpret data.

Response: Text has been added to clarify that data will be delivered in Microsoft® Access format.

68. **Comment: Page 10-1, Field Data Collection and Data Reporting, bulleted list.** The data reports should also discuss how well analytical results met specified reporting limits.

Response: The following text has been added to the 2nd bullet to address the comment, "Data quality assurance/quality control review including how analytical results met specified reporting limits and rules for data reduction and use,"

69. **Comment: Page 11-1, 11.1 Purpose of the Streamlined Risk Assessment, 1st paragraph of section. Final sentence, edit as follows--** "…~~and~~ to support the remedy selection for the sediments that will mitigate risk, and to assist in interpreting the significance of post remedial monitoring results."

Response: Text has been edited as suggested.

70. **Comment: Page 11-2, Section 11.2, second bullet.** Refer to comment on Page 11-4, Section 11.2.

Response: Comment acknowledged.

71. **Comment: Page 11-4, Section 11.2, first bullet.** Add the date of the Framework – August 2007. The Region 10 framework specifies consultation with the affected tribes, rather than application of EPA's interpretation. Therefore, the last sentence should be deleted and instead state "In consultation with the Suquamish and Muckelshoot Tribes, EPA will determine the best approach for applying the Framework at the Lockheed West site." Although the Framework has been used in the Lower Duwamish Waterway HHRA, this was done on a site specific basis and decisions reached are not necessarily transferable to the Lockheed West site. Where the site conditions are similar, the application of the Framework at the LDW site will be considered at Lockheed West.

Response: Edits have been made as suggested.

72. **Comment: Page 11-4, 11.3.1.1 Chemical Data.** Include a table in this Section identifying the COPCs for the site.

Response: COPCs are determined based on the screening steps of the risk assessments. The list of chemicals of interest (COIs) for the site is included as Table 11-1 and is referred to in this section.

73. **Comment: Page 11-6, 11.3.1.2 Screening Steps, 3rd item.** Chemicals should not be screened out based on the fact that their concentrations are less than background. EPA guidance states that risks should be computed for chemicals which may have background contributions and that the site and background components of risk are presented in the risk characterization section. Background should be defined as the 95% UCL on the mean, not the 90th percentile. The rationale for use of the UCL on the mean lies in the assumption that exposure should be characterized using an average and that use of a UCL is desirable to prevent underestimation of the average. Use of the 90th percentile is part of the Dept. of Ecology's methodology and differs from EPA's.

Response: Chemicals are not screened out based on a comparison with background concentrations. Background concentrations identified in the LDW risk assessments are only used for comparison purposes. Mention of the Ecology approach to identifying background concentrations has been removed.

Comment: Summarize the guidance (Role of Background in the CERCLA Cleanup Program, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response, April 26, 2002, OSWER 9285.6-07P),

• The COPCs retained in the quantitative risk assessment should include those hazardous substances, pollutants, and contaminants with concentrations that exceed risk-based screening levels.

Response: Comment noted; COPCs are identified as per the comment.

Comment: The Risk Characterization should include a discussion of elevated background concentrations of COPCs and their contribution to site risks.

Response: A discussion of background concentrations relevant to the Lockheed West site will be provided if appropriate background concentrations are available.

Comment: Naturally occurring elements that are not CERCLA hazardous substances, pollutants, and contaminants, but exceed risk-based screening levels should be discussed in the risk characterization.

Response: All chemical substances that exceed risk-based screening levels are identified as COPCs and will be discussed in the risk assessment.

Comment: See also comment on Page 6-11, 6.3 Determination of Background Concentrations.

Response: Comment noted.

74. **Comment: Page 11-6, Section 11.3.1.2. Screening Steps, Item 4.** In this section, state that "depth of sediment will be evaluated" as it is unclear if the top 10 centimeters will be protective.

Response: The Screening Step mentioned in the comment describes the comparison of the surface sediment chemistry data with risk-based screening criteria. Discussion of an evaluation of the depth of sediment that is protective does not seem appropriate for this section, but will be mentioned in the sediment chemistry data section that describes available sediment chemistry data to be evaluated.

75. **Comment: Page 11-7, 11.3.1.3 Risk-Based Screening Criteria, EPA Screening Criteria for Direct Sediment Exposures.** Specify that all equations used to compute screening levels should be presented in the risk assessment. A table should be provided that defines the exposure parameters and the values used for those parameters in the risk assessment.

Response: The equations that are referred to in the comment are those that are used by EPA Region 6 to calculate RBCs. The web site for the RBCs and the method that EPA uses to calculate them will be identified. Equations and parameters for calculating exposures and risks will be presented in the appropriate sections of the risk assessments.

76. **Comment: Page 11-9, 11.3.1.3 Risk-Based Screening Criteria, Sediment Criteria for Protection of Seafood Consumption, 1st paragraph. Edit as follows.** "~~,~~. ~~with the exclusion of salmon as per the tribal framework guidance (EPA 2006a)~~ The LDW risk assessment determined that the site-related contribution to the salmon body burden of risk driving contaminants was quite small. Multiplying the salmon consumption rate by a site-related contaminant concentration of zero results in zero site-related risks for salmon consumption. Thus, the consumption rate of resident seafood with site-related contamination, 97.5 grams per day, was used. Note-- some editing of subsequent text in this section may be appropriate for clarity.

Response: The text in strike-out was removed, and text is added and edited for clarity as recommended.

77. **Comment: Page 11-13, seafood consumption discussion.** The Lockheed West risk assessment shall include the Suquamish Tribe within the range of tribal populations exposed via seafood consumption.

Response: Comment acknowledged. The section that the comment refers to includes the Suquamish tribal seafood consumption as one of the pathways to be evaluated.

78. **Comment: Page 11-13, Section 11.3.2.1 Exposure Scenarios and Populations, Seafood Consumption.** See comment on page 11-4, Section 11.2.

Response: Comment acknowledged.

79. **Comment: Page 11-15, Section 11.3.2.2 Summary of Human Exposure Assessment Scenarios, 1st full paragraph on page.** The language in this section would be more appropriately provided on page 11-3, 11.2 Scope.

Response: This section summarizes the results of the preceding evaluation of which scenarios and pathways are to be evaluated in the HHRA, and as such is appropriate in its present location.

80. **Comment: Page 11-18, 11.3.3 Toxicity Assessment.** Add that EPA Region's 3 and 6 will be contacted to determine when the toxicity values for their tables were last updated. Depending on the currency of these tables, it may be appropriate to query IRIS and the PPRTV databases for toxicity values.

Response: Values in the Regions 3 and 6 databases will be checked for updates. All toxicity values to be used in the risk assessment will be freshly compiled from IRIS and PPRTV sources, as well as CalEPA, following the tiered approach in the OSWER directive.

81. **Comment: Page 11-19, 11.3.4 Risk Characterization.** Edit as follows to end of paragraph. "<u>The incremental site related risk above background will be discussed as appropriate</u>." The risk characterization section should also note that risks across relevant pathways will be integrated (e.g. netfishing, clamming, and tribal seafood consumption).

Response: Text has been edited as suggested.

82. **Comment: Page 11-21, *Benthic invertebrate communities,*** It would be helpful for some readers to note that the benthic invertebrate community includes clams.

Response: Text has been edited as per the comment.

83. **Comment: Page 11-22, fish receptor discussion.** In the risk assessment, discussion of fish ROCs should include juvenile salmon. All LDW stakeholders did not agree that risk estimates for juvenile salmon were not of concern, particularly for PAHs. Although predicted risks for juvenile salmon were lower than English sole and Pacific staghorn in the Lower Duwamish ERA and there is no reason to predict it would be different at Lockheed West, to include this receptor will clarify the risk assessment regarding salmon. Juvenile chinook were only evaluated for arsenic, cadmium, copper, and vanadium in the Phase 2 ERA; other COCs were screened out in the Phase 1 ERA. If juvenile salmon are omitted, it should be clearly spelled out how the assessment (i.e., other selected receptors) are protective of them.

Response: The work plan and the risk assessment will discuss juvenile salmon as a ROC and why risks to juvenile salmon will not be quantified. The rationale for exclusion is based on an assessment of the site-specific parameters related to juvenile salmon, which include the low exposure duration that would occur for migrating

juvenile salmon appropriate for the small size of the Lockheed West site. In addition, the potential exposures of juvenile salmon to dietary PAHs based on maximum sediment concentrations of total PAHs in Lockheed West sediment is evaluated in context of the maximum concentrations of total PAHs and related dietary exposures in the upstream LDW site. This evaluation compares potential exposures based on sediment total PAHs with those in the LDW. The comparison is based on the evaluation of risks to juvenile salmon from exposure to PAHs that is presented in the LDW Phase 2 ERA (Section A.2.5.2, Table A.2-27), and demonstrates the substantially lower exposures of juvenile salmon to PAHs at the Lockheed West site.

84. **Comment: Page 11-23, Wildlife, bottom of second paragraph,** "Risk-based threshold concentrations for wildlife exposures were also not as sensitive as those associated with human health risks; i.e., human health risks were the drivers of risk-based concentrations that would be the basis of risk-based cleanup levels." Take this sentence out of the document. Whether or not human health cleanup values cover wildlife cleanup values should be considered after the risk assessment. It should not be a factor in selecting wildlife receptors.

Response: Sentence has been deleted as per the comment.

85. **Comment: Page 11-25, bottom,** "Groundwater and its resulting transition zone water may be a concern for direct toxicity of transition zone water to benthic organism." This concept should be included in Figure 11-2 Conceptual Site Model. Put an arrow from the groundwater box to a new transition zone water box, and then an arrow from there to the benthic and shellfish community box.

Response: Modification to Figure 11-2 has been made as suggested.

86. **Comment: Page 11-26, Section 11.4.3.1.** Screening Steps, Item 3 Screening detected chemicals against background. See comment on Page 11-6, Section 11.3.1.2

Response: Comment noted; edits have been made consistent with the response to the comment on Page 11-6.

87. **Comment: Page 11-34, Summary of Biological Resources Evaluated in the Risk Assessments.** List the benthic community as an evaluated biological resource.

Response: Benthic community has been added to the list.

88. **Comment: Page 11-38, Section 11.4.6, Uncertainty Assessment.** The possible magnitude and direction of the uncertainty should also be discussed in this section. This will give the reader a better idea of the limitations of the assessment.

Response: Text has been edited to indicate the possible magnitude and direction of the uncertainty.

EPA Comments on March 2007 Draft Remedial Investigation/Feasibility Study Work Plan

Following are responses to comments provided by EPA on the two draft versions of the RI/FS Work Plans for the Lockheed West (LW) Superfund site on September 24, 2007. These comments were provided by EPA on the initial draft RI/FS Work Plan dated August 2006 and the revised draft dated March 2007.

After submittal of the August work plan, EPA met with Lockheed Martin Corporation (LMC) representatives and its consultants to informally discuss shortcomings of the work plan prior to documenting their concerns. Comments that were inclusive of the project trustee reviewers were provided to Lockheed Martin by EPA. Concurrent with EPA's review of the August Work Plan, Lockheed Martin was also in discussion with EPA regarding a change in the scope of the overall RI/FS. That is, the PRP proposed, and EPA accepted, that Lockheed Martin streamline the overall RI/FS approach in order to get to a cleanup decision sooner.

Prior to approval of the RI/FS Work Plan, Lockheed Martin revised the Sampling and Analysis Plan submitted as part of the August Work Plan (SAP, January 2007) to collect data identified as "data gaps" in the August 2006 Work Plan and to address the goals of the streamlined RI/FS approach. The SAP was approved by EPA to allow field data collection activities to commence. Lockheed Martin, with approval from EPA, implemented the data collection activities identified in the SAP in January 2007.

In response to the informal comments and discussions with EPA, Lockheed Martin prepared and submitted the March 2007 RI/FS Work Plan documenting these decisions. After reviewing the revised Work Plan (March 2007), EPA submitted comments covering both the August 2006 and March 2007 Work Plans. Many of the comments EPA had on the August 2006 Work Plan were addressed in the March 2007 Work Plan, the January 2007 SAP, and or the January 2007 sampling efforts.

EPA worked with LMC in October 2007 to determine which comments remained applicable to finalization of the Work Plan and would not be addressed in the second revision of the document, either because they had been addressed in the March 2007 Work Plan or the January 2007 SAP. Comments that were determined to be no longer applicable or had been responded to were deleted from the list of comments.

Following are the remaining comments for the LW RI/FS Work Plan. These comments were received from EPA in the form of:

- General Comments in the September 24, 2007 EPA Cover Letter to LMC transmitting formal comments on the RI/FS Work Plan (EPA Cover Letter 9/24/07)
- Electronic Redline/strikeout comments on the March 2007 version of the RI/FS Work Plan (EPA Redline Comments on March 2007 Draft)
- Comments on LMC's proposed response matrix table for the EPA's informal work plan comments on the August 2006 version (Response Matrix Table to EPA Comments)
- Supplemental Comments from EPA Risk Assessor on the March 2007 RI/FS Work Plan (EPA Risk Assessor Comments on March 2007 RI/FS Work Plan)

Many of the specific comments can be separated into six general categories including: 1) use of historical data, 2) source control, 3) sediment fate and transport, 4) risk assessment approach, 5) determination of background, and 6) editorial. All of the EPA comments have been grouped by the above categories, irrespective of their source. For tracking purposes, the original EPA comment identification and numbers were retained. For each of the general categories a specific response is presented. Additional responses are provided for comments not fully addressed by the overall response.

USE OF EXISTING DATA

Generalized EPA Comment: Independent validation of historical/existing data for use in the Lockheed West RI/FS has not been completed. Although the data has been assumed to be acceptable as qualified for its intended project purpose, EPA will not allow for its use in delineating the current site condition without a more complete data validation. This does not mean that unvalidated data can not be used at all. Such data could be used in a qualitative way as long as the status of that data is clear.

Response: Historical/existing data are presented to provide context for the site to help guide identification of data gaps for completion of the RI/FS including preliminary nature and extent of contamination related to historical shipyard activities. In most cases the background information to complete a detailed QA/QC review is not available and therefore, QA/QC reviews cannot be completed. The historical/existing data are useful for developing a preliminary understanding of the conceptual site model for contamination that serves as a basis for determining additional sampling and analysis requirements. A comprehensive field sampling program was recently completed under an EPA-approved SAP, therefore reliance on the historical/existing data are minimized. The current analytical data will be used in the RI/FS. Historical geotechnical data are considered to be valid since it describes only the physical properties of the sediments which have unlikely changed over-time. Historical geotechnical data will be used in conjunction with the recently collected geotechnical data. Historical/existing chemistry data will be compiled into an appendix and a qualifier will be presented that explains that the information is presented for informational purposes only. A statement on the usability of the existing geotechnical data will be added based on a review by a professional engineer.

EPA COVER LETTER COMMENT:

1. Comment: Use of Historic Data. EPA does not understand how the data collected before LW was listed on the NPL and the data collected after the NPL listing will be used. Data collected before EPA listed the site on the NPL needs to be validated or moved to an appendix. Data collected, analyzed and reported but not validated according to EPA standards should be placed in an appendix with the qualifier that states that the data in the appendix was not collected under EPA oversight and has not been reviewed and assessed data validity and usability. It is very important that EPA and Lockheed Martin (LM) have a good detailed common understanding of why/how data is/was collected, analyzed, interpreted and used. This does not mean that unvalidated data can not be used at all. Such data could be used in a qualitative way as long as the status of that data is clear.

Response: Comment addressed under category response.

EPA COMMENTS ON MARCH 07 DRAFT WP2.DOC:

3. Comment: Figure 1.1 Under Work Planning Box, 3rd bullet: We need to discuss how existing site data, gathered under Ecology oversight, will be used.

Under Work Planning Box, 5th and 6th bullets: The process for determining background has not been determined, nor the process for establishing cleanup numbers.

Under Site Investigation Box, last bullets: The process for determining background has not been determined.

Under Risk Assessment Box, first bullet: Is this still accurate?

Under Risk Assessment Box, last bullet: Data gathered under Ecology oversight should be included in an appendix unless LM plans to use it numerically. Data to be used numerically should be validated and assessed for usability.

Under the Remedial Investigation and Feasibility Study Box, first two bullets: We need to discuss how existing site data, gathered under Ecology oversight.

Response: Comment addressed under category response. Figure 1.1 was updated to address the comment.

Existing data collected under Ecology oversight will be presented for background purposes and to inform new data collection approaches.

Text has been added to clarify that the sampling will be performed to assist in the determination of background. It is recognized that the initial round of sampling is for the purposes of background range finding.

Text has been edited to better describe the currently agreed on risk assessment approach.

4. Comment: Section 2.1 first paragraph Need to discuss how the Ecology data is going to be used. The data has not been validated nor assessed for usability by EPA.

Response: Comment addressed under category response.

5. Comment: Section 2.1 second paragraph Useful in what way? Explain this in more detail. Other references to the data imply that data will be used in a quantitative decision making sense.

Response: Comment addressed under category response.

10. Comment: Section 2.1 second bullet issue of use of Ecology data.

Response: Comment addressed under category response. "and existing information" deleted from sentence.

13. Comment: Section 2.2 first paragraph Please explain this further. Same as other concerns about the use of Ecology data.

Response: Comment addressed under category response.

16. Comment: Section 2.5.3.1 How will "usability" be determined?

Response: Comment addressed under category response.

17. Comment: Section 2.5.3.1 The text can contain a brief discussion of what is revealed by the historical data but also qualified that it is not reviewed and approved by EPA due to a lack of validation and usability. The longer descriptive sections of the historic data and the data itself should be move to the appendix.

Response: Comment addressed under category response.

23. Comment: Section 4.0 Please explain. It does not appear that validation of existing data was completed according to EPA standards. How was the data determined to be useful (e g., usability in the sense of data validation and data usability assessments, risk assessment data usability)

Response: Comment addressed under category response.

24. Comment: Section 4.1.4 fifth paragraph Revise to "According to Ecology's assessment, the Central Area is the only area of the ... "

Response: Edit made in Section 4.1.6 Ecology Delineation of Cleanup Areas.

25. Comment: Section 4.1.4 fifth paragraph Revise to "According to Ecology's assessment, the Central Area is the only area of the … "

Response: Edit made in Section 4.1.6 Ecology Delineation of Cleanup Areas.

26. Comment: Section 4.1.4 six paragraph Revise to: "the EPA..."

Response: Edit not made. Suggested change inappropriate to the context of the sentence.

27. Comment: Section 4.1.4 seventh paragraph Revise to: According to Ecology..."

Response: Edit made in Section 4.1.6 Ecology Delineation of Cleanup Areas.

28. Comment: Section 4.1.4 seventh paragraph Strike-out unless the data set has been validated and assessed for usability or include in Ecology section.

Response: Sentence deleted from Section 4.1.6 Ecology Delineation of Cleanup Areas.

32. Comment: Section 4.1.5 tenth paragraph Validation and usability issue. Issue is the role of Ecology data. Can it be used to make quantitative evaluations?

Response: Comment addressed under category response.

33. Comment: Section 4.1.5 last paragraph For what, the Uplands, transport to sediments?

Response: Added "upland" to sentence in Section 4.1.7 Completed Upland Cleanup Actions.

47. Comment: Section 4.4 See EPA's comment on Section 4.4 which is: "Summary of site physical data is incomplete. Provide actual data from prior studies (and cite references throughout) for tidal currents, etc. Provide 1, 10, 25, and 100 year return period data for Lower Duwamish Waterway (LDW) flows, Elliott Bay waves, etc. The site and adjacent areas have been studied extensively (e.g., Elliott Bay Study circa 1996, various studies for Multi-User Disposal Facility, University of Washington River Histories Project, etc.). Please reference applicable studies and cite important data and conclusions from these studies. Make it clear how these conclusions are applicable for this project. References and data should be traceable to there original documents, not just generally described." Indicate the locations in the text that responses to the above comments were made.

Response: Comment addressed under category response. Available data has been presented and cited as appropriate.

48. Comment: Section 4.4 This data is dated. How reliable is it?

Response: Comment addressed under category response.

49. Comment: Section 4.4.6.2 how does this fit with the paper from the Muckleshoots?

Response: Section was prepared prior to receipt of data from Muckleshoots. Section was updated, as appropriate.

50. Comment: Section 4.4.7.1 How does this paragraph fit with the 2nd to the last sentence in this paragraph?

Response: This paragraph describes the different sediment loading for the Duwamish River and also the Green River that flows into the Duwamish. The estimated percent of load settled is for the Duwamish River load. Text has been clarified.

51. Comment: Section 4.4.7.1 Is this consistent with the paper submitted to Lockheed from the Muckleshoots?

Response: See response to comment 49.

52. Comment: Section 4.4.7.1 Where is the data to support this statement?

Response: There are no Site specific data to support this hypothesis. Text has been modified to qualify the assumption.

53. Comment: Section 4.4.8 Please elaborate on groundwater flow data. Is any data available indicating groundwater flow velocities, discharge zones, etc., from prior studies?

Response: Information is included in the Aspect Consulting hydrogeological report (2005; Appendix A.4)

54. Comment: Section 4.5 Ecology data should be presented in an Appendix unless it has been evaluated for usability and has been validated.

Response: Comment addressed under category response.

55. Comment: Section 4.5 Not always clear how the older data will be used?

Response: Comment addressed under category response.

56. Comment: Section 4.5.2 Groundwater data has not been collected from the T-5 uplands for many years so how can the statement that groundwater has minimal impact from soils?

Response: Comment addressed under category response. Existing historical data demonstrated that groundwater contained relatively low concentrations of upland COC's. New data will be incorporated as it becomes available.

57. Comment: Section 4.5.4 How reliable is this data given the age of the data?

Response: Comment addressed under category response.

58. Comment: Section 4.5.5 This entire section is inadequately explained and lacks the information to support its statements.

Response: Comment addressed under category response. Clarification will be added where appropriate to explain that it is assumed that the data are adequate for use as it is qualified given that the information was typically gathered under regulatory oversight and review.

59. Comment: Section 4.5.5.1 If the data is lacking in validation information, why is it suitable to be used for temporal trend analyses?

Response: Comment addressed under category response. Temporal trends are presented for informational purposes only.

60. Comment: Section 4.5.5.1 second paragraph insert "may be" or at least there should be multiple lines of evidence to support the idea of contaminant trends.

Response: "may be" inserted into text.

61. Comment: Section 4.5.5.1 second paragraph at least there should be multiple lines of evidence insert "may be"

Response: "may be" inserted into text.

62. Comment: Section 4.5.5.1 second paragraph or instead of comment NU 54, add "in a qualitative sense."

Response: Inserted "in a qualitative sense" into sentence.

63. Comment: Section 4.5.5.1 third paragraph Where is the validation? EPA does not understand how the determination of validation was made.

Response: Comment addressed under category response.

64. Comment: Section 4.5.5.1 third paragraph where is the analysis that shows that the geotechnical data is correct for current use. Also it is hard to follow how the pre-2003 data will be used.

Response: Comment addressed under category response.

65. Comment: Section 4.5.5.2 This survey does not follow EPA guidance and again only conducted for acute ecological risks.

Response: Comment addressed under category response.

66. Comment: Section 4.5.5.2 second paragraph This is not adequate to demonstrate that the data is valid.

Response: Comment addressed under category response.

67. Comment: Section 4.5.5.2 third paragraph Provide very specific information about how the 2003 data is used. Provide the information that will allow EPA to validate the data.

Response: Comment addressed under category response.

68. Comment: Section 4.5.5.3 What was done at one site does not mean it is appropriate for Lockheed West unless determined by EPA. Additionally standards and protocols change over time due to new standards, studies, and etc. EPA thinks this presentation is inadequate.

Response: Comment addressed under category response.

69. Comment: Section 4.5.5.3 Present the 2003 data and geotechnical data for verification of conclusions presented in this paragraph. As with all the conclusions presented in this RI/WP data to substantiate conclusions must be provided to EPA for verification.

Response: Comment addressed under category response.

70. Comment: Section 4.6 The entire Section 4.6 should be deleted. The data is old and not validated. What is the purpose of this presentation particularly when Lockheed stated the data was not going to be relied upon?

Response: Comment addressed under category response. Entire section removed and inserted into Appendix A.

71. Comment: Section 4.6 The usability of SEDQUAL is questionable.

Response: Comment addressed under category response. Entire section removed and inserted into Appendix A.

72. Comment: Section 4.6.1 Please consider whether dioxin is a chemical of interest.

Response: Entire section removed and inserted into Appendix A.

73. Comment: Section 4.6.2 This is only for acute effects and not bioaccumulation for human health. Also this is based on non-validated data. EPA disagrees with this analysis. Is this statistically valid?

Response: Comment addressed under category response. Entire section removed and inserted into Appendix A.

74. Comment: Section 4.6.2 Please verify these sections for accuracy. For example, in Section 4.6.2.1 (third sentence), please clarify what the PCB criterion is, such that only one sample exceeded the criterion. Numerous samples appear to exceed SQS.

Response: Comment addressed under category response. Entire section removed and inserted into Appendix A.

76. Comment: Section 4.6.4 Where is the data to support this?

Response: Comment addressed under category response. Entire section removed and inserted into Appendix A.

78. Comment: Section 4.6.5.2 The trend analyses are based on data that have not been subject to a data validation/ usability assessment. Even accepting the data, we do not concur with the categorization of all trends. For example, we suggest that LPAHs and PCBs in the shipway area be considered "stable" not "decreasing." PCBs in the central area and arsenic in the dry-dock area appear to be indeterminate, not decreasing. The concluding statement in the third to the last sentence of the last paragraph of this section, which states that contaminants whose concentrations are not decreasing are likely to be transported to the site from the Duwamish and West Waterway is not supported by evidence. Covering the site-contaminated surface sediments by the deposition of cleaner sediments from upriver appears to be the reason for the declining concentrations.

Response: Comment addressed under category response. Entire section removed and inserted into Appendix A.

79. Comment: Section 4.6.5.2 Summary Section Delete of all of Section 4.6. It is all based on unvalidated historical data and should go into an Appendix..

Response: Comment addressed under category response. Entire section removed and inserted into Appendix A.

80. Comment: Section 4.6.5.2 Summary section Tables 4-3 through 4-6 should go into appendix containing historical data.

Response: Comment addressed under category response. Entire section removed and inserted into Appendix A.

97. Comment: Figure 4-12 Please revise the symbols/colors for the well locations (existing versus historical), because they are too similar. This comment was made on the prior version of the Draft Work Plan, but apparently not addressed.

Response: Edits have been made.

98. Comment: Figure 4-18 Why is West Waterway data not included?

Response: No subsurface data was identified for the West Waterway.

99. Comment: Figure 4-20 Why are data in West Waterway (apparently from 1991) included on this figure, but not on other figures? Please clarify sample dates, and explain what each figure is intended to illustrate.

Response: Figure 4-20 was developed after additional data was provided by EPA. This figure is intended to represent a comprehensive summary of surface sediment quality in and about the former shipyard.

100. Comment: Figure 4-27 Arsenic (North): Some of the data points appear to be omitted. Arsenic (Dry Dock): Some of the trend lines appear to be omitted (when added, results appear indeterminate).

Response: Trend analysis has been removed from the Work Plan given that that no-action and natural attenuation alternatives will not be evaluated.

MATRIX TABLE WITH EPA COMMENTS

7. Comment: Section 4 The summary of existing information is incomplete and the conclusions drawn from the studies (individually and collectively) not articulated. The RI/FS process must build on these existing studies and therefore, a more substantial summary of all available studies must be included. Please provide such a summary of all prior site studies in tabular format listing study, date, author, description of activities (e.g., number of samples, analytes, etc.), data validation/data usability. A discussion summary of the results for each study must also be presented. If data is rejected, please explain the reason.

Response: As discussed in our recent meeting, LMC's philosophy toward the summary of existing information was to document that substantial work had been conducted at the site, but that most of it was dated and not going to be used directly in the RI and associated risk assessments. Thus, we provided a higher level summary of the data. A table, as suggested by the comment will be added to the text to help in the data summary.

Comment: EPA assumed, at the time of the comment, that the historic data was going to be validated. All text relating to the data collected that has not been validated should be presented in an appendix with the cover sheet stating clearly that the data is not acceptable to EPA and the RI/FS is not relying on the data.

Response: Comment addressed under category response.

20. Comment: Section 4.4 Summary of site physical data is incomplete. Provide actual data from prior studies (and cite references throughout) for tidal currents, etc. Provide 1, 10, 25, and 100 year return period data for Lower Duwamish Waterway (LDW) flows, Elliott Bay waves, etc. The site and adjacent areas have been studied extensively (e.g., Elliott Bay Study circa 1996, various studies for Multi-User Disposal Facility, University of Washington River Histories Project, etc.). Please reference applicable studies and cite important data and conclusions from these studies. Make it clear how these conclusions are

applicable for this project. References and data should be traceable to there original documents, not just generally described.

Response: This section will be revised to summarize information from the previous studies in the site vicinity.

Comment: OK. Also, Glen St. Amant submitted "Current Structure in Elliott Bay, Washington: 1977-1996. Was this reviewed and included? There should be at least a response on the document provided by the Muckleshoots previously provided to Gary Braun. Were the findings consistent with the statements made by LM?

Response: General findings of the referenced document have been incorporated into the revised Work Plan

27. Comment: Page 4-32 Available (historic, recent) ground water monitoring data must be tabularized and summarized. The current summary lacks any empirical basis to support it. Historic and recent ground water monitoring data should also be put onto a figure such as Figure 4-11. Constituents of concern from ongoing sources such as upland groundwater must be considered in the development of the offshore sediment and biota sampling strategies.

Response: LMC is not proposing to utilize any of the existing sediment chemistry data to delineate the current nature and extent of contamination, Existing data do show historical patterns of contamination and where detection limit issues were encountered. This information will be considered in the development of the RI sampling program.

Comment: How does LM plan on using historic data to show patterns of contamination? EPA will be interested in PCB concentrations and locations of the 2007 data.

Response: Comment addressed under category response.

31. Comment: Section 4.6.3 See comments on Section 4.5. Also, this should be discussed in the Data Validation/Usability section.

Response: Comment addressed under category response.

Comment: How is the comment going to be addressed?

Response: Comment addressed under category response.

MATRIX TABLE WITH DNR COMMENTS

8. Comment: Page 8-1, Section 8 The DNR compiled a document titled Geotechnical Considerations for the Proposed Southwest Harbor CAD Facility, June 1999. This document was developed by our Division of Geology (Steve Palmer) and may provide some useful insights for the evaluation of sediment stability and transport mechanisms. Please contact me if you would like to receive a copy.

Response: Text will be revised to address the comment. LMC will contact DNR to receive a copy of the report.

Comment: OK

Response: Information received from DNR. Information will be incorporated as appropriate.

LON KISSINGER COMMENTS ON 3/12/07 RI/FS WP

5. Comment: Page 4-34, 4.6.2.1 Historical Surface Sediment Contamination: In addition to LPAHs and HPAHs, there should be a plot of cPAHs. It is unclear as to what human health risk based standard should be used. The main human health concern would be bioaccumulation of cPAHs in benthic invertebrates. However benzo[a]pyrene toxic equivalents in sediment would in some way need to be converted to B[a]P toxic equivalents in tissue.

Response: LMC will review the presentation style for historical surface sediment contamination that was done in the EE/CA report for Slip 4 of the Lower Duwamish Waterway. We will evaluate whether the presentation style is appropriate for presenting multiple contaminant sediment data for the Lockheed West site.

6. Comment: Page 4-36, 4.6.2.1 Historical Surface Sediment Contamination, Summary: The explanation of Figure 15 is unclear to me.

Response: SEE resolution response to Comment #5. In addition, errors in the graph will be corrected.

7. Comment: Page 4-37, 4.6.2.2 Historical Subsurface Sediment Contamination, Figures 4-16, 4-17, 4-18: Figure 4-16 is very difficult to read. In general these figures are difficult for the viewer to interpret. It would be helpful if the CSL and SQS exceedances depicted in figures 4-17 and 4-18 were integrated in one figure on a contaminant or contaminant group basis. Again, this could be done with bar plots coded by depth increments using a three color code showing concentrations below the SQS, between the SQS and CSL, and above the CSL. Solid colors might be used for detected concentrations and some sort of a pattern for non-detects. Some consideration should be given to showing locations of structural features (e.g. piers, shipways, drydocks, storm drains etc.), either by using faint outlines for these features or a transparent overlay sheet.

Response: SEE resolution response to Comment #6.

9. Comment: Page 4-45, 4.6.5.2 Site-Specific Contaminant Trends: It would also be appropriate to see changes in cPAH concentrations expressed as Benzo[a]pyrene equivalents.

Response: Site-Specific Contaminant Trends section deleted.

25. Comment: Page 6-9, 6.2.3.2 Existing Background Data: As has been noted in discussions between LDWG and EPA/Ecology/other stakeholders, there are substantial issues associated with SEDQUAL quality assurance, age of data, and analytical methods. Whether or not or how the SEDQUAL data will be used is a matter of continuing discussion.

Response: Comment addressed under category response.

SOURCE CONTROL

Generalized EPA Comment: Understanding the status of source control is an important element to the selection of an appropriate remedial action for the site. Data gaps exist with respect to the potential for the uplands and adjacent in-water sources to contaminate sediment after remediation. Further evaluation of source control beyond which was presented in the draft Work Plan needs to be completed.

Response: A new source control evaluation section has been included in the revised Work Plan describing the approach to evaluating both upland and potential in-water sources. In addition, the detailed evaluation of existing source control data was removed from the work Plan and will be included in a separate source control evaluation report. A brief summary of the existing source control data are included in the revised Work Plan.

EPA CMTS ON MARCH 07 DRAFT WP2.DOC:

18. Comment: Section 2.5.3.1 How will this be determined?

Response: Comment addressed under category response. Added "potential" before "ongoing sources…"

29. Comment: Section 4.1.5 Move to all historic data that has to do with source control to the Source Control Report. Provide a brief summary for the RI/FS WP and reference Source Control Report.

Response: (Section 4.1.7) Comment addressed under category response.

30. Comment: Section 4.1.5 first paragraph Need more information regarding how the source was eliminated and the origin and history of the source. Put in Source Control Report.

Response: (Section 4.1.7) Comment addressed under category response.

31. Comment: Section 4.1.5 third paragraph What happened to the cPAHs?

Response: CPAHs are assumed to have been treated as part of the thermal desorption process.

34. Comment: Section 4.1.6 Move primary decision to Source Control Report.

Response: (Section 4.1. 8) Comment addressed under category response.

35. Comment: Section 4.1.7 Lockheed is also free to conduct a file review on the PSR site to gather information needed.

Response: (Section 4.1.8) Comment addressed under category response. LMC conducted file review and section will be updated.

36. Comment: Section 4.2 last paragraph or based on the extent of COC's that are known to be directly related to shipyard contamination, such as copper, zinc and TBT.

Response: Inserted text "…or based on the extent of COC's that are known to be directly related to shipyard contamination, such as copper, zinc, and TBT.."

37. Comment: Section 4.3 Move Section 4.3 through 4.3.4 to Source Control Report. Provide several sentences in the RI/FS text about potential sources and then reference source control section.

Response: Comment addressed under category response.

38. Comment: Section 4.3 The potential for off-site contamination is included in the CSM. However, the text in Section 4 sounds like contamination/recontamination of the LW site is real and known to be true.

Response: Comment addressed under category response.

39. Comment: Section 4.3.1.1 Lockheed has put a lot of effort into trying to make a case that other areas outside LW are responsible for contamination within LW. Present data that this is true otherwise it is conjecture.

Response: Comment addressed under category response.

40. Comment: Section 4.3.1.1 second paragraph Lockheed has put a lot of effort into trying to make a case that other areas outside LW are responsible for contamination within LW. Present data that is true otherwise it is conjecture.

Response: Comment addressed under category response.

41. Comment: Section 4.3.1.2 second paragraph Provide data -- contaminates characteristic of shipyards are not found in the WW.

Response: Last sentence of paragraph deleted. Text added to end of last sentence.

42. Comment: Section 4.3.1.2 third paragraph This language makes it sound as if the Duwamish River is another source of contamination to Lockheed West. Provide evidence that is true.

Response: Comment addressed under category response. Inserted "..possible…" into text.

43. Comment: Section 4.3.2.2 Provide proof or delete these conclusions.

Response: Deleted "high" and "likely". Inserted "may" in the last sentence of the third paragraph.

44. Comment: Section 4.3.2.2 Provide proof or delete these conclusions.

Response: Deleted "high" and "likely". Inserted "may" in the last sentence of the third paragraph.

45. Comment: Section 4.3.2.3 there must be boats in between these two sizes.

Response: Agreed, vessel types are intended to represent the potential range of sizes and navigational habits at the site. Clarification has been added to the text.

46. Comment: Section 4.3.3 Have not presented data that TSSOU and LSSOU are sources.

Response: Clarification was made to qualify assumptions about the contamination potential.

86. Comment: Section 4.8.1.1 Should appear in Source Control Report

Response: (Section 4.6.1.1) Comment addressed under category response.

87. Comment: Section 4.8.1.2 Should appear in Source Control Report

Response: (Section 4.6.1.2) Comment addressed under category response.

88. Comment: Section 4.8.1.3 Source Control. Section 4.8.1.3 (Adjacent Site Uses) states that remedial actions from the former PSR site "presumably have controlled the potential historical sources from this site." Source control from the adjacent, former PSR site should be quantitatively evaluated from the PSR monitoring data.

Response: Agreed. Status of source control at PSR will be further evaluated when updated information is received.

91. Comment: Section 4.8.5 Where is the supporting information to support this statement?

Response: (Section 4.6.5) Statement has been removed from the revised Work Plan.

92. Comment: Section 4.8.5 Where is the supporting information to support this statement? If based solely on bathrymetric surveys is not sufficient.

Response(Section 4.6.5) Inserted "appear to be" in text.

93. Comment: Section 4.9.1.1 A focus of the spatial resolution of contaminants may be to identify hot spots or concentrations of grit material for dredging. Please clarify.

Response: (Section 4.7.1.1) Comment addressed under category response. Clarification has been added.

95. Comment: Section 4.9.5.3 Why is this necessary when LM is not liable for off-site recontamination of LW?

Response: (Section 4.7.5.3)Comment addressed under category response.

12. Comment: Section 4.3 This section is full of potential off-site sources of contamination for LW. These are really data gaps and the text should state that upfront. The text could go on to explain that the RI/FS WP addresses how these data gaps will be filled otherwise it easily slips into a basis on which the RI/FS is based.

Response: Potential offsite sources of contamination will be included in the CSM and listed as data gaps. Data gaps will be filled and potential sources will be evaluated as discussed in the new "roadmap/framework" section of the Work Plan. Understanding these potential sources of recontamination is important to refining the conceptual site model and to determining the most appropriate remedial technologies for the Lockheed West site.

Data are available for the West Waterway that indicate that elevated concentrations of contaminants of concern are present in the waterway. These contaminants pose a recontamination potential to Lockheed West via downstream transport from the Duwamish River and also through tidal exchange.

Comment: Since the historical data is not validated, lengthy discussions of the data is unnecessary. Some of the text can be put in an appendix with references to the data. However, all conclusionary assumptions shall be deleted.

Potential locations of recontamination can be listed in the Source Control section. However, discussion of off-site sources should be shortened to a few paragraphs with a list of locations that could be evaluated in the future if LW becomes recontaminated.

Please explain the following "Understanding these potential sources of recontamination is important to refining the conceptual site model and to determining the most appropriate remedial technologies for the Lockheed West site." Why is knowledge of off-site potential sources necessary for the CSM and in evaluating remedial alternatives?

In section 4 there are too many assumptions made without supporting data regarding off-site source locations.

Most COCs are not elevated in the West Waterway. Regarding the last sentence of the second paragraph, don't speculate without sufficient information to make the statement likely. Otherwise just list the location in a list of areas to investigate when needed.

Response: Comment addressed under category response.

14. Comment: Section 4.3 The discussion of source control is incomplete; however, EPA recognizes that Lockheed has only recently received relevant information from the Port of Seattle. Therefore, the following comment is met to provide guidance concerning the presentation of information about the uplands investigation and cleanup.

- Please provide substantial additional detail regarding source control activities, contaminants identified, soil remediation actions, groundwater monitoring results, historic/current stormwater outfall locations and discharges and control actions, etc. Due to lack of systematic upland sampling, additional shoreline groundwater monitoring (including at new shoreline wells) may be needed to demonstrate historic

source control actions are sufficient to prevent sediment recontamination following sediment remedial action.

- Additionally, please identify existing contractual relations for source control, sampling, and access for properties within the inner harbor line and in the adjacent upland areas relevant for source control. Please discuss groundwater modeling completed for the adjacent PSR site and identify any data and conclusions relevant to the LW site (e.g., at what elevations does groundwater discharge to surface water).

Response: The Port of Seattle recently provided the following information to LM on the investigation and cleanup actions completed for the uplands and the long term GW monitoring plan currently under consideration by Ecology, which will be summarized in the revised RI/FS Work Plan:

- ***Phase 1 groundwater confirmation monitoring program: hydrologic characterization report (Aspect 2005)***
- ***Storm Drain System History and Existing Conditions Update Memo 8-10-06 [Lockheed Storm Drain Cleanup Documentation (Segale 1998) – attached]***
- ***Final Site Closure Report Former Lockheed Shipyard 2 (Enviros 1995)***
- ***Volume 2, Appendix A to Feasibility Study: Distillation Report Summarizing McLaren/Hart and Enviros Remedial Investigation Work at the Former Lockheed Shipyard (Yard 2) in West Seattle, Washington***
- ***Stormwater Sediment Closure Report for the Former Lockheed Yard II (Black & Veatch SP Corp, 1998)***
- ***Phase I Ground Water Confirmation Monitoring Program, Southwest Harbor Project Monitoring Network Construction Report (Aspect Consulting, LLC, 2002)***

We changed the title of this section to match up with the SOW – Identification of All Known Historical and Ongoing Sources of Contamination to the Site, and then addressed potential sources in a new data gaps section (added). Also we moved the historical site use information in Section 4.3.1 and the current site use information in Section 4.3.2 to the Site Use and History in Section 4.1. We then changed the title of Section 4.3.1 to Potential Historical Sources, and the title of Section 4.3.2 to Ongoing Potential Sources.

The following is the new organization of Section 4.3:

New Section 4.3.1, Potential Historical Sources (included discussion of source control activities):

Section 4.3.1.1 Upland Historical Sources

Upland Activities

Historical Outfalls

Atmospheric Sources

Section 4.3.1.2 In-Water Historical Sources:

Shipyard Activities

Historical Dredging and Filling Activities

Adjacent West Waterway/LDW Activities

New Section 4.3.2 Ongoing Potential Sources (included discussion of recontamination potential):

Section 4.3.2.1 Upland Ongoing Sources

SW Florida CSO

Section 4.3.2.2 In-water Ongoing Sources

Adjacent West Waterway/LDW Sediments/Particulates Activities

Add to Data Gap Section 4.9:

- ***T5 post-remediation groundwater elevation data and post-remediation groundwater chemistry data are current data gaps, The Port is currently negotiating the post-remediation groundwater monitoring work plan for T5. LM will work with the Port to obtain both groundwater elevation and groundwater chemistry data. These data will be used to determine if T5 groundwater is a potential ongoing contaminant source to project site sediments.***
- ***PSR year one monitoring report is a data gap. The data from this report will be used to determine if the PSR site is a potential source.***

  The Port of Seattle agreed to complete the remediation of the uplands in the purchase and sales agreement for the former shipyard property which includes source control. There are no existing accesses or use (lease) agreements for intertidal and subtidal areas.

Comment: All the cited reports should be included as part of the Source Control Report including all other information regarding the Upland RI/FS and ROD. EPA was planning on having our contractor collect and evaluate source control information for Lockheed approval.

We should discuss if this arrangement is still satisfactory.

Response: Include references in new source control evaluation report. Comment addressed under category response.

15. Comment: Section 4.3.2.1 This section identifies a number of off-site sources that may potentially contribute contaminants to LW. The WP states "(t)hese facilities have a high potential for contributing both metals and organic contaminants to the areas near Pier 21 and Pier 22 at Lockheed West, and have likely contributed to many of the observed SQS and CSL exceedances in the near-surface sediment." Where is the substantiation for this? What is the purpose of this section? It seems like the material in this section belongs in the data gaps section.

Response: Comment addressed under category response.

Comment: The main issue with this comment is that there are a number of statements in Section 4 that state or imply that off-site sources are mostly responsible for contamination at LW. There is no substantiation for these statements. Lockheed is spending a lot of effort to point to other sites as being responsible for contamination of LW. Why is this necessary for the RI/FS? EPA thought that is was agreed that fate and data gathering and interpretation were not going to be part of the RI/FS. Lockheed will not be held liable for recontamination from off-site sources as has been done with the other Lockheed site.

Response: Comment addressed under category response.

16. Comment: Section 4.3.2.1 The PSR cap does extent into LW thus containing contaminants associated PSR. Is LM assuming that not all contaminants from PSR have been contained by the PSR cap?

Response: The text will be revised to clarify LMC's understanding of the PSR remediation. LMC assumes that EPA's remedy at PSR is complete and has contained any potential contamination. This potential source will be evaluated and its associated data gaps filled as discussed in the new "roadmap/framework" section of the Work Plan.

Comment: PSR can be listed as a location to investigate if LW becomes recontaminated after remediation.

Response: Comment addressed under category response.

25. Comment: Section 4.4 Available (historic, recent) ground water monitoring data must be tabularized and summarized. The current summary lacks any empirical basis to support it. Historic and recent ground water monitoring data should also be put onto a figure such as Figure 4-11. Constituents of concern from ongoing sources such as upland groundwater must be considered in the development of the offshore sediment and biota sampling strategies.

Response: See response to Comment 14.

Comment: use in Source Control Report

Response: Comment addressed under category response.

34. Comment: Section 4.6.5.1, second paragraph This paragraph sounds very definitive and is so far unsubstantiated. In reality this is a data gaps. Remove the sentence or revise to indicate that it is a hypothesis and data gap that contaminated sediments are being deposited on LW sediments and "have likely contributed too many of the observed SQS and MCUL exceedances in near-surface sediments."

Response: This statement will be qualified as a working hypothesis for the conceptual site model (CSM). The CSM will be refined after site investigation activities and data evaluations are completed.

Comment: See General Comment #2

Response: Comment addressed under category responses for Source Control and Use of Existing Data.

40. Comment: Page 4-43, Assessment of ...sediment recontamination, first sentence
Why is an assessment for potential recontamination necessary for remedial design?

Response: A comprehensive understanding of potential sources of recontamination is essential to ensuring that the remedy is protective and to determining parameters on which to measure long-term performance.

From Section 2.7 of EPA's Contaminated Sediment Remediation for Hazardous Waste Sites, Dated December 2005 regarding source control:

The identification of continuing sources and an evaluation of their potential to re-contaminate site sediment are often essential parts of site characterization and the development of an accurate conceptual site model, regardless of source areas within the site. When there are multiple sources, it is often important to prioritize sources to determine the relative significance of continuing sources versus on-site sediment in terms of site risks to determine where to focus resources. Where sources are a part of the site, project managers should develop a source control strategy or approach for the site as early as possible during site characterization. Where sources are outside the site, project managers should encourage the development of source control strategies by other authorities, and understand those strategies. Generally, a source control strategy should include plans for identifying, characterizing, prioritizing, and tracking source control actions, and for evaluating the effectiveness of those actions. It is also useful to establish milestones for source control that can be linked with sediment remedial design and cleanup actions. If sources can be substantially controlled, it is normally very important to reevaluate risk pathways to see if sediment actions are still needed. If sources cannot be substantially controlled, it is typically very important to include these ongoing sources in the evaluation of what sediment actions may or may not be appropriate and what RAOs are achievable for the site.

Generally, significant continuing upland sources (including ground water, NAPL, or upgradient water releases) should be controlled to the greatest extent possible before sediment cleanup. Once these sources are controlled, project managers should evaluate the effectiveness of the actions, and should refine and adjust levels of source control, as warranted. In most cases, before any sediment action is taken, project managers should consider the potential for recontamination and factor that potential into the remedy selection process. If a site includes a source that could result in significant recontamination, source control measures will be likely necessary as part of that response action. However, where sediment remediation is likely to yield significant benefits to human health and/or the environment after considering the risks caused by an unaddressed or ongoing source, it may be appropriate to conduct an action for sediment prior to completing all land-based source control actions.

Comment: Lockheed is only liable for contamination that results from a remedy failure at Lockheed West. As with the LSSOU where the issue of recontamination was addressed their the OMMP and the CD detailed pre-ROD source identification efforts were not required. The guidances quoted in your response would make sense to incorporate into an ecosystem just starting an RI/FS. Otherwise, the quote supports the case for putting

Lockheed West on hold until all sources were identified and remediated, which is under Ecology's purview.

Response: EPA's position on approach to recontamination will be incorporated into the WP. Comments concerns addressed under category response.

40.1. Comment: 4-82 section 4.9.5.3 Bullets 3 and 5: what are the purposes of Bullets 3 and 5. EPA concedes that recontamination from off-site sources is a possibility. The OMMP will address monitoring to detect contamination coming from off-site sources.

Response: OK

Comment: added: Sept. 5, 2007

Response: Lockheed agrees that recontamination from off- site sources is a possibility that needs to be considered in the development of the OMMP.

45. Comment: Section 5.5, 6th and 7th bullet Again these statements are unsubstantiated and should be considered data gaps. They are written as if it is almost a foregone conclusion that LW is actively being contaminated by the West Waterway**.**

Response: These bullets summarize the conceptual site model and as such are testable hypotheses developed using site specific data. These points will be confirmed or modified by the remedial investigation results and the CSM will be refined accordingly.

Comment: how will the 6th and 7th bullet be confirmed or modified by the remedial investigation result? Also not in section 5.

Response: Comment addressed under category response.

47. Comment: Page 7-1, fourth bullet The West Water 90 percentile (confirmational) numbers are not to be used as screening or cleanup numbers. The one time purpose of these numbers was to distinguish contaminates from the Todd and Lockheed shipyards from the same contaminates found in the West Waterway. These numbers need to be viewed in the context from which they were built. An explanation of how these numbers were developed and how they were meant to be used can be found in Appendix X.

Response: The West Waterway confirmational numbers will be removed from the TBC list; however, LMC believes that the issues that lead to the generation of these numbers for the LSSOU and Todd SSOU will be relevant for Lockheed West and that post-cleanup concentrations will need to account for the elevated West Waterway sediment concentrations. Appendix X was not included with the comments.

Comment: Applicability to Lockheed West can be discussed and may be used when considering monitoring data from the OMMP.

Response: Comment acknowledged.

78. Comment: Page 9-13, Section 9.5 How is the potential or proof for recontamination from West Waterway going to be factored in the RI/FS?

Response: The potential source and processes will be quantified to the extent supportable by the data. This information will be used to determine the most appropriate remedial alternative for the site and long-term monitoring requirements.

Comment: EPA does not understand the response to this comment.

Response: The long term monitoring program will take into account the potential of recontamination of the site from off-site sources.

MATRIX TABLE WITH NOAA COMMENTS

2. Comment: Page 4-6, Section 4.1.7, Upland Cleanup Actions More information needs to be provided regarding the upland cleanup activity. A discussion needs to be included regarding the sampling and analysis of the upland. Figures with sampling locations and results need to accompany the narrative. Understanding the characterization is necessary for source control and for determining the sampling needs for this RI/FS.

In addition groundwater monitoring results during the cleanup and subsequent compliance monitoring for any aspect of the project should be included.

Response: Comment acknowledged. Text will be revised. See response to Comment #14.

Comment: Should go into Source Control Report with short summary in RI/FS WP.

Response: Comment addressed under category response.

FATE TRANSPORT

Generalized EPA Comment: The Work Plan contains descriptions of multiple cases by which off site sediments could be transported to the site resulting in recontamination after remedial actions are completed. These scenarios are not backed by specific analysis of the site and are therefore, not considered to be valid by EPA. Further, EPA does not understand the need to present these cases, stating that *recontamination from off site sources would not be the responsibility of LMC.*

Response: Sediment fate and transport is an important element to understanding the status of source control from potential adjacent in-water sources. These processes will be described in conjunction with the site source control assessment.

Clarification as to the purpose to describing fate and transport processes has been added and assumptions have been qualified where sediment fate and transport processes cannot be supported by site-specific data. However, given the proximity of Lockheed West to the West Waterway, Lower Duwamish River and PSR and the unrestricted current-driven exchange of sediment between these sites, there is a recontamination potential if higher concentration materials are transported to and deposited on to the site. This assumption is presented to provide a background context for the preliminary conceptual site model (part of the inventory of processes that need to be addressed in the FS). Fate and transport issues may constitute a data gap for the post remediation site.

EPA COVER LETTER COMMENTS:

2. Comment: Too Many Unsubstantiated Statements regarding Recontamination and Fate and Transport. Previous comments by EPA stated that:

> *"The WP presents unsubstantiated assumptions such as transport of sediment from the Duwamish/West Waterway to Lockheed West (LW) and the other industrial facilities acting as a source of contaminants that can be transported to Lockheed West (Section 4.3). The WP should provide a framework for substantiating these assumptions instead of presenting them as a possibility. The WP should serve as a basis for what **is** known, what is not and how information will be gathered and interpreted...This assumption is made so frequently that EPA wonders how this information will be used in the RI/FS, particularly the alternative analysis?"*

An example of one of these statements from the previous RI/FS WP is as follows:

> *The WP states "(t)hese facilities have a high potential for contributing both metals and organic contaminants to the areas near Pier 21 and Pier 22 at Lockheed West, and have likely contributed to many of the observed SQS and CSL exceedances in the near-surface sediment."*

EPA is still finding references to other locations outside LW as being potential sources of contamination to LW. As stated in previous comments, such statements should be considered data gaps, substantiated or deleted. Lockheed should go through the document and remove assumptions that are not substantiated or include those assumptions in the Data Gaps section.

Response: Comment addressed under category response.

EPA CMTS ON MARCH 07 DRAFT WP2.DOC:

12. Comment: Section 2.2 first paragraph How would the potential for recontamination be assessed without current data on fate and transport? Just assume that recontamination is a possibility and the OMMP should have the tools to assess whether recontamination is from out-site sources or whether it is cap failure.

Response: Comment addressed under category response.

89. Comment: Section 4.8.2 Where is the data that indicates that some of the COCs are from other areas? Why does Lockheed keep asserting such statements? What is the point?

Response: Comment addressed under category response.

90. Comment: Section 4.8.3 Either delete of present data to support these claims. This could result in reversing our decision not to conduct fate and transport studies.

Response: Comment addressed under category response. Assumption as to potential for contamination from nearby sites has been qualified.

94. Comment: Section 4.9.5.3 Why is all this work being put into what is essentially fate and transport? Earlier Lockheed mentioned this information is needed for remedial design. Please explain further how this might be the case.

Response: (Section 4.7.5.3) Comment addressed under category response.

103. Comment: Section 7.0 Stability

Response: "Transport" deleted and "Stability" inserted into heading.

104. Comment: Section 7.0 This section is more about stability than transport. Plus EPA thought that sediment transport was dismissed as a topic for the RI/FS

Response: Section title changed to Sediment Stability. Comment addressed under category response.

105. Comment: Section 7.1 Tiers 1 and 2 are not sufficient to assess sediment stability particularly given that EPA has questioned the quality of Lockheeds contaminant trends evaluation. Tier 3 is essential to determine the stability of capping material. The only other need for reliable sediment stability data is to evaluate the ability to cap and dredge the site. Modeling data has been used at TSSOU and LSSOU and has been found to be a reliable tool for evaluating sediment stability.

Response: Agreed, Tier 3 evaluations will be performed. Comment addressed under category response.

MATRIX TABLE WITH EPA COMMENTS

13. Comment: Section 4.3.1 Copper is mentioned in the last sentence which implies that the source of copper is the SW Florida CSO. This is the only instance where a specific contaminant is associated with a historical or ongoing source. For example, the first sentence of the second paragraph mentions a wide range of organic compounds and metals

but does not identify what these might be. It would be very helpful to know what contaminants were found in outfalls, upland catch basins, dry dock areas, etc. If this is discussed in another part of the document, please reference that.

Response: Section 4.3 will be updated to summarize the recently received data reports from the Port of Seattle regarding historical upland source information (See response to Comment 14 below for the list of recently received information from the Port of Seattle). Data gaps will be identified and filled and potential sources evaluated as discussed in the new "roadmap/framework" section of the Work Plan.

Comment: Since EPA made this comment, there has been an agreement between EPA and Lockheed to forego sediment fate and transport data that would be gathered for a no action of attenuation remedy and only a cap and/or dredge remedy would be evaluated for remedial action. So why is there so much speculation about fate and transport which Lockheed is agreeing to call data gaps to be fulfilled?

Response: Edit – reduce fate and transport discussion and focus on sediment stability for cap and dredge design. Comment concerns addressed under comment response.

33. Comment: Section 4.6.5 Contaminant trends are not well discussed and need to be expanded to provide LM's understanding of why increases in concentration for some constituents may be occurring in parts of the Site. Please discuss the extent to which data variability due to non-co-located samples (even co-located samples can often come up with significantly different results), and limited number of data points over time, could skew the trends. EPA is assuming that the Legend for the gray circle is wrong and should read "surface grab" for Figure 4-21.

Response: In summary, the chemical concentrations that appear to not be decreasing over time are likely to be transported to the site from the Duwamish River and West Waterway systems. Contaminants of concern showing these trends are characteristic of the Duwamish River and West Waterway.

LMC recognizes that inter location variability has the potential to show differential results, However, contaminant trends are relatively consistent throughout the site and are not necessarily single location- specific.

Comment: Move to sections 4.5 to 4.7 to an appendix and qualify it as data and information not approved for use in the EPA RI/FS. However, can be used in a qualitative way to develop the preliminary CSM. Therefore, contaminant trends as reported are suspect especially given few data points. The message that post-remediation contamination could potentially come from the West Waterway and the Lower Duamish can be included in the main text. See EPA comment 2.

Response: Edit will be addressed in new Appendix. Comment addressed under comment response.

35. Comment: Section 4.6.5.1, second to last and last paragraph Is the Ecology estimate of natural recovery in 10 years incorrect? The natural recovery study in SWH Project RI study should be in the existing data section where it is critiqued for its validity and usability. Was sediment deposition considered as a natural attenuation vehicle?

Response: Sediment deposition was considered as a component of the natural recovery evaluation for the SWH project. Natural recovery models assume, however, that the depositional source material is clean. The existing data indicate that the modeled predictions for the SWH Site were correct and that sediments did naturally recover within the predicted 10 –year time period.

Comment: See General Comment #2

Response: Edit will be addressed in appendix. Discussion of NR removed from text since it is no longer an option.

39. Comment: Page 4-43, Assessment of sediment...natural recovery Please explain how the first two sentences are not contradictory if natural recovery is occurring due to deposition. What is the sensitivity of the bathymetric survey? Is it sufficient to demonstrate stability for natural recovery purposes such as the impact of prop wash?

Response: Natural recovery is the result of multiple processes including sedimentation, mixing with underlying sediment, and chemical degradation. The hydrographic survey does indicate that the gross bathymetric features of the shipyard are evident. The resolution of the survey is not evidence that sedimentation at the site is not occurring (e.g., features at the site show greater than 10 vertical feet of relief whereas sedimentation since the close of the shipyard would be on the order of feet.

Comment: This is not sufficient to demonstrate sediment stability. For instance, the piles will be removed allowing further access for boaters, etc. If Lockheed wants to demonstrate sediment stability, a fate and transport work plan should be developed. Also, provide information that sedimentation at the site would be on the order of feet.

Response: Information pared back since NR is no longer an option. Comment concerns addressed under comment response.

43. Comment: Section 5.3 So much of the WP is focused on demonstrating that surface contamination at LW is from off-site without addressing on-site distribution of contaminants nor the fate and transport characteristics of each COC that would aid in supporting the movement of contaminated sediments onto LW. Also, this should be tied to what is known about the role of grain size.

Response: Agreed that grain size and intra-site distribution of contaminants are equally important factors for the site RI/FS.

Comment: not in section 5

Response: Comment concerns addressed under category response.

53. Comment: Section 8.2 EPA is not convinced that the three core sample locations proposed for evaluation subsurface sediment quality using isotopic data are sufficient. No explicit rationale is provided for why only the three locations proposed are sufficient (the DQO tables do not address this well either). Additionally, EPA will require that the empirical modeling evaluation of sediment transport from wind, waves, currents, and prop wash (Section 8.3) be conducted regardless of the outcome of Tiers 1 and 2. Empirical data

on sediment transport within the waterway, appear to be limited, are poorly discussed throughout the Work Plan and therefore must be more fully developed to support the FS evaluations. Sediment stability analyses must consider extreme events such as the 100 year flood. Additionally, permanent sediment stability cannot be inferred from 10 to 20 years of net sediment deposition at the site.

Response: Comment is no longer applicable. Collection and evaluation of sediment isotope data and other sediment stability evaluations were intended to support evaluation of natural recovery alternatives. Natural recovery is no longer under consideration for remediation of the site. Stability of capping materials will be evaluated during remedial design.

Comment: EPA thought that this data was also going to be used to evaluate sediment stability for evaluating capping and dredging. See section 7. Best to call this section Sediment Stability instead of Sediment Transport. Or is this same data and methodology also refer to the evaluation of attenuation in section 8?

Response: Comment addressed under category response. Title changed to Sediment Stability.

54. Comment: Page 8-2, second bullet Assuming one of the purposes of the sediment stability analysis is to assess whether Natural Recovery (NR) or Enhanced Natural Recovery (ENR) is a viable alternative. NR relies on the deposition of a thin layer of sediments in a stable environment. ENR is the addition of 10 cm of sediments in a stable environment. How can a qualitative comparison of recent and past bathymetric surveys determine the stability of such a small amount of material?

Response: Comment no longer applicable. See response to comment #53.

Comment: See response to comment # 53.

Response: NR is no longer an option. Further comment concerns addressed under category response.

55. Comment: Page 8-3, section 8.3 Sediment Transport Work Plan must include Tier 3 analyses and must be done as part of the RI/FS. The information gained from Tier 3 will be vital in assessing remedial alternatives.

Response: Comment no longer applicable. See response to comment #53.

Comment: Comment is applicable to section 7

Response: Comment addressed under category response.

55.2. Comment: Section 8.3.5 Is this section suppose to serve the same purpose as section 7? If not, please explain the difference.

Response: Edit; this section is presented to section 8 to show how the data gaps will be evaluated. It is intended to be the same as Sec 7

Comment: Comment as of Sept. 5, 2007

Response: Section 7 describes the three tiered approach to evaluating sediment stability. Section 8.3.5 discusses the evaluations themselves.

MATRIX TABLE WITH NOAA COMMENTS

9. Comment: Page 8-1, Section 8, Sediment Transport This section header is sediment transport, but the focus of this section is sediment stability. The intent is to demonstrate that this area is depositional in nature. However, what needs to be understood is whether areas within the site are erosional, depositional, or in dynamic equilibrium. Is the area subject to episodic events (vessel wake, propeller wash/scour, tidal action, flooding events, etc) that would cause erosion or resuspension of material? There may be evidence that some contaminants in the surface have decreased over time. That may be due in part to deposition, erosion of contaminated material, or a combination of both. Calculating a 'net' sedimentation rate will not inform whether erosion or dynamic equilibrium is taking place. An uncertainty analysis should include a discussion that erosion rates will not be calculated and while net sedimentation rates are being estimated, areas of erosion and dynamic equilibrium will not determined.

What time of year will these samples be collected? If a majority of the source material is assumed to be provided by flows from the Lower Duwamish, flow conditions during and prior to the sampling event need to be understood. For example, summer flows will likely be lower relative to other times of the year. If sampling occurs at the end of the summer, more fines and silt material would be expected on the surface. If samples are collected at the beginning of the summer when higher flows typically occur, less fine material will be deposited, resulting in coarser material on the surface. NOAA recommends that analysis of the samples needs to be put in the context of the time of year of collection, as assumptions made about the results will impact the remedial design.

Response: Agreed. The intention is to show that sediments at the site are stable and potentially subject to deposition over-time.

Section 8 will be revised to detail the sediment transport and stability evaluations that will be performed as discussed in the new "roadmap/framework" section.

The sampling was conducted in January 2007. Potential times of intermediate to high flow.

Comment: Sediment stability is needed for only cap design and dredge design. EPA does not understand why sediment transport is needed for analysis of alternatives.

Response: OK addressed in previous responses

10. Comment: Page 8-1, Section 8.1 "Stability will be indicated by evidence of sediment burial over time"

Burial does not mean that some material has not been subject to erosion.

"Characteristics of a stable environment at the Site are the burial of historical shipyard contaminants and infilling of site features over time"

Infilling could be the result of bedload movement by vessel traffic.

- "Review existing sediment quality data to identify subsurface sediment chemical concentration trends…"
  Other trends should also be investigated and reported, i.e. trends of episodic and erosional events. Or, there may be too much variability to detect trends, which also should be reported.

- "Existing geotechnical data will be reviewed…grain size can be representative of the deposition energy within the site…"
  The season in which the data is collected needs to be noted with respect to flows as that will impact the type of material deposited. Grain size during one snapshot in the year may not be representative of an annual cycle.

- "Subsurface sediment chemical concentration trends….Decreasing surface COC concentrations are indicative of sediment deposition and stability…."
  It should not be assumed that decreasing trends confirm that sediment is being deposited or stable. Decreasing surface COC conc. can also be indicative of resuspension, mixing and redeposition, groundwater discharge, and leaching of material.

Ripples and dunes in sandy sediment bed is typically evidence of sand in motion, i.e. bedload movement. A video camera on the bottom or still pictures can elucidate this characteristic. NOAA recommends adding this component to the investigation.

The report should acknowledge that the radioisotope dating will likely overestimate current net sedimentation rates. Estimates will likely be made over approximately 40 years based on the results of dating of the Cesium profiles. Over this time, there have been reductions in sediment loading to the system due to decreases in CSO and storm drain solids inputs, organic solids from the Renton municipal sewage treatment plant, and flows from the upper Duwamish River. It's likely that a majority of depositional material in the Lockheed West area may be a result of loading from the Lower Duwamish. Therefore, the current rate of deposition will likely be overestimated due to averaging the geochronology data over an inappropriately long timeframe.

Using the isotope Pb^{210} for radiochemical dating relies on two simplifying assumptions to support the requirement of a constant Pb^{210} flux into the sediments: 1) that the sediments have a relatively uniform grain distribution with depth, and 2) that the sediments have a relatively constant historical deposition rate. As much as possible, these conditions must be determined during the initial inspection of sediment cores taken at a site, and through examination of particle size distribution (PSD), moisture content analyses, and Pb^{210} vertical concentration profiles in the cores (Stout, 2002). Due to the history of this area as an active shipyard and construction/demolition of pier structures, it's unlikely that a historical deposition rate is constant. This should be included in an uncertainty section when geochronology results are discussed.

Tiering of the sediment stability studies should be reconsidered. The third study is one of the more important because wind, waves, currents, and propeller scour will be evaluated. This information would be important to know in terms of ongoing and future impacts at the site. This study should consider vessel traffic volume, vessel size, tug boat impacts and an

increase or decrease in all of the above based on predicted future use. For example, the Port is considering expansion of T-5 which presumably would accommodate larger vessels and require a change in maneuvering the vessels to the dock. This could impact potential remedial actions. NOAA recommends conducting Tier 3 studies regardless of the outcome of Tier 1 and 2 studies. Modeling may not be necessary for each component within Tier 3, but all factors should be evaluated.

Is there information regarding transport mechanisms from the Lower Duwamish into Elliott Bay? It would be helpful to know circulation patterns and deposition patterns in Elliott Bay to put the Lockheed West site in context with the bigger picture.

Response: Comment no longer applicable. See response to comment #53.

Comment: EPA agrees with NOAAs comments.

Also, data is needed only for cap and dredge designs.

Response: NOAA's comment to complete Tier 3 study is accepted. Comment addressed under category response.

19. Comment: Page 9-11, Section 9.3.5, Sediment Stability and Transport, first paragraph "High resolution multibeam bathymetry data also indicate that surface sediments are relatively stable over most of the Site."

What is the accuracy of the high res bathymetry? Typically accuracy ranges from one-half foot to one foot. The level of accuracy of all bathymetry surveys should be reported. The older the survey, the less accuracy, most likely. In addition, the vertical datum for each survey should be reported. Ideally, the vertical datum for each survey should be the same; otherwise, it's difficult to make a good comparison. These issues should be noted when presenting data analysis. And what does it mean to say that the sediments are "relatively stable" in a more quantitative way?

Response: This statement was a qualitative assessment of the current site conditions that reflect the historical activities and that do not appear to have changed since the shipyard stopped operations. The bathymetry is the first tier assessment of the site sediment stability.

Comment: EPA agrees with NOAA and multiple lines of evidence is needed

Response: Section 7-Sediment Stability, text modified to address sediment stability using multiple lines of evidence.

RISK ASSESSMENT

Generalized EPA Comment: EPA has multiple concerns on the streamlined risk assessment approach for Lockheed West. Specifically, EPA is concerned with the lack of quantification of existing risk estimates for human health receptors.

Response: Lockheed Martin has agreed to perform baseline risk calculations for the existing conditions. The revised risk assessment approach is detailed in the revised Work Plan as agreed to with EPA. Generally, the risk assessment will be streamlined through the use of approaches and assumptions established for the LDW site.

EPA COVER LETTER COMMENTS:

3. Comment: Use of LDW Data for LW Risk Assessment. To date, EPA has not approved a risk assessment process. There have been discussions between EPA (Lon Kissinger) and LM (Gary Pascoe) regarding how and where the risk assessment may be streamlined, if appropriate. The NCP permits flexibility in developing RI/FS documents based on the complexity of the site. Specific risk assessment comments are attached. Different approaches have been discussed. Both parties will continue discussions.

Response: Comment addressed under category response.

EPA CMTS ON MARCH 07 DRAFT WP2.DOC:

19. Comment: Section 2.5.3.2 last paragraph "or a pier repair construction worker!"

Response: Removed "as a tribal netfisher" and inserted "onshore/offshore" to text.

20. Comment: Section 2.5.3.2 last paragraph Add text in an appropriate location describing Tribal uses of the area (subsistence fishers).

Response: Text has been added that tribal fishing, clamming, and netfishing occur in the area.

21. Comment: Section 2.5.3.5 Include all evaluation criteria exactly. Cost is the criteria that is weighted against other criteria such as feasibility.

Response: The subject statements are intended to describe the goals of the CERCLA evaluation. The CERCLA criteria are presented in Section 13.4.2.

22. Comment: Section 3.1 Has a review of the 1993 identification of ARARs been updated by Lockheed -- see the footnote below.

Response: Comment addressed under category response.

75. Comment: Section 4.6.4 Reference to PRG screening levels is confusing; please clarify. Are these the same levels presented in Section 11? Section 5 notes that PRGs follow from RAOs.

Response: The RPG screening levels in Section 4.6.4 refer to SMS used for comparison with historical data. Additional PRGs are used in Section 11. Section 4 has been moved to Appendix A.

81. Comment: Section 4.7 What is the purpose of summarizing previous and somewhat dated risk assessments? The only relevant and timely risk assessment is the LDW DRAFT risk assessment.

Response: Only the LDW risk assessments will be used to provide supporting information. Remaining summaries are provided for completion and to demonstrate that they do not provide useful information. Section moved to Appendix A.

82. Comment: Section 4.7 Please explain the purpose of presenting these risk assessment summaries.

Response: Summaries are provided for completion and to demonstrate the level of useful information they provide. Section moved to Appendix A.

83. Comment: Section 4.7.2.2 Exposure Quantitation section Delete "because this level of subsistence fishing was not expected to occur". This statement implies a limitation on treaty fishing rights.

Response: This text was quoted from the referenced report. Removed text "and because this level of subsistence fishing was not expected to occur at the Site". Section moved to Appendix A.

84. Comment: Section 4.7.4.2 For groundwater, the work plan discusses previous groundwater to surface water estimations and the uncertainty of groundwater contributions from Puget Sound Resources However, a missing piece of the ecological risk assessment is the effects of transition zone water (groundwater expressing in sediments) on benthos. Groundwater and its resulting transition zone water may be a concern both as the potential for sediment (cap) recontamination and as the potential for direct toxicity of transition zone water to benthic organisms.

Response: Section moved to Appendix A. Comment noted. This Section summarizes existing risk assessments.

96. Comment: Table 4-8 Title Please add a footnote that these EPCs are based on ingestion and dermal contact, not bioaccumulation. Please add EPCs for all relevant pathways or explain the rationale for including these EPCs.

Response: Section moved to Appendix A. Added text to footnote "EPCs are based on ingestion and dermal contact." The EPCs shown are for the COPCs identified in the report for the netfishing pathway EPCs for other pathways are shown in Table 4-9.

108. Comment: Section 11.0 See comments from Lon.

Response: See Responses to Lon.

109. Comment: Section 11.4.1 Seafood Consumption section Lockheed documents based on the Lower Duwamish Superfund site be consistent and reflect the comments/revisions to the framework and draft Lower Duwamish (LDW) Human Health Risk Assessment (HHRA). Examples include, but are not limited to, the following.

- Child consumption rates,
- Inclusion of Suquamish consumption survey in range of tribal consumption rates,
- COC screening using "adjusted" Region 3 RBSC's,
- Dioxins, furans, and arsenic.
- Exposure parameters (duration, frequency, etc.).

For additional detail regarding human health consistency issues we recommend that you contact Lon Kissinger of EPA. We would be happy to provide you copies of our comments submitted on the LDW HHRA if needed.

Response: The risk assessment will follow the LDW HHRA in exposure pathways and exposure parameters for tribal scenarios.

110. Comment: Section 11.5.3 For groundwater, the workplan discusses previous groundwater to surface water estimations and the uncertainty of groundwater contributions from Puget Sound Resources However, a missing piece of the ecological risk assessment is the effects of transition zone water (groundwater expressing in sediments) on benthos. Groundwater and its resulting transition zone water may be a concern both as the potential for sediment (cap) recontamination and as the potential for direct toxicity of transition zone water to benthic organisms.

Response: Comment addressed under category response.

111. Comment: Figure 11-2. Draft Conceptual Site Model for Fish and the Benthic Invertebrate Community at the Lockheed West (adapted from Windward 2006b), a footnote should be added stating that the benthic and shellfish community have direct exposure to transition zone water. This statement should highlight the need to look at impacts of groundwater on the benthos.

Response: A footnote will be added stating that the benthic and shellfish community have direct exposure to transition zone water. Groundwater is considered a potential pathway of exposure. Groundwater monitoring data will be evaluated in the RI.

112. Comment: Section 12.4 See previous comment on "cost-effective". Use language as found in the NCP.

Response: Section revised; see response to Comment #21.

19. Comment: Section 4.3.4, first paragraph, last two sentences This statement should be qualified. The risk assessment was performed pursuant to Ecology's oversight and is dated. What is actually the usability of the risk assessment? Where is the evidence that natural recovery is occurring. This is a data gap and does it really mean all upland source control is in place?

Response: Because the risk assessment for the PSR site does not directly address source control, reference to it will be removed from this paragraph. The risk assessment demonstrates minimal potential for risk to benthos from upland groundwater based on data prior to upland remediation. Results of the PSR risk assessment are summarized in Appendix A. More discussion will be added on the potential for upland groundwater to be a source to the site aquatic environment. The source control documentation provided by the Port of Seattle in the documents listed in response 14 will be summarized in the revised RI/FS Work Plan and data gaps will be identified, filled and evaluated as discussed in the new "roadmap/framework" section of the Work Plan.

Comment: Data risk assessments may no longer be applicable due to recent updates in standards or applicability. Why is Lockheed adding all these data gaps regarding off-site sources when if in the event LW becomes recontaminated after remediation, potential sources of the recontamination will be investigated as part of the OMMP?

Response: Edit – Clarification will be added to Source control document – this is a summary of existing data that will help in the development of OMMP and CSM.

46. Comment: As stated in the EPA RI/FS Guidance, RAOs should specify the following three items: contaminant of concern, the exposure route and receptor and an acceptable contaminant level or range of levels. The RAOs do not include all of these items. Please delete the first two preliminary RAOs. Add the following:

- Reduce to acceptable levels the risk to tribal members (adults and children) from ingestion of fish and shellfish taken from the site.
- Reduce to acceptable levels the risk to tribal members (adults and children) from dermal contact with contaminated sediments while harvesting fish and shellfish from the site.
- Reduce to acceptable levels the risk to tribal members (adults and children) from dermal contact with contaminated sediments while harvesting fish and shellfish from the site.
- Reduce to acceptable levels the risk to tribal members (adults and children) from dermal contact with contaminated sediments while harvesting fish and shellfish from the site.
- Reduce to acceptable levels the toxicity to benthic organisms at the site.
- Reduce to acceptable levels the risks to fish that feed on benthic organisms that have become contaminated at the site.

Modify the third bullet to read:

Reduce to site COCs acceptable levels in sediments that may be acting as an ongoing source of sediment contamination at the site.

Response: The suggested RAOs will be added.

Comment: Please note that the EPA RAOs have not replaced the Lockheed RAOs in Section 5.1

Response: EPA RAOs will replace LM RAOs in Section 5.1.

81. Comment: Page 17-1 number 3 This is an interpretation of CERCLA that may be misleading. EPA does not make a specific cost-effective determination. Also, refers to WP, Page 2-7, section 2.4.5 last sentence.

Response: Comment acknowledged.

Comment: OK

Response: Comment acknowledged. Text as been clarified.

MATRIX TABLE WITH NOAA COMMENTS

3. Comment: Page 4-29, Tributyltin Section Why are TBT concentrations compared to West Waterway TBT confirmational number of 76 ppm OC-norm? The confirmational number was not intended to be a screening value for impacts to aquatic resources.

Several studies demonstrate that TBT is very toxic to marine invertebrates (Maguire, 1987; Cardwell and Meador, 1989; Heard et al., 1989; Fent, 1996; Maguire, 2000). It is known that marine species exhibit a range in responses when exposed to TBT in water (Cardwell and Meador, 1989; Meador, 1997; Fent, 1996); because of its persistence in sediment, there is concern about its impact on organisms.

The most common sublethal endpoints measured are growth inhibition, shell chambering in oysters, histological and behavioral abnormalities, and imposex in prosobranch gastropods. In terms of exposure concentrations and sublethal effects, it is clear that molluscs are the most sensitive taxon to TBT, primarily due to their weak ability to metabolize this compound and their high rate of uptake. It should be noted that many of the sublethal responses reported for TBT exposure would eventually lead to death of the organism in the environment (Meador et al 2002a). NOAA's National Marine Fisheries Service (NMFS) has determined that a threshold concentration of 6 ppm OC-norm will result in adverse effects to prey species of salmonids (Meador, 2002a). NOAA recommends using this concentration as a protective value to compare with concentrations measured at this site. If bioaccumulation tests are performed, Jim Meador (NOAA Fisheries) should be consulted to develop an appropriate protocol.

Response: Agreed, the reference to the West Waterway confirmational values will be removed.

Details on the biological effects of TBT, as recommended, will be presented in the ecological risk assessment.

The approach to assessing risks from TBT exposures is provided in the risk assessment section. Much of the recent work and analyses performed at the LDW site, as well as relationships between tissue and sediment TBT developed for the West Waterway OU, will form the basis for the risk assessment of TBT.

Comment: OK.

OK.

This response (3rd paragraph) is too **vague** to response to. Please provide more detail. Check with Erika Hoffman for updated information on TBT.

Also, see response to comment # 7.

Response: Summary of existing information has been moved to Appendix A. Relationships between tissue and sediment TBT developed for the West Waterway (i.e. 76 mg/kg-OC) are used for the summary of existing information. However, .NOAA's National Marine Fisheries Service (NMFS) threshold concentration of 6 ppm OC-norm will be included as a measurement endpoint TRV for TBT in benthic invertebrates as part of the ecological risk assessment.

7. Comment: Page 7-2, Section 7.1.2, Results of Risk Assessments "…will develop risk based screening levels as an initial step in the final identification of contaminants of potential concern. These screening levels will be derived from EPA and MTCA criteria."

Literature values should also be considered for screening levels as needed. Contaminants such as TBT do not have MTCA or EPA screening concentrations. In addition, MTCA SMS standards are designed to protect benthic invertebrates and not organisms in higher trophic levels, such as fish. Bioaccumulation screening thresholds need to be incorporated.

Response: As noted in Response 50, PRGs will be developed in the risk assessments, which will be criteria and toxicology based, as well as other considerations. Bioaccumulation will be addressed as per Responses 26 and 50.

Comment: EPA previously agreed that data from other sites , such as the LDW, could be used, as appropriate. LM needs to explain why use of data from other sites is appropriate considering habitat and salinity. As LM stated this issue will be addressed further as the WP develops.

Response: Habitat and salinity will be described in the context of the applicability of information from the LDW site to the LW site. The receptors evaluated in the LDW risk assessments are the same marine species of Puget Sound that would be found at the LW site. The LW site is also an estuarine habitat like the LDW site but with more influence from Elliott Bay and hence generally more saline. For that reason, the LW site is appropriately characterized by the same marine receptors evaluated in the LDW risk assessments.

MATRIX TABLE WITH DNR COMMENTS

5. Comment: Page 6-2 Please add the following to the list of RAOs: 1) Significantly reduce the volume of sediment contamination to ensure long-term economic, ecological and public uses of the area are protected. 2) Where possible, restore important, relevant habitat functions."

Response: See response to Comment #46.

Comment: See EPA's RAOs

Response: RAO's suggested by EPA were added to text and text modified as appropriate.

LON KISSINGER COMMENTS ON 3/12/07 RI/FS WP

1. Comment: Page 2-3, Lockheed West RI/FS Scope of Work: It may be necessary to complete a baseline risk assessment in order to delineate the risks associated with a no-action alternative. In reviewing the memo "Role of the Baseline Risk Assessment…" it appears that violation of other ARARs besides a risk ceiling of 1 in 10,000 could result in a need for action.

Response: SEE comment (Page 4-10, 4.1.8 Pacific Sound Resources Cleanup Actions)

Acknowledged. Lockheed-Martin Corporation (LMC) discussed this comment with Lynda Priddy, EPA Project Manager, at a meeting held at EPA on June 27, 2007. As per agreements from those discussions, a baseline risk assessment is necessary for the site. The revised work plan will cite the OSWER Directive 9355.0-30 on the Role of the Baseline Risk Assessment in Superfund Remedy Section Decisions as guidance for the approach to the baseline risk assessment as described in the work plan. Specifically, the OSWER Directive states that other chemical-specific ARARs may be used to determine whether a site warrants remediation. This guidance will be quoted in the risk assessment as providing the analyses necessary to demonstrate unacceptable baseline risks that can then be used to justify proceeding with the streamlined RI/FS process as described in the RI/FS work plan. For the Lockheed West site, demonstration of the exceedance of Washington State SMS by sediment chemistry will be regarded as one of the ecological risk assessment components for the site. The baseline risk assessment will consist of demonstrating the exceedance of SMS as ARARs, and unacceptable risks calculated for human exposures, which together will form the basis for the decision by LMC to actively remediate the entire site. The streamlined approach to the RI/FS is based on that decision. The revised work plan will include a section describing this baseline risk assessment approach for the site.

Note that because of the decision to actively remediate the entire site, the RI/FS work plan does not include an evaluation of the no-action alternative, nor does it include evaluations of any natural recovery alternatives; instead, the plans call for active remediation of the entire site to mitigate all assumed human health and ecological risks.

If cPAHs could be contributed from PSR why not dioxins/furans?

Dioxins/furans will be added to the text as also possibly contributed from the PSR site.

2. Comment: Page 4-24, 4.4.9 Biota: This section should be expanded to discuss current or future use of aquatic biota for human consumption?

Response: Agreed, the text will include mention of use of aquatic biota for human consumption. Text added, "The current use of aquatic biota for human consumption is unknown."

3. Comment: Page 4-31 4.5.5.2 2003 Lockheed Martin Due Diligence Survey: It is not clear whether the 2003 data meet risk based analytical concentration goals for the current CERCLA cleanup.

Response: As per agreement with Lynda Priddy at the June 27 meeting, the present plans for the RI/FS and risk assessment do not include use of the 2003 data, but will rely only on the data recently collected under the RI work plan.

4. Comment: Page 4-32, 4.6.1 Chemicals of Interest: In addition to SMS contaminants, this section should note that any contaminants that could pose an unacceptable hazard to the environment or human health are of concern. For example, cPAHs, chlorinated dibenzofurans and dioxins are contaminants of concern that are not noted in the SMS tables. The SMS tables refer to contaminants that are of ecological concern. Generally, COPCs of human health risk concern are determined by comparing levels in environmental media to preliminary remediation goals (PRGs). This needs to be done for the Lockheed West site. The LDW HHRA developed PRGs for various exposure pathways using EPA Region 9 methodology. Because EPA Region 9 is no longer actively maintaining their PRG's, EPA Region 10 is now using EPA Region 6 PRGs. Since there are no tissue contaminant data for Lockheed West, it will be necessary to model tissue concentrations based on sediment concentrations. Use of BSAFs may be the simplest way to accomplish this. The LDW HHRA compiled BSAFs for a large number of contaminants.

Response: Acknowledged. The text will be edited to make it consistent with risk assessment-related text in Sections 6 and 9, where PRG development is explained.

The determination of Nature and Extent of sediment contamination and the subsequent site boundaries in the RI will be based on a variety of factors: Existing boundaries and contamination at adjacent sites, exceedances of risk-based concentrations for sediment, background concentrations in sediment, and analytical ability to identify contaminants. This section is presented in Appendix A, Historical Data..

8. Comment: Page 4-43, 4.6.4 Extent of PRG Exceedances and Other Standards as Identified by EPA: It would be helpful if what constituted a "PRG" was defined here. At no previous point in this document are PRGs defined. Traditionally, PRGs in human health risk assessment are computed using health protective hazard quotients, cancer risks, and exposure assumptions.

Response: The concept of PRG will be defined, and the text will be clarified as to which benthic PRG (i.e., which Ecology Sediment Management Standard) was used. Section moved to Appendix A, Historical Data.

10. Comment: Page 4-49, 4.7 Summaries of Previous Risk Assessments, 1st text block on page: The information presented in this section of the RI/FS work plan does cover the history of divergent risk assessment approaches employed for sites in the vicinity of Lockheed West. A number of policy/regulatory initiatives have occurred since the first RA conducted in 1991 that should focus RA approaches relative to those that have been employed in the past. The key initiatives that are of relevance to the Lockheed West site are as follows:

1) For Elliott Bay and the Lower Duwamish Waterway, the Washington Department of Ecology has replaced the default seafood consumption rate and source fraction terms (effective consumption rate 27 grams per day) used in the Model Toxics Control Act with a consumption rate that accounts for the fraction of site affected seafood. That consumption rate is 57 grams per day. http://www.ecy.wa.gov/programs/tcp/SAB/SAB_mtg_info/mtg_060915/02%20RecapAPIFishConsumptionRateDiscussions.pdf
2) EPA Region 10 has been developing a policy document, "The Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia," that should be released shortly and delineates EPA's position on Tribal seafood consumption risk assessment in Puget Sound. The Framework has been interpreted with regards to its application to the Lower Duwamish Waterway HHRA
3) The Lower Duwamish Waterway HHRA has been the most comprehensive and recent effort to assess seafood consumption risks. Consequently EPA believes that approaches taken in this document should be the starting point for risk assessment considerations at the Lockheed West site.

These more recent initiatives establish appropriate seafood consumption risk assessment procedures. Discussions of previous risk assessments done in the area, while informative, are not regarded as current or appropriate, and will not be commented on.

Response: Acknowledged. The text in the comment will be added to the work plan as justification for the previous risk assessments being considered not appropriate to evaluate present risks. Section moved to Appendix A, Historical Data.

11. Comment: Page 4-67, 4.7.5.1 Human Health Risk Assessment, Exposure Scenarios: The 95th percentile API rate used in the LDW HHRA is 57.1 g/day.

The rate of 7.5 g/day is not a relevant recreational consumption rate, but rather was included in the HHRA for informational purposes only. A number of creel surveys were done in the 1980's that could be used to characterize recreational fish consumption. Tetra Tech (1988) in developing an assessment of health risks from Puget Sound seafood consumption, utilized data from these studies to estimate 5th, 50th, and 95th percentile consumption rates. Table 10 of the Tetra Tech report tabulates these values which are presented here for ease of reference:

Percentiles of Seafood Consumption by Recreational Anglers				
		Cumulative Percentile of Angler Population		
Study	Angler Type	5	50	95
NOAA 1985	Shore	2.8	26.1	246.2
NOAA 1987	Boat	1.6	12.3	95.1
Pierce et al. 1981	Shore	0.6	7.1	78.2
Pierce et al. 1981	Shore/boat	1.3	13.6	147.1

Response: Acknowledged. The text will be edited for the corrections identified.

Comment: Page 4-67, 4.7.5.1 Human Health Risk Assessment, Chemicals of Concern and EPCs, bullet entitled "consumption rate": The consumption rate of 98 grams per day was developed using the following process:

1) The consumption rates of Puget Sound harvested seafood by surveyed Tulalip Tribal members were determined.
2) These rates were rank ordered and used to determine a 95th percentile consumption rate of 194 g/day.
3) The total rate was allocated to individual market basket fractions by the following calculation:

   Market basket rate = total rate x avg. rate for a market basket fraction ÷ sum of all avg. market basket rates.

   Using this process, Salmon comprised 96.5 g/day of the total consumption rate. It was decided that salmon did not accumulate a significant site-related contaminant body burden. Consequently, the "effective" consumption rate was 194 g/day – 96.5 g/day = 97.5 g/day consumption of species with a site related contaminant body burden.

Citing the interim draft final LDW HHRA, 59 chemicals were determined to be COPCs based on seafood consumption and/or direct sediment contact, an additional 8 chemicals were COPCs based on direct sediment contact only. It might be appropriate to drop specific citations of numbers of contaminants in discussing various categories of COPCs until the LDW HHRA is finalized.

Response: Acknowledged. Specific information on the derivation of numerical parameters will be added for clarity, as suggested in the comment. The statements regarding the outcomes of the LDW risk assessments will be edited to include finalized values. Section moved to Appendix A, Historical Data.

12. Comment: Page 4-68, 4.7.5.1 Human Health Risk Assessment, Chemicals of Concern and EPCs, beach play scenario: Though this information is noted at the end of the LDW HHRA discussion in the Lockheed RI/FS work plan, it would be clearer to simply include only the interim draft final LDW HHRA information in the Lockheed document. Eight distinct areas were identified as beaches suitable for assessing risks to children

engaging in beach play. Children's beach play exposure frequency was set at 65 days per year based on a King County survey of human use of King County shoreline parks.

Response: SEE response to Comment #11 on editing text that mentions the LDW risk assessments.

13. Comment: Page 4-69, **4.7.5.1 Human Health Risk Assessment, risk characterization:** The quality of the Tulalip and Suquamish fish consumption surveys is quite similar. Either survey may be appropriate to characterize site risks depending on the nature of a cleanup site. Consequently, EPA does not utilize an "adult tribal scenario" in the LDW HHRA but prefers to specifically identify the scenario as a Tulalip Tribal scenario. In the case of the LDW, considerations of habitat quality in applying the Tribal Framework lead to use of the Tulalip Tribes' data to characterize seafood consumption risks for RAO considerations. Suquamish Tribe consumption rates are used to characterize the range of possible Tribal risks. Please replace "adult tribal scenario" with "Tulalip Tribes' scenario."

Response: As per the meeting at EPA on June 25, the tribal scenarios will be re-titled as the "adult tribal scenario parameterized with the Tulalip survey" and "…parameterized with the Suquamish scenario".

Comment: The HHRA included a major effort to characterize background arsenic sediment concentrations. A much lower level of effort was used to characterize sediment background concentrations for vanadium. Recently LDWG, Ecology, EPA, and stakeholders have been meeting to determine sediment area background concentrations for PCBs.

Response: Acknowledged; the text will be edited to indicate that the effort is ongoing.

14. Comment: Page 4-76, 4.7.5.3 Remedial Investigation, Food Web Model: It should be noted that BSAFs may be used to relate sediment and tissue PCB concentrations for clams.

Response: Acknowledged; the possible use of BSAFs will be added to the text.

15. Comment: Page 4-78, 4.8.2 Types of Contamination and Affected Media: Contaminants of human health concern need to be added to this list. COIs are not simply the contaminants on the SMS list (SEE comment on Page 4-32, 4.6.1 Chemicals of Interest).

Response: Acknowledged; the list will be corrected to include contaminants of interest to human health.

16. Comment: Page 4-79, 4.8.4 Exposure Media, and Known or Suspected Human and Ecological Receptors: Potential direct exposure might also occur to individuals engaging in recreational activities.

Response: Text added: " and/or through recreational activities".

17. Comment: Page 4-79, 4.8.5 CSM Summary, 1st bullet: This list may need to be expanded upon considering human health risks.

Response: Acknowledged; the summary will be edited to ensure that human health risks are included.

18. Comment: Page 4-80, 4.9 Identification of Data Gaps: It is unclear as to whether or not detection limits are sufficient to meet risk based analytical concentration goals. In several instances, most notably SVOCs, detection limits were above SMS standards. It is likely that similar issues would occur for PRGs.

Response: Acknowledged. Risk-based analytical concentration goals were adapted from the LDW site to evaluate detection limits for the 2007 sediment sampling.

19. Comment: Page 4-82, 4.9.4 Human Health and Ecological Baseline Risk Assessment: A baseline risk assessment may be needed to characterize risks associated with a no-action alternative. Exceedance of ARARs may be sufficient justification for site cleanup actions.

Response: SEE response to Comment #1.

20. Comment: Page 6-1, 6 Preliminary Remediation Goals: PRGs can not simply be the SMS. The SMS are ecological criteria that do not take into account human health risks. PRGs must consider human health. SEE comment: Page 4-32, 4.6.1 Chemicals of Interest.

Response: Acknowledged; see response to Comment #4.

21. Comment: Page 6-4, 6.2.1.1 Approach, Human Health Risk Assessment: It should be noted here that the selected exposure scenarios are deemed to provide the most stringent (i.e. lowest cleanup level) when considering all populations of receptors that might undergo that exposure. For example, Asian and Pacific Islander seafood consumers are likely to have lower exposures to seafood contaminants than Tribal seafood consumers.

Response: Acknowledged; exposure scenarios will be described as per the comment. In addition, the text will note that the scenarios are considered RME that no CTE scenarios are included, and no recreational scenarios are included.

Comment: There needs to be a discussion about selection of what data (e.g. Tulalip or Suquamish) are appropriate for assessing Tribal seafood consumption risks based on EPA's Tribal Framework. The Lockheed West site differs from the LDW in that it is clearly within the U&A of the Suquamish Tribe. Though actual cleanup numbers may be based on Tulalip Tribes' consumption rates, the Framework states that a Tribe may request analysis of an alternate scenario.

Response: Acknowledged; the framework document will be mentioned, as will text from the document on using the framework to select cleanup levels based on tribal scenarios.

22. Comment: Page 6-4, 6.2.1.2 Sources of Risk-Based Concentration Values: LDW PRGs were developed using EPA Region 9 and Region 3 PRG procedures. Since EPA Region 10 has now adopted EPA Region 6 PRG development procedures, LDW PRGs must be modified to be consistent with Region 6 values. EPA Region 6 PRGs utilize an HQ of 0.1 for purposes of screening. Consequently, it is not likely that Region 6 PRGs would be directly used for developing RBTCS.

Response: Acknowledged; PRGs presented at the end of Section 11 of the work plan were developed using Region 6 values as modified by Region 10 guidance.

23. Comment: Page 6-5, 6.2.1.2 Sources of Risk-Based Concentration Values: The methodology to be used to develop site specific BSAFs needs to be expanded upon. EPA's Duluth Laboratory has been working on data needs for site specific BSAFs. Tissue data will clearly be needed to compute site-specific BSAFs. If site specific BSAFs cannot be computed, it may be necessary to utilize BSAFs from other sources. BSAFs are variable, and a question arises as to what BSAF to select from a distribution of BSAFs. The applicability of BSAFs from the LDW site to Lockheed West needs to be considered in light of difference in habitat and food web structure. Food web modeling experts should be consulted in this regard. Given that the entire site is going to be actively remediated, use of health protective BSAFs may not be of concern. It may be necessary to agree on a hierarchy/methodology of approaches for developing BSAFs.

It may also be necessary to determine the applicability of the LDW FWM to Lockheed West given differences in food webs and habitat for the two sites.

Response: Acknowledged; the final BSAFs will be determined by consultation with EPA. Data from the LDW site may be used to develop BSAFs for species common to both sites. As per discussion at the EPA meeting of June 25, because the Lockheed West site is more marine in nature than the LDW site, data from the LDW site on sediment and tissue may come from the downstream Area 1 segment. If data may be used from the LDW, differences in salinity and food webs between the two sites will be discussed; experts within EPA will be consulted on such ecological differences between the two sites and the appropriateness of extrapolating Area 1 data from the LDW site to the Lockheed West site.

26. Comment: Page 8-1, 8.1.2 Proposed RI Sampling Summary: Another purpose of sediment sampling is to characterize exposures and consequent risks for human and ecological receptors.

Response: Text added ", to characterize exposure and consequent risk for human and ecological receptors."

28. Comment: Page 8-3, 8.2 Identify Extent of Sediment Contamination Exceeding PRGs: The definition of PRGs should be clarified either by citation of a previous section or re-statement of a quick summary. It is important to note that risk-based concentrations protective of human health will be considered as PRGs.

Response: Text added " protective of human health and the environment as described in Section 6."

30. Comment: Page 8-4, 8.2.1 Surface Sediment Samples: In addition to SMS values, the exceedances of human and environmental health risk based concentrations need to be considered.

Response: Text added "and the exceedances of human and environmental health risk-based concentrations."

31. Comment: Page 8-5, 8.2 Identify Extent of Sediment Contamination Exceeding PRGs, Background Samples: Clarify what "conservative" means here.

Response: Text will be clarified.

32. Comment: Page 8-8, 8.2.2 Subsurface Sediment Sampling and Analysis: The cleanup must be protective of human health, consequently human health risk based PRGs need to be considered with regards to the vertical extent of contamination in addition to SMS values.

Response: Comment disregarded. Doesn't not apply to Section.

34. Comment: Page 11-1, Risk Assessment Work Plan, 11.1 Purpose of the Focused Risk Assessment: An assessment of risks may be necessary for the no-action alternative.

Response: See response to Comment #1.

35. Comment: Page 11-2, 11.2 Scope: It will be important to consider PRGs or risk based concentration goals in determining the analyses and levels of detection employed BEFORE the risk assessments are completed.

Response: Risk based analytical concentration goals were presented in the plan in preparation for the 2007 sediment data collection.

36. Comment: Page 11-3, 11.3 Technical Approach to the Lockheed West Risk Assessment, item 2 on list in this section: An issue with the LDW HHRA was failure to consider detection frequency sufficiently in the COPC selection process. In the LDW interim final HHRA, page 49, Section B.3.3 Chemical screening and evaluation, Flowchart bubble "3a," a contaminant is included as a COPC if its maximum detected concentration exceeds the RBC. It is suggested that detection frequency be considered before a contaminant is designated as a COPC in this step. Generally, the detection frequency should be decreased from 10% to 5%.

Response: Acknowledged; detection frequency of 5 percent will be considered in the COPC selection process.

37. Comment: Page 11-5, 11.3.2 Process for Selection of COPCs, item 1: Additionally, this point should note that an infrequently detected contaminant may only be rejected if is not found in other environmental media, if there is no reason to believe that the contaminant should be found, and if there is not a unique site feature that may explain the presence of the contaminant.

Response: Acknowledged; text will be edited as per the comment.

38. Comment: Page 11-5, 11.3.2 Process for Selection of COPCs, item 2: SEE comment Page 6-8, 6.2.3 Determination of Background. This might be altered to read: "Where 95% UCL background concentrations exceed risk based concentrations, the 95% UCL background concentration will serve as the cleanup level."

Response: Acknowledged; edits will be made as suggested. Also see response to Comment #24.

39. Comment: Page 11-5, 11.3.2 Process for Selection of COPCs, item 3: Maximum **or?** .P**age 11-5, 11.3.2 Process for Selection of COPCs**: In particular it should be noted that a contaminant may still be a risk driver if contributes a small fraction of overall risk but is associated with high absolute risk.

Response: Acknowledged; text will be edited as suggested.

44. Comment: Page 11-7, 11.4.1 Exposure Scenarios: There should be some discussion of reasonable future use here.

Response: Acknowledged; discussion on future use will be added.

45. Comment: Page 11-8, 11.4.1 Exposure Scenarios, Recreational Uses: Though no residences are immediately adjacent to the facility, if a park were created at the facility the potential for recreational exposures would be greatly enhanced. There are recreational areas immediately adjacent to the Lockheed West site.

Response: Acknowledged; potential future recreational uses will be mentioned. As per the meeting at EPA on June 25, the text will also point out that the seafood consumption scenario will be more stringent than a recreational scenario.

46. Comment: Page 11-8, 11.4.1 Exposure Scenarios, Recreational Swimming: The inclusion of this scenario should be discussed rather than dismissing it out of hand.

Response: Acknowledged, the scenario will be discussed, with consideration given to similar discussion in the LDW HHRA and the original King County risk assessment.

47. Comment: Page 11-9, 11.4.1 Exposure Scenarios, Tribal Clamming: Is there is the possibility that clam habitat could be enhanced. It should be noted that the LDW is the only marine habitat within the Muckleshoot Tribe's Usual and Accustomed fishing area.

Response: The potential for enhanced clam habitat will depend on the remedial design necessary for the site.

48. Comment: Page 11-11, 11.4.2 Human Exposure Data, Seafood Consumption: The source of BSAF data should be noted here as well.

Response: As per the meeting at EPA on June 25, the process for developing cleanup levels and monitoring performance criteria will be emphasized, and the actual source of BSAF data will be determined should use of BSAFs be necessary.

49. Comment: Page 11-23, 11.6.1.3 Risk-Based Threshold Criteria for Direct and Indirect Sediment Exposures: The following concepts should be integrated into this section: Division of a large contaminated area into operable units may result in conclusions that a risk does not exist when if all the operable units were considered together, a substantial risk might exist. Further, small groups of anglers may obtain a large fraction of their seafood from a small area. For these reasons, EPA has concluded in the Tribal Framework that site size should not affect the fraction of seafood affected by source specific contamination."

Response: The EPA perspective as outlined in the tribal framework document will be mentioned. The present plan for the Lockheed West site RI/FS is to use risk-based threshold criteria as developed directly from the LDW site, without modification to account for the vast differences in area of sediment or length of useable shoreline between the two sites.

50. Comment: Page 11-28, 11.7 Identification of Chemicals of Concern: A cross reference should be provided to a discussion of application of the Tribal Framework to the Lockheed West site that needs to be provided here. Please note that this area is an U&A for not only the Muckleshoots but also for the Suquamish.

Response: Acknowledged, the framework document will be mentioned here, as will potential application of both tribal scenarios due to their overlapping U&A at the site. Any analysis that applies the Suquamish scenario parameters will be performed for informational purposes only, as per the meeting at EPA on June 25.

51. Comment: Page 11-29, Table 11-1: Reference the sources of the BSAFs used to develop the indirect exposure RBCs.

Response: The source that is cited in the LDW documents where this table originated will be footnoted.

DETERMINATION AND USE OF BACKGROUND CONCENTRATIONS FOR CLEANUP GOALS

Generalized EPA Comment: EPA has not accepted that the proposed background range-finding approach is sufficient for establishing sediment background concentrations for Elliott Bay.

Response: Based on review of the LDW risk assessments and draft remedial investigation, LMC recognizes the potential for cleanup levels to be below background concentrations. LMC proposed to explore urban background conditions through the collection of several range-finding samples during the January sampling event – given the context of the site location within an urban and industrialized embayment. LMC sampled multiple locations within Elliott Bay believed to be outside of the direct influence of known sources of contamination in consultation with the EPA and tribal representatives. LMC worked with the EPA and tribal representatives to develop the proposed range finding sampling locations but agreed to work with EPA and the tribes to further refine the approach to identifying background concentrations to provide for a practical and achievable cleanup level at the Lockheed West site.

EPA COVER LETTER COMMENTS:

5. Comment: Determination of Background. Determination and use of background concentrations has not been determined at this point for LW. The LDW is in the vicinity of LW. The process for determining background for LDW may have an impact on the process for LW. Presently, the process for determining background for the LDW is under debate. LM conducted some sampling called "rangefinding" but EPA did not approve the purpose and approach of the "rangefinding" exercise because EPA agreed with the Tribes that they would be included in discussions for determining background. To date, such discussions have not occurred. If the determination of background for the LDW is not determined in a timely manner for LW, the use of an "interim" background may be one approach to be investigated as a potential solution.

Response: Comment addressed under category response.

EPA CMTS ON MARCH 07 DRAFT WP2.DOC:

6. Comment: Section 2.1 fourth paragraph See other background comments.

Response: Removed "within Elliott Bay" from text.

11. Comment: Section 2.1 third bullet see other Elliott Bay comments

Response: Replaced "evaluated and utilized" with "considered".

14. Comment: Section 2.3 Please note that the range finding sampling locations were not approved by EPA?

Response: Inserted text "however, rangefinding sampling locations were not approved by EPA."

77. Comment: Section 4.6.5.1 Please delete this paragraph. It is speculative and unsupported by any evidence.

Response: Section moved to Appendix A and paragraph deleted.

102. Comment: Section 6.2.3 Rangefinding

Response: Removed "Background" and inserted "Rangefinding".

106. Comment: Section 8.1.2 Several of the proposed locations are either within Washington State MTCA sites along the Seattle waterfront, are down-current from these MTCA sites or are down-current from unremediated CERCLA sites (e.g., within the plume of the Duwamish River and/or the East Waterway). Additionally, it is important for sampling sites not to be within areas influenced by historic contaminant sources. I propose that the specific sampling locations be deleted from this document and an approach be jointly developed in the future. The utility of this sampling effort is also not clear if an appropriate background concentration is developed via the Lower Duwamish Waterway Feasibility Study

Response: Comment addressed under category response.

107. Comment: Section 8.2.1 Locations and Rationale section Background Sampling. I am very concerned about the proposed background sample locations as illustrated on Figure 8-3 and discussed on pages 8-6 and 8-7. Several of the proposed locations are either within Washington State MTCA sites along the Seattle waterfront, are down-current from these MTCA sites or are down-current from unremediated CERCLA sites (e.g., within the plume of the Duwamish River and/or the East Waterway). Additionally, it is important for sampling sites not to be within areas influenced by historic contaminant sources. I propose that the specific sampling locations be deleted from this document and an approach be jointly developed in the future. The utility of this sampling effort is also not clear if an appropriate background concentration is developed via the Lower Duwamish Waterway Feasibility Study.

Response: Comment addressed under category response.

MATRIX TABLE WITH EPA COMMENTS

55.1. Comment: Page 8-5 References to "Background Samples" should be called "Rangefinding Samples". EPA agreed with the Tribes that they would be involved in defining background for Lockheed West.

Response: Comment addressed under category response.

Comment: Comment as of Sept. 5, 2007.

Response: Replace "background" with "range finding" as appropriate throughout section..

60. Comment: Page 9-2, third paragraph, figure 9-1 Why is area 1b different from 2a? Should the shipway be included in area 5?

Response: The areas presented on Figure 9-1 were based on knowledge of historical site uses, future site plans, and recent high-resolution site bathymetry. These general areas were used to focus the selection of additional sampling needs, as explained in the text. Area 1b and 2a were split because of potential future site uses by the POS; the shipway is included in Area 5.

Comment: OK

Response: Comment resolved.

MATRIX TABLE WITH DNR COMMENTS

3. Comment: Page 4-26; Section 4.6.1 As part of the Constituents of Potential Concern, consideration may be needed to consider wood debris. The WAC 173-204 (SMS) includes provisions for "deleterious substances." The SMS has developed a narrative standard to address "…sediment affected by radioactive, biological or other deleterious substances (e.g., organic debris, tributyltin, DDT, etc.)." Because it is not fully clear if this area was formerly used for log storage, and the multi-beam bathymetry survey has identified "timber pilings, on the sea floor" (possibly logs or log bundles?) it is reasonable to believe that some areas within the site could be affected by excessive accumulations of wood debris. If this is the case, it will be valuable to add TVS and total sulfides analyses to sample areas where log storage or booming activities may have occurred.

Response: Comment acknowledged.

Comment: EPA at this point does not believe it has to authority to regulate substances that are not "hazardous substances". Wood debris does not fall in that category unless data is presented that wood debris contains toxic substances.

Response: Comment acknowledged and resolved.

LON KISSINGER COMMENTS ON 3/12/07 RI/FS WP

24. Comment: Page 6-8, 6.2.3 Determination of Background: Missing from this discussion is a consideration of the sample size needed to characterize background. EPA, stakeholders and PRPs need to discuss use of the 90th percentile of the background distribution to characterize background. The 90th percentile of background may have relevance for Ecology. However, from a risk assessment perspective, I think the background concentration should be defined as the 95% UCL on the arithmetic mean. The arithmetic mean is the overall medium concentration to which a receptor is exposed as the receptor repeatedly contacts an environmental medium with contamination to produce an exposure potentially associated with chronic health effects. The 95% UCL on the mean is a health protective measure of mean exposure. The 90th percentile has no meaning in this regard. From a risk assessment standpoint, the question is what increment of exposure is due to background and what is due to the site? Again, the appropriate measure of this is the 95% UCL on the mean. There should be some discussion of the data requirements then to characterize an appropriate 95% UCL on the mean.

Response: Due to the ongoing discussions among regulatory agencies in Washington State on how to determine background concentrations, specifically for the LDW site, the two approaches as mentioned in the comment will be presented in the work plan for consideration. The approach that is finally used for the LDW site will be adapted to the Lockheed West site, in consultation with EPA.

41. Comment: Page 11-6, 11.3.4 Background Concentrations: SEE comment Page 6-8, 6.2.3 Determination of Background.

Response: Comment addressed under category response.

42. Comment: Page 11-6, 11.3.4.2 Existing Background Data: The PAH data for PSR need to be reviewed for their appropriateness for Lockheed West.

Response: Agreed, PAH data will be reviewed if it is determined that they may be needed for development of background.

43. Comment: Page 11-7, 11.3.4.3 "Urban" or "Area" Background: Note that EPA does discuss this concept in a limited sense in its 2002 Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites:

> The ideal background reference area would have the same distribution of concentrations of the chemicals of concern as those which would be expected on the site if the site had never been impacted. In most situations, this ideal reference area does not exist. If necessary, more than one reference area may be selected if the site exhibits a range of physical, chemical, geological, or biological variability. Background reference areas are normally selected from off-site areas, but are not limited to natural areas undisturbed by human activities. It may be difficult to find a suitable background reference area in an industrial complex. In some cases, a non-impacted onsite area may be suitable as a background reference area.

Response: Acknowledged; text will be added as suggested.

EDITORIAL

No general response is provided. See individual responses below.

EPA COVER LETTER COMMENTS:

4. Comment: Better Tracking of Revisions. EPA can not determine if all of EPA's comments, dated September 19, 2006, were addressed in the March 2007 version of the draft RI/FS Work Plan. Also, some of LM's responses merely state "comment noted" or LM provides an explanation of a revision that LM intends to make in the next draft. In these two cases, EPA can not tell if a revision was made, in the case of "comment noted" or where a revision was made in the other case. EPA recommends that the exact revision to be made be stated in the response column or the location of the revision in the revised draft be specified in the response column. Also, the Page/Section column should refer to the draft document under review.

Response: Comment-Response document created with reviewing party's comments and responses.

6. Comment: EPA has not reviewed the appendices given the nature of EPA's comments.

Response: Appendices in development.

EPA CMTS ON MARCH 07 DRAFT WP2.DOC:

1. Comment: Section 1.0 Introduction add "protective,"

Response: Edit made.

2. Comment: Section 1.2 insert "maybe" delete "are also". This is just conjecture.

Response: Edit made.

7. Comment: Section 2.1 fourth paragraph Last 5 sentences are not in the March 2007 deliverable. Maybe earlier comment by Lynda; never the less I agree with the 5 sentences.

Response: Removed "within Elliott Bay" from previous sentence.

8. Comment: Section 2.1 fifth paragraph Replace with: Dredging, capping or some combination of dredging and capping are the only remedial alternatives under consideration.

Response: Edit made. Suggested sentence added.

9. Comment: Section 2.1 second bullet insert "as applicable".

Response: Edit made.

15. Comment: Section 2.4 Change to Bill Bath

Response: Edit made.

85. Comment: Section 4.8 Preliminary

Response: "Preliminary" added.

101. Comment: Section 5.0 For sections 5.0 to 13.0 see comments on Response to Comments Chart, except for comments for section 11.0 see Lon's comments.

Response: Comments addressed as appropriate.

MATRIX TABLE WITH EPA COMMENTS

1. Comment: General The WP presents unsubstantiated assumptions such as transport of sediment from the Duwamish/West Waterway to Lockheed West (LW) and the other industrial facilities acting as a source of contaminants that can be transported to Lockheed West (Section 4.3). The WP should provide a framework for substantiating these assumptions instead of presenting them as a possibility. The WP should serve as a basis for what is known, what is not and how information will be gathered and interpreted. Comments, such as 4.3.2.1., below will also address this comment. This assumption is made so frequently that EPA wonders how this information will be used in the RI/FS, particularly the alternative analysis?

Response: A new section will be added to the Work Plan to provide a "roadmap/framework" for the proposed project approach. The text will be revised to clarify our understanding of what is known, what is not known and how information will be gathered and interpreted.

Comment: The Framework (Figure 1-1) does not answer the comment.

Response: Figure 1.1 revised to address comment #3 from EPA COMMENTS ON MARCH 07 DARFT WP2.DOC.

17. Comment: Section 4.3.2.2 This section is pretty generalized. How do we know that the large vessels do not impact the eastern side of the site? What specific type of vessel does enter the site and what is its potential for disturbing the sediments? This is important for the sediment stability analysis.

Response: Size of vessels potentially entering the northern portion of the site is unknown, but these are assumed to be of limited draft. At present, the existing navigational channel is located east of the Lockheed West property boundary. Standard practice for large vessels is to stay within the navigational channel. Smaller vessels may enter the site, but significant vessel traffic is unlikely given that the large pier structures pose navigational hazards. Preliminary review of the recent high resolution bathymetry does not show evidence of scour, plowing or anchor drag at the site.

Comment: What will happen when the piers are removed as part of the remedy and the area is used for barge mooring?

Response: Do not know and cannot control. Commercial vessels will still stick to the navigational channel. Barge mooring will reduce vessel traffic.

85. Comment: Miscellaneous The Duwamish turning basis is scheduled for periodic dredging, next in 2007. LM may want to consider how this dredge material could be beneficially used at the site for capping and habitat creation.

Response: Remediation at the site will not occur in 2007 and therefore, can not utilize dredged materials from the upcoming Duwamish River dredging event. Cap material sources will be evaluated as part of the remedial design.

Comment: OK

Response: When we get to remedial design phase, we will consider all sources of capping material.

MATRIX TABLE WITH NOAA COMMENTS

22. Comment: Section 10, Data Management While stakeholders will receive hardcopies of future documents, NOAA would also like to request electronic versions of some of the deliverables. To facilitate review of analyses and support decision-making, digital spatial data layers should accompany all deliverables of documents containing figures, tables and spatial analyses. In addition to contaminant data or data tables that are delivered in separately specified formats, NOAA requests delivery of all GIS (Geographic Information System) files and database tables used to create figures and relevant analyses. ESRI ArcGIS (shapefiles or grids) containing attribute data and including metadata, projection and datum information are the preferred format. If projection and datum information are not explicitly specified in an accompanying projection file (for ESRI projects, *shapefile.prj*), this information should be noted in a metadata file.

Response: LMC intends to provide the data to EPA in a format specified by EPA. As discussed in Section 10, it is not LMC's intent to provide all data in multiple formats

Comment: EPA will request other data formats as needed.

Response: Will await EPA's data format request.

LON KISSINGER COMMENTS ON 3/12/07 RI/FS WP

27. Comment: Page 8-2, 8.1.2 Proposed RI Sampling Summary, Surface Sampling: An issue with a regular grid is that it may over or underestimate contamination that is spaced systematically. The piers are somewhat regularly spaced and may be associated with systematic spacing of sediment contaminants. Issues associated with a systematic grid laid over systematic contamination should be considered. For example, Figure 8-2 shows that none of the samples have been taken from areas under piers 23 or 24.

Some discussion should also be done of how well the grid addresses contamination associated with unique site features (e.g. pier locations, former storm drain outfalls, the ship way).

Response: The work plan will be clarified as to how the specific sampling strategy was developed.

29. Comment: Page 8-4, 8.2 Identify Extent of Sediment Contamination Exceeding PRGs, "Subtital" [sic] Surface Sediment Samples: editorial "tow" should be "two." This section should be expanded to discuss how the sampling addresses measurement of contamination that may be associated with unique site feature (e.g. (e.g. pier locations, former storm drain outfalls, the ship way). It may be appropriate to sample along transects with smaller spacing to characterize contaminant contributions associated with unique site features.

Response: SEE response to Comment #27.

33. Comment: Page 8-14, 8-7 Water Quality: The collection depth should be specified. The question of how duration of collection time affects representativeness should be discussed.

Response: Acknowledged; information on collection depth will be made to the text as per the comment.