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Site 34 Site Investigation Quality Assurance Project Plan

for

Portsmouth Naval Shipyard

Kittery, Maine

Engineering Field Activity Northeast
Naval Facilities Engineering Command

Contract Number N62467-D-94-0888

Contract Task Order 0825

March 2003

080201/P

SITE 34 SITE INVESTIGATION
QUALITY ASSURANCE PROJECT PLAN

FOR

PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Northeast
Environmental Branch Code 18
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

Submitted by:
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CONTRACT NUMBER N62467-D-94-0888
CONTRACT TASK ORDER 0825

MARCH 2003

PREPARED UNDER THE DIRECTION OF:

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I have reviewed the attached "*Site 34 Site Investigation Quality Assurance Project Plan for Portsmouth Naval Shipyard, Kittery, Maine*" dated March 2003, prepared by Tetra Tech NUS, Inc. (TtNUS). TtNUS specialists developed the data quality objectives, sampling and analytical programs, risk assessment protocols and data management and quality assessment plans presented in this QAPP.

STATE OF MAINE
CHARLES D. RACE
243
CERTIFIED GEOLOGIST

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LIST OF ACRONYMS

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CG	Certified Geologist
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
COC	Contaminants of Concern
CRQL	contract required quantitation limit
CTO	Contract Task Order
DAF	Dilution/Attenuation Factor
DDE	Dichloro-, Diphenyl-, Trichloroethene
DDT	Dichloro-, Diphenyl-, Trichloroethane
DPT	direct-push technology
DQO	data quality objectives
DVM	Data Validation Manager
EE/CA	Engineering Evaluation/Cost Analysis
EFA	Engineering Field Activity
EFANE	Engineering Field Activity - North East
FID	flame ionization detector
FOL	Field Operations Leader
FWENC	Foster Wheeler Environmental Corporation
GIS	geographical information system
GPR	ground-penetrating radar
HASP	health and safety plan
ICP	Inductively Coupled Plasma
IDLs	instrument detection limits
IDW	investigation-derived waste
IRCDQM	Installation Restoration Chemical Data Quality Manual
IRG	Interim Remediation Goal
IRP	Installation Restoration Program
LAN	local area network
LCSs	laboratory control samples
LQAP	laboratory quality assurance plan
M.H.W.	mean high water
M.L.W.	mean low water
MDLs	method detection limits

MEDEP	Maine Department of Environmental Protection
MIS	management information system
MSD	matrix spike duplicate
MSs	matrix spikes
MSSTA	monitoring station
NAD	North American Datum
NFESC	Naval Facilities Engineering Service Center
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity units
ORP	oxidation/reduction potential
OU4	Operable Unit 4
PAHs	polycyclic aromatic hydrocarbons
PARCC	precision, accuracy, representativeness, comparability, and completeness
PCBs	polychlorinated biphenyls
PDSs	post-digestion spikes
PE	performance evaluation
PID	photoionization detector
PM	Project Manager
PNS	Portsmouth Naval Shipyard
PPE	personal protective equipment
PRGs	preliminary remediation goals
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RAB	Restoration Advisory Board
RBC	risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facilities investigation
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
RPM	Remedial Project Manager
SDG	sample delivery group
SMC	Sample Management Coordinator
SOP	standard operating procedure
SOWs	statements of work

SS	site screening
SSI	site screening investigation
SSLs	Soil Screening Levels
SVOCs	semi-volatile organic compounds
SWDIV	South West Division
T.B.D	to be determined
TAL	Target Analyte List
TCL	Target Compound List
TPH	total petroleum hydrocarbons
TtNUS	Tetra Tech NUS, Inc
TW	temporary wells
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
USEPA-NE	U.S. Environmental Protection Agency Region I - New England
VOC	volatile organic compound

EXECUTIVE SUMMARY

This Quality Assurance Project Plan (QAPP) for the site investigation for Site 34 (Former Oil Gasification Plant) at Portsmouth Naval Shipyard (PNS), Kittery, Maine, has been prepared by Tetra Tech NUS, Inc. (TtNUS) for the U.S. Department of the Navy (Navy) under the Comprehensive Long-term Environmental Action Navy (CLEAN) program, Contract Number N62467-D-94-0888, Contract Task Order (CTO) 825. The scope of the investigation is the ash disposal area and the environmental media potentially impacted by the historical operations within Building 62 at the site.

This QAPP has been designed to meet the following requirements for the investigation:

- The Navy has determined that based on the limited analytical data on the soil and ash at the site, and the offshore sediment data that a non-time-critical removal action of the ash and associated contaminated soil is required. Data to determine the nature and extent of contamination is needed to prepare an engineering evaluation/cost analysis (EE/CA) to support the removal action.

- The Navy has also determined that following a removal action of the ash pile and associated contaminated soil, any impacts to the environmental media that may have occurred due to other sources at the site also need to be evaluated for site screening (SS) purposes. These other sources are the tar pit that may be present under the floor of Building 62, and the pesticide-rinse wash pad/drainage. The site screening focuses on determining whether unacceptable risk could be present at the site from hazardous substance activities conducted at the site. To determine the potential for unacceptable risk at the site, the most likely media and locations where storage, release, and/or disposal activities may have occurred are primarily targeted for sampling and analysis. The data are evaluated through a series of risk-based decision-making steps to determine further courses of action (i.e., no further action, interim action, or remedial investigation/feasibility study) for each medium (soil, groundwater, and offshore sediment) at the site.

The following is an outline of the sampling and analytical tasks under this investigation:

- Ash chemical characterization: An analysis of a full suite of chemicals, i.e., Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), metals, and pesticides/polychlorinated biphenyls (PCBs). Additional analysis will include dioxins, and possibly cyanide. These data will be used to focus the list of chemicals for the removal action and to characterize the source for site screening purposes.

- Ash characterization for selected engineering parameters, to support the development of an EE/CA.

- Soil chemical characterization: Analysis of a full suite of chemicals, and depending on the results of the ash characterization, possibly dioxins. Analysis for cyanide will be included if the ash samples are selected for cyanide analysis. These data will be used to develop the vertical and horizontal extent of contamination associated with the ash for the removal action. These data will also be used for site screening following the removal action.

- Groundwater sampling: Analysis of a full suite of chemicals for site screening and possibly cyanide (if ash samples are selected for cyanide analysis), to assess impacts to groundwater.

- Sediment sampling: Analysis of pesticides in selected locations on site and offshore for site screening to assess potential impacts to the offshore.

1.0 INTRODUCTION

This section discusses the objectives and scope of the investigation, the Quality Assurance Project Plan (QAPP) organization, and background information on Site 34, Former Oil Gasification Plant, at Portsmouth Naval Shipyard (PNS), Kittery, Maine. This section also discusses the usability of data from previous investigations at this site.

1.1 OBJECTIVES AND SCOPE

Tetra Tech NUS, Inc., (TtNUS) prepared this QAPP for the U.S. Department of Navy under the Comprehensive Long-Term Environmental Action Navy (CLEAN) program, Contract Task Order (CTO) 825. This QAPP provides the basis and methods to be followed to collect data to support a non-time-critical removal action for the ash pile at Site 34 and to support the site screening evaluation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for Site 34. The scope of the investigation is the ash disposal area and the environmental media potentially impacted by the historical operations at the site.

1.2 REPORT ORGANIZATION AND DOCUMENT CONTROL

This section provides information on the QAPP organization and document control. This QAPP was written with a crosswalk format, following the U.S. Environmental Protection Agency (USEPA) Region I-New England (USEPA-NE) QAPP guidance (USEPA, October 1999). The crosswalk table (Section 1.2.2) correlates the section numbers in the document to standardized section numbers used in the USEPA guidance to show in which section the required information is provided. The USEPA-NE QAPP Worksheet No. 2 was used to provide the crosswalk. The QAPP contents and Worksheet No. 2 are provided in Sections 1.2.1 and 1.2.2, respectively. Document control (including distribution and sign-off on the QAPP) is discussed in Section 1.2.3.

1.2.1 QAPP Contents

The QAPP consists of the following sections:

- Section 1.0 is this introduction and includes the background information on Site 34.
- Section 2.0 discusses the basis and data quality objectives (DQOs) of the investigation and includes an overview of the investigation.
- Section 3.0 presents the project organization and responsibilities.

- Section 4.0 discusses the details of the field investigation procedures and field laboratory analytical plan.
- Section 5.0 discusses the details of the fixed laboratory analytical plan.
- Section 6.0 presents the project documentation, records, data management, and data usability.
- Appendix A contains information from previous site activities.
- Appendix B contains the DQOs
- Appendix C contains the standard operating procedures (SOPs) and field documentation forms to be used in the fieldwork.
- Appendix D contains the responses to comments.

1.2.2 USEPA-NE QAPP Worksheet No. 2

The USEPA-NE QAPP guidance (USEPA, October 1999a) requires inclusion of Worksheet No. 2 to provide introductory information in the QAPP, to identify key project players, previous site work, and the USEPA program for which the current project is being performed. USEPA-NE QAPP Worksheet No. 2 for the Site 34 investigation and also include the cross walk to the elements of QAPP per the guidance, which is provided on pages 1-3 through 1-8.

1.2.3 Document Control

The document control procedures are used to identify the most current version of the QAPP and to help ensure that only the most current version of the QAPP is used by all project participants. To meet this goal, text, tables, and figures in the Site 34 investigation QAPP include a header indicating the document name and revision number and date. The footer indicates the page number within the section. Revision 0 with the month and year will be used as part of the header, for the draft, draft final and final versions. Any revisions made after submittal of the final will be indicated with appropriate revision number and date.

A document control numbering system will not be used for this QAPP because this project has a distinct document distribution list. The QAPP and any revisions, addenda, or amendments will be provided in accordance with the PNS distribution list. The PNS distribution list includes the USEPA, Maine Department of Environmental Protection (MEDEP), Navy, Natural Resource Trustees, and Restoration

USEPA-NE QAPP Worksheet #2 - Rev. 0

Site Name/Project Name: Site Investigation
Site Location: Portsmouth Naval Shipyard (PNS), Kittery, Maine
Site Number/Code: Site 34
Operable Unit: Not Assigned

Contractor Name: Tetra Tech NUS, Inc. (TtNUS)
Contract Task Order Number: 825
Contract Title: Navy Comprehensive Long-term Environmental Action Navy (CLEAN) Program

1. **Identify Guidance used to prepare QAPP:**

   Region I, USEPA-NE Compendium QAPP Guidance, Attachment and/or other*:*

   Region 1 USEPA*-New England Compendium of Quality Assurance Project Plan Guidance, October 1999, Final.*

2. **Identify USEPA Program:** *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*

3. **Identify approval entity: USEPA-NE or State:** *USEPA-NE*

   or other entity:

4. **Indicate whether the QAPP is a generic program QAPP or a project specific QAPP:** *Project Specific*

5. **List dates scoping meetings were held:** *Scoping meetings were held between the Navy (EFANE/PNS) and TtNUS in 2001. Regulatory and RAB input was provided by review and comment on the DQOs and QAPP. See Section 2.1 for details.*

6. **List dates and titles of QAPP documents written for previous site work, if applicable:**

   References to previous investigations can be found in Section 1.4.1

7. **List organizational partners (stakeholders) and connection with USEPA and/or State:**

   MEDEP; Natural Resources Trustees; PNS RAB

8. **List data users:** *The Navy will use the data to prepare the engineering evaluation/cost analysis, site screening, and to support further investigation, as necessary for Site 34. The USEPA, MEDEP, Natural Resources Trustees, and RAB will review the documents prepared for Site 34.*

9. **If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable to the project, then circle the omitted QAPP Elements, Worksheets, and Required Information on the attached Table. Provide an explanation for their exclusion below:**

   The information needed for the worksheets was directly filled into the tables of relevant QAPP sections; therefore, except for this work sheet (Worksheet No. 2), worksheets are not included in the QAPP.

USEPA-NE QAPP Worksheet #2 (Continued)

REQUIRED USEPA QA/R-5 ELEMENTS	QAPP CORRESPONDING SECTION	REQUIRED USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Project Management and Objectives				
A1	Title and Signature page	1.0 Title and Approval Page	1	- Title and Approval Page
A2	1.2 Begin. of Document 1.2.3 1.2.3 1.2.2	2.0 Table of Contents and Document Format 2.1 Table of Contents 2.2 Document Control Format 2.3 Document Control Numbering System 2.4 USEPA-NE QAPP Worksheet #2	2	- Table of Contents - USEPA-NE QAPP Worksheet
A3	1.2.3	3.0 Distribution List and Project Personnel Sign-off Sheet	3 4	- Distribution List - Project Personnel Sign-off Sheet
A4, A8	3.0 3.1 3.2 3.2.1 3.3 3.4	4.0 Project Organization 4.1 Project Organizationa Chart 4.2 Communication Pathways 4.2.1 Modifications to Approved QAPP 4.3 Personnel Responsibilities and Qualifications 4.4 Special Training Requirements/ Certification	5a 5b 6 7	- Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table
A5	2.1 2.1 1.3,1.4, 1.5,1.6, 2.2	5.0 Project Planning/Project Definition 5.1 Project Planning Meetings 5.2 Problem Definition/Site History and Background	8a 8b	- Project Planning Meeting Documentation - Project Scoping Meeting Attendance Sheet with Agenda - Problem Definition/Site History and Background - USEPA-NE DQO Summary Form - Site Maps (historical and present)

USEPA-NE QAPP Worksheet #2 (Continued)

REQUIRED USEPA QA/R-5 ELEMENTS	QAPP CORRESPONDING SECTION	REQUIRED USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Project Management and Objectives (Continued)				
A6	2.0 2.2, 2.3, 2.4, 2.6, 5.1 3.7	6.0 Project Description and Schedule 6.1 Project Overview 6.2 Project Schedule	9a 9b 9c 9d 10	- Project Description - Contaminants of Concern and Other Target Analytes Table - Field and Quality Control Sample Summary Table - Analytical Support Laboratories - System Designs - Project Schedule Timeline, Products, and Deliverable table
A7	2.0, 5.0, 6.0 2.5 6.3	7.0 Project Quality Objectives and Measurement Performance Criteria 7.1 Project Quality Objectives 7.2 Measurement Performance Criteria	11 11	- Measurement Performance Criteria - Concentration Levels
Measurement/Data Acquisition				
B1	4.0 2.6 and 4.0	8.0 Sampling Process Design 8.1 Sampling Design Rationale	12a 12b	- Sampling Rationale - Sampling Locations, Sampling and Analytical Method/SOP Requirements Table - Sample Location Map
B2, B6, B7, B8	4.0 4.3, 4.4, 4.5, 4.6 4.13 4.10 4.14 4.15 4.15	9.0 Sampling Procedures and Requirements 9.1 Sampling Procedures 9.2 Sampling SOP Modifications 9.3 Cleaning and Decontamination of Equipment/Sample Containers 9.4 Field Equipment Calibration 9.5 Field Equipment Maintenance, Testing and Inspection Requirements 9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers	13 12b 14 15	- Sampling SOPs - Project Sampling SOP Reference Table - Sampling Container, Volumes and Preservation Table - Sampling Equipment Calibration Table - Cleaning and Decontamination SOPs - Field Equipment Maintenance, Testing and Inspection Table

USEPA-NE QAPP Worksheet #2 (Continued)

REQUIRED USEPA QA/R-5 ELEMENTS	QAPP CORRESPONDING SECTION	REQUIRED USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Measurement/Data Acquisition (Continued)				
B3	4.9 4.9.1 4.12 4.12 4.9 4.9	10.0 Sample Handling, Tracking, and Custody Requirements 10.1 Sample Collection Documentation 10.1.1 Field Notes 10.1.2 Field Documentation Management System 10.2 Sample Handling and Tracking System 10.3 Sample Custody	16	- Sample Handling, Tracking and Custody SOPs - Sample Handling Flow Diagram - Sample Container Label (Sample Tag) - Chain-of-Custody Form and Seal
B4, B6, B7, B8	4.0 4.14 4.14.2 4.14.1 4.15 4.15	11.0 Field Analytical Method Requirements 11.1 Field Analytical Methods and SOPs 11.2 Field Analytical Method/ SOP Modifications 11.3 Field Analytical Instrument Calibration 11.4 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements 11.5 Field Analytical Inspection and Acceptance Requirements for Supplies	17 18 19	- Field Analytical Methods/SOPs - Field Analytical Method/SOP Reference Table - Field Analytical Instrument Calibration Table - Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Table

USEPA-NE QAPP Worksheet #2 (Continued)

REQUIRED USEPA QA/R-5 ELEMENTS	QAPP CORRESPONDING SECTION	REQUIRED USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
		Measurement/Data Acquisition (Continued)		
B4, B6, B7, B8	5.0 5.2 5.2 5.3 5.3, 5.4 5.5	12.0 Fixed Laboratory Analytical Method Requirements 12.1 Fixed Laboratory Analytical Methods and SOPs 12.2 Fixed Laboratory Analytical Method/SOP Modifications 12.3 Fixed Laboratory Instrument Calibration 12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements 12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies	20 21	- Fixed Laboratory Analytical Methods/SOPs - Fixed Laboratory Analytical Method/SOP Reference Table - Fixed Laboratory Instrument Maintenance and Calibration Table
B5	4.8 4.8 4.8, 5.4 NA 5.4	13.0 Quality Control Requirements 13.1 Sampling Quality Control 13.2 Analytical Fixed Laboratory Quality Control 13.2.1 Field Analytical QC 13.2.2 Fixed Laboratory QC	22a 22b 23a 23b 24a 24b	**Sampling** - Field Sampling QC Table - Field Sampling QC Table cont. **Analytical** - Field Analytical QC Sample Table - Field Analytical QC Sample Table cont. - Fixed Laboratory Analytical QC Sample Table - Fixed Laboratory Analytical QC Sample Table cont.
B9	1.5	14.0 Data Acquisition Requirements	25	- Non-Direct Measurements Criteria and Limitations Table

USEPA-NE QAPP Worksheet #2 (Continued)

REQUIRED USEPA QA/R-5 ELEMENTS	QAPP CORRESPONDING SECTION	REQUIRED USEPA-NE QAPP ELEMENT(S) and CORRESPONDING USEPA-NE QAPP SECTION(S)	USEPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Measurement/Data Acquisition (Continued)				
A10, B10	6.1 6.1.1 6.1.2 6.1.3 6.1.4 6.1.5 6.1.6	15.0 Documentation, Records, and Data Management 15.1 Project Documentation and Records 15.2 Field Analysis Data Package Deliverables 15.3 Fixed Laboratory Data Package Deliverables 15.4 Data Reporting Formats 15.5 Data Handling and Management 15.6 Data Tracking and Control	26	- Project Documentation and Records Table - Data Management SOPs
Assessment/Oversight				
C1	3.5 3.5.1 3.5.2 3.5.3	16.0 Assessments and Response Actions 16.1 Planned Assessments 16.2 Assessment Findings and Corrective Action Responses 16.3 Additional QAPP Non-Conformances	27a 27b 27c	- Assessment and Response Actions - Project Assessment Table - Project Assessment Plan - Audit Checklists
C2	3.6	17.0 QA Management Reports	28	- QA Management Reports Table
Data Validation and Usability				
D1	6.2	18.0 Verification and Validation Requirements		- Validation Criteria Documents
D2	6.2	19.0 Verification and Validation Procedures	29a 29b 29c	- Data Evaluation Process - Data Validation Summary Table - Data Validation Modifications
D3	6.3	20.0 Data Usability/Reconciliation with Project Quality Objectives	30	- Data Usability Assessment

Advisory Board (RAB) members. The mailing address and number of copies of the document are provided for each name on the mailing list. In addition, the cover letter accompanying the document indicates the distribution list and number of copies (in the case of multiple copies only). The distribution list for the Site 34 investigation QAPP is summarized in Table 1-1. Each person listed in Table 1-1 will receive a copy of this Revision 0 QAPP and any subsequent revisions.

Table 1-2 provides an example of the project personnel sign-off sheet, which will be signed by all personnel working on the project. A signature on this form indicates the person has read this QAPP and is familiar with the tasks to be performed. The completed sign-off sheet will be maintained in the TtNUS project file.

1.3 BACKGROUND INFORMATION

This section presents the facility and site information regarding the location, features, and history.

1.3.1 Site Location and Description

PNS is a military facility with restricted access on an island located in the Piscataqua River separating Kittery, Maine and Portsmouth, New Hampshire, as shown on Figure 1-1. PNS is located on an island in the Piscataqua River, referred to on National Oceanic and Atmospheric Administration (NOAA) nautical charts as Seavey Island, with the eastern tip given the name Jamaica Island. Attached by a rock causeway is Clark's Island, which is not industrialized. The Piscataqua River is a tidal estuary that forms the southern boundary between Maine and New Hampshire. PNS is located at the mouth of the Great Bay Estuary (commonly referred to as Portsmouth Harbor).

PNS is engaged in the conversion, overhaul, and repair of submarines for the Navy. The long history of shipbuilding in Portsmouth Harbor dates back to 1690, when the first warship launched in North America, the Falkland, was built. PNS was established as a government facility in 1800, and it served as a repair and building facility for ships during the Civil War. The first government-built submarine was designed and constructed at PNS during World War I. A large number of submarines have been designed, constructed, and repaired at this facility since 1917. PNS continues to service submarines as its primary military focus. Site 34 is located north of Smoot Street near the northern shoreline of PNS. The location of Site 34 at PNS is shown on Figure 1-2.

A preliminary site visit indicated that the ash pile is mounded along the northern side of Building 62 in between the building wall and street, as shown on Figure 1-3 of the QAPP. The southern side of the building is on Smoot Street, which is at a higher elevation than the street on the northern side. The land on the northern side of Building 62 slopes gently towards the road/driveway, and then slopes steeply to

the water's edge at the back channel of the Piscataqua River. Access to the shoreline from the site is difficult for a recreational user because of the rapid change in terrain. The ash pile apparently continues past the western end of Building 62 within a narrow strip of land between Building 62-Annex and the street on the northern side. It is not known if any ash exists beneath Building 62-Annex.

A wash pad, approximately 10 feet x 10 feet in area is located adjacent to the southern wall of Building 62 with no obvious signs of any release to the adjacent soil or breach in the concrete. However, if the drain 49-1 is the inlet that leads to the Outfall 49, this is a conduit that might have existed for the discharge of wastewater from the pad to the offshore. The exact location at the shoreline where this outfall terminates is not known, and therefore shown as to be determined (T.B.D.)

Building 62 is currently used as a bobcat (mini-bulldozer) shop and storage. Building 60, located adjacent to the northwest of Building 62, has historically been used for the building of small ships. A floor plan dated July 1994 (included in the report by Dolph and Turpin) shows that Building 62 is about a quarter office space, a quarter workshop space, and half storage space, with a restroom in the approximate location of the tar pit (from gasification operations). The 1994 floor plan shows the annex is mostly storage space; with about a third occupied by a locker room and lunch room. Because of the age of the site and the presence of historical buildings, archaeological and historical architectural resources will be considered during the investigation. Therefore, the Shipyard Cultural Resources Department will be contacted to determine any constraints or requirements during investigation.

1.3.2 Site History and Background

Building 62 (built in the late 1800s) and its more recent annex (Building 62-Annex, built in the 1940s) are the most prominent features related to the use of Site 34. Site 34 is the location of a former oil gasification process plant. Very limited information is available on the process details. A majority of the history of the site has been obtained from the "Industrial History of Building 62 (Former Gas Manufacturing Plant), by James Dolph and Dennis Turpin, October 1996" and from general literature describing similar plants that were historically located at several cities around the country.

The following is a listing of the site history as excerpted from the above-mentioned sources:

- From the 1870s to the early 1900s (Dolph and Turpin, October 1996), the building housed a process that converted kerosene to illuminating gas, which was piped to various locations on the shipyard. Coal was used to provide heat for the process wherein kerosene was subjected to fractional volatilization in equipment called retorts. Tar was produced as a residue from the volatilization of the lighter fraction of kerosene. The tar was likely to have been deposited in a tar pit within the building. A gas purifier may have been used to remove the corrosive gases from the oil gas, which may have

led to the production of woodchip waste and limestone waste that would have contained other chemicals such as polycyclic aromatic hydrocarbons (PAHs), and heavy metals. Cyanides are not expected to be found because the process apparently did not employ coal gasification, however, wastes (wood chips or stones) bearing a prussian blue color may indicate the presence of cyanides.

- Between 1901 and 1912, the plant was closed, all of the machinery was removed, and a concrete floor was laid, according to Dolph and Turpin (October 1996)

- Between 1915 and 1930, the building was used as a blacksmith shop by the Public Works Department, during which time (in 1919), the building was gutted by a fire, according to Dolph and Turpin (October 1996).

PNS sources report that Building 62 was used for pesticide storage by Public Works. Pesticides stored in the building included several pesticides/insecticides/herbicides, such as Diazinon, Dursban, Baygon, Malthion, Bromacil, Biotrol, Carbaryl, and Avitrol. This activity reportedly occurred after the building was used as a blacksmith shop, in the 1960s to 1985 time period, according to the Navy. The pesticide storage was reportedly conducted in the southern portion of the original Building 62 (on the Smoot Street side of the building). A steam line on the exterior of the building was reportedly used for flushing equipment and washing coveralls that were used for the pesticide shop. However, information from the Initial Assessment Study (Weston, 1983) indicates that pesticides management at PNS from the 1960s to the present was carefully managed and that procedures included triple rinsing all sprayers, empty cans, and containers, and reusing the rinse water in diluting the next batch of pesticides. Building 62 did not meet all the requirements for pesticide storage (venting, building materials, and other uses of the building at the time of storage); therefore, a new pesticide control shop was built in 1985 (Building 314, formerly located at Site 29), and pesticide storage activities at Building 62 ended. A bermed concrete pad (not currently in use, as indicated by the presence of a large amount of debris in the pad) is located on the southern side of the building near a former steam line and drains that are part of the Outfall 49 drain system. A drain that is located in the pad was potentially used as part of the flushing activities; although historical records of this level of precision are not available.

PNS sources state that the building is currently used as a bobcat (mini-bulldozer) shop. The annex building is currently used for storage.

Buildings 60 and 63 are located adjacent of Building 62 to the northwest and east, respectively. Building 60 has historically been used for the building of small ships. Building 63 was constructed in 1874 as a Cart and Wheel Shed and is currently used for Public Works Storage.

In 1997, the Navy contracted Foster Wheeler Environmental Corporation (FWENC) to remove a small quantity of ash on the slope behind Building 62 (see Appendix A). However, after six drums of ash were removed, the action was stopped because it became apparent that a much larger quantity of ash was present than expected (FWENC, April 1999). The excavation was 6 feet wide by 6 feet long and 2.5 feet deep, and ash was visible on all four sidewalls and the base of the excavation (FWENC, April 1999). The excavation was provided with a herculite cover (FWENC, April 1999). Currently the ash pile appears to have soil and vegetation on the surface.

The site uses that potentially led to waste generation and subsequent disposal on site are expected to be the following:

- Ash, assumed to be from the combustion of coal (and potentially including ash from the building fire) appears to have been deposited outside Building 62. The ash pile outside the building appears to cover an area that is approximately 100 feet long (along the length of Building 62 and the Building 62 Annex) and 30 feet wide, i.e., up to the edge of the road that runs east-west parallel to the northern edge of the buildings. The depth of the ash pile below ground surface is unknown.

- Coal (fuel) combustion during the oil gasification process, which led to the generation of ash from 1870s to early 1900s. Tar generation (by product of the oil gasification process), which was disposed of in a tar pit inside the building during this time period. The specific process used at this plant reportedly was very efficient and produced very small volumes of tar residue, however, records of actual volumes are not available. The tar pit had a small (approximately 5 feet x 5 feet) opening. It is possible that this tar pit may have been removed when the oil gasification process was terminated and all of the equipment from the building was removed, following which a concrete floor was installed within the building between 1901 and 1912.

- Coal (fuel) combustion during the blacksmithy operation, which also led to the generation of ash from 1915 to 1930

- Pesticide storage inside Building 62 and possibly rinsing of equipment and overalls from approximately the1960s to 1985 at the small (approximately 10 feet x 12 feet) wash pad area, which is located adjacent to the southern wall of the building.

1.4 SUMMARY OF PREVIOUS INVESTIGATIONS

This section provides a summary of previous investigations that included the Site 34 onshore or offshore area. These summaries are intended to provide an understanding of the site characteristics to support the development of the site model for supporting the removal action and an understanding of the potential

contaminant migration pathways. Section 1.4.1 provides information on previous investigations and the usability of the data from these investigations as part of the Site 34 investigation. Section 1.4.2 provides a general expectation of the geological and hydrogelogical conditions at the site.

1.4.1 Previous Investigations

Previous sampling at and investigation in the vicinity of Site 34 included soil and sediment sampling. In 1998, the Navy collected soil and sediment samples at Site 34 to support their relative risk ranking for the site. Two locations were sampled for ash/soil material and soil, respectively, and two intertidal sediment samples were collected (Navy, January 1999). Sample collection field logs of these samples are presented in Appendix A. One intertidal location (MS-01 STA.2) and two subtidal locations (MS-01 STA.1 and STA.3) within Monitoring Station 1 (M01) were sampled during the Interim Offshore Monitoring Program (Rounds 1 through 5, 1999 to 2001) as reported in TtNUS, February 2000, October 2000, January 2001, September 2001, and February 2002. A sixth round of sampling was conducted in August 2002.

Figure 1-4 shows these previous sampling locations. The 1998 sediment sample locations are only approximately located using field notes. Furthermore, Figure 1-4 shows topographic contours for the site including the Mean High Water (M.H.W.) level. Contour intervals were developed from aerial photography and topography by Aerial Photo & Survey, Inc., Norridgewock, Maine, produced on November 22, 2002 from photography and control data collected during aerial flight of the shipyard on July 27, 2001. Elevations are based on the 2002 PNS Vertical Datum and Control Network. Horizontal locations are based on the North American Datum 1983 (NAD83), Maine State Plane Coordinate System, West Zone.

The sample of the ash/soil material and the sample of the soil from a location within 30 to 40 feet from the north side of the building collected in 1998 were analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs), TCL Semi-volatile Organic Compounds (SVOCs), Target Analyte List (TAL) metals, cyanide, and pesticides/polychlorinated biphenyls (PCBs). A summary of the data is provided in Table 1-3, which includes human health risk screening levels and the representative facility background concentrations.

VOCs were not detected in these samples. Except for 4,4'-DDT, 4,4'-DDE, and aldrin, none of the other pesticides or PCBs analyzed were detected. The three pesticides were detected at concentrations less than residential screening levels.

Among SVOCs, the most significant detections were PAHs in the range of 1,100 to180,000 µg/kg in the ash/soil sample, with significantly (one or more orders of magnitude) lower levels of the same compounds

in the soil sample. Some of these PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene) are present at concentrations that exceed screening levels (USEPA Region 9 residential screening levels) noted in Table 1-3, by an order of magnitude or more. Concentrations of these compounds are indicated in dark shaded cells on Table 1-3.

Among inorganics, antimony and lead were detected in the ash/soil sample at concentrations that were significantly (order of magnitude) greater than their respective USEPA Region 9 residential screening levels and also exceeded their respective facility background levels noted in Table 1-3. Cyanide was not detected in either sample. Concentrations of the two metals are indicated in dark shaded cells on Table 1-3.

A summary of the sediment data for Monitoring Station 01 (M01) from the interim offshore monitoring program and the two intertidal sediments (BS-6201-SD-0898 and BC-6202-SD-0898) is presented in Table 1-4. This table compares the data for chemicals that were selected as Contaminants of Concern (COCs) for sediment in Operable Unit 4 (OU4) with their Preliminary Remediation Goals (PRGs). The concentrations of high molecular weight PAHs exceeded the PRG value. Sporadic exceedances of PRGs for 4,4'-DDT, endrin, and transnonachlor were also noted. The concentrations of 4,4'-DDT exceeded its PRG by greater than an order of magnitude in one round. The concentrations of other pesticides marginally exceeded their respective PRGs.

Furthermore, during the development of PRGs, sediment samples were collected from two of the three locations at M01 during Round 2 for toxicity testing (TtNUS, November 2001). Neither sample was toxic in the whole sediment amphipod toxicity test. However, the sample from M01-3 was toxic in the sediment pore water toxicity test for sea urchin development. The sample from M01-2 was not toxic in the sea urchin development test.

1.4.2 Geology and Hydrogeology

No subsurface investigations have been conducted at this site; therefore, the information available is not specific to the site. However, based on the information available from the other sites that have been investigated at PNS, a general understanding of the geology and hydrogeology of the site vicinity is as follows:

- Site 34 is located along the northern shoreline of the original Dennett's Island near the back channel. Based on the facility-wide investigation performed during the Resource Conservation and Recovery Act (RCRA) Facilities Investigation (RFI) Data Gap (Halliburton NUS, 1995), the ground surface of Dennett's Island slopes moderately from the south of Building 62/62A towards the north, and then more rapidly toward the back channel.

- Depth to bedrock along original island boundaries is typically 5 to 15 feet below ground surface (bgs). Natural overburden materials are expected to consist of fractured or weathered bedrock, glacial till, or river/tidal deposits. Fresh groundwater is expected to flow from the recharge area located in the central portion of Dennett's Island and discharge to the back channel. Because Site 34 is located within 100 feet of the shoreline, brackish to saline groundwater conditions are expected in the overburden groundwater (if present) and shallow bedrock groundwater. Deeper bedrock groundwater is expected to be brackish or saline, depending on the hydraulic connections between the recharge area and the back channel.

1.5 CONCEPTUAL SITE MODEL

An understanding of the conceptual site model helps in the development of problem statement, which forms the basis for the sampling plan rationale, discussed in Section 2.0. This subsection discusses the current understanding of the areas where potential sources of contamination are present and the model for the potential contaminant migration pathways from these wastes to the environmental media. An understanding of the areas of potential sources at the site will help focus the investigation to support the removal action. An understanding of the conceptual model of contaminant migration pathways will help focus the investigation on the areas where environmental media need to be investigated for the site screening evaluation.

1.5.1 Potential Sources of Contamination

The potential sources of contamination at the site have been mentioned in the section on site background. Among these sources, the removal action is intended to address the ash disposal area, and associated contaminated soil. The ash from coal combustion would likely contain heavy metals from the mineral origin of the coal and PAHs from the partial combustion of coal. Any ash from the building fire would most likely have contained creosote from the wood preservative that was typically used as a preservative. Creosote would have also contained PAHs. The wash pad area and drain may be sources of pesticide contamination. In summary, the potential sources of contamination from historical site uses are the following:

- Ash disposed alongside Building 62 and 62-A.
- Pesticide rinse area (former wash pad) and drain
- Tar pit within Building 62

1.5.2 Potential Contaminant Migration Mechanisms

A preliminary understanding of the topography of the site and the potential locations of the sources along with their chemical nature, aids in the indication of potential contaminant migration mechanisms.

A visual inspection of the site indicates that the ash pile is mounded along the northern side of the building between the building wall and the street. The southern side of the building is on Smoot Street, which is at a higher elevation than the street on the northern side. The land on the northern side of the street slopes gently towards the shoreline and then steeply to the water's edge at the back channel of the Piscataqua River. The drain leading from the abandoned wash pad adjoining the southern side of Building 62 may have been a previous pathway of pesticide rinse waters to the offshore.

The potential current pathways of contaminant migration from the potential sources discussed previously are as follows:

- Rainfall infiltration through the ash pile and into underlying soil/groundwater, followed by transport of dissolved contaminants to the offshore surface water/sediments. The remainder of the site is paved or covered by buildings so infiltration of precipitation is not likely to be a significant current migration mechanism in those areas of the site.

- Surficial erosion of the ash pile in areas exposed to direct incidental rainfall, followed by transport of the eroded material in drainage paths leading to the offshore surface water/sediments.

- Seepage from the tar pit into the underlying soil and groundwater, followed by transport of dissolved contaminants to the offshore surface water /sediments.

- Rainfall infiltration through leaks (if any) in the wash pad and drain into the underlying soil/groundwater, followed by transport of dissolved contaminants to the offshore surface water/sediment.

- Infiltration of contaminated soil particles from the wash pad area into the drain system leading to Outfall 49.

A potential pathway of contaminant migration in the past might have been wind-blown erosion of freshly deposited ash particles. However, wind erosion is not noted to be a current potential pathway of contaminant migration because of the age of the ash and the presence of a vegetated cover on the majority of the surface of the ash pile.

The offshore monitoring station data shows that the sediment has certain PAH levels that show a potential impact has occurred. The presence of one or more sources of PAHs (ash pile and tar pit) indicates that the site may be a source of the offshore PAH contamination, although a definitive link has not been evaluated.

1.5.3 Land Uses and Potential Exposure

PNS is a military facility with restricted access. The current land use for Site 34 is used by Public Works as the bobcat shop and storage. The site uses are likely to remain as it is currently. However, unrestricted residential, recreational, commercial, or industrial use of the site may be possible scenarios if the Shipyard were to close.

The site is mostly covered with asphalt on the southern side of the buildings or asphalt and grass on the northern side of the buildings. Therefore, potential onshore exposure pathways for human exposure to soil is through recreational or industrial (i.e., construction worker and/or occupational) use. Potential future residential exposure to soil is also a consideration. A potential future resident's use of the groundwater for potable uses is also a consideration if the groundwater is fresh. A construction worker's exposure to groundwater would be the only route to be considered if the groundwater is saline/brackish. The industrialized nature of the site minimizes exposure to any onshore ecological receptors.

Offshore exposure to a recreational user is an unlikely scenario because the steep shoreline directly adjoining the site reduces the likelihood of access from the site. However access to the intertidal area is possible from areas adjacent to the site (although the terrain is still rugged). Ecological exposure to the offshore sediment is a likely scenario.

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TABLE 1-1

DISTRIBUTION LIST
SITE 34 SITE INVESTIGATION QAPP
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

QAPP Recipients	Title	Organization	Telephone Number
Mr. Matthew Audet	USEPA Remedial Project Manager (RPM)	USEPA Region 1	(617) 918-1449
Mr. Iver McLeod	MEDEP RPM	Maine Department of Environmental Protection	207-287-8010
Mr. Fred Evans	Navy RPM	EFANE, Navy	610-595-0567 ext. 159
Ms. Marty Raymond	PNS Installation Restoration Program (IRP) Manager	Portsmouth Naval Shipyard	207-438-2536
Ms. Deborah Cohen	TtNUS PNS Facility Coordinator/Project Manager	Tetra Tech NUS, Inc., Pittsburgh, PA	Contact Fred Evans
Mr. J.P. Kumar	TtNUS Task Manager/Technical Lead	Tetra Tech NUS, Inc., Pittsburgh, PA	Contact Fred Evans
Ms. Kelly Carper	TtNUS Quality Assurance (QA) Officer	Tetra Tech NUS, Inc., Pittsburgh, PA	Contact Fred Evans
Mr. Charles Race	TtNUS Lead Hydrogeologist/Maine Certified Geologist (CG)	Tetra Tech NUS, Inc., Wilmington, MA	Contact Fred Evans
Ms. Andrea Colby	Laboratory Contact	Katahdin Analytical Services/ Geo Testing Express	Contact Fred Evans

Note: All members on the PNS distribution list (including the Natural Resources Trustees and RAB) will receive copies of the QAPP and all updates to the QAPP. A complete distribution list is available from the Navy and can be readily provided on request. The TtNUS Project Manager will be responsible for distribution of copies of the QAPP and all updates to the QAPP to TtNUS project personnel, including the field operations leader (FOL).

TABLE 1-2

EXAMPLE PROJECT PERSONNEL SIGN-OFF SHEET
SITE 34 SITE INVESTIGATION QAPP
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Project Personnel	Title	Signature	Date QAPP Read	QAPP Acceptable As Written
Deborah Cohen	TtNUS Facility Coordinator/Project Manager			
J.P. Kumar	TtNUS Task Manager/Technical Lead			
Kelly Carper	TtNUS QA Officer			
Charles Race	TtNUS Lead Hydrogeologist, Maine CG			
Joseph Samchuck	Data Validation Supervisor			

TABLE 1-3

SOIL DATA FOR SITE 34 COMPARED TO HUMAN HEALTH SCREENING LEVELS AND FACILITY BACKGROUND LEVELS
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
PAGE 1 OF 3

Location Sample Depth of Range (ft) Sample Date Matrix	BCSG BC-6203-SS-0001 (0-0.667) 8/5/1998 Soil/Ash		BCSG BC-6204-SS-0001 (0-1) 8/5/1998 Soil		USEPA Region 9 Residential PRGs [1] (r9sores_10)	USEPA Region 9 SSLs [2] (DAF=1) (r9ssl1_10)	Foot Note Reference [3]	95% UCL Background[4] - Soil (Fill and Non-fill)
Volatile Organic Compounds (µg/kg)								
1,1,1-TRICHLOROETHANE	11	UJ	11	UJ	1200000	100	SAT	ND
1,1,2,2-TETRACHLOROETHANE	11	UJ	11	UJ	380	0.2	C	ND
1,1,2-TRICHLOROETHANE	11	UJ	11	UJ	840	0.9	C	ND
1,1,2-TRICHLOROTRIFLUOROETHANE	11	UJ	11	UJ	5600000	NC	SAT	N/A
1,1-DICHLOROETHANE	11	UJ	11	UJ	59000	1000	N	ND
1,1-DICHLOROETHENE	11	UJ	11	UJ	12000	3	N	3
1,2-DICHLOROETHANE	11	UJ	11	UJ	350	1	C	ND
1,2-DICHLOROPROPANE	11	UJ	11	UJ	350	1	C	ND
2-BUTANONE	11	UJ	11	UJ	730000	NC	N	ND
2-HEXANONE	11	UJ	11	UJ	NC	NC	NA	ND
4-METHYL-2-PENTANONE	11	UJ	11	UJ	79000	NC	N	ND
ACETONE	11	U	11	U	160000	800	N	ND
BENZENE	11	UJ	11	UJ	650	2	C	ND
BROMODICHLOROMETHANE	11	UJ	11	UJ	1000	30	C	ND
BROMOFORM	11	UJ	11	UJ	62000	40	C	ND
BROMOMETHANE	11	UJ	11	UJ	390	10	N	ND
CARBON DISULFIDE	11	UJ	11	UJ	36000	2000	N	ND
CARBON TETRACHLORIDE	11	UJ	11	UJ	240	3	C	ND
CHLOROBENZENE	11	UJ	11	UJ	15000	70	N	ND
CHLORODIBROMOMETHANE	11	UJ	11	UJ	1100	20	C	ND
CHLOROETHANE	11	UJ	11	UJ	3000	NC	C	ND
CHLOROFORM	11	UJ	11	UJ	3600	30	C	ND
CHLOROMETHANE	11	UJ	11	UJ	1200	NC	C	ND
CIS-1,3-DICHLOROPROPENE	11	UJ	11	UJ	700	0.2	C	ND
ETHYLBENZENE	11	UJ	11	UJ	8900	700	C	ND
METHYLENE CHLORIDE	43	U	24	U	9100	1	C	2
STYRENE	11	UJ	11	UJ	1700000	200	SAT	ND
TETRACHLOROETHENE	11	UJ	11	UJ	1500	3	C	5.6
TOLUENE	11	UJ	11	UJ	520000	600	SAT	1
TOTAL1,2-DICHLOROETHENE	11	UJ	11	UJ	4300	NC	N	ND
TOTAL XYLENES	11	UJ	11	UJ	27000	10000	N	ND
TRANS-1,3-DICHLOROPROPENE	11	UJ	11	UJ	700	0.2	C	ND
TRICHLOROETHENE	11	UJ	11	UJ	53	3	C	ND
VINYL CHLORIDE	11	UJ	11	UJ	79	0.7	C	ND
Semivolatile Organic Compounds (µg/kg)								
1,2,4-TRICHLOROBENZENE	360	U	360	U	65000	300	N	ND
1,2-DICHLOROBENZENE	360	U	360	U	370000	900	SAT	ND
1,3-DICHLOROBENZENE	360	U	360	U	1300	NC	N	ND
1,4-DICHLOROBENZENE	360	U	360	U	3400	100	C	67
2,2'-OXYBIS(1-CHLOROPROPANE)	360	U	360	U	2900	NC	C	ND
2,4,5-TRICHLOROPHENOL	910	U	910	U	610000	14000	N	ND
2,4,6-TRICHLOROPHENOL	360	U	360	U	610	N	C	ND
2,4-DICHLOROPHENOL	360	U	360	U	18000	50	N	ND
2,4-DIMETHYLPHENOL	1100		360	U	120000	400	N	ND
2,4-DINITROPHENOL	910	UJ	910	UJ	12000	10	N	ND
2,4-DINITROTOLUENE	360	U	360	U	12000	0.04	N	ND
2,6-DINITROTOLUENE	360	U	360	U	6100	0.03	N	ND
2-CHLORONAPHTHALENE	360	U	360	U	390000	NC	N	ND
2-CHLOROPHENOL	360	U	360	U	6300	200	N	ND
2-METHYLNAPHTHALENE	11000		1300		5600	NC	NA	44
2-METHYLPHENOL	480		20	J	310000	800	N	ND
2-NITROANILINE	910	U	910	U	170	NC	N	ND
2-NITROPHENOL	360	U	360	U	NA	NC	N	ND
3,3'-DICHLOROBENZIDINE	360	UJ	1700	J	1100	0.3	C	ND
3-NITROANILINE	910	UJ	910	UJ	170	NC	N	ND
4,6-DINITRO-2-METHYLPHENOL	910	U	910	U	NC	NC	NA	ND
4-BROMOPHENYL-PHENYLETHER	360	U	360	U	NC	NC	NA	ND
4-CHLORO-3-METHYLPHENOL	360	UJ	360	UJ	NC	NC	NA	ND
4-CHLOROANILINE	360	U	360	U	24000	30	N	ND
4-CHLOROPHENYL-PHENYLETHER	360	U	360	U	NC	NC	NA	ND
4-METHYLPHENOL	1400		54	J	31000	NC	N	ND
4-NITROANILINE	910	UJ	910	UJ	170	NC	N	ND
4-NITROPHENOL	910	UJ	910	UJ	NA	NC	N	ND
ACENAPHTHENE	28000		1100		370000	29000	N	ND

TABLE 1-3

SOIL DATA FOR SITE 34 COMPARED TO HUMAN HEALTH SCREENING LEVELS AND FACILITY BACKGROUND LEVELS
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
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Location Sample Depth of Range (ft) Sample Date Matrix	BCSG BC-6203-SS-0001 (0-0.667) 8/5/1998 Soil/Ash		BCSG BC-6204-SS-0001 (0-1) 8/5/1998 Soil		USEPA Region 9 Residential PRGs [1] (r9sores_10)	USEPA Region 9 SSLs [2] (DAF=1) (r9ssl1_10)	Foot Note Reference [3]	95% UCL Background[4] - Soil (Fill and Non-fill)
ACENAPHTHYLENE	4000		1400		370000	29000[6]	NA	74
ANTHRACENE	360	U	2200		2200000	590000	N	62
BENZO(A)ANTHRACENE	85000	J	9500		620	80	C	233
BENZO(A)PYRENE	51000	J	5300		62	400	C	264
BENZO(B)FLUORANTHENE	46000	J	9000		620	200	C	315
BENZO(G,H,I)PERYLENE	3500	J	360	U	5600[7]	NC	N	235
BENZO(K)FLUORANTHENE	60000	J	5300		6200	2000	C	292
BIS(2-CHLOROETHOXY)METHANE	360	U	360	U	2900	NC	N	ND
BIS(2-CHLOROETHYL) ETHER	360	U	360	U	210	0.02	C	ND
BIS(2-ETHYLHEXYL)PHTHALATE	360	U	360	U	35000	NC	C	167
BUTYLBENZYLPHTHALATE	360	U	360	U	1200000	810000	N	ND
CARBAZOLE	19000	J	910		24000	30	C	94
CHRYSENE	83000	J	11000		62000	8000	C	294
DIBENZO(A,H)ANTHRACENE	20000	J	1700		62	80	C	190
DIBENZOFURAN	27000		870		29000	NC	N	ND
DIETHYLPHTHALATE	360	U	360	U	4900000	NC	N	ND
DIMETHYLPHTHALATE	360	U	360	U	100000000	NC	MAX	42
DI-N-BUTYLPHTHALATE	360	U	30	J	610000	270000	N	100
DI-N-OCTYLPHTHALATE	36000	UJ	360	U	240000	10000000	N	100
FLUORANTHENE	170000	J	10000		230000	210000	N	354
FLUORENE	34000		1700		260000	28000	N	42
HEXACHLOROBENZENE	360	U	360	U	300	100	C	ND
HEXACHLOROBUTADIENE	360	U	360	U	6200	100	C	ND
HEXACHLOROCYCLOPENTADIENE	360	U	360	U	37000	20000	N	ND
HEXACHLOROETHANE	360	UJ	360	UJ	35000	20	C	ND
INDENO(1,2,3-CD)PYRENE	38000	J	6700		620	700	C	235
ISOPHORONE	360	U	360	U	510000	30	C	ND
NAPHTHALENE	18000		820		5600	4000	N	43
NITROBENZENE	360	U	360	U	2000	7	N	ND
N-NITROSO-DI-N-PROPYLAMINE	360	U	360	U	69	0.002	C	ND
N-NITROSO-DIPHENYLAMINE	360	U	360	U	99000	60	C	
PENTACHLOROPHENOL	910	UJ	910	UJ	3000	1	C	ND
PHENANTHRENE	180000	J	8700		230000 [8]	210000 [8]	NA	213
PHENOL	420	J	360	UJ	3700000	5000	N	98
PYRENE	140000	J	20000		230000	210000	N	309
Pesticides/PCBs (µg/kg)								
4,4'-DDD	7.3	UJ	7.4	U	2400	800	C	38.5
4,4'-DDE	7.3	UJ	180		1700	3000	C	1475
4,4'-DDT	390	J	420	J	1700	2000	C	1300
ALDRIN	99	R	8.9	J	29	20	C	ND
ALPHA-BHC	3.8	UJ	3.8	U	90	0.03	C	ND
ALPHA-CHLORDANE	3.8	UJ	8.6	R	1600[9]	500[9]	C	ND
AROCLOR-1016	73	UJ	74	U	390	NC	N	ND
AROCLOR-1221	150	UJ	150	U	220	NC	C	ND
AROCLOR-1232	73	UJ	74	U	220	NC	C	ND
AROCLOR-1242	73	UJ	74	U	220	NC	C	ND
AROCLOR-1248	73	UJ	74	U	220	NC	C	ND
AROCLOR-1254	73	UJ	74	U	220	NC	C	ND
AROCLOR-1260	73	UJ	74	U	220	NC	C	ND
BETA-BHC	3.8	UJ	3.8	U	320	0.1	C	ND
DELTA-BHC	3.8	UJ	3.8	UJ	90[10]	NC	C	ND
DIELDRIN	7.3	UJ	7.4	U	30	0.2	C	ND
ENDOSULFAN I	3.8	UJ	3.8	U	37000	900	N	ND
ENDOSULFAN II	7.3	UJ	7.4	U	37000	900	N	ND
ENDOSULFAN SULFATE	7.3	UJ	7.4	U	37000[11]	900[11]	N	ND
ENDRIN	7.3	UJ	7.4	U	1800	50	N	ND
ENDRIN ALDEHYDE	7.3	UJ	7.4	U	1800[12]	50[12]	N	ND
ENDRIN KETONE	7.3	UJ	7.4	U	1800[12]	50[12]	N	ND
GAMMA-BHC (LINDANE)	3.8	UJ	3.8	U	440	0.5	C	ND
GAMMA-CHLORDANE	3.8	UJ	3.8	U	1600[9]	500[9]	C	ND
HEPTACHLOR	3.8	UJ	3.8	U	110	1000	C	ND
HEPTACHLOR EPOXIDE	3.8	UJ	3.8	U	53	30	C	ND

TABLE 1-3

SOIL DATA FOR SITE 34 COMPARED TO HUMAN HEALTH SCREENING LEVELS AND FACILITY BACKGROUND LEVELS
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
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Location Sample Depth of Range (ft) Sample Date Matrix	BCSG BC-6203-SS-0001 (0-0.667) 8/5/1998 Soil/Ash		BCSG BC-6204-SS-0001 (0-1) 8/5/1998 Soil		USEPA Region 9 Residential PRGs [1] (r9sores_10)	USEPA Region 9 SSLs [2] (DAF=1) (r9ssl1_10)	Foot Note Reference [3]	95% UCL Background[4] - Soil (Fill and Non-fill)
METHOXYCHLOR	38	UJ	38	U	31000	8000	N	ND
TOXAPHENE	380	UJ	380	U	440	2000	C	ND
Miscellaneous (mg/kg)								
CYANIDE	1	U	1	U	1.1	NC	N	N/A
Inorganic Compounds (mg/kg)								
ALUMINUM	6350	J	15600	J	7600	NC	N	21101
ANTIMONY	231	J	12.3	J	3.1	0.3	N	4.98
ARSENIC	16.5		17.6		0.39	1	C	17.8
BARIUM	140		176		540	82	N	95.8
BERYLLIUM	0.52	U	0.83		15	3	N	0.82
CADMIUM	3.6	J	1.1	J	3.7	0.4	N	2.1
CALCIUM	2600	J	6760	J	NC	NC	NA	2465
CHROMIUM	88		55.7		210	2	C	66.8
COBALT	14.7		21.5		140[13]	NC	N	12.7
COPPER	317	J	85.4	J	290	NC	N	125
IRON	18500	J	37000	J	2300	NC	N	24976
LEAD	5450		485		400	NC	N	439
MAGNESIUM	3140	J	11400	J	NC	NC	NA	8562
MANGANESE	178		405		180	NC	N	361
MERCURY	1.7	J	0.66	J	2.3	NC	N	0.24
NICKEL	26	J	70.7	J	160	7	N	44
POTASSIUM	1360		2880		NC	NC	NA	2377
SELENIUM	1.9	J	0.56	UJ	39	0.3	N	0.66
SILVER	0.49	U	0.47	U	39	2	N	ND
SODIUM	141		143		NC	NC	NA	1119
THALLIUM	0.59	UJ	0.57	UJ	0.52	NC	N	0.23
VANADIUM	21.9		60.4		55	300	N	56.7
ZINC	4190		1060		2300	620	N	221

1. USEPA Region 9 screening criteria [referred to as USEPA Region 9 Preliminary Remediation Goals (PRGs)] for Residential Soil (USEPA Region 9, October 2002). Please note that 1/10 the PRG for a non-carcinogen value is presented if this value is lower than SSL. This does not apply to PRGs that are not a risk-based number.
2. USEPA Generic SSLs for Migration to Groundwater, dilution attenuation factor = 1 (USEPA, October 2002).
3. C= Carcinogen
   N= Non-carcinogen
4. Source of 95% UCL Facility Background Levels:
   "Facility Background Report for Portsmouth Naval Shipyard, Kittery, Maine" TtNUS, Inc., May 2000.
5. Value for 4-nitrophenol presented
6. Value for acenaphthene presented.
7. Value for naphthalene presented
8. Value listed is for the surrogate pyrene.
9. Value for chlordane presented.
10. Value for alpha-BHC presented
11. Value for Endosulfan presented
12. Value for endrin presented.
13. Value is for the combined residential pathways with a target hazard quotient of 0.1 (USEPA, Region 9, October 2002).

Highlighted cells represent concentrations that are greater than ten times the Region 9 PRG criteria.
Source of data is noted in the first paragraph of Section 1.4.1.
NA Not Available
ND Not Detected
µg/L = micrograms per liter.
mg/kg = milligrams per kilogram.
mg/L = milligrams per liter.
PRG = Preliminary Remediation Goal
sat=Soil saturation, not a risk based number
max=Ceiling limit, not a risk based number

TABLE 1-4

SEDIMENT CONCENTRATIONS FROM SITE 34 OFFSHORE LOCATIONS COMPARED TO ECOLOGICAL SCREENING LEVELS
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 3

Parameter	Frequency of Detection (1)	Concentration Range (2)	Reference Station Range	Minimum Concentration	Maximum Concentration	Combined Range of Nondetects	Combined Mean Concentration	Average of Positive Hits	Sample of Maximum Detection	OU4 (Ecological) PRG (3)
Volatile Organics (ug/kg)										
TOLUENE	1/2	3-3	NA	3	3	12	4.50	3	BC-6202-SD-0898	NC
Semivolatile Organics (ug/kg)										
1,1-BIPHENYL	14/15	8.8-118	0.41 - 17.5	8.8	118	6.2	31.7	33.726429	OU4-SD-M01-300B	NC
1,2,4-TRICHLOROBENZENE	1/2	100-100	NA	100	100	430	158	100	BC-6201-SD-0898	NC
1,4-DICHLOROBENZENE	1/2	94-94	NA	94	94	430	155	94	BC-6201-SD-0898	NC
1-METHYLNAPHTHALENE	13/15	26.7-297.1	0.6 - 51.5	26.7	297.1	13.8 - 35.6	93.0	105.4	OU4-SD-M01-301A-D	NC
1-METHYLPHENANTHRENE	15/15	39.2-989.7	0.54 - 498.3	39.2	989.7	---	286	285.566667	OU4-SD-M01-101A	NC
2,3,5-TRIMETHYLNAPHTHALENE	15/15	7.2-134.6	0.19 - 64.8	7.2	134.6	---	36.8	36.824	OU4-SD-M01-101A	NC
2,6-DIMETHYLNAPHTHALENE	15/15	10.6-157.7	0.7 - 44.7	10.6	157.7	---	48.2	48.226667	OU4-SD-M01-101A	NC
2-METHYLNAPHTHALENE	16/17	27.5-486.8	0.9 - 73.9	27.5	486.8	48.8	155	163.509375	OU4-SD-M01-301A-D	NC
ACENAPHTHENE	16/17	9.63-1591.2	0.19 - 154	9.63	1591.2	11.4	254	269.383125	OU4-SD-M01-301B	NC
ACENAPHTHYLENE	17/17	71.5-2900	1.69 - 206	71.5	2900	---	483	482.597059	BC-6202-SD-0898	210
ANTHRACENE	17/17	99.7-3471.3	2.26 - 1392	99.7	3471.3	---	954	953.947059	OU4-SD-M01-301B	1236
BENZO(A)ANTHRACENE	17/17	227-9200	2.82 - 1949	227	9200	---	2047	2047.476471	BC-6202-SD-0898	NC
BENZO(A)PYRENE	17/17	127-6600	5.01 - 2515	127	6600	---	2159	2158.911765	BC-6202-SD-0898	NC
BENZO(B)FLUORANTHENE	17/17	316-7100	5.81 - 2138	316	7100	---	1890	1889.788235	BC-6202-SD-0898	NC
BENZO(E)PYRENE	15/15	225-3428	2.99 - 990	225	3428	---	1051	1050.93	OU4-SD-M01-301B-D	NC
BENZO(G,H,I)PERYLENE	15/17	207-2800.7	3.36 - 1026	207	2800.7	400 - 430	894	986.086667	OU4-SD-M01-301B-D	NC
BENZO(K)FLUORANTHENE	17/17	78.4-6500	1.86 - 838.9	78.4	6500	---	961	960.685294	BC-6202-SD-0898	NC
C1-CHRYSENES	15/15	253.5-4956.7	2.19 - 1153.4	253.5	4956.7	---	1181	1181.06	OU4-SD-M01-301B-D	NC
C1-DIBENZOTHIOPHENES	15/15	11.5-169.8	0.42 - 191	11.5	169.8	---	61.1	61.1	OU4-SD-M01-101A	NC
C1-FLUORANTHENES/PYRENES	15/15	315.5-9585.9	2.62 - 1996.4	315.5	9585.9	---	2190	2189.996667	OU4-SD-M01-301B-D	NC
C1-FLUORENES	14/15	28.5-1589.9	1 - 267	28.5	1589.9	277	268	277.421429	OU4-SD-M01-301B-D	NC
C1-NAPHTHALENES	13/15	65.6-783.9	1.5 - 124	65.6	783.9	41.4 - 84.4	227	256.703846	OU4-SD-M01-301A-D	NC
C1-PHENANTHRENES/ANTHRACENES	15/15	137.1-3519.3	2.34 - 1350.5	137.1	3519.3	---	1031	1031.343333	OU4-SD-M01-301B-D	NC
C2-CHRYSENES	15/15	105-2054.7	0.19 - 417	105	2054.7	---	506	506.19	OU4-SD-M01-301B-D	NC
C2-DIBENZOTHIOPHENES	15/15	16.8-344.1	0.5 - 529	16.8	344.1	---	83.7	83.71	OU4-SD-M01-301B-D	NC
C2-FLUORENES	15/15	32.4-1798.7	1.6 - 506	32.4	1798.7	---	247	246.753333	OU4-SD-M01-301B-D	NC
C2-NAPHTHALENES	13/15	38.5-786.1	0.8 - 186	38.5	786.1	39.5 - 114	204	229.088462	OU4-SD-M01-101A	NC
C2-PHENANTHRENES/ANTHRACENES	15/15	110-4409.4	2.15 - 1141.5	110	4409.4	---	886	885.993333	OU4-SD-M01-301B-D	NC
C3-CHRYSENES	15/15	0.27-70.6	0 - 82	0.27	70.6	---	20.0	19.999	OU4-SD-M01-201A	NC
C3-DIBENZOTHIOPHENES	15/15	13.1-329.5	0.39 - 420	13.1	329.5	---	74.5	74.543333	OU4-SD-M01-301B-D	NC
C3-FLUORENES	14/15	27.2-1590.6	0.56 - 763	27.2	1590.6	63.2	227	241.421429	OU4-SD-M01-301B-D	NC
C3-NAPHTHALENES	15/15	29.2-946.5	1.2 - 460	29.2	946.5	---	198	197.653333	OU4-SD-M01-101A	NC
C3-PHENANTHRENES/ANTHRACENES	15/15	64.8-2692.8	0.95 - 1034.8	64.8	2692.8	---	524	524.436667	OU4-SD-M01-301B-D	NC
C4-CHRYSENES	15/15	0.8-277.5	0.01 - 60.3	0.8	277.5	---	40.3	40.279	OU4-SD-M01-301B	NC
C4-NAPHTHALENES	14/15	19.6-596.5	0.4 - 1490	19.6	596.5	127	119	122.889286	OU4-SD-M01-101A	NC
C4-PHENANTHRENES/ANTHRACENES	15/15	32.7-1037.9	0.02 - 856.4	32.7	1037.9	---	204	203.686667	OU4-SD-M01-301B-D	NC
CHRYSENE	17/17	0.4-10000	4.01 - 1702	0.4	10000	---	1993	1993.361765	BC-6202-SD-0898	NC
DIBENZO(A,H)ANTHRACENE	17/17	51.2-2500	0.59 - 262	51.2	2500	---	418	418.082353	BC-6202-SD-0898	NC
DIBENZOTHIOPHENE	15/15	7.1-450	0.27 - 104	7.1	450	---	89.2	89.162	OU4-SD-M01-301A-D	NC
FLUORANTHENE	17/17	342-11714.1	6.11 - 3324	342	11714.1	---	3024	3024.170588	OU4-SD-M01-301B	NC
FLUORENE	17/17	21.5-2109	0.6 - 249	21.5	2109	---	444	443.691176	OU4-SD-M01-301B	500
HIGH MOLECULAR WEIGHT PAHS	15/15	939.9-37252	23.365 - 12673	939.9	37252	---	10377	10377.20333	OU4-SD-M01-301B	13057
INDENO(1,2,3-CD)PYRENE	17/17	183-7200	3.59 - 1164	183	7200	---	1290	1290.329412	BC-6202-SD-0898	NC
LOW MOLECULAR WEIGHT PAHS	15/15	448.25-18247.3	9.84 - 3496.15	448.25	18247.3	---	4153	4152.662	OU4-SD-M01-301B	NC

TABLE 1-4

SEDIMENT CONCENTRATIONS FROM SITE 34 OFFSHORE LOCATIONS COMPARED TO ECOLOGICAL SCREENING LEVELS
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 3

Parameter	Frequency of Detection [1]	Concentration Range [2]	Reference Station Range	Minimum Concentration	Maximum Concentration	Combined Range of Nondetects	Combined Mean Concentration	Average of Positive Hits	Sample of Maximum Detection	OU4 (Ecological) PRG [3]
NAPHTHALENE	15/17	41.2-1221.3	1.3 - 155	41.2	1221.3	40.3 - 70.2	268	299.54	OU4-SD-M01-301A-D	NC
PENTACHLOROPHENOL	1/2	86-86	NA	86	86	1100	318	86	BC-6201-SD-0898	NC
PERYLENE	15/15	45.2-618.1	1.67 - 352	45.2	618.1	---	217	217.02	OU4-SD-M01-301A-D	NC
PHENANTHRENE	17/17	164-9222.8	3.05 - 1583	164	9222.8	---	2261	2260.658824	OU4-SD-M01-301B	NC
PYRENE	17/17	0.3-12000	5.84 - 2921	0.3	12000	---	3744	3743.764706	BC-6202-SD-0898	NC
TOTAL PAHS	15/15	1388.15-55499.3	33.205 - 16169.15	1388.15	55499.3	---	14530	14529.86533	OU4-SD-M01-301B	NC
Pesticides/PCB's (ug/kg)										
1,2,3,4-TETRACHLOROBENZENE	11/15	0.01-1.39	0.02 - 1	0.01	1.39	0.02 - 0.28	0.161	0.190182	OU4-SD-M01-201A	NC
1,2,4,5-TETRACHLOROBENZENE	10/15	0.24-1	0.01 - 3.1	0.24	1	0.26 - 1.9	0.549	0.5615	OU4-SD-M01-200A	NC
2,4'-DDD	15/15	7.6-58	0.02 - 8.2	7.6	58	---	17.7	17.66	OU4-SD-M01-200B	NC
2,4'-DDE	15/15	0.03-2.2	0.033 - 0.8	0.03	2.2	---	0.663	0.663	OU4-SD-M01-200B	NC
2,4'-DDT	15/15	0.58-25	0.01 - 1.98	0.58	25	0.074	9.67	9.668567	OU4-SD-M01-299A,	NC
4,4'-DDD	15/17	11-153	0.04 - 4.2	11	153	8.2 - 8.4	37.7	42.218	OU4-SD-M01-200B	NC
4,4'-DDE	15/17	2.9-59	0.049 - 9.7	2.9	59	8.2 - 8.4	13.5	14.725667	OU4-SD-M01-200B	NC
4,4'-DDT	16/17	2.6-1113	0.01 - 12	2.6	1113	8.4	124	131.18625	OU4-SD-M01-399A	66.4
ALDRIN	5/16	0.08-32	0.01 - 5.4	0.08	32	0.05 - 4.2	3.03	9.21125	OU4-SD-M01-301B	NC
ALPHA-BHC	12/17	0.03-0.57	0.014 - 0.29	0.03	0.57	0.04 - 4.3	0.363	0.149167	OU4-SD-M01-101A	NC
ALPHA-CHLORDANE	16/17	1.5-16	0.01 - 1.5	1.5	16	4.3	5.56	5.77	OU4-SD-M01-200B, BC-6201-SD-0898	NC
BETA-BHC	12/17	0.06-3.14	0.02 - 0.4	0.06	3.14	0.18 - 4.3	0.769	0.709167	OU4-SD-M01-201A	NC
CHLORPYRIFOS	6/15	0.025-2.58	0.01 - 3.6	0.025	2.58	0.065 - 0.48	0.356	0.711167	OU4-SD-M01-201A	NC
CIS-NONACHLOR	15/15	0.27-5.5	0.007 - 3.2	0.27	5.5	---	0.926	0.926	OU4-SD-M01-301B-D	NC
DELTA-BHC	10/17	0.03-0.11	0.007 - 0.36	0.03	0.11	0.037 - 4.3	0.298	0.067525	OU4-SD-M01-201A	NC
DIELDRIN	15/17	0.03-32	0.01 - 0.68	0.03	32	0.083 - 8.4	8.32	8.874383	OU4-SD-M01-200A	NC
ENDOSULFAN II	13/17	0.29-7	0.02 - 4.8	0.29	7	0.074 - 8.4	2.71	2.890769	OU4-SD-M01-399A	3.95
ENDRIN	9/17	0.12-0.89	0.023 - 1.94	0.12	0.89	0.056 - 8.4	0.721	0.414444	OU4-SD-M01-200B	NC
GAMMA-BHC (LINDANE)	11/17	0.11-0.82	0.01 - 1.2	0.11	0.82	0.15 - 4.3	0.544	0.385682	OU4-SD-M01-201A	NC
GAMMA-CHLORDANE	16/17	0.21-16	0.01 - 0.43	0.21	16	0.034 - 4.3	4.55	4.698625	BC-6201-SD-0898, OU4-SD-M01-399A	NC
HEPTACHLOR	14/17	0.04-1	0.007 - 0.57	0.04	1	0.17 - 4.3	0.590	0.406964	OU4-SD-M01-399A	NC
HEPTACHLOR EPOXIDE	3/17	0.13-1.6	0.01 - 0.22	0.13	1.6	0.02 - 4.3	0.333	0.3915	OU4-SD-M01-301B-D	NC
HEXACHLOROBENZENE	8/17	0.01-0.1	0.006 - 71	0.01	0.1	0.038 - 430	24.4	0.053125	OU4-SD-M01-201A	NC
MIREX	7/15	0.22-1.7	0.03 - 0.63	0.22	1.7	0.025 - 0.1	0.323	0.665	OU4-SD-M01-300B	NC
OXYCHLORDANE	12/15	0.04-1.57	0.02 - 0.99	0.04	1.57	0.012 - 0.062	0.484	0.601667	OU4-SD-M01-101A	NC
PCB-101/90	15/15	0.39-2.8	0.05 - 30.04	0.39	2.8	---	1.20	1.202333	OU4-SD-M01-200B	NC
PCB-105	15/15	0.08-6.4	0.015 - 12	0.08	6.4	---	0.720	0.72	OU4-SD-M01-301B-D	NC
PCB-118	15/15	0.43-3.52	0.034 - 29.07	0.43	3.52	0.43	1.44	1.442833	OU4-SD-M01-301A-D	NC
PCB-126	7/15	0.01-0.45	0.006 - 2.3	0.01	0.45	0.15 - 0.89	0.144	0.098571	OU4-SD-M01-200B	NC
PCB-128	15/15	0.26-4.1	0.01 - 9.75	0.26	4.1	---	1.35	1.353	OU4-SD-M01-301B-D	NC
PCB-138/160	14/15	1.21-6.3	0.1 - 38.45	1.21	6.3	1.5	2.14	2.241071	OU4-SD-M01-301B	NC
PCB-149/123	14/15	0.66-8.1	0.01 - 26.35	0.66	8.1	0.9	1.50	1.5775	OU4-SD-M01-301B-D	NC
PCB-153/132	14/15	0.99-26	0.06 - 42.1	0.99	26	0.96	2.64	2.788929	OU4-SD-M01-301B-D	NC
PCB-156	12/15	0.55-4.34	0.01 - 10.23	0.55	4.34	0.22 - 0.48	1.77	2.164375	OU4-SD-M01-399A	NC
PCB-167	14/15	0.26-84	0.01 - 298	0.26	84	0.37 - 0.43	4.83	5.164107	OU4-SD-M01-301B-D	NC
PCB-169	8/15	0.01-0.42	0.005 - 0.4	0.01	0.42	0.01 - 0.89	0.150	0.125	OU4-SD-M01-201A	NC
PCB-170/190	14/15	0.54-100	0.26 - 49.48	0.54	100	0.79 - 0.97	21.3	22.8275	OU4-SD-M01-301B-D	NC
PCB-18/17	7/15	0.03-1.2	0.046 - 5.4	0.03	1.2	0.08 - 0.12	0.209	0.391786	OU4-SD-M01-300B-D	NC

TABLE 1-4

SEDIMENT CONCENTRATIONS FROM SITE 34 OFFSHORE LOCATIONS COMPARED TO ECOLOGICAL SCREENING LEVELS
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 3 OF 3

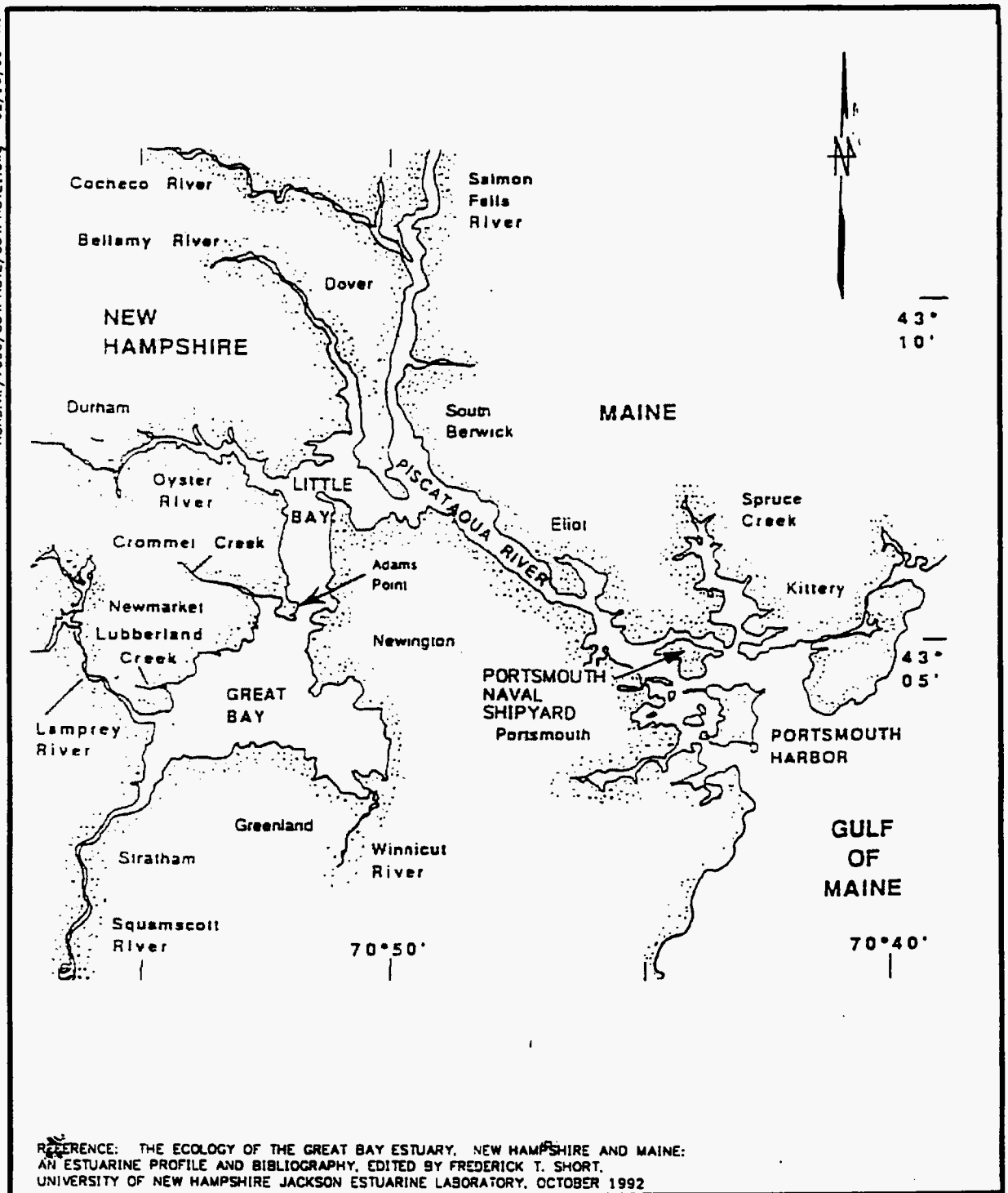
Parameter	Frequency of Detection (1)	Concentration Range (2)	Reference Station Range	Minimum Concentration	Maximum Concentration	Combined Range of Nondetects	Combined Mean Concentration	Average of Positive Hits	Sample of Maximum Detection	OU4 (Ecological) PRG (3)
PCB-180	14/15	0.21-3.6	0.05 - 26.81	0.21	3.6	0.9	1.23	1.2825	OU4-SD-M01-301B-D	NC
PCB-187	15/15	0.25-16	0.02 - 18.93	0.25	16	---	2.44	2.443333	OU4-SD-M01-301B	NC
PCB-189	14/15	0.19-23	0.01 - 0.67	0.19	23	0.15 - 0.45	1.34	1.43125	OU4-SD-M01-301B-D	NC
PCB-195/208	13/15	0.3-2.1	0.004 - 4.1	0.3	2.1	0.14 - 0.15	0.816	0.93	OU4-SD-M01-100A	NC
PCB-201/157/173	15/15	0.19-15	0.01 - 2.28	0.19	15	0.48	1.14	1.143667	OU4-SD-M01-301B	NC
PCB-206	15/15	0.17-5	0.02 - 18.52	0.17	5	0.07	1.17	1.165833	OU4-SD-M01-399A	NC
PCB-209	13/15	0.12-2.6	0.02 - 7.94	0.12	2.6	0.08 - 0.086	0.968	1.110769	OU4-SD-M01-300A-D	NC
PCB-28	11/15	0.02-1.1	0.07 - 3.6	0.02	1.1	0.084 - 0.33	0.402	0.506364	OU4-SD-M01-300B, OU4-SD-M01-300B-D	NC
PCB-44	13/15	0.11-0.87	0.02 - 3.53	0.11	0.87	0.13 - 0.16	0.354	0.397308	OU4-SD-M01-300B	NC
PCB-52	14/15	0.11-2.5	0.03 - 13	0.11	2.5	0.1 - 0.11	0.763	0.81375	OU4-SD-M01-200B	NC
PCB-66	15/15	0.09-3.62	0.01 - 3.1	0.09	3.62	---	0.969	0.969	OU4-SD-M01-301A-D	NC
PCB-77	8/15	0.01-0.41	0.01 - 0.41	0.01	0.41	0.02 - 0.46	0.157	0.190125	OU4-SD-M01-100B	NC
PCB-8/5	13/15	0.086-3.3	0.048 - 4.5	0.086	3.3	0.18 - 0.21	0.719	0.814308	OU4-SD-M01-300B	NC
PCB-81	12/15	0.01-0.63	0.006 - 1.83	0.01	0.63	0.21 - 0.42	0.202	0.21475	OU4-SD-M01-301B	NC
PENTACHLOROANISOLE	10/15	0.06-0.68	0.01 - 0.91	0.06	0.68	0.04 - 0.11	0.138	0.1859	OU4-SD-M01-200B	NC
PENTACHLOROBENZENE	7/15	0.03-0.48	0.01 - 1	0.03	0.48	0.07 - 0.32	0.0879	0.126429	OU4-SD-M01-300B-D	NC
TOTAL DDT	15/15	37.59-1228.28	0.2045 - 22.24	37.59	1228.28	---	221	220.7339	OU4-SD-M01-399A	NC
TOTAL PCB CONGENERS	15/15	21.25-323.496	2.021 - 516.24	21.25	323.496	---	81.7	81.7226	OU4-SD-M01-301B-D	NC
TRANS-NONACHLOR	15/15	0.41-5.8	0.006 - 1	0.41	5.8	---	1.71	1.711	OU4-SD-M01-399A	3.99
Inorganics (mg/kg)										
ALUMINUM	17/17	4800-55569	28497.5 - 59600	4800	55569	---	40393	40392.71177	OU4-SD-M01-399A	NC
ANTIMONY	2/2	0.48-1	NA	0.48	1	---	0.740	0.74	BC-6201-SD-0898	NC
ARSENIC	17/17	6.9-19.49	1.5 - 14.8	6.9	19.49	---	11.0	11.040853	OU4-SD-M01-201B	NC
BARIUM	2/2	15.2-20.2	NA	15.2	20.2	---	17.7	17.7	BC-6202-SD-0898	NC
CADMIUM	11/17	0.09-0.94	0.04 - 0.81	0.09	0.94	0.1849 - 0.48	0.286	0.345455	OU4-SD-M01-101A	NC
CALCIUM	2/2	1410-3230	NA	1410	3230	---	2320	2320	BC-6202-SD-0898	NC
CHROMIUM	17/17	26.5-108	19.3 - 97.86	26.5	108	---	64.1	64.082647	OU4-SD-M01-199A	NC
COBALT	2/2	3.9-4.7	NA	3.9	4.7	---	4.30	4.3	BC-6201-SD-0898	NC
COPPER	17/17	17.9-200	2.1 - 51.7	17.9	200	---	57.8	57.84	OU4-SD-M01-300B	486
IRON	17/17	12600-34775	6872.26 - 29000	12600	34775	---	22009	22009.22647	OU4-SD-M01-200A	NC
LEAD	17/17	62.5-452.96	13.1 - 142	62.5	452.96	---	155	154.676471	OU4-SD-M01-201B	NC
MAGNESIUM	2/2	3430-3680	NA	3430	3680	---	3555	3555	BC-6202-SD-0898	NC
MANGANESE	17/17	102-1503	122.97 - 1110	102	1503	---	506	506.217353	OU4-SD-M01-200A	NC
MERCURY	14/17	0.05-0.31	0.01 - 3.4347	0.05	0.31	0.0436 - 0.1514	0.147	0.168471	OU4-SD-M01-300B	NC
NICKEL	17/17	12.2-30.5	7.15 - 38.2	12.2	30.5	---	21.7	21.68	OU4-SD-M01-300B	124
POTASSIUM	2/2	1270-1640	NA	1270	1640	---	1455	1455	BC-6202-SD-0898	NC
SILVER	13/17	0.09-3.84	0.02 - 4.15	0.09	3.84	0.2557 - 0.55	0.810	1.000223	OU4-SD-M01-300A-D	NC
SODIUM	2/2	2400-3390	NA	2400	3390	---	2895	2895	BC-6202-SD-0898	NC
VANADIUM	2/2	17.3-19.7	NA	17.3	19.7	---	18.5	18.5	BC-6202-SD-0898	NC
ZINC	17/17	54.5-205	13.4 - 110	54.5	205	---	104	104.392941	OU4-SD-M01-300B-D	NC

Notes:
NA - Not analyzed.
NC - No criteria.
Highlighted cells represent maximum concentrations that exceed criteria.
1 - The average of the duplicate and the original is used for this calculation.
2 - The duplicate and original sample are counted as two separate samples.
3 - Ecological risk-based PRG calculated for OU4 (TtNUS, November 2001). Note that based on the OU4 PRG development process, only a limited list of chemicals were identified, that at that time required PRGs, i.e., these chemicals were identified as "limiting PRGs."

Sediment Sample Numbers Represented in the Concentration Range

BC-6201-SD-0898	OU4-SD-M01-200A	OU4-SD-M01-301A-AVG
BC-6202-SD-0898	OU4-SD-M01-200B	OU4-SD-M01-301B-AVG
OU4-SD-M01-100A	OU4-SD-M01-201A	OU4-SD-M01-399A
OU4-SD-M01-100B	OU4-SD-M01-201B	
OU4-SD-M01-101A	OU4-SD-M01-299A	
OU4-SD-M01-101B	OU4-SD-M01-300A-AVG	
OU4-SD-M01-199A	OU4-SD-M01-300B-AVG	

ACAD:R:/7090/CUTPASTE/CUTPASTE1.dwg 02/16/99 HJP



REFERENCE: THE ECOLOGY OF THE GREAT BAY ESTUARY, NEW HAMPSHIRE AND MAINE: AN ESTUARINE PROFILE AND BIBLIOGRAPHY, EDITED BY FREDERICK T. SHORT, UNIVERSITY OF NEW HAMPSHIRE JACKSON ESTUARINE LABORATORY, OCTOBER 1992

DRAWN BY HJP DATE 2/16/99	Tetra Tech NUS, Inc.	CONTRACT NO. 7090	OWNER NO. 0256
CHECKED BY DJC DATE 6/13/01	GREAT BAY ESTUARY AND SITE LOCATION PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE	APPROVED BY	DATE
COST/SCHED-AREA		APPROVED BY	DATE
SCALE NOT TO SCALE		DRAWING NO. FIGURE 1-1	REV. 0

FORM CADD NO. T1NUS_AV.DWG - REV 0 - 1/22/98

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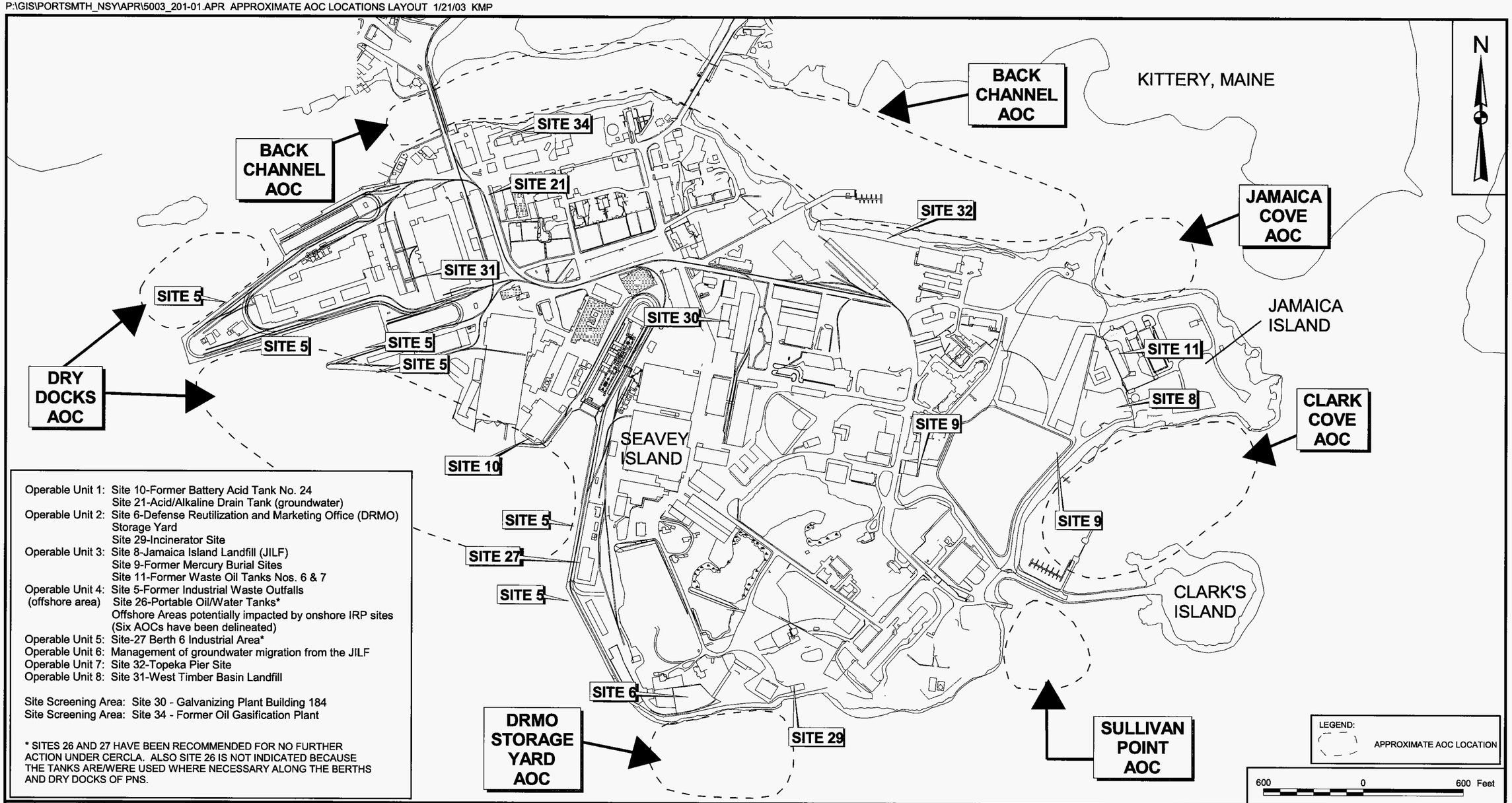
P:\GIS\PORTSMTH_NSY\APR\5003_201-01.APR APPROXIMATE AOC LOCATIONS LAYOUT 1/21/03 KMP



Operable Unit 1: Site 10-Former Battery Acid Tank No. 24
Site 21-Acid/Alkaline Drain Tank (groundwater)
Operable Unit 2: Site 6-Defense Reutilization and Marketing Office (DRMO) Storage Yard
Site 29-Incinerator Site
Operable Unit 3: Site 8-Jamaica Island Landfill (JILF)
Site 9-Former Mercury Burial Sites
Site 11-Former Waste Oil Tanks Nos. 6 & 7
Operable Unit 4: Site 5-Former Industrial Waste Outfalls
(offshore area) Site 26-Portable Oil/Water Tanks*
Offshore Areas potentially impacted by onshore IRP sites (Six AOCs have been delineated)
Operable Unit 5: Site-27 Berth 6 Industrial Area*
Operable Unit 6: Management of groundwater migration from the JILF
Operable Unit 7: Site 32-Topeka Pier Site
Operable Unit 8: Site 31-West Timber Basin Landfill

Site Screening Area: Site 30 - Galvanizing Plant Building 184
Site Screening Area: Site 34 - Former Oil Gasification Plant

* SITES 26 AND 27 HAVE BEEN RECOMMENDED FOR NO FURTHER ACTION UNDER CERCLA. ALSO SITE 26 IS NOT INDICATED BECAUSE THE TANKS ARE/WERE USED WHERE NECESSARY ALONG THE BERTHS AND DRY DOCKS OF PNS.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

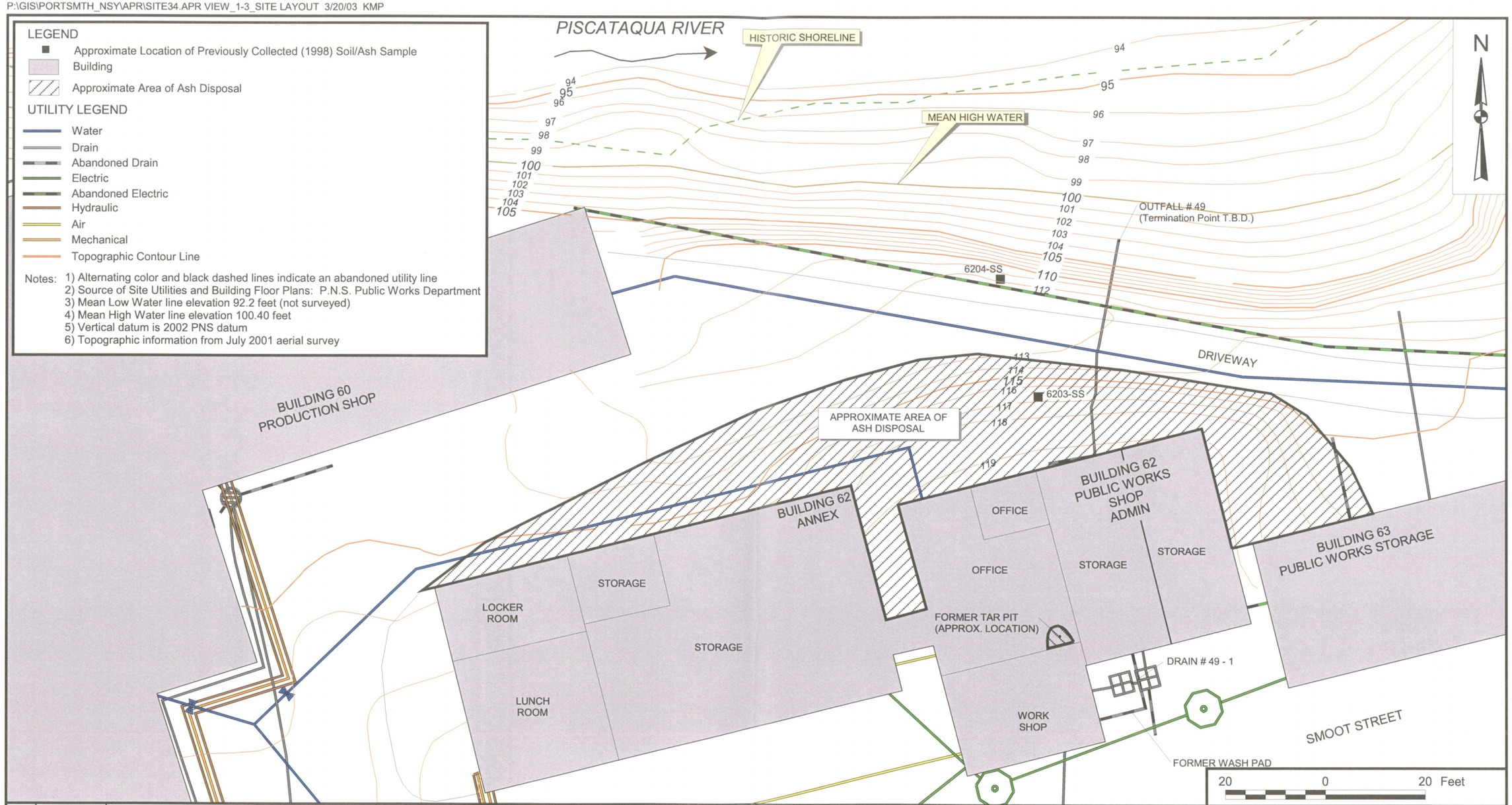
DRAWN BY D. PERRY	DATE 4/16/99
CHECKED BY A. BERNHARDT	DATE 11/06/01
COST/SCHEDULE-AREA	
SCALE AS NOTED	

Tetra Tech NUS, Inc.

FACILITY SITE MAP
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

CONTRACT NUMBER 4088	OWNER NUMBER 0824
APPROVED BY —	DATE —
APPROVED BY —	DATE —
DRAWING NO. FIGURE 1-2	REV 0

P:\GIS\PORTSMTH_NSY\APR\SITE34.APR VIEW_1-3_SITE LAYOUT 3/20/03 KMP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

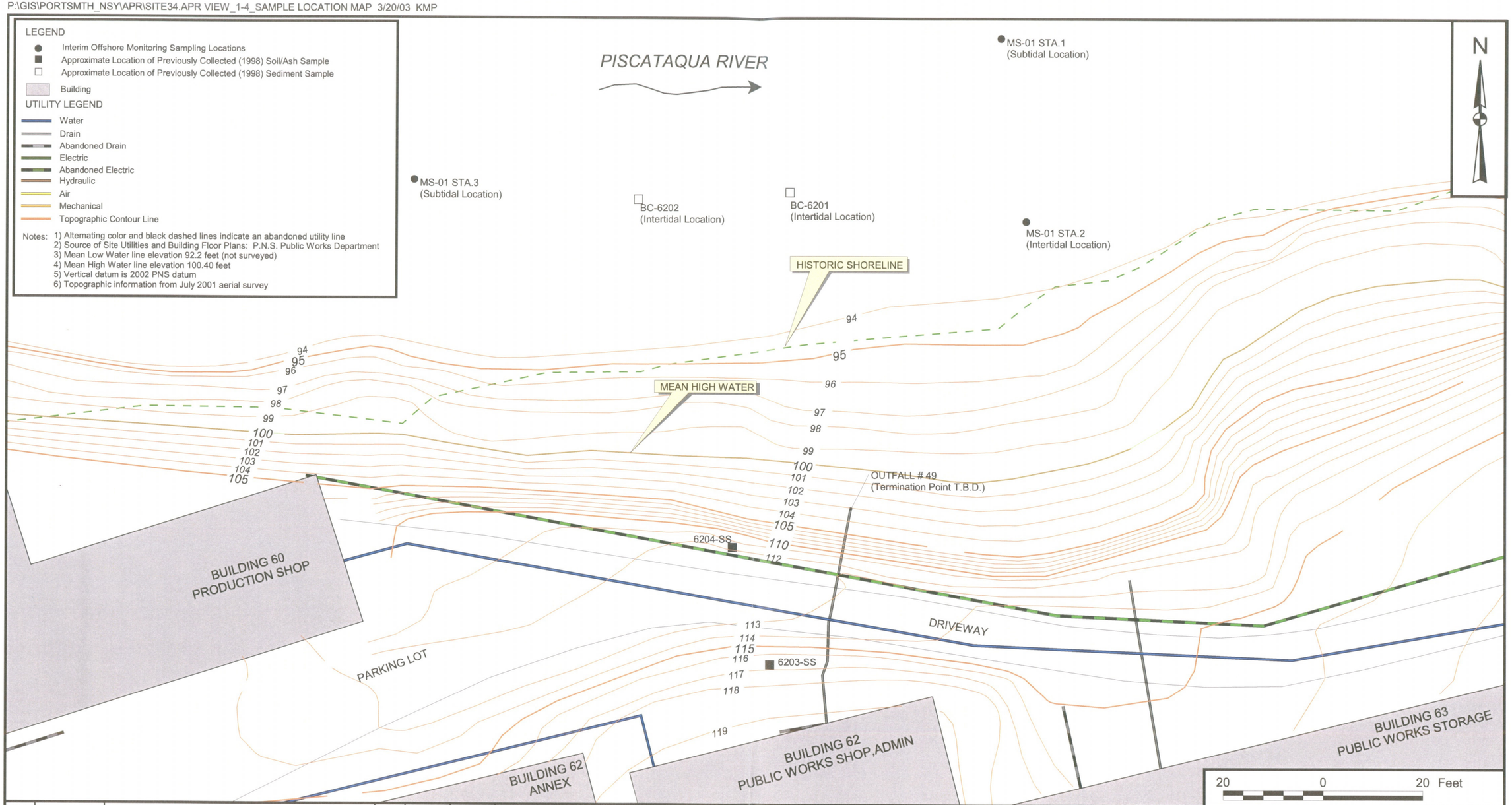
DRAWN BY K. PEILA	DATE 5/30/02
CHECKED BY J.P. KUMAR	DATE 8/19/02
COST/SCHEDULE-AREA	
SCALE AS NOTED	

Tetra Tech NUS, Inc.

SITE LAYOUT
SITE 34 - SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

CONTRACT NUMBER 4089	OWNER NUMBER 825
APPROVED BY —	DATE —
APPROVED BY —	DATE —
DRAWING NO. FIGURE 1 - 3	REV 0

P:\GIS\PORTSMTH_NSY\APR\SITE34.APR VIEW_1-4_SAMPLE LOCATION MAP 3/20/03 KMP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY K. PEILA	DATE 5/1/02
CHECKED BY J.P. KUMAR	DATE 8/19/02
COST/SCHEDULE-AREA	
SCALE AS NOTED	

Tetra Tech NUS, Inc.

PREVIOUS SAMPLING LOCATIONS AT SITE 34
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

CONTRACT NUMBER 4089	OWNER NUMBER 825
APPROVED BY —	DATE —
APPROVED BY —	DATE —
DRAWING NO. FIGURE 1 - 4	REV 0

2.0 DATA QUALITY OBJECTIVES

This section summarizes the Data Quality Objectives (DQOs) for the Site 34 investigation. The project DQOs were developed in accordance with the USEPA Guidance for the DQO Process, commonly known as QA/G-4 (USEPA, August 2000). The following discussion provides information on the project planning conducted to develop the DQOs, the project definition, the project quality objectives, and measurement performance criteria identified based on the DQOs. Appendix B of this QAPP provides the complete DQOs developed for the Site 34 investigation, based on the USEPA seven-step DQO process. For brevity and to maintain consistency, Step 7 (Sampling Plan Design) was moved in its entirety from the appendix (after the DQOs were finalized) to Section 2.6 Sampling Design and Rationale.

2.1 PROJECT PLANNING MEETINGS

TtNUS project personnel and the Navy conducted project planning and scoping discussions and meetings in 2001. The Navy's preliminary DQOs were provided to the regulators and RAB on March 27, 2002. The DQOs were revised based on comments from the regulators/RAB on the preliminary draft DQOs and the draft QAPP was prepared based on the revised DQOs. The draft DQOs were further revised based on regulatory/RAB comments on the draft QAPP, and the final DQOs are presented in Appendix B. Revisions to the draft and draft final QAPP were made based on regulatory/RAB comments. Responses to comments on the preliminary draft DQOs and the draft and draft final QAPPs are provided in Appendix D.

The USEPA Region I QAPP guidance (USEPA, October 1999a) provides worksheets to be completed during DQO planning meetings. The worksheets were not used; the information needed for the worksheets was directly filled into the tables of relevant sections of the QAPP.

2.2 PROBLEM DEFINITION

The available data on the ash and soil at the site, as discussed in Section 1.0, already indicate that high levels of certain contaminants (PAHs and metals) are present in the ash and associated soil. These levels exceed human health screening levels, and can pose a potential risk to human health. Moreover, an evaluation of the offshore sediment data, as discussed in Section 1.0, indicate the presence of elevated levels of PAHs exceeding ecological screening levels. The PAH contamination could have occurred via erosion of the exposed ash pile or transport of dissolved PAHs in the groundwater from the site, although other upstream (non-PNS) sources may also be present. In order to address the potential human health and ecological risk concerns, and in lieu of conducting further studies to try to establish the

link between the PAHs in the offshore with the site sources, the Navy has determined that a removal action is needed.

In support of the removal action, an Engineering Evaluation/Cost Analysis (EE/CA) is required to evaluate potential removal action alternatives for the ash source area. Information on the extent of the ash pile and associated soil contamination is required to conduct the EE/CA. Therefore, one of the primary study questions (provided in Section 2.3), relates to this information requirement.

Following a removal action of the ash pile and associated contaminated soil, any impacts to the environmental media that may have occurred due to other sources at the site also need to be evaluated for site screening (SS) purposes. These other sources are the tar pit that may be present under the floor of Building 62, and the pesticide rinse wash pad/drainage. The site screening focuses on determining whether unacceptable risk could be present at the site from hazardous substance activities conducted at the site. To determine the potential for unacceptable risk at the site, the most likely media and locations where storage, release, and/or disposal activities may have occurred are primarily targeted for sampling and analysis. The data are then compared with facility background and screening levels to determine the potential for risk caused by site-related contaminants. If the chemical concentrations are less than facility background and screening levels, there is no unacceptable condition. If chemical concentrations exceed background and screening levels, the site is likely to require additional action (i.e., RI/FS or removal action). Some of the information collected during the investigation to support the EE/CA will also be used for the site screening evaluation. However, it is anticipated that the site screening evaluation cannot be completed until the EE/CA and removal action have been completed. Therefore, the other study question discussed in Section 2.3 addresses the needs for additional sampling and analysis of the environmental media that may be potentially impacted at the site.

The Navy will evaluate methods to investigate whether the tar pit exists under the building. However, the scope of the current investigation does not include this additional evaluation.

Offshore sediment data are available from monitoring station M-01 located offshore of the site, as discussed in Section 1.4.1. However, sediment data are necessary to provide an indication of whether discharges from the previous pesticide handling/storage activities in Building 62 through the storm sewer system to Outfall 49 may have impacted the offshore. Therefore, limited sediment data focused around the storm sewer system/Outfall 49 will be included in the scope of the current investigation.

Problem Statement

Based on the available information for the site and considering the conceptual site model, as discussed in Section 1.0, the following are the problem statements that were developed for this investigation:

- Data on the nature and extent of contamination is needed to support an EE/CA for a removal action of the ash source area.

- Data on soil and groundwater at the site, and limited data on offshore sediment are also needed to determine the potential that site sources may have impacted environment media for the site screening SS evaluation.

2.3 DECISION STATEMENTS

Decision statements are summaries of decisions that have been developed to address the problem. Based on the concerns described above, two primary statements and one secondary decision statement were identified (see DQO Step 2 in Appendix B).

Principal Study Question for the EE/CA:

- What are the chemical contaminants, where are they present, and what are their concentrations in ash/soil pile and associated contaminated soil at Site 34?

Principal Study Question for SS:

- Has groundwater, soil, or offshore sediment been affected by Site 34 potential sources?

Secondary Study Question for EE/CA:

- Is sufficient information available to evaluate alternatives in the EE/CA?

There are no secondary study questions for the SS.

Potential Actions for EE/CA Principal Question:

Conduct an EE/CA for the ash/soil. Evaluate the following potential general response actions:

- No Action
- Limited action (monitoring and land use controls)
- Containment
- Excavation and On-site or Off-site Treatment/Disposal
- Insitu Treatment

Potential Actions for SS Principal Question:

- Determine whether an impact of one or more contaminant sources has occurred on the soil, groundwater, or sediment. Propose one of the following actions:

  - No Action
  - Enter the Remedial Investigation/Feasibility Study process
  - Interim Action or Removal Action

Note that it is assumed that the removal action to address the ash and impacted soil has been completed before the site screening evaluation.

Potential Actions for Secondary EE/CA Question:

Evaluate the data and all available information and propose one of the following actions:

- Continue with development of the EE/CA
- Recommend further investigation/data collection to support the EE/CA

(Note: If analytical data indicate the necessity, treatability studies may be necessary to complete the EE/CA.)

Decision Statements:

Principal Decision for EE/CA

- Determine whether the data are sufficient to determine the nature and extent of contamination associated with the ash pile. If they are, then conduct an EE/CA. If not, recommend additional data collection before conducting the EE/CA.

Principal Decision for SS:

- Determine whether groundwater, soil, or offshore sediment has been contaminated by Site 34 sources. If any of these media has been contaminated, proceed to a Remedial Investigation/Feasibility Study (RI/FS) or an interim action/removal action. If none of these media has been contaminated, take no further action for the current site conditions. (Again, it is assumed that the removal action for the ash will be complete before the site screening evaluation is completed.)

Secondary Decision for EE/CA:

- Determine whether adequate site-specific engineering input-related information is available to conduct an EE/CA. If it is, then conduct the EE/CA. If not then recommend additional data collection before conducting the EE/CA. (Note that this decision will occur in conjunction with the evaluation of the nature and extent information in the principal study decision.)

2.4 INTENDED DATA USES

This section provides a detailed description of the project target parameters, screening levels for the EE/CA and the SS. Field and laboratory parameters necessary to support the primary decisions for the Site 34 removal action and SS, and the secondary decision for the EE/CA were identified during the DQO development (see DQO Step 3 in Appendix B). The field and laboratory parameters targeted for this project are summarized in this section; the specific field and laboratory parameters are discussed in detail in the field sampling and analysis plan (Section 4.0) and the fixed laboratory analytical plan (Section 5.0), respectively.

2.4.1 Target Parameters Selection and Development of Removal Action Levels for EE/CA

The removal action is focused on the ash pile outside Buildings 62 and 62-Annex. If ash is present, then it must be addressed in the removal action. Chemical characterization is not necessary to determine whether the presence of ash constitutes an unacceptable level of contamination. However, chemical characterization of the soil under the ash pile or outside the ash pile is necessary to determine the extent of soil contamination that needs to be addressed with the ash as part of the removal action.

The main contaminants of concern that are assumed to be associated with ash (which are also indicated by data from the two previously collected soil/ash samples at the site in 1998) are PAHs and metals. This assumption needs to be confirmed via a complete characterization of the ash. Therefore, ash will need to be sampled for the following full suite of analysis: TCL VOCs, TCL SVOCs (including alkylated PAHs), TCL Pesticides/PCBs, and TAL inorganics. Dioxins are not expected to be present, however, samples of ash will be analyzed to verify whether significant levels exist. Dioxin analysis will be included in surface and subsurface soil samples if the results from the ash analysis meet the conditions discussed in the "Decision Tree for Analysis of Dioxin in Soil and Sediment Samples at Site 34", presented in the DQOs, in Appendix B. Cyanides analysis in ash samples will be included if field observation indicates a prussian blue coloration in the ash. Cyanide analysis will be included for surface and subsurface soil samples if the ash samples are selected for cyanide analysis.

The visual presence of ash indicates the extent of contaminated media that must be included in the removal action. The presence of ash-related contaminants in the soil outside and beneath the ash pile at levels exceeding screening levels will also be used for determining whether adequate data have been gathered to estimate the extent of contamination in an EE/CA. The selection of contaminants to be addressed in a removal action and screening criteria for determining whether adequate data are available for estimating the extent of contamination in an EE/CA, will be based on the USEPA Region 9 Residential PRGs (including a factor of 0.1 for noncarcinogenic chemicals).

These considerations and those of the site screening investigation, discussed below will be used for developing target parameters and target reporting limits for the analyses.

2.4.1.1 Target Parameters for EE/CA Secondary Decisions

The secondary objective of the investigation to support the EE/CA is to determine the volume of the ash and engineering parameters. The volume of ash does not require chemical characterization. Visual inspection for the predominance of ash (cinders, dark/burnt remainders of coal/debris mixed in with soil) and/or the presence of coal/phenolic odors will be adequate to determine the presence of ash. Gas purifier wastes (wood chips and limestone) will also be considered related to the ash for the removal action.

Engineering parameters required to support the EE/CA are the following:

- Grain-size distribution (via sieve analysis)
- Bulk density
- Total Petroleum Hydrocarbons (TPH) and heat of combustion of free product, if any

Composite samples selected in the field to be representative of the variability in type of material will be collected for grain-size (sieve analysis) and intact samples using Shelby tubes will be collected from the same locations for bulk density testing. If adequate recovery cannot be obtained (i.e., 24 inches), then a composite will be taken and laboratory instructed to recompact the material for bulk density measurement. The laboratory will also be instructed to measure the bulk density of the material without compaction or in a loosely filled container. The two readings will be used to obtain a range of bulk densities for engineering purposes. If a sample containing a free product is noted (i.e., oily appearance and odor), then that sample will be collected for TPH and heat of combustion.

No risk-based screening levels are required to evaluate the data for the secondary decision.

2.4.2 Target Parameters Selection and Development of Screening Levels for SS

For SS purposes, characterization of the ash will provide an understanding of the composition of the source of ash-related contamination to the environmental media. Only one sample of ash was collected and analyzed for a full suite consisting of TCL organics and TAL metals. However, dioxins and cyanide were not analyzed in this sample, therefore, the chemical characterization will also help determine whether dioxins and cyanide are present at levels that could affect the decision-making process for this site.

The ash is expected to have originated from the combustion of coal from the oil gasification process, the blacksmith operations, the building fire, etc. The variability in the sources of ash could result in variability in the contaminant levels, therefore additional samples of ash will be collected and analyzed for the full suite, to provide an indication of the variability in its chemical composition.

Laboratory parameters that are necessary to support the primary decisions for the project are as follows:

- Ash: TCL organics (VOCs, SVOCs, Pesticides, PCBs), dioxins, and TAL metals. Cyanide analysis will be included if field observation indicates a Prussian blue coloration in the ash samples.

- Soil: TCL organics (VOCs, SVOCs, Pesticides, PCBs), and TAL metals. Dioxin analysis will be included if the results from the ash analysis meet the conditions discussed in the "Decision Tree for Analysis of Dioxin in Soil and Sediment Samples at Site 34", presented in the DQOs, in Appendix B. Cyanide analysis will be included for surface and subsurface soil samples if the ash samples are selected for cyanide analysis.

- Groundwater: TCL organics (VOCs, SVOCs, Pesticides, PCBs), and TAL metals (total and filtered using 0.45-micron filter size). Dioxin analysis will not be included for groundwater under the current investigation. If the ash and soil sample results meet the conditions discussed in the dioxin sampling decision tree noted earlier, then the need for collection of groundwater samples for dioxin analysis will be evaluated and if recommended, sampling and analysis will be conducted under a separate program. Cyanide analysis will be included for groundwater samples if the ash samples are selected for cyanide analysis.

- Sediment: TCL Pesticides (considered to be conservative indicators of pesticide contamination because of greater toxicity and persistence of these compared to the other pesticides/insecticides/ herbicides reported by PNS to have been mixed/stored in Building 62). The need for dioxin analysis for sediment will be evaluated if the results from the ash and soil analysis meet the conditions discussed in the dioxin sampling decision tree noted earlier.

For assessing impacts on the soil, samples collected from beneath the ash pile, adjacent to the ash pile, and the wash pad area are expected to be representative of the two known sources outside Building 62. Following the removal action, some or all of the samples from beneath the ash pile and adjacent to the ash pile may be replaced by confirmatory samples. The confirmatory samples will then represent the residual impact to the soil under what will then be considered new site conditions.

The soil data will be compared to human health risk screening levels for potential residential receptors. For each carcinogenic chemical, a residential incremental cancer risk of 10^{-6} will be used. For non-carcinogenic chemicals, a hazard index level of 0.1 will be used. The soil data will also be compared to USEPA's Generic Soil Screening Levels for Migration to Groundwater, although the site groundwater is expected to be brackish or saline (due to its proximity to the shoreline) and therefore, unfit for human consumption. Table 2-1 presents these screening levels and provides the available facility background levels (95th percentile Upper Confidence Level on mean) for the soil analytes.

For assessing potential impacts on the overburden groundwater, temporary overburden monitoring wells will be installed at locations within or near the ash pile and Building 62 and sampled to detect a plume, if any. A well located within the ash pile is expected to be downgradient of the tar pit within the building as well as the wash pad behind the building. Wells located downgradient of the ash pile and sidegradient of the ash pile should also be useful in detecting a possible plume. Groundwater samples will be analyzed for a full suite of chemical parameters.

The groundwater data will be compared to drinking-water screening levels (USEPA Region 9 Tap-water PRGs), an estimated risk-based concentration for a construction worker exposure, and water quality standards for surface water (USEPA Recommended Water Quality Criteria, November 2002). The groundwater is expected to be brackish or saline (and therefore unfit for human consumption), however, if fresh water is present, then it is consistent with Navy policy to use the Tap-water PRGs for screening purposes. The Water Quality Criteria for saline water will also be used for screening; however, a conservative dilution factor of 100 will be used. Table 2-2 presents these screening levels and provides the available facility background levels (95th percentile Upper Confidence Level on the mean) in saline groundwater at PNS for the analytes.

The data will be compared to ecological screening levels to assess potential impacts to the offshore sediment due to pesticide operations. These screening levels are OU4 PRGs for chemicals that have been identified in the PRG development process and ER-Ms for other chemicals. These screening levels are presented in Table 2-3. As discussed in Section 1.5.3, recreational exposure to the intertidal area offshore of Site 34 is unlikely; however, because access to the intertidal sediments from adjacent areas of

the site may be possible, exposure to a recreational user will be considered during evaluation of potential site risks. For the SS, ecological screening levels, which are more stringent than human health screening levels for pesticides will be used to evaluate the sediment data.

Field information that is necessary to support the primary decisions for the project are as follows:

- Groundwater-level measurements and monitoring well stabilization parameters
- Topographical survey
- Survey of all sampling locations

2.5 DECISION RULES

Outputs from the first four DQO steps were used to generate decision rules that show how the attainment of project objectives will be assessed. The decision rules to address the decision statements are provided in DQO Step 5 of Appendix B. For convenience, the table summarizing the rules is presented here.

Principal Decision Rule for the EE/CA

The decision rules for the EE/CA are intended to reduce the risk potentially posed by at the site and not for a complete risk assessment, which the Navy will conduct as part of an RI if the SS decision rules following the removal action determine the need.

The following table summarizes the steps to be followed for the EE/CA principal decision rule for extent of removal action.

EE/CA DECISION RULE TABLE

Medium	Condition	Action	Comment
Soil (beneath or around ash pile)	Ash/cinders present	Include that sample location/depth in removal action extent	Sample logs and professional judgment will be used.
Soil (beneath or around ash pile)	Any PAH or inorganic concentration exceeds background (1) and its concentration at any individual location exceeds its screening level for EE/CA (2)	Include that sample location/depth in estimating extent of contamination(2)	Additional sampling locations away from the ash pile may be required to better estimate the extent of contamination.

Medium	Condition	Action	Comment
Soil (beneath ash pile or around ash pile)	Any PAH or inorganic concentrations exceeds background (1) but its concentration at any individual location does not exceed screening level for EE/CA (2) Or PAH or inorganic concentrations do not exceed background (1)	Extent of contamination is defined at that location.	Additional sampling is not required for EE/CA. Include that location for residual contamination for site screening
Soil (beneath or around ash pile)	PAH or inorganic concentrations do not exceed background (1)	Extent of contamination is defined at all locations	Additional sampling is not required for EE/CA. Include all locations for residual contamination for site screening

1. Site data set for each chemical must be shown to exceed facility background data set for that chemical to be considered for the removal action. Background evaluation will be conducted according to the following guidance: "Procedural Guidance for Statistically Analyzing Environmental Background Data" (SWDIV & EFA WEST, 1998) and the accompanying "Handbook for Statistical Analysis of Environmental Background Data" (SWDIV & EFA WEST, 1998).
2. Screening levels as discussed in the text (Section 2.4.1) will be used only to determine whether adequate data are available to meet the requirements of the Principal Study Question for the EE/CA. Preliminary removal action cleanup levels will be developed as necessary to meet remedial action objectives to be defined in the EE/CA. A removal action extent will then be determined based on the preliminary removal action cleanup levels such that the soil will meet acceptable risk levels following a removal action.

Principal Decision Rule for SS:

The following table summarizes the steps to be taken for the SS decision rule:

Medium	Condition	Action	Comment
Soil	Any chemical concentration exceeds background (1) and residential screening level(2).	Consider soil has been impacted. Recommend removal action or RI.	The soil data set will consist of data to be collected under the current investigation and any appropriate data from the confirmatory sampling at the time of the removal action.
	Any chemical concentration exceeds background (1) but does not exceed residential screening level(2).	Designate that soil has not been impacted by that chemical. If soil has not been impacted by any chemical, then recommend no further action for soil outside buildings. Evaluate possible methods to investigate beneath buildings.	

Medium	Condition	Action	Comment
	Any chemical concentration does not exceed background[1].	Designate that soil has not been impacted by that chemical. If soil has not been impacted by any chemical, then recommend no further action for soil outside buildings. Evaluate possible methods to investigate beneath buildings.	
Groundwater	Any chemical concentration exceeds background [1] and risk-based screening level[2].	Consider groundwater has been impacted. Recommend removal action or RI.	Site groundwater data set excludes upgradient monitoring well data. However, the upgradient data will be used to evaluate whether the impact is attributable to Site 34 sources.
	Any chemical concentration exceeds background but does not exceed risk-based screening level[3].	Designate that groundwater has not been impacted by that chemical. If no chemical has impacted groundwater, then recommend no further action for groundwater.	
	Any chemical concentration does not exceed background[1].	Designate that groundwater has not been impacted by that chemical. If no chemical has impacted groundwater, then recommend no further action for groundwater.	
Sediment	No pesticide concentration exceeds ecological screening levels[2] in the offshore sediment samples.	Propose no further action for these chemicals in the offshore of Site 34.	Continue monitoring of other COCs in the offshore as part of the ongoing interim offshore monitoring program.
	Any pesticide concentration exceeds an ecological screening level[2] in the offshore sediment sample only.	Propose no further action for these chemicals in the offshore of Site 34.	Continue monitoring of other COCs in the offshore as part of the ongoing interim offshore monitoring program.
	Any pesticide concentration exceeds an ecological screening level[2] in the offshore sediment sample and onshore drain system/outfall sample.	Designate that the sediment may be contaminated by Site 34.	Continue monitoring of other COCs in the offshore as part of the ongoing offshore monitoring program. Evaluate the need for IRGs for the selected pesticides.

1. Site data set for each chemical must be shown to exceed facility background data set by statistical method (SWDIV & EFA WEST, 1998) for that chemical to be considered for the impact assessment. Background evaluation will be conducted according to the following guidance: “Procedural Guidance for Statistically Analyzing Environmental Background Data” (SWDIV & EFA WEST, 1998) and the

accompanying "Handbook for Statistical Analysis of Environmental Background Data" (SWDIV & EFA WEST, 1998).
2. Residential and ecological screening levels are noted below and discussed in Section 2.4.
3. Risk-based screening levels for the SS depend on the saline or brackish nature of the groundwater as noted below and discussed in Section 2.4.

- Screening levels for the soil are as follows:

  - For each carcinogenic chemical, a residential incremental cancer risk of 10^{-6} will be used.
  - For non-carcinogenic chemicals, a hazard index level of 0.1 will be used
  - For lead, the screening level will be set at the residential PRG level of 400 mg/kg.

- Screening levels for groundwater are as follows:

  - Facility-specific construction worker risk-based concentrations (facility specific risk-based concentrations, i.e., RBCs) will be used if the water is saline/brackish. Tap-water PRGs will be used as screening levels if the groundwater is fresh.
  - Federal Water Quality Criteria (National Recommended Water Quality Criteria) (USEPA, November 2002), with a conservative dilution factor of 100 is proposed, for screening purposes.

- Sediment screening levels for pesticides are as follows:

  - OU4 PRGs
  - ER-Ms or similar values from literature for other pesticides not included in the OU4 PRGs.

EE/CA Secondary Decision Rules:

To determine whether adequate data has been collected to conduct an EE/CA, the following decision rule applies:

- If a preliminary screening of technologies and process options indicates that an adequate set of alternatives can be developed and evaluated for effectiveness, implementability and cost, then conduct the EE/CA.

  Otherwise

  Collect additional site-specific data (such as treatability studies) before conducting the EE/CA.

2.6 SAMPLING DESIGN AND RATIONALE

It is assumed that the ash is contaminated and must be addressed in the removal action. Therefore, visual evidence of the predominance of ash in any sample is adequate to determine that the sample is contaminated. Based on this conservative assumption, the primary sampling objective for the removal action is to determine the horizontal and vertical extent of the soil contamination that was caused by the constituents in the ash. Ash characterization is also required to verify the contaminants to be targeted for the removal action. The secondary objective for the removal action is sampling of the ash to obtain characteristics to aid in the engineering evaluation of remedial options. The primary sampling objective for the SS is to investigate whether soil, sediment, and/or groundwater contamination has occurred because of the sources at the site. Source (ash) characterization for the SS will be required to link the environmental media affected by the source to the source constituents. Some of the data collected for the removal action on the vertical and horizontal extent of soil contamination can also be used for the SS because they may be representative of the site following the removal action. Also, data to be collected from the confirmatory sampling after a removal action (which is not included in this investigation) will be used for the SS. Although all the samples planned under this investigation will be collected, some of the analysis (i.e., dioxins in soil samples) that are contingent on ash characterization will be placed on hold.

The following is a discussion of the rationale for the sampling and analytical plan for the current investigation.

Ash Pile Characterization

Additional information on the chemical characterization of the ash (for an indication of the variability of the contaminant levels) is needed to meet the needs of the SS. Given the relatively small area covered by the ash pile (approximately 90 feet long by 15 to 30 feet wide), and the three possible sources of ash (historical oil gasification process, the blacksmithy operation and the building fire), it is expected that three evenly spaced locations across the entire length of the ash pile should adequately characterize the variability in ash composition, if any. The three samples should be collected from a minimum depth of 2 feet below the surface of the ash pile in order to include VOCs, if any. A full suite of analyses (TCL organics-VOCs, SVOCs (including alkylated PAHs), pesticides, PCBs, and TAL inorganics) will be conducted. Analyses of dioxins and cyanide will also be conducted.

Within the ash pile, additional sampling locations will be used for vertical profiling of the ash. These samples will be collected for engineering parameters to support the removal action will also be required, and these are discussed further later on.

Soil Contamination Beneath Ash Pile

For the removal action, determination of the vertical extent of soil contamination beneath the ash pile is required. Three locations should be adequate for characterizing the horizontal variability of soil contamination beneath the ash pile, for similar reasons as those stated above for the ash pile characterization. For soil sampling, the boring will proceed from the top of the ash pile with visual determination of the physical characteristics of the ash, until the underlying soil is encountered. When a visual determination is made that soil has been encountered, then samples of soil will be collected at discrete sampling depths until groundwater is encountered or 10 feet below ground surface (whichever is shallower). Soil analyses to support the removal action will be limited to PAHs and metals. Sampling intervals of 2 feet will be useful to estimate the volume of soil contamination with adequate accuracy. This data will provide the vertical "profiling" of soil for the estimation of contaminated soil volume to be included in the removal action.

For the SS, additional analyses of a full suite (TCL organics-VOCs, SVOCs, pesticides, PCBs, and TAL inorganics) will be conducted. Analysis for dioxins in soil samples will be placed on hold until the ash characterization results are obtained from the laboratory and the results are evaluated against the dioxin sampling decision tree. If ash samples are collected for cyanide analysis, all the soil and groundwater samples will also be analyzed for cyanide. Analytical holding time for dioxins are up to one year, therefore adequate time will be available to evaluate the data against the decision tree. The dioxin analysis will be phased in the following sequence in time: ash samples will be analyzed first; followed by surface soil samples when determined by the decision tree; and finally followed by subsurface soil samples when determined by the decision tree. Cyanide analysis will be conducted on all soil and groundwater samples, if triggered by the potential presence of cyanide in the ash samples, which will be indicated by the field observation of Prussian blue coloration in the ash samples.

Note that samples considered "clean" for defining the vertical extent for removal action can be used for the SS. The analytical requirements for the confirmatory sampling will be determined in the removal action work plan. These samples may also be used to supplement the data for site screening.

Soil Contamination Outside Ash Pile

For the removal action, determination of the horizontal extent of contamination in the soil is required. Considering typical historical filling and waste disposal practices, it is likely that disposal of the waste occurred adjacent to the building in the beginning of the plant operations and continued in an outwardly direction over time. Visual observation of the presence of ash indicates that the disposal did not extend beyond what is currently known to be Storer Street. However, surface soil contamination (in the 0 to 1 foot bgs depth) has been noted in samples taken from the northern side of this street in 1998, which is

expected to have been caused by erosion of the ash pile surface followed by deposition. Therefore, subsurface soil contamination is not expected to be found in the area north of Storer Street, which needs to be verified. Similarly, based on visual information, the ash disposal seems to have ended at a distance of approximately 23 feet beyond the eastern end of Building 62, with a limited area of ash disposal in the space between Building 62 and Building 63. Also based on visual information, the western edge of the ash disposal seems to be near the end of Building 62-Annex. A limited area of disposal also appears to exist between Building 62 and Building 62-Annex. These five visual observations of the horizontal extent of the ash also need to be verified. Although five locations may suffice, a sixth location is proposed to provide more confidence on the extent of soil contamination north of the ash pile.

At these six locations, soil samples will be taken at discrete sampling depths until groundwater is encountered or 10 feet below ground surface (whichever is shallower) for chemical analysis, which will be used to verify that the location is “clean”. Surface soil samples will be collected from either 0 to 2 feet bgs or 0 to 1 foot bgs depending on the purpose of the sample. Surface soil samples to support the EE/CA only are for extent and will be collected from a surface soil interval of 0 to 2 feet bgs. Surface soil samples to support the SS will be used to evaluate risk and will be collected from 0 to 1 foot bgs. It is acknowledged that surface soil sampling alone will not suffice at these six locations because contaminants could have leached from the ash and migrated into the subsurface soil while the surface soil may not have been impacted. Therefore, subsurface soil sampling is required at these six locations. At these locations, the sampling will begin at the depth where the fraction of ash in comparison to the soil is no longer predominant in a sample. Analyses to support the removal action require only PAHs and metals. The area of contamination outside the ash pile is expected to be limited, therefore a 2-foot resolution in sampling depth is not required for a more precise estimation of volume. A 4-foot sampling interval will suffice especially because the vertical profiling beneath the ash pile can be used to extrapolate the depth of soil contamination outside the ash pile. The relative lack of vertical resolution in soil data outside the ash pile (compared to beneath the ash pile) should not be of concern for the conceptual design and costing of removal action alternatives in an EE/CA. If one or more of these samples yield data that are considered “clean” for defining the horizontal extent for removal action, then those samples can be used for the SS. If one or more of these locations yield data that are not considered “clean” for defining the horizontal extent for removal action, then additional sampling locations may need to be reconsidered in a subsequent sampling event.

Soil samples for the SS will be obtained from the same location as those noted above for the horizontal extent outside the ash pile. Analytical requirements for the SS will be the same as those noted above for soil under the ash pile, i.e., a full suite, with a contingent analysis of dioxins and cyanide, which will be based on the same rationale noted earlier. A 4-foot soil sampling interval for subsurface will be adequate. Sampling intervals to serve this purpose can be broader than those required for the volume estimation,

and therefore a 4-foot interval is adequate. The sampling interval of 4 feet is being proposed for subsurface soils to a depth of 10 feet bgs or to the water table depth, whichever is shallower. The data will be compared to residential risk screening levels (as discussed in Section 2.5), which is a very conservative approach considering that the potential exposure to subsurface soil would be to a construction worker. Therefore, any uncertainty in the difference in concentrations between the two 2-foot sections within a 4-foot section, compared to the composite of the 4-foot section should be minor. In addition, soil samples will also be collected from the pesticide rinse area. Analyses of soil samples from this location will be limited to pesticides. A 4-foot soil sampling interval will be adequate for subsurface.

Groundwater Impact Investigation

To investigate whether the groundwater has been impacted, the subsurface zone directly beneath or downgradient of the sources (ash pile, tar pit inside Building 62, wash pad outside the Building 62) will be investigated. A monitoring point will also be required in a location upgradient of the source to provide a perspective on the groundwater contamination beneath the source. From past knowledge of hydrogeology at PNS, the general groundwater flow direction is known to be toward the Piscataqua River. Therefore the upgradient monitoring well will be located on the Smoot Street side of Building 62. Three other monitoring points (east and west sidegradient locations, and north downgradient location) will be located near the ash pile and Building 62. Soil sample locations selected to meet the needs discussed previously can be converted to groundwater monitoring points.

It is also noted that the groundwater is expected to be tidally influenced at this site because of its proximity (i.e., less than 100 feet) from the shoreline. Therefore, the groundwater flow direction is expected to reverse at high tide. To verify the groundwater flow direction at low tide, additional groundwater elevation information is also required. The five monitoring points proposed above will be used to obtain the required information. Unless a determination has been made that there has been an impact to the groundwater at this site, it is not necessary to install permanent monitoring wells. Moreover, because of the rapidly changing terrain at the proposed locations of some of the monitoring wells (in the ash pile and downgradient), a well point (i.e., a small diameter well of temporary construction using a truck-mounted drill rig) would be easier to install. Therefore, all of the monitoring wells will be installed as temporary well points.

To meet the SS objective, the groundwater samples from the five locations will be analyzed for the full suite, i.e., TCL VOCs, TCL SVOCs, TAL metals, and TCL pesticides/PCBs. Cyanide analysis will also be included if the ash samples are selected for cyanide analysis based on field observation of the presence of a Prussian blue coloration. Dioxin analysis will not be included for groundwater under the current

investigation. Total Suspended Solids (TSS) will be included to provide an indication of the impact of particulates on unfiltered groundwater constituent levels.

Sediment Impact Investigation

Sediment sampling for this investigation will focus on determining whether discharges from previous pesticide storage and handling activities in Building 62 through the storm sewer system to Outfall 49 have potentially impacted the offshore. Samples should be collected in the offshore under Outfall 49. Sampling depth will be 0 to 10 cm, which will be consistent with the sampling program for the monitoring stations under the interim offshore monitoring program. Any sediment present within the catch basin of the wash pad and any sediment present within the Outfall 49 pipe outlet should also be sampled, if possible. TCL Pesticides analysis will be conducted on the sediment samples.

Secondary Data to Support EE/CA

To meet the secondary objective, additional sampling locations in a row between the edge of the ash pile and the borings used for profiling will be required. These sampling locations will be used for visual identification of the depth of the ash only, and will terminate when the interface with the soil is encountered. For an indication that the bottom of the ash pile has been encountered, the field observation will be the lack of a predominance of ash in comparison to the soil fraction. For engineering parameters, a few samples that are representative of the ash will be needed. Composite samples selected in the field to be representative of the variability in type of material will be collected for grain-size (sieve analysis) and intact samples using Shelby tubes will be collected from the same locations for bulk density testing. If adequate recovery cannot be obtained (i.e., 24 inches), then a composite will be taken and the laboratory will be instructed to recompact the material for bulk density measurement. The laboratory will also be instructed to measure a bulk density of the material without compaction or loosely filled container. The two readings will be used to obtain a range of bulk densities for engineering purposes. If a sample containing a free product is noted (i.e., oily appearance and/or odor), then that sample will be collected for TPH and thermal value.

A summary of the sampling and analytical program rationale is presented in the following table. (Details of the field sampling plan are presented in Section 4.0, and details of the analytical program are presented in Section 5.0).

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM RATIONALE
SITE 34 INVESTIGATION

Sample location	Sample Matrix/Sampling Interval/Analytical program	Proposed Use of Data		Summary of Rationale for Data Usage
		EE/CA	SS	
34-01 (TW-01)	Groundwater/Shallow overburden/Full Suite[1]		X	• Upgradient to assess impact on site groundwater
34-01	Soil (0-1, 2-6, 6-10 ft bgs or to water table)/Full Suite[1]		X	• SS of soil
34-02	Soil (0-2, 2-6, 6-10 ft bgs or to water table)/PAHs, metals	X		• Horizontal extent for EE/CA
34-03 (TW-02)	Groundwater/Shallow overburden/Full Suite[1]		X	• Downgradient impact on site groundwater north of source
34-03	Soil (0-1, 2-6, 6-10 ft bgs or to water table)/Full Suite[1]	X	X	• Horizontal extent for EE/CA • SS of soil
34-04 (TW-03)	Groundwater/Shallow overburden/Full Suite[1]		X	• Sidegradient impact on site groundwater east of source
34-04	Soil (0-1, 2-6, 6-10 ft bgs or to water table)/Full Suite[1]	X	X	• Horizontal extent for EE/CA • SS of soil
34-05 (TW-04)	Groundwater/Shallow overburden/Full Suite[1]		X	• Source impact on site groundwater
34-05	Soil under ash pile (0-2, 2-4, 4-6, 6-8, 8-10 ft bgs or to water table) [3]/Full Suite[1]	X	X	• Vertical extent for EE/CA • SS of soil
34-06	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-07	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-08	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization

Sample location	Sample Matrix/Sampling Interval/Analytical program	Proposed Use of Data		Summary of Rationale for Data Usage
		EE/CA	SS	
34-09	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-10	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-11	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-12	Soil under ash pile (0-2, 2-4, 4-6, 6-8, 8-10 ft bgs or to water table)[3]/Full Suite [1]	X	X	• Vertical extent for EE/CA • SSI of soil (post-removal action)
34-13	Soil under ash pile (0-2, 2-4, 4-6, 6-8, 8-10 ft bgs or to water table)[3]/Full Suite[1]	X	X	• Vertical extent for EE/CA • SSI of soil
34-14	Soil outside ash pile (0-2, 2-6, 6-10 ft bgs, or to water table)/PAHs, metals	X		• Horizontal extent for EE/CA
34-15	Soil outside ash pile (0-1, 2-6, 6-10 ft bgs, or to water table)/ Full Suite [1]	X	X	• Horizontal extent for EE/CA • SS of soil
34-15 (TW-05)	Groundwater/Shallow overburden/Full Suite[1]		X	• Side gradient impact on site groundwater west of source
34-16	Soil under wash pad (0-1, 2-6, 6-10 ft bgs, or to water table)/Pesticides		X	• Impact of pesticide operations for SS of soil
34-17	Soil outside ash pile (0-2, 2-6, 6-10 ft bgs, or to water table)/PAHs, metals	X		• Horizontal extent for EE/CA
34-18 (SD-01)	Sediment sample from catch basin at wash pad (Pesticides)		X	• Impact of pesticide operations for SS of sediment
34-19 (SD-02)	Sediment sample from Outfall 49 outlet (Pesticides)		X	• Impact of pesticide operations for SS of sediment

Sample location	Sample Matrix/Sampling Interval/Analytical program	Proposed Use of Data		Summary of Rationale for Data Usage
		EE/CA	SS	
34-20 (SD-03)	Sediment sample from offshore underneath Outfall 49 (Pesticides)		X	• Impact of pesticide operations for SS of sediment

Note: X indicates that the data from the sample will be used for the purpose indicated in the appropriate column header, i.e., EE/CA or SS. A blank entry indicates that the data will not be used for purpose indicated in the header.

1. Full suite: TCL VOCs, TCL SVOCs, TAL inorganics, and Pesticides/PCBs. Groundwater analyses for filtered and unfiltered samples for TAL metals only, and all other analyses will be on unfiltered samples. Groundwater analyses will also include TSS. Dioxin analysis will not be included for groundwater samples. Dioxin analysis will be placed on hold for soil samples. Cyanide analysis will be included for all soil and groundwater samples, if ash samples are selected in the field for cyanide analysis.
2. Engineering parameters: Grain-size, bulk density, and heat of combustion of free product, if present.
3. Soil sampling intervals at this location start at 0 ft bgs beginning at the surface soil beneath the ash pile.
4. Composite samples from three of these locations will be selected in the field for the engineering parameters except bulk density. For bulk density, three intact samples from these locations will be selected in the field and collected using a shelby tube.
5. One composite ash sample from 3 of the 6 locations (total of 3 composite samples) will be analyzed for a full suite (including alkylated PAHs), and dioxins. Cyanide analysis will be conducted if a prussian blue coloration is noted in the ash. For VOC analysis, field screening will be used to select a discrete (grab) soil sample from each location prior to compositing.

TABLE 2-1

SOIL/ASH SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
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Parameter	Units	USEPA Region 9 Residential PRGs (1) (r9sores_10)	Foot Note Ref.	USEPA Region 9 SSLs (2) (DAF=1) (r9ssl1_10)	95% UCL Background(3) - Soil (Fill and Non-fill)	Minimum Screening Level	Basis of Minimum Screening Level Source
Volatiles							
1,1,1-TRICHLOROETHANE	UG/KG	1200000	SAT	100	ND	100	SSL
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	UG/KG	5600000	SAT	NC	ND	5600000	R9RES
1,1,2,2-TETRACHLOROETHANE	UG/KG	380	C	0.2	ND	0.2	SSL
1,1,2-TRICHLOROETHANE	UG/KG	840	C	0.9	ND	0.9	SSL
1,1-DICHLOROETHANE	UG/KG	59000	N	1000	ND	1000	SSL
1,1-DICHLOROETHENE	UG/KG	12000	N	3	3	3	SSL
1,2,4-TRICHLOROBENZENE	UG/KG	65000	N	300	ND	300	SSL
1,2-DIBROMO-3-CHLOROPROPANE	UG/KG	450	C	NC	ND	450	R9RES
1,2-DIBROMOETHANE	UG/KG	6.9	C	NC	ND	6.9	R9RES
1,2-DICHLOROETHANE	UG/KG	350	C	1	ND	1	SSL
1,2-DICHLOROBENZENE	UG/KG	370000	SAT	900	ND	900	SSL
1,2-DICHLOROPROPANE	UG/KG	350	C	1	ND	1	SSL
1,3-DICHLOROBENZENE	UG/KG	1300	N	NC	ND	1300	R9RES
1,4-DICHLOROBENZENE	UG/KG	3400	C	100	67	100	SSL
2-BUTANONE	UG/KG	730000	N	NC	ND	730000	R9RES
2-HEXANONE	UG/KG	NC	NA	NC	ND	NC	NA
4-METHYL-2-PENTANONE	UG/KG	79000	N	NC	ND	7900	R9RES
ACETONE	UG/KG	160000	N	800	ND	800	SSL
BENZENE	UG/KG	650	C	2	ND	2	SSL
BROMODICHLOROMETHANE	UG/KG	1000	C	30	ND	30	SSL
BROMOFORM	UG/KG	62000	C	40	ND	40	SSL
BROMOMETHANE	UG/KG	390	N	10	ND	10	SSL
CARBON DISULFIDE	UG/KG	36000	N	2000	ND	2000	SSL
CARBON TETRACHLORIDE	UG/KG	240	C	3	ND	3	SSL
CHLOROBENZENE	UG/KG	15000	N	70	ND	70	SSL
CHLOROETHANE	UG/KG	3000	C	NC	ND	3000	R9RES
CHLOROFORM	UG/KG	3600	C	30	ND	30	SSL
CHLOROMETHANE	UG/KG	1200	C	NC	ND	1200	R9RES
CIS-1,2-DICHLOROETHENE	UG/KG	4300	N	20	ND	20	SSL
CIS-1,3-DICHLOROPROPENE	UG/KG	700	C	0.2	ND	0.2	SSL
CYCLOHEXANE	UG/KG	140,000	SAT	NC	ND	140000	R9RES
DIBROMOCHLOROMETHANE	UG/KG	1100	C	20	ND	20	SSL
DICHLORODIFLUOROMETHANE	UG/KG	9400	N	NC	ND	9400	R9RES
ETHYLBENZENE	UG/KG	8900	C	700	ND	700	SSL
ISOPROPYLBENZENE	UG/KG	16000	N	NC	ND	16000	R9RES
METHYL ACETATE	UG/KG	2200000	N	NC	ND	2200000	R9RES
METHYLCYCLOHEXANE	UG/KG	260000	N	NC	ND	260000	R9RES
METHYLENE CHLORIDE	UG/KG	9100	C	1	2	1	SSL
METHYL TERT-BUTYL ETHER	UG/KG	62000	C	NC	ND	17000	R9RES
STYRENE	UG/KG	1700000	SAT	200	ND	200	SSL
TETRACHLOROETHENE	UG/KG	1500	C	3	5.6	3	SSL
TOLUENE	UG/KG	520000	SAT	600	1	600	SSL
TRANS-1,2-DICHLOROETHENE	UG/KG	6300	N	30	ND	30	SSL

TABLE 2-1

SOIL/ASH SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
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Parameter	Units	USEPA Region 9 Residential PRGs [1] (r9sores_10)	Foot Note Ref.	USEPA Region 9 SSLs [2] (DAF=1) (r9ssl1_10)	95% UCL Background[3] - Soil (Fill and Non-fill)	Minimum Screening Level	Basis of Minimum Screening Level Source
TRANS-1,3-DICHLOROPROPENE	UG/KG	700	C	0.2	ND	0.2	SSL
TRICHLOROETHENE	UG/KG	53	C	3	ND	3	SSL
TRICHLOROFLUOROMETHANE	UG/KG	39000	N	NC	ND	39000	R9RES
VINYL CHLORIDE	UG/KG	79	C	0.7	ND	0.7	SSL
XYLENES (TOTAL)	UG/KG	27000	N	10000	ND	10000	SSL
Semivolatiles							
ACENAPHTHENE	UG/KG	370000	N	29000	ND	29000	SSL
ACENAPHTHYLENE	UG/KG	370000 [4]	NA	29000[4]	74	29000 [4]	SSL
ANTHRACENE	UG/KG	2200000	N	590000	62	590000	SSL
BENZO(A)ANTHRACENE	UG/KG	620	C	80	233	80	SSL
BENZO(A)PYRENE	UG/KG	62	C	400	264	62	R9RES
BENZO(B)FLUORANTHENE	UG/KG	620	C	200	315	200	SSL
BENZO(G,H,I)PERYLENE	UG/KG	NC	NA	NC	235	NC	NA
BENZO(K)FLUORANTHENE	UG/KG	6200	C	2000	292	2000	R9RES
BIS(2-CHLOROETHOXY)METHANE	UG/KG	NC	NA	NC	ND	NC	NA
BIS(2-CHLOROETHYL)ETHER	UG/KG	210	C	0.02	ND	0.02	SSL
BIS(2-ETHYLHEXYL)PHTHALATE	UG/KG	35000	C	NC	167	35000	R9RES
4-BROMOPHENYL-PHENYLETHER	UG/KG	NC	NA	NC	ND	NC	NA
BUTYLBENZYLPHTHALATE	UG/KG	1200000	N	810000	ND	810000	SSL
CARBAZOLE	UG/KG	24000	C	30	94	30	SSL
4-CHLORO-3-METHYLPHENOL	UG/KG	NC	NA	NC	ND	NC	NA
4-CHLOROANILINE	UG/KG	24000	N	30	ND	30	SSL
2-CHLORONAPHTHALENE	UG/KG	390000	N	NC	ND	390000	R9RES
2-CHLOROPHENOL	UG/KG	6300	N	200	ND	200	SSL
4-CHLOROPHENYL-PHENYLETHER	UG/KG	NC	NA	NC	ND	NC	NA
CHRYSENE	UG/KG	62000	C	8000	294	8000	SSL
DIBENZ(A,H)ANTHRACENE	UG/KG	62	C	80	190	62	R9RES
DIBENZOFURAN	UG/KG	29000	N	NC	ND	29000	R9RES
3,3'-DICHLOROBENZIDINE	UG/KG	1100	C	0.3	ND	0.3	SSL
DIETHYLPHTHALATE	UG/KG	4900000	N	NC	ND	4900000	R9RES
DI-N-BUTYLPHTHALATE	UG/KG	610000	N	270000	100	270000	SSL
DI-N-OCTYLPHTHALATE	UG/KG	240000	N	10000000	100	240000	R9RES
4,6-DINITRO-2-METHYLPHENOL	UG/KG	NC	NA	NC	ND	NC	NA
2,4-DINITROPHENOL	UG/KG	12000	N	10	ND	10	SSL
2,4-DINITROTOLUENE	UG/KG	12000	N	0.04	ND	0.04	SSL
2,4-DICHLOROPHENOL	UG/KG	18000	N	50	ND	50	SSL
DIMETHYLPHTHALATE	UG/KG	100000000	MAX	NC	42	100000000	R9RES
2,4-DIMETHYLPHENOL	UG/KG	120000	N	400	ND	400	SSL
2,6-DINITROTOLUENE	UG/KG	6100	N	0.03	ND	0.03	SSL
FLUORANTHENE	UG/KG	230000	N	210000	354	210000	SSL
FLUORENE	UG/KG	260000	N	28000	42	28000	SSL
HEXACHLOROBENZENE	UG/KG	300	C	100	ND	100	SSL
HEXACHLOROBUTADIENE	UG/KG	6200	C	100	ND	100	SSL
HEXACHLOROCYCLOPENTADIENE	UG/KG	37000	N	20000	ND	20000	SSL

TABLE 2-1

SOIL/ASH SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
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Parameter	Units	USEPA Region 9 Residential PRGs (1) (r9sores_10)	Foot Note Ref.	USEPA Region 9 SSLs (2) (DAF=1) (r9ssl1_10)	95% UCL Background(3) - Soil (Fill and Non-fill)	Minimum Screening Level	Basis of Minimum Screening Level Source
HEXACHLOROETHANE	UG/KG	35000	C	20	ND	20	SSL
INDENO(1,2,3-CD)PYRENE	UG/KG	620	C	700	235	620	R9RES
ISOPHORONE	UG/KG	510000	C	30	ND	30	SSL
2-METHYLNAPHTHALENE	UG/KG	5600	NA	NC	44	5600	R9RES
2-METHYLPHENOL	UG/KG	310000	N	800	ND	800	SSL
4-METHYLPHENOL	UG/KG	31000	N	NC	ND	31000	R9RES
NAPHTHALENE	UG/KG	5600	N	4000	43	4000	SSL
2-NITROANILINE	UG/KG	170	N	NC	ND	170	R9RES
3-NITROANILINE	UG/KG	170	N	NC	ND	170	R9RES
4-NITROANILINE	UG/KG	170	N	NC	ND	170	R9RES
NITROBENZENE	UG/KG	2000	N	7	ND	7	SSL
2-NITROPHENOL	UG/KG	NC	NA	NC	ND	NC	NA
4-NITROPHENOL	UG/KG	NC	NA	NC	ND	NC	NA
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	69	C	0.002	ND	0.002	SSL
N-NITROSODIPHENYLAMINE	UG/KG	99000	C	60	ND	60	SSL
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/KG	2900	C	NC	ND	2900	R9RES
PENTACHLOROPHENOL	UG/KG	3000	C	1	ND	1	SSL
PHENANTHRENE	UG/KG	230000 (5)	NA	210000 (5)	213	210000 (5)	SSL
PHENOL	UG/KG	3700000	N	5000	98	5000	SSL
PYRENE	UG/KG	230000	N	210000	309	210000	SSL
2,4,5-TRICHLOROPHENOL	UG/KG	610000	N	14000	ND	14000	SSL
2,4,6-TRICHLOROPHENOL	UG/KG	610	N	8	ND	8	SSL
Pesticides/PCBs							
4,4'-DDD	UG/KG	2400	C	800	38.5	800	SSL
4,4'-DDE	UG/KG	1700	C	3000	1475	1700	R9RES
4,4'-DDT	UG/KG	1700	C	2000	1300	1700	R9RES
ALDRIN	UG/KG	29	C	20	ND	20	SSL
ALPHA-BHC	UG/KG	90	C	0.03	ND	0.03	SSL
ALPHA-CHLORDANE	UG/KG	1600 (6)	C	500 (6)	ND	500 (6)	SSL
BETA-BHC	UG/KG	320	C	0.1	ND	0.1	SSL
DELTA-BHC	UG/KG	90	C	0.03	ND	0.03	SSL
DIELDRIN	UG/KG	30	C	0.2	ND	0.2	SSL
ENDOSULFAN I	UG/KG	37000 (7)	N	900 (7)	ND	900 (7)	SSL
ENDOSULFAN II	UG/KG	37000 (7)	N	900 (7)	ND	900 (7)	SSL
ENDOSULFAN SULFATE	UG/KG	37000 (7)	N	900 (7)	ND	900 (7)	SSL
ENDRIN	UG/KG	1800	N	50	ND	50	SSL
ENDRIN ALDEHYDE	UG/KG	1800 (8)	N	50 (8)	ND	50 (8)	SSL
ENDRIN KETONE	UG/KG	1800 (8)	N	50 (8)	ND	50 (8)	SSL
GAMMA-BHC (LINDANE)	UG/KG	440	C	0.5	ND	0.5	SSL
GAMMA-CHLORDANE	UG/KG	1600 (6)	C	500 (6)	ND	500 (6)	SSL
HEPTACHLOR	UG/KG	110	C	1000	ND	110	R9RES
HEPTACHLOR EPOXIDE	UG/KG	53	C	30	ND	30	SSL
METHOXYCHLOR	UG/KG	31000	N	8000	ND	8000	SSL

TABLE 2-1

SOIL/ASH SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
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Parameter	Units	USEPA Region 9 Residential PRGs [1] (r9sores_10)	Foot Note Ref.	USEPA Region 9 SSLs [2] (DAF=1) (r9ssl1_10)	95% UCL Background[3] - Soil (Fill and Non-fill)	Minimum Screening Level	Basis of Minimum Screening Level Source
TOXAPHENE	UG/KG	440	C	2000	ND	440	R9RES
AROCLOR-1016	UG/KG	3900	C	NC	ND	3900	R9RES
AROCLOR-1221	UG/KG	220	C	NC	ND	220	R9RES
AROCLOR-1232	UG/KG	220	C	NC	ND	220	R9RES
AROCLOR-1242	UG/KG	220	C	NC	ND	220	R9RES
AROCLOR-1248	UG/KG	220	C	NC	ND	220	R9RES
AROCLOR-1254	UG/KG	220	C	NC	ND	220	R9RES
AROCLOR-1260	UG/KG	220	C	NC	ND	220	R9RES
Metals							
ALUMINUM	MG/KG	7600	N	NC	21101	7600	R9RES
ANTIMONY	MG/KG	3.1	N	0.3	4.98	0.3	SSL
ARSENIC	MG/KG	0.39	C	1	17.8	0.39	R9RES
BARIUM	MG/KG	540	N	82	95.8	82	SSL
BERYLLIUM	MG/KG	15	N	3	0.82	3	SSL
CADMIUM	MG/KG	3.7	N	0.4	2.1	0.4	SSL
CALCIUM	MG/KG	NC	NA	NC	2465	NC	NA
CHROMIUM	MG/KG	210	C	2	66.8	2	SSL
COBALT	MG/KG	140[9]	N	NC	12.7	140	R9RES
COPPER	MG/KG	290	N	NC	125	290	R9RES
IRON	MG/KG	2300	N	NC	24976	2300	R9RES
LEAD	MG/KG	400	N	NC	439	400	R9RES
MAGNESIUM	MG/KG	NC	NA	NC	8562	NC	NA
MANGANESE	MG/KG	180	N	NC	361	180	R9RES
MERCURY	MG/KG	2.3	N	NC	0.24	2.3	R9RES
NICKEL	MG/KG	160	N	7	44	7	SSL
POTASSIUM	MG/KG	NC	NA	NC	2377	NC	NA
SELENIUM	MG/KG	39	N	0.3	0.66	0.3	SSL
SILVER	MG/KG	39	N	2	ND	2	SSL
SODIUM	MG/KG	NC	NA	NC	1119	NC	NA
THALLIUM	MG/KG	0.52	N	NC	0.23	0.52	R9RES
VANADIUM	MG/KG	55	N	300	56.7	55	R9RES
ZINC	MG/KG	2300	N	620	221	620	SSL
Miscellaneous							
CYANIDE	MG/KG	1.1	N	NC	N/A	1.1	R9RES
Dioxins							
2,3,7,8-TCDD	NG/KG	3.9	C	NC	ND	3.9	R9RES
1,2,3,4,6,7,8,9-OCDD	NG/KG	39000	C	NC	ND	39000	R9RES
1,2,3,4,6,7,8,9-OCDF	NG/KG	39000	C	NC	ND	39000	R9RES
1,2,3,4,6,7,8-HPCDD	NG/KG	390	C	NC	ND	390	R9RES
1,2,3,4,6,7,8-HPCDF	NG/KG	390	C	NC	ND	390	R9RES
1,2,3,4,7,8,9-HPCDF	NG/KG	390	C	NC	ND	390	R9RES
1,2,3,4,7,8-HXCDD	NG/KG	39	C	NC	ND	39	R9RES
1,2,3,4,7,8-HXCDF	NG/KG	39	C	NC	ND	39	R9RES
1,2,3,6,7,8-HXCDD	NG/KG	39	C	NC	ND	39	R9RES

TABLE 2-1

SOIL/ASH SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
PAGE 5 OF 5

Parameter	Units	USEPA Region 9 Residential PRGs (1) (r9sores_10)	Foot Note Ref.	USEPA Region 9 SSLs (2) (DAF=1) (r9ssl1_10)	95% UCL Background(3) - Soil (Fill and Non-fill)	Minimum Screening Level	Basis of Minimum Screening Level Source
1,2,3,6,7,8-HXCDF	NG/KG	39	C	NC	ND	39	R9RES
1,2,3,7,8,9-HXCDD	NG/KG	39	C	NC	ND	39	R9RES
1,2,3,7,8,9-HXCDF	NG/KG	39	C	NC	ND	39	R9RES
1,2,3,7,8-PECDF	NG/KG	7.8	C	NC	ND	7.8	R9RES
2,3,4,7,8-PECDF	NG/KG	7.8	C	NC	ND	7.8	R9RES
1,2,3,7,8-PECDD	NG/KG	3.9	C	NC	ND	3.9	R9RES
2,3,4,6,7,8-HXCDF	NG/KG	39	C	NC	ND	39	R9RES
2,3,7,8-TCDF	NG/KG	39	C	NC	ND	39	R9RES
TOTAL TCDD	NG/KG	NC	C	NC	ND	NC	NA
TOTAL PECDD	NG/KG	NC	C	NC	ND	NC	NA
TOTAL HXCDD	NG/KG	NC	C	NC	ND	NC	NA
TOTAL HPCDD	NG/KG	NC	C	NC	ND	NC	NA
TOTAL TCDF	NG/KG	NC	C	NC	ND	NC	NA
TOTAL PECDF	NG/KG	NC	C	NC	ND	NC	NA
TOTAL HXCDF	NG/KG	NC	C	NC	ND	NC	NA
TOTAL HPCDF	NG/KG	NC	C	NC	ND	NC	NA

Notes:
N - Non-carcinogenic risk
C - Carcinogenic risk
NC - No criteria
NA - Not applicable
PRG - Preliminary Remediation Goal.
SSL - Soil Screening Levels.
SAT - Saturated value
MAX - Maximum value
Note: 1/10th PRG value used for noncarcinogens.

Minimum screening levels are the lower of the Region 9 PRGs and the SSLs.
1 - USEPA, October, 2002. "Region 9 Residential Preliminary Remediation Goals (PRGs)".
2 - USEPA, October, 2002. "Soil Screening Levels (SSLs) (DAF = 1)."
3 - The 95% UCL background values are presented.
4 - Value listed is for the surrogate acenaphthene.
5 - Value listed is for the surrogate pyrene.
6 - Value listed is for the surrogate chlordane
7 - Value listed is for the surrogate endosulfan
8 - Value listed is for the surrogate endrin
9 - Value is for the combined residential pathways with a target hazard quotient of 0.1 (USEPA, Region 9, October 2002).

TABLE 2-2

GROUNDWATER SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
PAGE 1 OF 5

Parameter	Units	Foot Note Ref.	Construction Worker Exposure RBC (1)	USEPA Tap Water PRGS (2)	Federal Saltwater Criteria (3) (swchronic)	PNS 95% UCL Facility Background Saline Groundwater (4) (bkg_s)	Minimum Screening Level	Basis of Minimum Screening Level Source
Volatiles								
1,1,1-TRICHLOROETHANE	UG/L	N	NC	320	NC	ND	320	r9_tap
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	UG/L	N	NC	5900	NC	ND	5900	r9_tap
1,1,2,2-TETRACHLOROETHANE	UG/L	C	NC	0.055	NC	ND	0.055	r9_tap
1,1,2-TRICHLOROETHANE	UG/L	C	NC	0.2	NC	ND	0.2	r9_tap
1,1-DICHLOROETHANE	UG/L	N	NC	81	NC	ND	81	r9_tap
1,1-DICHLOROETHENE	UG/L	N	NC	34	NC	ND	34	r9_tap
1,2,4-TRICHLOROBENZENE	UG/L	N	115	19	NC	ND	19	r9_tap
1,2-DIBROMO-3-CHLOROPROPANE	UG/L	C	NC	0.048	NC	ND	0.048	r9_tap
1,2-DIBROMOETHANE	UG/L	C	NC	0.00076	NC	ND	0.00076	r9_tap
1,2-DICHLOROETHANE	UG/L	C	NC	0.12	NC	ND	0.12	r9_tap
1,2-DICHLOROBENZENE	UG/L	N	2040	37	NC	ND	37	r9_tap
1,2-DICHLOROPROPANE	UG/L	C	NC	0.16	NC	ND	0.16	r9_tap
1,3-DICHLOROBENZENE	UG/L	N	481	0.55	NC	ND	0.55	r9_tap
1,4-DICHLOROBENZENE	UG/L	C	645	0.5	NC	ND	0.5	r9_tap
2-BUTANONE	UG/L	N	NC	190	NC	ND	190	r9_tap
2-HEXANONE	UG/L	NA	NC	NC	NC	ND	NC	NA
4-METHYL-2-PENTANONE	UG/L	N	NC	16	NC	ND	16	r9_tap
ACETONE	UG/L	N	NC	61	NC	ND	61	r9_tap
BENZENE	UG/L	C	NC	0.35	NC	ND	0.35	r9_tap
BROMODICHLOROMETHANE	UG/L	C	NC	0.18	NC	ND	0.18	r9_tap
BROMOFORM	UG/L	C	NC	8.5	NC	ND	8.5	r9_tap
BROMOMETHANE	UG/L	N	NC	0.87	NC	ND	0.87	r9_tap
CARBON DISULFIDE	UG/L	N	NC	100	NC	ND	100	r9_tap
CARBON TETRACHLORIDE	UG/L	C	NC	0.17	NC	ND	0.17	r9_tap
CHLOROBENZENE	UG/L	N	NC	11	NC	ND	11	r9_tap
CHLOROETHANE	UG/L	C	NC	4.6	NC	ND	4.6	r9_tap
CHLOROFORM	UG/L	C	NC	6.2	NC	ND	6.2	r9_tap
CHLOROMETHANE	UG/L	C	NC	1.5	NC	ND	1.5	r9_tap
CIS-1,2-DICHLOROETHENE	UG/L	N	NC	6.1	NC	ND	6.1	r9_tap
CIS-1,3-DICHLOROPROPENE	UG/L	C	NC	0.4	NC	ND	0.4	r9_tap
CYCLOHEXANE	UG/L	N	NC	3500	NC	ND	3500	r9_tap
DIBROMOCHLOROMETHANE	UG/L	C	NC	0.13	NC	ND	0.13	r9_tap
DICHLORODIFLUOROMETHANE	UG/L	N	NC	39	NC	ND	39	r9_tap
ETHYLBENZENE	UG/L	C	NC	2.9	NC	ND	2.9	r9_tap
ISOPROPYLBENZENE	UG/L	N	NC	66	NC	ND	66	r9_tap
METHYL ACETATE	UG/L	N	NC	610	NC	ND	610	r9_tap
METHYLCYCLOHEXANE	UG/L	N	NC	520	NC	ND	520	r9_tap
METHYLENE CHLORIDE	UG/L	C	NC	4.3	NC	ND	4.3	r9_tap
METHYL TERT-BUTYL ETHER	UG/L	C	NC	13	NC	ND	13	r9_tap
STYRENE	UG/L	N	NC	160	NC	ND	160	r9_tap

TABLE 2-2

GROUNDWATER SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
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Parameter	Units	Foot Note Ref.	Construction Worker Exposure RBC (1)	USEPA Tap Water PRGS (2)	Federal Saltwater Criteria (3) (swchronic)	PNS 95% UCL Facility Background Saline Groundwater (4) (bkg_s)	Minimum Screening Level	Basis of Minimum Screening Level Source
TETRACHLOROETHENE	UG/L	C	NC	0.66	NC	ND	0.66	r9_tap
TOLUENE	UG/L	N	NC	72	NC	ND	72	r9_tap
TRANS-1,2-DICHLOROETHENE	UG/L	N	NC	12	NC	ND	12	r9_tap
TRANS-1,3-DICHLOROPROPENE	UG/L	C	NC	0.4	NC	ND	0.4	r9_tap
TRICHLOROETHENE	UG/L	C	NC	0.028	NC	ND	0.028	r9_tap
TRICHLOROFLUOROMETHANE	UG/L	N	NC	130	NC	ND	130	r9_tap
VINYL CHLORIDE	UG/L	C	NC	0.02	NC	ND	0.02	r9_tap
XYLENES (TOTAL)	UG/L	N	NC	21	NC	ND	21	r9_tap
Semivolatiles								
ACENAPHTHENE	UG/L	N	NC	37	NC	ND	37	r9_tap
ACENAPHTHYLENE	UG/L	NA	NC	37	NC	ND	37	r9_tap
ANTHRACENE	UG/L	N	NC	180	NC	ND	180	r9_tap
BENZO(A)ANTHRACENE	UG/L	C	1.14	0.092	NC	ND	0.092	r9_tap
BENZO(A)PYRENE	UG/L	C	0.0668	0.0092	NC	ND	0.0092	r9_tap
BENZO(B)FLUORANTHENE	UG/L	C	0.658	0.092	NC	ND	0.092	r9_tap
BENZO(G,H,I)PERYLENE	UG/L	NA	NC	18	NC	ND	18	r9_tap
BENZO(K)FLUORANTHENE	UG/L	C	NC	0.92	NC	ND	0.92	r9_tap
BIS(2-CHLOROETHOXY)METHANE	UG/L	NA	NC	270	NC	ND	270	r9_tap
BIS(2-CHLOROETHYL)ETHER	UG/L	C	329	0.0098	NC	ND	0.0098	r9_tap
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	C	NC	4.8	NC	ND	4.8	r9_tap
4-BROMOPHENYL-PHENYLETHER	UG/L	NA	NC	NC	NC	ND	NC	NA
BUTYLBENZYLPHTHALATE	UG/L	N	NC	730	NC	ND	730	r9_tap
CARBAZOLE	UG/L	C	NC	3.4	NC	ND	3.4	r9_tap
4-CHLORO-3-METHYLPHENOL	UG/L	N	NC	NC	NC	ND	NC	NA
4-CHLOROANILINE	UG/L	N	NC	15	NC	ND	15	r9_tap
2-CHLORONAPHTHALENE	UG/L	N	NC	49	NC	ND	49	r9_tap
2-CHLOROPHENOL	UG/L	N	632	3	NC	ND	3	r9_tap
4-CHLOROPHENYL-PHENYLETHER	UG/L	NA	NC	NC	NC	ND	NC	NA
CHRYSENE	UG/L	C	114	9.2	NC	ND	9.2	r9_tap
DIBENZ(A,H)ANTHRACENE	UG/L	C	0.0432	0.0092	NC	ND	0.0092	r9_tap
DIBENZOFURAN	UG/L	N	NC	2.4	NC	ND	2.4	r9_tap
3,3'-DICHLOROBENZIDINE	UG/L	C	57.2	0.15	NC	ND	0.15	r9_tap
DIETHYLPHTHALATE	UG/L	N	120000	2900	NC	ND	2900	r9_tap
DI-N-BUTYLPHTHALATE	UG/L	N	1880	360	NC	ND	360	r9_tap
DI-N-OCTYLPHTHALATE	UG/L	N	NC	150	NC	ND	150	r9_tap
4,6-DINITRO-2-METHYLPHENOL	UG/L	N	22	NC	NC	ND	22	cw_rbc
2,4-DINITROPHENOL	UG/L	N	994	7.3	NC	ND	7.3	r9_tap

TABLE 2-2

GROUNDWATER SCREENING LEVEL SUMMARY
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Parameter	Units	Foot Note Ref.	Construction Worker Exposure RBC (1)	USEPA Tap Water PRGS (2)	Federal Saltwater Criteria (3) (swchronic)	PNS 95% UCL Facility Background Saline Groundwater (4) (bkg_s)	Minimum Screening Level	Basis of Minimum Screening Level Source
2,4-DINITROTOLUENE	UG/L	N	487	7.3	NC	ND	7.3	r9_tap
2,4-DICHLOROPHENOL	UG/L	N	122	11	NC	ND	11	r9_tap
DIMETHYLPHTHALATE	UG/L	N	NC	36000	NC	ND	36000	r9_tap
2,4-DIMETHYLPHENOL	UG/L	N	1900	73	NC	ND	73	r9_tap
2,6-DINITROTOLUENE	UG/L	N	360	3.6	NC	ND	3.6	r9_tap
FLUORANTHENE	UG/L	N	121	150	NC	ND	121	cw_rbc
FLUORENE	UG/L	N	NC	24	NC	ND	24	r9_tap
HEXACHLOROBENZENE	UG/L	C	1.46	0.042	NC	ND	0.042	r9_tap
HEXACHLOROBUTADIENE	UG/L	C	12.5	0.86	NC	ND	0.86	r9_tap
HEXACHLOROCYCLOPENTADIENE	UG/L	N	NC	22	NC	ND	22	r9_tap
HEXACHLOROETHANE	UG/L	C	177	4.8	NC	ND	4.8	r9_tap
INDENO(1,2,3-CD)PYRENE	UG/L	C	0.657	0.092	NC	ND	0.092	r9_tap
ISOPHORONE	UG/L	C	208000	71	NC	ND	71	r9_tap
2-METHYLNAPHTHALENE	UG/L	NA	NC	0.62	NC	ND	0.62	r9_tap
2-METHYLPHENOL	UG/L	N	NC	180	NC	ND	180	r9_tap
4-METHYLPHENOL	UG/L	N	NC	18	NC	ND	18	r9_tap
NAPHTHALENE	UG/L	N	443	0.62	633	ND	0.62	r9_tap
2-NITROANILINE	UG/L	N	NC	0.1	NC	ND	0.1	r9_tap
3-NITROANILINE	UG/L	N	NC	0.1	NC	ND	0.1	r9_tap
4-NITROANILINE	UG/L	N	NC	0.1	NC	ND	0.1	r9_tap
NITROBENZENE	UG/L	N	NC	0.34	NC	ND	0.34	r9_tap
2-NITROPHENOL	UG/L	N	1910	NC	NC	ND	1910	cw_rbc
4-NITROPHENOL	UG/L	N	1600	NC	NC	ND	1600	r9_tap
N-NITROSO-DI-N-PROPYLAMINE	UG/L	C	NC	0.0096	NC	ND	0.0096	r9_tap
N-NITROSODIPHENYLAMINE	UG/L	C	NC	14	NC	ND	14	r9_tap
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/L	C	NC	0.27	NC	ND	0.27	r9_tap
PENTACHLOROPHENOL	UG/L	C	7.28	0.56	7.9	ND	0.56	r9_tap
PHENANTHRENE	UG/L	N	166	18	NC	ND	18	r9_tap
PHENOL	UG/L	N	162000	2200	NC	ND	2200	r9_tap
PYRENE	UG/L	N	NC	18	NC	ND	18	r9_tap
2,4,5-TRICHLOROPHENOL	UG/L	N	NC	360	NC	ND	360	r9_tap
2,4,6-TRICHLOROPHENOL	UG/L	C	1250	0.36	NC	ND	0.36	r9_tap
Pesticides/PCBs								
ALDRIN	UG/L	C	6.82	0.004	0.16 (7)	ND	0.004	r9_tap
ALPHA-BHC	UG/L	C	NC	0.011	0.16 (7)	ND	0.011	r9_tap
ALPHA-CHLORDANE	UG/L	C	14.6	0.19	0.004	ND	0.004	sw_chronic
BETA-BHC	UG/L	C	NC	0.037	0.16 (7)	ND	0.037	r9_tap

TABLE 2-2

GROUNDWATER SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
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Parameter	Units	Foot Note Ref.	Construction Worker Exposure RBC [1]	USEPA Tap Water PRGS [2]	Federal Saltwater Criteria [3] (swchronic)	PNS 95% UCL Facility Background Saline Groundwater [4] (bkg_s)	Minimum Screening Level	Basis of Minimum Screening Level Source
4,4'-DDE	UG/L	C	5.05	0.2	3.26 [7]	ND	0.2	r9_tap
4,4'-DDD	UG/L	C	6.28	0.28	0.84 [7]	ND	0.28	r9_tap
4,4'-DDT	UG/L	C	2.69	0.2	0.001	ND	0.001	sw_chronic
DELTA-BHC	UG/L	C	NC	0.011	0.16 [7]	ND	0.011	r9_tap
DIELDRIN	UG/L	C	0.953	0.0042	0.0019	ND	0.0019	sw_chronic
ENDOSULFAN I	UG/L	N	NC	22	0.0087	ND	0.0087	sw_chronic
ENDOSULFAN II	UG/L	N	NC	22	0.0087	ND	0.0087	sw_chronic
ENDOSULFAN SULFATE	UG/L	N	NC	22	0.0087	ND	0.0087	sw_chronic
ENDRIN	UG/L	N	6.53	1.1	0.0023	ND	0.0023	sw_chronic
ENDRIN ALDEHYDE	UG/L	N	NC	1.1	0.0023	ND	0.0023	sw_chronic
ENDRIN KETONE	UG/L	N	NC	1.1	0.0023	ND	0.0023	sw_chronic
GAMMA-BHC (LINDANE)	UG/L	C	20.3	0.052	0.16 [7]	ND	0.052	r9_tap
GAMMA-CHLORDANE	UG/L	C	14.6	0.19	NC	ND	0.19	r9_tap
HEPTACHLOR	UG/L	C	4.96	0.015	0.0036	ND	0.0036	sw_chronic
HEPTACHLOR EPOXIDE	UG/L	C	NC	0.0074	0.0036	ND	0.0036	sw_chronic
METHOXYCHLOR	UG/L	N	NC	18	0.03	ND	0.03	sw_chronic
TOXAPHENE	UG/L	C	NC	0.061	0.0002	ND	0.0002	sw_chronic
AROCLOR-1016	UG/L	C	NC	0.96	0.03	ND	0.03	sw_chronic
AROCLOR-1221	UG/L	C	NC	0.034	0.03	ND	0.03	sw_chronic
AROCLOR-1232	UG/L	C	NC	0.034	0.03	ND	0.03	sw_chronic
AROCLOR-1242	UG/L	C	NC	0.034	0.03	ND	0.03	sw_chronic
AROCLOR-1248	UG/L	C	NC	0.034	0.03	ND	0.03	sw_chronic
AROCLOR-1254	UG/L	C	NC	0.034	0.03	ND	0.03	sw_chronic
AROCLOR-1260	UG/L	C	NC	0.034	0.03	ND	0.03	sw_chronic
Inorganics								
ALUMINUM	UG/L	N	NC	3600	NC	ND	3600	r9_tap
ANTIMONY	UG/L	N	94	1.5	NC	ND	1.5	r9_tap
ARSENIC	UG/L	C	4700	0.045	36	ND	0.045	r9_tap
BARIUM	UG/L	N	7660	260	NC	60.6	260	r9_tap
BERYLLIUM	UG/L	N	21.9	7.3	NC	ND	7.3	r9_tap
CADMIUM	UG/L	N	39.1	1.8	8.8	ND	1.8	r9_tap
CALCIUM	UG/L	NA	NC	NC	NC	108760	NC	NA
CHROMIUM	UG/L	N	58.6	11	50	5.5	11	r9_tap
COBALT	UG/L	N	31300	73	NC	ND	73	r9_tap
COPPER	UG/L	N	NC	140	3.1	15.91	3.1	sw_chronic
IRON	UG/L	N	NC	1100	NC	728	1100	r9_tap
LEAD	UG/L	NA	NC	NC	8.1	1.5	8.1	sw_chronic
MAGNESIUM	UG/L	NA	NC	NC	NC	21955	NC	NA

TABLE 2-2

GROUNDWATER SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE
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Parameter	Units	Foot Note Ref.	Construction Worker Exposure RBC (1)	USEPA Tap Water PRGS (2)	Federal Saltwater Criteria (3) (swchronic)	PNS 95% UCL Facility Background Saline Groundwater (4) (bkg_s)	Minimum Screening Level	Basis of Minimum Screening Level Source
MANGANESE	UG/L	N	1250	88	NC	340	88	r9_tap
MERCURY	UG/L	N	32.8	1.1	0.94	0.06	0.94	sw_chronic
NICKEL	UG/L	N	6250	73	8.2	4.2	8.2	sw_chronic
POTASSIUM	UG/L	NA	NC	NC	NC	14681	NC	NA
SELENIUM	UG/L	N	7810	18	71	ND	18	r9_tap
SILVER	UG/L	N	520	18	0.79 (7)	ND	0.79	sw_chronic (7)
SODIUM	UG/L	NA	NC	NC	NC	162107	NC	NA
THALLIUM	UG/L	N	109	0.24	NC	ND	0.24	r9_tap
VANADIUM	UG/L	N	284	26	NC	0.87	26	r9_tap
ZINC	UG/L	N	781300	1100	81	14.5	81	sw_chronic
Miscellaneous								
CYANIDE	UG/L	N	NC	0.62	1	N/A	0.62	r9_tap

Notes:
N - Non-carcinogenic risk
C - Carcinogenic risk
NC - No criteria available
NA - Not Applicable
N/A - Not Analyzed
UCL - Upper Confidence Limit.
Dioxin screening values are the TEQs calculated from Region 9 PRG for 2,3,7,8-TCDD.
1/10th PRG value and RBC value is used for noncarcinogens.

1 - Calculated screening levels based on dermal exposure of construction workers to water. RBCs have been estimated only for previously detected groundwater contaminants at other sites at PNS.
2 - USEPA, October, 2002. "Region 9 Tapwater Preliminary Remediation Goals (PRGs)".
3 - USEPA, November, 2002. National Recommended Water Quality Criteria. Values presented are Criterion Continuous Concentration (CCC) for Saltwater, previously referred to as surface water chronic (swchronic) criteria. These apply to dissolved phase (filtered) concentrations for metals.
4 - The 95% UCL background values are presented for saline water.
5 - USEPA, January 1996, "ECO Update, Ecotox Thresholds"
6 - Suter and Tsao, 1996 "Toxicological Benchmarks for Screening Potential Constituents of Concern for Effects on Aquatic Biota:1996 Revision."
7 - TtNUS, November 2001. WQC-SC presented in the draft revised silver criteria (0.92, USEPA, 1987), and adjusted to represent dissolved metals (f=0.85, USEPA, 1999).

TABLE 2-3

SEDIMENT SCREENING LEVEL SUMMARY
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE

Parameter	Units	OU4 (Ecological) PRG (1) or ER-M (2)
Pesticides		
4,4'-DDD	UG/KG	20(2)
4,4'-DDE	UG/KG	27(2)
4,4'-DDT	UG/KG	66.4(1)
ALDRIN	UG/KG	80(2)
ALPHA-BHC	UG/KG	NC
ALPHA-CHLORDANE	UG/KG	6(2)
BETA-BHC	UG/KG	NC
DELTA-BHC	UG/KG	NC
DIELDRIN	UG/KG	NC
ENDOSULFAN I	UG/KG	NC
ENDOSULFAN II	UG/KG	3.95(1)
ENDOSULFAN SULFATE	UG/KG	NC
ENDRIN	UG/KG	NC
ENDRIN ALDEHYDE	UG/KG	NC
ENDRIN KETONE	UG/KG	NC
GAMMA-BHC (LINDANE)	UG/KG	0.99(2)
GAMMA-CHLORDANE	UG/KG	NC
HEPTACHLOR	UG/KG	50(2)
HEPTACHLOR EPOXIDE	UG/KG	50(2)
METHOXYCHLOR	UG/KG	NC
TOXAPHENE	UG/KG	NC

Notes:
N - Non-carcinogenic risk
C - Carcinogenic risk
NC - No criteria

1 - PRG calculated for Operable Unit 4 ecological risk based (TtNUS, November 2001). Note that based on the OU4 PRG development process, only a limited list of chemicals were identified, that at that time required PRGs, i.e. these chemicals were identified as "limiting PRGs".
2 - ER-M or similar criteria from Seep/Sediment Summary Report (TtNUS, August 2000).

3.0 PROJECT ORGANIZATION

This section discusses the project organization and personnel responsibilities.

3.1 PROJECT ORGANIZATION CHART

A project organization chart depicting the agencies and contracting personnel involved with the Site 34 investigation is shown on Figure 3-1. The Navy is the lead agency for this site, and TtNUS (the Navy contractor) will implement the investigation. Names and telephone numbers are provided in the organization chart.

3.2 COMMUNICATION PATHWAYS

Pathways have been established to transfer information and to make alterations to project methods that may be required because of unforeseen circumstances. It will be the responsibility of the TtNUS project manager (PM) to keep both the TtNUS project team and the Navy informed of the following:

- Schedule, deliverables, meetings, and milestones
- Recent data collected from the site
- Technical changes made to the plans and specifications
- Developments that will cause changes in the schedule

The TtNUS PM will be in frequent verbal and electronic mail communication with the Navy remedial project manager (RPM). Any changes in the plans and specifications, field methodology, sampling protocol, or data objectives will be communicated to the RPM and the Maine-certified geologist (CG) in a timely manner. As appropriate, a field modification record will be used to identify the need for a change and a recommended course of action. The Navy will consult with USEPA and MEDEP on any major scope changes that may occur while the fieldwork is proceeding.

The TtNUS PM will, by telephone or electronic mail, communicate directly with the field team and indirectly with the designated Contract Laboratory Program (CLP) laboratories (through the lead chemist). The lead chemist will provide technical guidance and assess data as they become available. The laboratories, by telephone or electronic mail, will notify TtNUS immediately of any issues that develop with the data or quality assurance/quality control (QA/QC) requirements. The Navy will be notified if significant issues arise with the laboratories regarding data, data quality objectives, or schedule.

The field operations leader (FOL) will verbally notify the TtNUS PM of the daily sample shipping information and will be in daily contact with the TtNUS PM. The PM will provide sample shipping information to the sample shipping coordinator. The FOL and the required subcontractors will communicate directly on site. During site activities, project sample logsheets, logbook notations, and appropriate field forms will be completed in the field and maintained at the TtNUS office.

3.2.1 Modifications to the Approved QAPP

This section documents the procedures that will be followed when any project activity described in the approved QAPP requires real-time modification to achieve the project goals.

TtNUS will present proposed changes to the Navy and follow up with a field modification record for significant changes. The documentation will describe why the change is necessary, the nature of the proposed change, and the impacts of the change on the project. The change will be implemented after Navy concurrence. Minor changes will be documented in the field logbook.

When changes require immediate action, the proposed change will be briefly discussed internally by TtNUS and approved, as appropriate, by the TtNUS PM or designee (i.e., QA officer or technical lead). The Navy RPM will be notified as soon as possible. Concurrence from USEPA and MEDEP will be sought for any major scope changes, as determined by the Navy. In the event of conditions requiring a major scope change, the investigation will be put on hold until concurrence is obtained. The Navy will consult with USEPA and MEDEP on any major scope changes that may occur while fieldwork is proceeding.

3.3 PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

John Trepanowski, the program manager, is responsible for the overall management and implementation of the Navy CLEAN contract for TtNUS. Deborah Cohen serves as the TtNUS facility coordinator for PNS and will oversee the coordination of the Site 34 investigation with other site investigations. She serves as the primary liaison between the Navy RPM and TtNUS for work at PNS. She will also serve as the PM for the Site 34 investigation. J.P. Kumar will serve as the TtNUS task manager for the work assignment, and he will assist Ms. Cohen with the primary responsibility for the implementation and execution of the work assignment, including technical quality, oversight and review, control of costs and schedule, and implementation of appropriate QA procedures during all phases.

The TtNUS FOL is the primary person who implements the field work activities outlined in this QAPP. The FOL will report directly to the TtNUS PM and the Maine CG. Responsibilities of the FOL include supervising TtNUS field staff and field operations, coordinating with the various subcontractors on site

ensuring the procedures specified in the QAPP are properly implemented, identifying and documenting necessary field changes, maintaining daily schedules, and reporting to the PM on a regular basis regarding the status and progress of the field activities. Before starting field work, the FOL will ensure that field SOPs are consistent with the QAPP and that any questions affecting the quality of planned field work are resolved. The FOL will also be responsible for ensuring that the field staff adhere to the primary duties of the health and safety plan (HASP), reporting any health and safety issues to the TtNUS health and safety officer, and reporting any hazards, injuries, or decisions to stop work to the TtNUS PM.

The TtNUS QA officer will provide input on all aspects of adherence to the QAPP to the PM as needed. The sample management coordinator will be responsible for ensuring that the laboratory supplies the appropriate sample containers and preservatives to the field, verifying receipt of samples and their integrity at the laboratory, ensuring that the data supplied by the laboratory are complete, and providing liaison with the laboratory contact to obtain data in a format that is suitable for validation.

The TtNUS lead hydrogeologist/Maine CG will provide review of the QAPP, oversight of the field activities, and certification of the QAPP and project report for the field activities.

The Natural Resources Trustees and RAB (not listed in the organizational chart but included on the PNS distribution list for reports) will review and provide input on this QAPP and successive reports.

Table 3-1 lists the Site 34 investigation personnel and includes their respective roles, names, and titles. Resumes of the TtNUS personnel are available on request.

3.4 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

Field activities that require special training are summarized in Table 3-2.

3.5 ASSESSMENTS AND RESPONSE ACTIONS

Assessment activities ensure that the data quality is adequate for the data's intended use and that appropriate corrective actions are implemented to address nonconformances and deviations from the QAPP.

3.5.1 Planned Assessments

The planned assessments are system audits and field audits. The assessments planned for this project are identified in Table 3-3.

System audits will be performed as appropriate to ensure that work is being implemented in accordance with the approved project SOPs and in an overall satisfactory manner. These audits will be performed in the following manner:

- The FOL will supervise and check on a daily basis that the field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and fieldwork is accurately and neatly documented. Documentation includes verifying that the sample names on sample log sheets, field notes, chain-of-custody records, and sample labels are identical matches to sample names in the QAPP. The FOL will update the TtNUS PM of field activities on a daily basis.

- System audits for the laboratory will be performed regularly and in accordance with NFESC guidance, as provided in the Laboratory Quality Assurance Plan (LQAP).

- The data validator will review the chemical analytical data packages submitted by the laboratory. The data validator will check that the data were obtained through use of the approved methodology, that the appropriate level of QC effort and reporting was conducted, and whether or not the results are in conformance with QC criteria. On the basis of these factors, the data validator will generate a report describing data limitations that will be reviewed internally by the data validation manager (DVM) before submittal to the PM.

- The PM will maintain contact with the FOL and DVM to ensure that management of the acquired data proceeds in an organized and expeditious manner.

Additionally, an independent performance audit of field activities may be conducted at the discretion of and under the direction of the QA officer. If a formal field audit is conducted, the QA officer will check that sample collection, handling, and shipping protocols, as well as equipment decontamination and field documentation procedures, are being performed in accordance with the approved project planning documents and SOPs.

Performance audits of laboratories are coordinated through Naval Facilities Engineering Service Center (NFESC) and are conducted periodically by NFESC's independent quality assurance contractor.

3.5.2 Assessment Findings and Corrective Action Responses

Assessment findings that require corrective action initiate a sequence of events that include documentation of deficiencies, notification of findings, request for corrective action, implementation of corrective action, and follow-up assessment of the corrective action effectiveness. Table 3-3 summarizes

any QAPP deviations and project deficiencies that are identified through the planned project assessments will be handled.

Potential problems may involve nonconformance with the SOPs and/or analytical procedures established for the project or other unforeseen difficulties. Any person identifying a condition adverse to project quality will notify the TtNUS PM. The TtNUS PM, with the assistance of the QA officer, will be responsible for developing and initiating appropriate corrective action through the FOL and verifying that the corrective action has been effective. Corrective actions may include the following: resampling and/or reanalyzing a sample or amending or adjusting project procedures. If warranted by the severity of the problem (for example, if a change in the approved plan is required), the Navy will be notified in writing and the Navy's approval will be obtained before any change is implemented. The USEPA and MEDEP will be consulted about any significant scope changes that may occur while fieldwork is underway. Communication and correspondence to the RAB will occur via mailing to the distribution list or updates at RAB meetings. Minor changes will be documented for the main file by the TtNUS PM. Additional work that depends on a nonconforming activity will not be performed until the problem has been eliminated. The overall corrective action responsibility for system audits will reside with the TtNUS PM. The overall corrective action responsibility for field audits will reside with the TtNUS QA officer.

For QA issues involving the analytical laboratory to be used for the project, the laboratory also maintains an internal closed-loop corrective action system that operates under the direction of the laboratory QA coordinator.

3.5.3 Additional QAPP Nonconformances

Deviations from the QAPP that are noted by project personnel outside the formal assessment process will be documented and resolved using the procedures and personnel detailed in Sections 3.5.1 and 3.5.2.

3.6 QA MANAGEMENT REPORTS

This section presents the activities that will be performed to keep management updated on the project status. Open communication pathways will benefit the project by allowing all appropriate personnel to be aware of activities and have the ability to provide input in a timely manner. Input from these parties will be used to make necessary corrective actions so project quality objectives are met.

The information to be included in each of the QA Management Reports listed in Table 3-4 is summarized as follows.

Verbal Status Reports

The project chemist and FOL will give verbal status reports to the TtNUS PM on a daily basis or more frequently if needed. The status reports will include the field activities completed for the day, the personnel who completed each activity, the anticipated activities to be completed during the next day, and any issues or problems identified. A summary of most significant progress in project activities will be sent via electronic mail to the PM.

Project Status Reports

No formal status reports are needed because of the short duration of the project. The field logbooks will serve as records of field activities.

Field Audit Report

Field audits may be performed at the discretion of the QA officer. The audits will be performed by the QA officer or designee during field investigations. The audits will include checks on adherence to the QAPP and all applicable SOPs. The QA officer will prepare an audit report summarizing the findings. Nonconformance quality notices will be issued to document each observation, deficiency, or concern discovered during the audit. This report is distributed to the Navy RPM, the TtNUS PM, and the project files. Any findings that require immediate corrective action will be communicated immediately to the TtNUS PM.

Data Validation Reports

Tier I and Tier III data validation reports will be developed for this project. Tier I validation will be conducted for field data. Tier III validation will be performed for the metals, SVOCs, PCBs, pesticides, dioxins, and cyanide results. The data validation reports will be prepared and formatted as described in Section 6.2. The data validation reports will be included in the Site 34 investigation report.

Data validation will not be conducted on the results for the physical parameters (i.e. bulk density, grain size, etc.). However the laboratory results will be verified for completeness, and results will be checked as discussed in Section 6.0.

3.7 PROJECT SCHEDULE

The schedule for the main phases of the project and deliverables are presented in Table 3-5.

3.8 OUTLINE OF PROJECT REPORTS

The following are the project reports that will be prepared as the outcome of this investigation and further actions taken by the Navy:

- Site Investigation Data Package: This report will consist of a compilation of the results of the site investigation with a summary of the field activities and the validated data in tabular form.

- Engineering Evaluation/Cost Analysis: This report will evaluate the data from the site investigation; develop removal action objectives for a removal action; and develop, evaluate, and screen removal action alternatives, followed by a recommended alternative.

- Removal Action Work Plan: This work plan will detail the field activities, sampling and analytical requirements, schedule, and cost for the selected removal action alternative.

- Removal Action Closure Report: This report will summarize the removal action activities and present the confirmatory sampling data, along with a recommendation for further action and site screening report preparation.

- Site Screening Report: This report will evaluate all of the available data from the environmental media at the site, perform risk screening, and make recommendations regarding one or more of the following further actions for the site: RI/FS, removal action, or No Further Action.

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TABLE 3-1

**PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS
SITE 34 INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

Name	Organizational Affiliation	Responsibilities	Location of Personnel Resumes, if not included	Education and Experience Qualifications
John Trepanowski/ Garth Glenn	TtNUS	Program Manager/Deputy	TtNUS, King of Prussia, PA	Available on request
Deborah Cohen	TtNUS	Facility Coordinator, PM	TtNUS Pittsburgh, PA	Available on request
J.P. Kumar	TtNUS	Task Manager	TtNUS, Pittsburgh, PA	Available on request
Kelly Carper	TtNUS	QA Officer	TtNUS, Pittsburgh, PA	Available on request
Matt Soltis	TtNUS	Health & Safety Officer	TtNUS, Pittsburgh, PA	Available on request
Angie Sheetz	TtNUS	Lead Chemist	TtNUS, Pittsburgh, PA	Available on request
Charles Race	TtNUS	Maine CG/Lead Hydrogeologist	TtNUS, Wilmington, MA	Available on request
Tom Johnston	TtNUS	QA Advisor	TtNUS Pittsburgh, PA	Available on request
TBD	TtNUS	FOL	TtNUS	Available on request

TABLE 3-2

SPECIAL PERSONNEL TRAINING REQUIREMENTS
SITE 34 INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Project Function	Specialized Training Title of Course or Description	Training Provided By	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Field Sampling	• 40-Hour OSHA training, 8-Hour annual refresher training. • Supervisory training.	Health and safety training specialists.	Various.	• All field (on-site) personnel. • FOL	FOL and field sampling team members.	Training records are maintained by TtNUS.

OSHA – Occupational Safety and Health Administration.

TABLE 3-3

PROJECT ASSESSMENT
SITE 34 INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person responsible for performing assessment, title and organizational affiliation	Person responsible for responding to assessment findings, title and organizational affiliation	Person responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person responsible for monitoring effectiveness of CA, title and organizational affiliation
System Audit	See text for Section 3.5.1.	Internal	TtNUS	TtNUS PM. D. Cohen,	TtNUS FOL	TtNUS FOL	TtNUS Program Manager, J. Trepanowski
Field Audit	Conducted at the discretion of the QA officer.	Internal	TtNUS	TtNUS QA Officer. K. Carper (or designate)	TtNUS PM, D. Cohen	TtNUS FOL	TtNUS QA Officer, K. Carper

TABLE 3-4

**QA MANAGEMENT REPORTS
SITE 34 INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

Type of Report	Frequency	Project Delivery Date	Person Responsible for Report Preparation	Report Recipients
Verbal Status Report	Daily during field activities.	At the end of every day of field activities or as needed.	TtNUS FOL	TtNUS PM, D. Cohen
Field Audit Report	Conducted at the discretion of the QA officer.	10 days after audit.	TtNUS QA Officer, K. Carper	TtNUS PM, D. Cohen

TABLE 3-5

**PROJECT SCHEDULE TIMELINE
SITE 34 INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

Activities	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverables	Deliverable Due Dates
Prepare Draft QAPP	June 2002	August 2002	Report	August 26, 2002
Prepare Draft Final QAPP	October 2002	January 2003	Report	January 27, 2003
Prepare Final QAPP	February 2003	March 2003	Report	March 28, 2003
Field Activities	May 2003	August 2003	None	Not Applicable
Laboratory Reporting	August 2002	September 2003	Data Packages (including electronic reports)	30 days from receipt of samples
Data Validation/Data Processing	September 2003	November 2003	Data Validation Memoranda	Estimated 8 weeks following receipt of final lab data
Prepare Data Package	October 2003	January 2004	Final Data Package	TBD

Note: A schedule for the EE/CA, removal action, and site screening report will be developed and presented at a later date.

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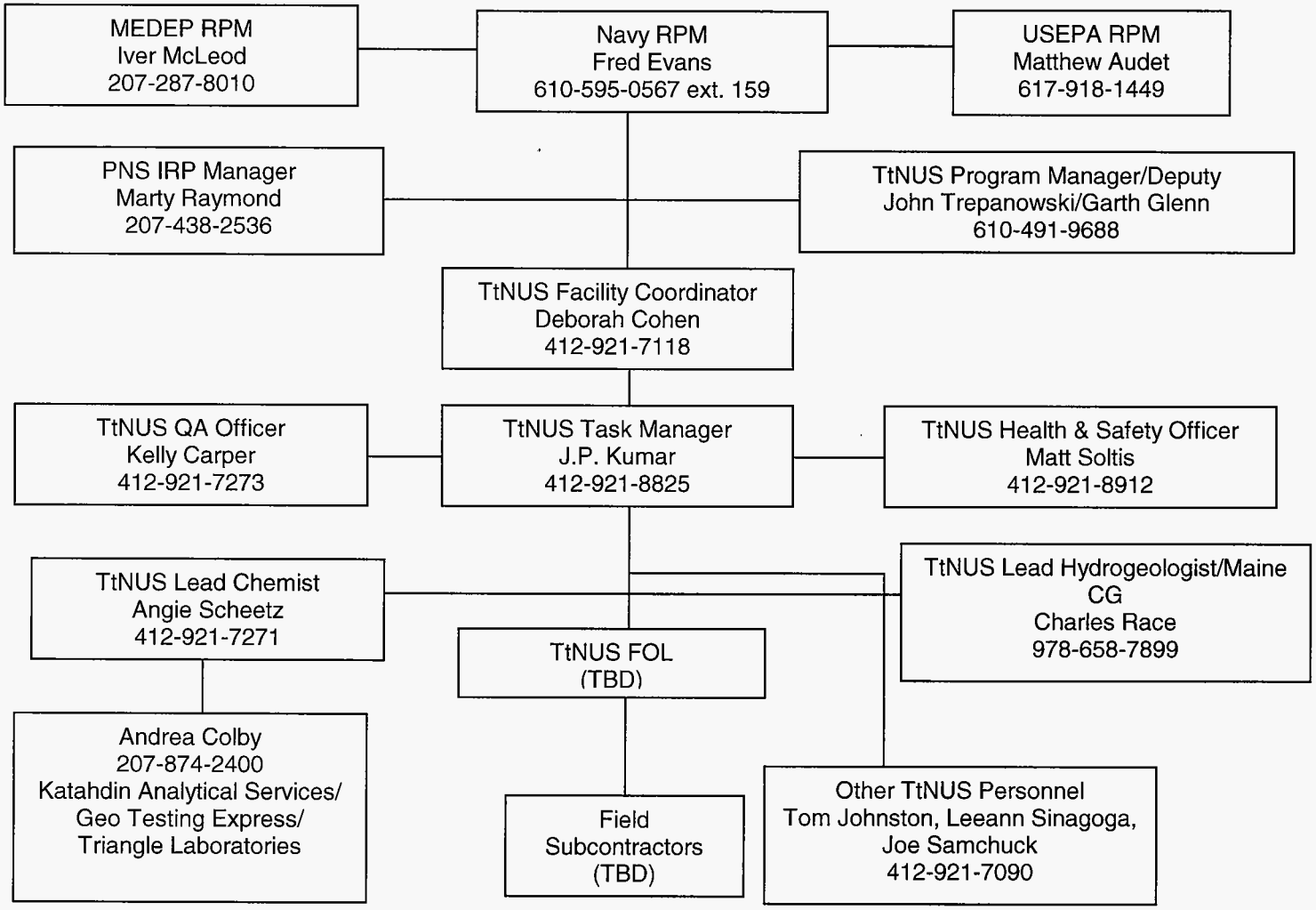
FIGURE 3-1

PROJECT ORGANIZATION CHART
SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE



* All contact with TtNUS personnel and subcontractors by nonfield personnel should be made through Mr. Fred Evans.

4.0 FIELD SAMPLING AND ANALYSIS PLAN

TtNUS will conduct ash, soil, groundwater, and sediment sampling during the Site 34 Investigation. This section of the QAPP describes how representative samples will be collected in an appropriate and consistent manner to meet the project objectives. SOPs for conducting the field investigation are summarized in this section. Table 4-1 lists these SOPs and the SOPs are provided in Appendix C. Field documentation forms are also provided in Appendix C. A complete listing of sampling locations, sample identification numbers, analytical requirements, and sample volumes/containers/preservation requirements/holding times, is presented in Tables 4-2 through 4-7.

In addition to the specific requirements outlined in the USEPA-NE QAPP guidance, this section also includes subsections for site utility clearance and digging permits, surveying of sample locations, and management of investigation-derived waste (IDW).

4.1 ARCHAEOLOGICAL/HISTORICAL ARCHITECTURAL CONSIDERATIONS

The field investigation will be coordinated with representatives of PNS's Cultural Resources Program to minimize potential impacts on historical or archaeological resources. If issues are anticipated, action will be taken to avoid such negative impacts.

4.2 SITE UTILITY CLEARANCE AND DIGGING PERMIT

Before any intrusive drilling or subsurface sampling activities commence at the site, utility maps of the facility will be obtained and thoroughly reviewed by the FOL. A utility surveyor will locate and map the utilities in the field. Ground-penetrating radar (GPR) and/or other geophysical instruments will then be used to survey the area to more accurately locate the buried utility lines. No intrusive activities (i.e., drilling or hand augering) will occur until the proposed areas intended for drilling have been completely cleared in accordance with SOP S1.

4.3 SOIL AND GROUNDWATER INVESTIGATION EQUIPMENT AND PROCEDURES

Soil borings and temporary wells will be completed by direct-push methods. A Geoprobe® or other similar direct-push technology (DPT) will be used to collect soil and ash samples and to install temporary groundwater monitoring wells. The main advantage of using DPT for this project, is the greater mobility and flexibility that it can offer in locating the limits of the ash pile or for installing temporary well points, compared to conventional drilling methods. The DPT will also generate less IDW, minimize decontamination time, and minimize access space required relative to conventional drilling methods.

4.3.1 Direct-Push Methods for Surface and Subsurface Soil and Ash Sampling

A total of 17 soil borings will be advanced using DPT methods at site 34. Figure 4-1 (DQO Figure 1-5) shows the location of the 17 soil borings. Five of the soil borings will be converted into temporary monitoring points for the purpose of groundwater sampling (Section 4.6). The procedure for soil sampling using DPT is included in SOP S2. Borings will be attempted within 2-3 hours after low tide has occurred as predicted in tide charts.

A new acetate liner will be advanced at each boring location until groundwater is encountered or 10 feet below ground surface (whichever is shallower) using a 4 foot Macro-Core® or similar sampler and in accordance with procedures outlined in SOP S3. Each removed soil core will be scanned for VOCs using either a photoionization detector (PID) or flame ionization detector (FID). The soil core will be visually inspected and logged by the field geologist, noting the presence or absence of ash, soil texture, grain size (sand, silt or clay), color (and any unusual discoloration), qualitative moisture content, and classification according to the Unified Soil Classification System (USCS). The field geologist will identify the soil depositional environment. Results of the vapor monitoring will be recorded on TtNUS boring logs. Soil samples will be collected and logged in accordance with procedures outlined in TtNUS SOP S3 and S4.

Borings 34-05, 34-12, and 34-13 will proceed from the top of the ash pile until a visual determination is made that soil beneath the ash pile has been encountered. The proposed sampling/analytical program at these three locations is as summarized below:

- Soil from two-foot sampling intervals (0-2, 2-4, 4-6, 6-8, and 8-10 ft bgs or (or terminating where groundwater is encountered)) will be collected for VOCs, SVOCs, pesticides/PCBs, dioxins, metals, and, if selected, also cyanide analysis. If adequate soil volume is not available for all analyses, then the drive tool will be moved and driven within 1 ft or a suitable distance from the original location to ensure that borehole collapse does not occur. Additional soil will then be collected from the deficient interval.

- Dioxins analysis will be placed on hold at the laboratory for all of the above samples until results on the ash characterization are available.

Borings 34-01, 34-03, 34-04, and 34-15, are located outside the ash pile, and these expected to be conducted after coring through asphalt or concrete or beneath a vegetated layer. Soil will be sampled from the following intervals for the analysis as follows:

- Soil from 0-1, 2-6, 6-10 ft bgs (or terminating where groundwater is encountered) will be collected for VOCs, SVOCs, pesticides/PCBs, metals, dioxins, and, if selected, also cyanide.

- Dioxins analyses will be placed on hold at the laboratory for all of the above samples until the results on the ash characterization are available.

Borings 34-02, 34-14, 34-16, and 34-17 are also located outside the ash pile, and soil samples taken after coring through concrete or asphalt, or under a vegetated layer. Soil will be sampled as follows:

- At borings 34-02, 34-14, and 34-17, soil from the 0-2, 2-6, and 6-10 ft (or terminating where groundwater is encountered), will be collected for PAHs and metals analysis.

- At boring 34-16 (near the wash pad), soil from the 0-1, 2-6, and 6-10 ft bgs (or terminating where groundwater is encountered) will be collected for Pesticides analysis.

Borings 34-06, 34-07, 34-08, 34-09, 34-10 and 34-11 will be used to obtain additional information of the profile of the ash thickness using visual inspection for the predominance of ash. Of these borings, three samples selected to be representative of the variability of the ash (based on visual observation of color, texture, grain size, compaction, etc.) will be collected for sieve analysis, bulk density, and chemical analysis. The sieve analysis will be conducted on composite samples selected from borings that are representative of the variability in grain size. The composite samples will also be analyzed for SVOCs (including alkylated PAHs), Pesticides/PCBs, and dioxins. Composite samples that contain wood chips or limestone with a prussian blue coloration will be analyzed for cyanide. Compositing will be conducted using the methods specified in SOP S3. Discrete samples of ash will be scanned for VOCs using a PID before making composites and three samples (each from a different location) exhibiting the highest presence of VOCs will be selected for TCL VOCs analysis. The bulk density measurement will be conducted on three intact (Shelby Tube) samples collected from the same or different borings that will be selected to be representative of the variability in compaction observed across the borings. A discretionary sample will be collected for TPH and Heat of Combustion analysis if a free product is noted. The general physical properties of the free product such as color, odor, viscosity, etc. will also be noted.

Table 4-3 provides a summary of soil analytical program.

All borings not converted into temporary well points will be backfilled with bentonite chips and patched with cement, cold-patch asphalt, or soil at grade to match the surrounding area. Care will be taken to return each location to its original condition after sampling. Each boring location will be revisited after backfilling is completed to re-apply soil, cement grout, or cold-patch, if necessary. After a boring has been sampled and backfilled, it will be identified by a wooden stake, driven into the center of boring. If two or more drive attempts were made to collect adequate sample volume, the stake will be driven in the

center of the area represented by these borings. The locations and distances between the borings will be clearly explained in the sample collection logs. The stake will have both brightly colored flagging attached to increase visibility, and be labeled using a waterproof marker with the soil boring number.

All direct-push equipment will be steam cleaned prior to the start of the field investigation, decontaminated between each borehole to prevent cross-borehole contamination and decontaminated prior to leaving the site, as discussed in Section 4.10.

4.3.2 Temporary Monitoring Point Installation

Five borings (34-01, 34-03, 34-04, 34-05, and 34-15) will be converted into temporary groundwater monitoring wells (labeled 34-TW01, 34-TW02, 34-TW03, 34-TW04, and 34-TW05, respectively), and sampled for groundwater. Borings for installation of temporary monitoring wells will be advanced using DPT and in accordance with TtNUS SOP S2 and the following described methodology. A GeoProbe® or similar DPT will be used to advance 2-inch outside diameter Macro-Core® or similar sampler of 4-foot length to several feet below the local water table. If cobbles or thick gravel layers are encountered and prohibit advancement of the sampler using DPT or if open boreholes can not be maintained that allow installation of temporary monitoring wells, small diameter hollow-stem augers (2-3/4- to 3-1/4-inch inside diameter) will be used to advance the boring to the required depth.

The Macro-Core® sampler will be removed from the borehole, and a temporary polyvinyl chloride (PVC) well will be installed. The PVC well screen (Schedule 40) used for the temporary well will have an outside diameter of 1-1/4 inches, and a slot size of either 0.006 inches or 0.01 inches depending on the particle size of the monitored interval, and a length of 10 feet. The well screen will be capped at the bottom. The DPT well installation will be attempted around low tide time of the Piscataqua River as predicted in the tide charts. The target will be to install the screen starting at the depth of the saturated soil encountered within a 2-hour interval of time after low tide occurs in the river. PVC riser pipe (Schedule 40) will be attached to the screen to extend the well above grade. The screen and riser pipe will be flush jointed. A sand pack (No. 20 to No. 40 U.S. Standard sieve size or 00 Morie) will be installed in the annulus from 6-inches below the well screen, around the well screen, and up to 1 foot above the top of the screen, unless the formation collapses around the well screen. If a sand pack is installed, a bentonite seal (minimum 6-inch thickness) will be installed above the sand pack. A pre-manufactured sand pack is recommended because the boring size is expected to be too small for the annulus between the well screen and the boring to allow free flow of sand. Only 100 percent, certified pure, sodium bentonite will be used for well construction. The remaining annulus above the bentonite seal will be backfilled with bentonite pellets or chips.

Each temporary well will be developed by repeatedly pumping the well, creating drawdown, then allowing the well to recover thus causing a surging effect. The purpose of well development is to remove sediments from inside the casing and within the sand pack which surrounds the well screen. Due to the diameter and volume of the proposed temporary wells, a peristaltic pump will be used to develop the wells. Each of the wells will be developed for approximately one-half hour. If a sand pack and bentonite seal is installed, the wells will be developed after waiting approximately 12 hours or more after installation is complete.

The water levels in the temporary wells will be allowed to stabilize for 12 hours or more after development, depending on the permeability of the formation, before sampling. The temporary wells will be capped when left unattended to minimize the introduction of particles or contaminants into the well from the surface.

To abandon the temporary wells, the riser and screen will be grouted. The grout will be emplaced from the bottom of the hole to the surface and consist of a cement-bentonite slurry. The surface at each temporary well location will be restored to its original condition (vegetated, asphalt or concrete).

Boring logs will be prepared for each temporary well. The boring logs will record installation methods, depths of installation, abandonment details, and other pertinent information. A map of the temporary monitoring well locations and appropriate data from the boring logs will also be recorded into the field logbook notes.

4.3.3 Sediment Sampling

Sediment samples will be collected from the wash pad catch basin (at 34-18), the outlet of Outfall 49 (34-19), and intertidal sediment under the outlet of Outfall 49 (at 34-20). It is anticipated that the samples 34-18 and 34-19 will need to be scraped from a limited layer of sediment. The sample from 34-20 will be collected from a 0 to 10 cm depth. These samples will be collected in accordance with SOP S122 and analyzed for pesticides.

4.4 WATER-LEVEL MEASUREMENTS AND PRELIMINARY TIDAL INFLUENCE STUDY

One round of water levels will be manually measured in all on-site temporary monitoring wells and in the Piscataqua River during low tide and high tide to gauge whether each well is significantly tidally influenced or not. A difference in water elevations of 0.5 feet or greater is considered to be indicative of tidal influence. These measurements will be made using an electric water-level indicator capable of 0.01-foot accuracy in accordance with SOP S7. Water levels will be recorded on Groundwater-Level Measurement log sheets.

4.5 TIDAL STUDY

A limited tidal study will be conducted in a selected temporary monitoring well and a stilling well (installed at a suitable location in the river close to the site), prior to any sampling event, to determine the magnitude of tidal effects, response times, and proper sampling times for the tidally influenced temporary monitoring wells. The tidal study will be conducted over two complete tidal cycles (i.e., more than 24 hours). The stilling well will consist of a 2-inch internal diameter PVC pipe attached to a pier or a suitable structure in the river close to the site. The study will also be conducted when no significant precipitation events are forecasted to minimize the influence of the precipitation on water levels

Pressure transducers with data loggers will be used to collected the water level data at 10-minute intervals at one temporary well on site and the stilling well. The data will be used to determine the minimum and maximum tidal influence and the lag (response) time for the groundwater at the site. One set of lag times will be calculated as the time difference between the occurrence of low tide at the stilling well and the low groundwater level at the temporary monitoring well. The water levels at the other temporary monitoring wells will be manually measured at 30 minute intervals within a 4-hour interval (2 hours before, and 2 hours after) the predicted low tide time of the river. Graphs showing the water elevations in each well with time will be created in order to determine the timing of the tidal effects in individual temporary monitoring wells.

4.6 GROUNDWATER PURGING AND SAMPLING

After the groundwater elevation data have been collected for a period of three days for each well, the data will be evaluated and the timing of high water and low water levels for each well will be determined. The goal of the groundwater sampling activities is to time the sampling so that the samples will be collected when the groundwater elevations are at their lowest point. The groundwater sampling and analysis program is summarized in Table 4-4.

4.6.1 Groundwater Purging

An adjustable-rate peristaltic pump will be used in each of the five temporary wells for purging and sampling purposes. The tubing inlet will be placed near the midpoint of each well screen so as not to disturb any sediment that may be located near the bottom of the well. Low-flow purging and sampling techniques will be utilized in accordance with SOPs S5 and S10. Low-flow purging and sampling is being implemented because this method will provide the least disturbance to the surrounding formation (i.e., less turbulence in sampling and hence less turbidity) allowing for a more representative groundwater sample to be collected. Low-flow purging and sampling activities will not begin until at least 12 hours after the

temporary monitoring wells have been installed and developed. A peristaltic pump will be used for purging and sampling. New silicone pump tubing and teflon or teflon lined polyethylene tubing will be attached to the pump and inserted to the mid point of the well screen before each well is purged.

Groundwater samples will be collected in each well at a time when the water level in that well is near the lowest point of its tidal oscillation. At low tide, contaminant concentrations are expected to be most representative of the contaminants being released from the saturated zone soil. The timetable for high and low tides for each well will be determined based on data collected by the data loggers, as discussed earlier in Section 4.5.

During well purging, the water level in each well will be monitored every 5 to 10 minutes as purging occurs. A drawdown of less than 0.3 feet will be targeted at a monitoring well where the initial high-tide versus low-tide water level comparison indicates a tidal influence is not present. Initially, the pumping rate will be set at approximately 0.3 liters per minute (L/min) or lower if needed. The pumping rate will be reduced if turbidity is greater than 5 Nephelometric Turbidity Units (NTUs) after all other field parameters have stabilized. The measured pumping rates and groundwater level data will be recorded on the well purging log sheets.

Water quality parameters [pH, specific conductance, temperature, oxidation/reduction potential (ORP), salinity, and dissolved oxygen] will be measured during purging using a YSI Model 6820 water quality meter (or equivalent) and flow-through cell. Turbidity will be measured using a Lamotte 2020 (or equivalent) and the turbidity measurement will be performed from a sample collected from a “T” connector before the flow-through cell. Water quality measurements will be recorded on the well purging log sheet every 5 to 10 minutes.

Calibration and standards checks will be conducted on the water quality meter in accordance with the manufacturer’s recommendations and SOP S11, as discussed in Section 4.14.1.1. The flow-through cell will be decontaminated before initiation of well purging at each well. Precautions will be taken to prevent air entrapment and/or air leaks in the purging system so that potential problems with stabilizing dissolved oxygen are minimized. Precautions will include: (1) taking care to fill the entire flow-through cell with water, while minimizing air entrapment, before initiating purging and (2) maintaining a full cell of water by pinching the discharge line shut and elevating the discharge at the end of the tubing from the pump, above the cell.

Purging will continue until all of the parameters have stabilized to the criteria listed below and the minimum purge volume (one well volume) has been removed from a well. Stabilization criteria for the water quality parameters are as follows:

- pH ± 0.1 standard units
- turbidity ± 10 percent for values greater than 5 NTU
- specific conductance ± 3 percent
- temperature ± 3 percent
- ORP ± 10 millivolts
- dissolved oxygen ± 10 percent

Purging will begin approximately 2-1/2 hours before low tide in each well. If the parameters have not stabilized within 2 hours, then sampling will be initiated. The final values of water quality parameters measured just before sampling commences will be recorded on the groundwater sample collection log sheet.

4.6.2 Temporary Monitoring Well Sampling

After purging is completed, the flow-through cell will be disconnected from the pump discharge tube and unfiltered samples will be collected directly from the discharge tube of the pump. Sample containers for VOCs will be filled (following the method detailed in SOP S2) by allowing the groundwater trapped within the intake end of the tubing leading to the pump, to flow gently down the inside of the container with minimal turbulence. The bottle should be filled completely with no head space remaining in the bottle. Once these bottles are filled, capped, and properly labeled, a new disposable filter cartridge containing a 0.45-um filter will be attached to the end of the pump discharge tube. The filter will be pre-rinsed with at least 100 mL of groundwater allowing it to pass through the in-line filter and discarded with the purge water. The sample bottles for filtered samples will then be filled with groundwater after it passes through the filter cartridge. All sample bottles will have the appropriate type and amount of preservative already added to the containers as specified in Table 4-2, prior to arrival at the site (i.e., preservatives are added to the bottles by the Laboratory before shipping to the site) SOPs S5 and S10 will be followed for purging and sampling activities. SOP S7 will be followed for filtration procedures.

Groundwater samples will be analyzed for the following parameters:

- TCL VOCs, TCL SVOCs, TAL inorganics (filtered and unfiltered), cyanide (unfiltered), pesticides, PCBs, and TSS.

4.7 SAMPLE IDENTIFICATION SYSTEM

4.7.1 Environmental Samples

All environmental samples collected at Site 34 will be properly labeled with a sample label affixed to the sample container. Each sample will be assigned a unique sample tracking number. The sample tracking number will consist of a four segment alphanumeric code that identifies the sample's associated site, sample type, location, and, for aqueous samples where applicable whether a sample is filtered and/or the sample round number.

The alphanumeric coding to be used in the Site 34 sample system is explained in the diagram and the subsequent definitions:

AA	AA	A or N 2 to 4 characters	NNNN and/or A Aqueous only	NNNN Soils and Sediment Only
Site	Sample Type	Location	Round Identifier and/or filtered	Depth Interval

Character Type:

A = Alpha
N = Numeric

Site:

34 = Site 34

Sample Type:

GW = Groundwater sample
TW = Temporary Well sample
SD = Sediment sample
SW = Surface water sample
SB = Soil boring sample
SS = Surface soil sample

Location:

The sample location code is the well number, the soil sample location, or sediment sample location.

Round Identifier:

A four digit round identifier specifying the numeric month and last two digits of the year will be used to track the aqueous samples taken from a particular location over time. A sample collected in April 2003 would be assigned the round identifier "0403."

Filtered:

Water samples that are field filtered (dissolved analysis) will be identified with an “F” in the last code section. No entry in this segment signifies an unfiltered (total) sample.

Depth Interval, Soil and Sediment only:

The depth code is used to note the depth, below ground surface (bgs), at which a soil or sediment sample is collected. The first two numbers of the four number code specify the top interval and the third and fourth specify the bottom, feet bgs (soil) inches bgs (sediment) of the sample. The depths will be noted in whole numbers only, further detail, if needed, will be recorded on the sample log sheet, boring log, log book, etc.

Depth (for soils, in feet bgs):

0001 = soil collected from 0 to 1 foot bgs
0002 = soil collected from 0 to 2 feet bgs
0204 = soil collected from 2 to 4 feet bgs
0810 = soil collected from 8 to 10 feet bgs, etc.

Depth (for sediments, in inches bgs):

Sediment samples will be collected from a depth of less than 10 cm, which is less than 4 inches. Therefore, the sample depth will be "0000" in the sediment sample numbers. The sample collection logs will indicate the actual depth range in inches that the sample was collected.

Examples of Sample Nomenclature

The filtered groundwater sample collected from temporary well 34TW01 in April 2003 would be designated as 34GWTW010403F.

The unfiltered groundwater sample collected from a temporary well 34TW05 would be designated as 34GWTW050403.

A subsurface soil sample from 34SB10 at an interval of 4-6 feet bgs would be designated as 34SB100406.

A sediment sample from 34-18 (SD-01) collected from 0 to 0.3 feet bgs (0 to 10 cm) would be designated as 34SD010001.

4.7.2 Field Quality Assurance/Quality Control (QA/QC) Sample Nomenclature

Field QA/QC samples will be designated using a different coding system. The QC code will consist of a three- to four-segment alphanumeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN	F
QC Type	Date	Sequence Number (per day)	Filtered (aqueous only, if needed)

The QC types are identified as:

TB = Trip Blank
RB = Rinsate Blank (Equipment Blank)
FD = Field Duplicate
SB = Source Water Blank

The sampling time recorded on the chain-of-custody form, labels, for duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory).

Examples of Field QA/QC Nomenclature

For example, the first duplicate of the day for a filtered groundwater sample collected on June 3, 2003, would be designated as FD06030301F. The third duplicate sample collected on November 17, 2003, would be designated as FD11170303.

4.8 FIELD QUALITY CONTROL SAMPLES

QC samples will be collected or generated during environmental sampling activities. QC samples will include field duplicates for both soil and groundwater media. Field duplicates are obtained during a single

act of sampling and are used to assess the overall precision of the sampling and analysis program. Field duplicates will be collected at a frequency of 10 percent per sampling matrix. Duplicates shall be analyzed by the laboratory for the same parameters as their environmental sample counterparts. One duplicate sample will be collected per 10 units of a medium sampled. Summary of QA/QC samples requirements are provided in Tables 4-5 through 4-7. The four types of field QC samples are defined as follows:

Field Duplicates. Field duplicates are obtained during a single act of sampling and are used to assess the overall precision of the sampling and analysis program. Field duplicates will be collected at a frequency of 10 percent per sampling matrix. Duplicates shall be analyzed by the laboratory for the same parameters as their environmental sample counterparts.

Equipment Rinsate Blanks. Equipment rinsate blanks are obtained under representative field conditions by running analyte-free water through or over decontaminated sample collection equipment (bailer, DPT cutting shoe, etc.). Equipment blanks will be used to assess the effectiveness of decontamination procedures. Equipment blanks will be collected for each type of non-dedicated sampling equipment used and will be submitted at a frequency of one per day or one per 10 units of a medium sampled which ever is less. One equipment rinsate blank will also be collected from each dedicated sampling device for this SI. Equipment rinsate blanks will be analyzed for the same suite of analytical parameters as the associated environmental samples and will be collected in the appropriate sample containers.

Source Water Blank - Source water blanks are collected to assess the presence of contamination in the water used to decontaminate the sampling equipment. Field personnel prepare source water blanks. One source water blank is to be collected for each type of decontamination water (deionized water, tap water, etc.) used during this sampling event.

Temperature Blank - Temperature blanks are vials of water inserted into each sample cooler prior to shipment from the field. The temperature of the temperature blank is measured prior to shipment and upon receipt at the laboratory to assess whether samples were properly cooled during transit.

4.9 SAMPLE HANDLING AND MANAGEMENT

The following sections outline the procedures that will be used by field personnel to document project activities and sample collection procedures during the Site 34 SI project. Detailed and accurate documentation is necessary in order to ensure data integrity.

4.9.1 Sample Custody

Documentation of field observations will be recorded in a field logbook and/or field log sheets including sample collection logs, boring logs, and monitoring well construction logs. Field logbooks utilized on this project will consist of a bound, water-resistant logbook. All pages of the logbook will be numbered sequentially and observations will be recorded with indelible ink. Field logbooks will be maintained according to SOP S9. Field sample log sheets will be used to document sample collection details, and other observations and activities will be recorded in the field logbook. Instrument calibration logs will be used to record the daily instrument calibration.

For sampling and field activities, the following types of information will be recorded as appropriate:

- Site name and location
- Date and time of logbook entries
- Personnel and their affiliations
- Weather conditions
- Activities involved with the sampling
- Subcontractor activity summary
- Site observations including site entry and exit times
- Site sketches made onsite
- Visitor names, affiliations, arrival and departure times
- Health & Safety issues including PPE

The following sections outline the information that will be documented in the field according to the media to be sampled and the activities to be performed.

Soil sample collection, temporary well installation, and groundwater sample collection will be recorded on TtNUS sampling logs. The field logbooks and sample log sheets will remain on-site for the duration of the investigation. After the investigation, all documents will be archived in the project file.

After the investigation is completed, the field sampling log sheets will be organized by date and media and placed in the project file. The field logbooks for this project will be used only for this site, and will also be categorized and maintained in the project file after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be given titles based on date and activity.

Sample custody procedures are designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. Field chain-of-custody procedures are described in TtNUS SOP S9. Laboratory chain-of-custody procedures are described in the laboratory SOPs.

Integrity of the samples collected during the site investigation will be the responsibility of identified persons from the time the samples are collected until they, or their derived data, are incorporated into the final report. Stringent chain-of-custody procedures will be followed to document sample possession.

4.9.2 Field Custody

The FOL is responsible for the care and custody of the samples collected until they are delivered to the laboratory or are entrusted to a carrier.

Sample logs or other records will be signed and dated by the persons making the entries.

Chain-of-custody forms will be completed to the fullest extent possible before sample shipment. They will include the following information: project name, sample identification, date and time collected, analyses to be conducted, matrix, type of sample, grab or composite designation, preservative, and name of sampler. Sample salinity will be noted on chain-of-custody forms to aid the analytical laboratory in establishing dilution requirements for metals analyses where salinity could present an interference concern. Sample depths will be indicated on the chain-of-custody form also.

These forms will be filled out in a legible manner, using waterproof ink, and will be signed by the sampler. Similar information will be provided on the sample label, which will be securely attached to the sample bottle. The label will also include the general analyses to be conducted. In addition, sampling forms will be used to document collection, filtration, and preparation procedures. Copies of all forms used during field activities are provided in the SOPs.

4.9.3 Transfer of Custody

The following procedures will be used when transferring custody of samples:

Sample coolers will be custody-sealed for security according SOP S9 and accompanied by a chain-of-custody form. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This record documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common carrier). Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the laboratory SOPs.

Prior to shipment to the laboratory for analysis, samples will be properly packaged. Individual custody records will accompany each shipment. Shipping containers will then be sealed for shipment to the laboratory. The methods of shipment, courier name, and other pertinent information will be entered in the "remarks" section of the custody record.

All shipments will be accompanied by the chain-of-custody form identifying the contents. The original record will accompany the shipment and a copy will be retained by the field sampler.

Proper documentation will be maintained (i.e. airbills) for shipments by common carrier.

4.9.4 Sample Shipment Procedures

The following procedures will be followed when shipping samples for laboratory analysis:

Samples requiring cooling to 4°C will be promptly chilled with ice or Blue Ice and will be packaged in an insulated cooler for transport to the laboratory. A temperature blank will be included in each cooler to be used as a temperature indicator. Each temperature blank will be clearly identified by the field sampling team. Ice will be sealed in containers to prevent leakage of water. Samples will not be frozen.

Only shipping containers that meet all applicable state and federal standards for safe shipment will be used.

The field chain-of-custody form will be placed inside the shipping container in a sealed, plastic envelope. Shipping containers will be sealed with nylon strapping tape, and custody seals will be signed, dated, and affixed, in a manner that will allow the receiver to quickly identify any tampering that may have occurred during transport to the laboratory.

Samples to be delivered to the laboratory will be made by a public courier. After samples have been collected, they will be sent to the laboratory within 72 hours. Under no circumstances will sample holding times be exceeded.

4.9.5 Laboratory Sample Custody

To ensure the integrity of a sample from collection through analysis, it is necessary to have an accurate, written record that traces the possession and handling of the sample. This documentation is referred to as the chain-of-custody form.

A sample is under custody if:

The sample is in the physical possession of an authorized person.
The sample is in view of an authorized person after being in his/her possession.
The sample is placed in a secure area by an authorized person after being in his/her possession.
The sample is in a secure area, restricted to authorized personnel only.

When samples are received, the chain-of-custody is signed and dated to acknowledge sample receipt. The sample custodian must examine the shipping containers and verify that the correct number of containers was received. The shipping containers are then opened and the enclosed sample paperwork is removed. Samples are removed from the shipping containers and the bottle condition, temperature blank, and sample salinity must be noted. The information on the chain-of-custody, the airbill, the containers, and the laboratory request is reviewed to note any discrepancies.

The laboratory will be required to fax the chain-of-custody forms and sample log-in information to the TtNUS PM after every shipment.

All samples received by the laboratory must be stored at 4°C until analysis. Laboratory holding times are specified by the contract and presented in Table 4-2.

4.10 EQUIPMENT DECONTAMINATION

TtNUS will obtain precleaned sample containers for laboratory analyses. These containers will meet the requirements of the USEPA Specification and Guidance for Contaminant-Free Sample Containers (OSWER Directive No. 9240.0-05A).

Equipment decontamination will follow the procedures described in the TtNUS decontamination SOP S8. Nondisposable equipment items that come in contact with the media to be sampled and will require decontamination include:

- stainless steel mixing bowls and spoons (in contact with soils)
- DPT tooling (in contact with soils)
- water level indicators (in contact with groundwater)

If the equipment is new, the initial cleaning will consist only of a soapy water wash followed by a tap water and distilled water rinse. Disposable sampling materials (e.g., polyethylene or teflon tubing for pumps) that are individually packaged from the factory will not require decontamination before sampling.

To ensure that sampling equipment has been decontaminated properly, equipment rinsate blanks will be collected and analyzed, as described in Section 4.8.

4.11 IDW MANAGEMENT

Five types of IDW will be generated during this investigation that could be potentially contaminated: soil cuttings, well development and purge water, DPT decontamination wastewater, sampling equipment decontamination wastewaters, and personnel protective equipment and clothing (PPE). Based on the historical site activities and types of contaminants present, none of these IDW materials is expected to present a significant risk to human health or the environment if properly managed.

Although not anticipated during DPT activities, soil cuttings and excess soil core material resulting from the DPT drilling activity will be placed in 55-gallon labeled, sealable steel drums. The soils from each hole will be segregated, so that if the soil analyses show that soils from one or more of the holes are clean, these soil materials can later be retrieved and disposed of as clean soil. The drum(s) of soil IDW will be labeled, sealed, and transported to a central location at the PNS designated by the Navy. Proper disposal of these wastes will be performed by the Navy once the analytical results of the soil samples are received from the laboratory and reviewed.

Well development waters and purge waters will be pumped into 55-gallon sealable drums, which will be properly labeled and transported to a central location to be designated by the Navy. Proper disposal of these wastes will be performed by the Navy once the analytical results of the groundwater samples are received from the laboratory and reviewed.

4.12 FIELD DOCUMENTATION AND DOCUMENTATION RESPONSIBILITIES

It will be the responsibility of the FOL to secure all documents produced in the field (e.g., sampling logs, calibration forms) at the end of each work day. Copies of all forms used during field activities are included in the SOPs. Copies of all field logbooks will be sent to EFANE to the attention of Mr. Fred Evans (Navy RPM). Sample logs and chain-of-custody records will be included as an appendix to the report that will be prepared based on results of this investigation.

At the completion of field activities, the FOL will send Ms. Deborah Cohen (the TtNUS PM) all field records, data, field notebooks, logbooks, chain-of-custody forms, sample log sheets, daily logs, etc. The PM will ensure that these materials are entered into the TtNUS document control system in accordance with appropriate administrative guidelines.

Changes in project operating procedures may be necessary as a result of changed field conditions or unanticipated events. A summary of the sequence of events associated with field changes is as follows:

The FOL will notify the TtNUS PM and Maine CG of the need for the change.

If necessary, the PM will discuss the change with the pertinent individuals (e.g., Maine CG, Navy RPM, TtNUS QA Manager) and will provide a verbal approval or denial to the FOL for the proposed change. The USEPA and MEDEP will be consulted by the Navy of any major scope changes that may occur while fieldwork is ongoing. Communications and correspondences to the RAB will be handled through inclusion on the distribution list or written correspondence and updates at RAB meetings.

The FOL will document the change on a Task Modification Request form and forward the form to the TtNUS PM at the earliest convenient time.

The TtNUS PM will sign the form and distribute copies to the Navy RPM, QA Manager, FOL, and project file.

A copy of the completed Task Modification Request form will be attached to the field copy of the affected document.

The possession of all records will be documented; however, only the project FOL or designee may remove field data from the site for reduction and evaluation.

4.13 SAMPLING SOP MODIFICATIONS

No modification of SOPs is anticipated.

4.14 FIELD ANALYTICAL METHOD REQUIREMENTS

4.14.1 Water Quality Meters

4.14.1.1 Field Analytical Method Requirements – Water Quality Meters

Field measurements of pH, dissolved oxygen, specific conductance, salinity, temperature, turbidity, and ORP will be performed during low-flow purging for well sampling and pH, specific conductance, temperature, turbidity will be performed during development as described in SOP S5. These measurements will be made using a YSI Model 6820 (or equivalent) for all parameters except turbidity. A Lamotte 2020 (or equivalent) will be used for the turbidity measurement. Each of these measurements

will be performed using an electrode or sensor designed specifically for the parameter being measured. The calibration and use of the meter will be performed per SOP S5 and SOP S11.

4.14.1.2 Field Analytical Instrument Calibration – Water Quality Meters

The multiprobe water quality meters will be calibrated per SOP S5 and SOP S11. The meter will be calibrated at the beginning of each field day. The calibration will be checked against standard solutions at the end of each field day or more frequently if fluctuations in readings appear to be abnormal. Records of instrument calibration will be maintained on a field instrument calibration log sheet, provided in SOP S5. The field geologist will maintain instrument manuals on site. If the meter does not maintain an acceptable level of calibration during a single day's use, then the meter will be calibrated more frequently or it will be replaced.

4.14.2 Field Analytical Method/SOP Modifications

No modifications of methods or SOPs are anticipated.

4.15 FIELD EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION REQUIREMENTS

Equipment, instruments, gauges, and other items requiring preventive maintenance will be serviced, when appropriate, by the equipment supplier, the FOL (or designee), and/or drilling subcontractor in accordance with the manufacturer's recommendations. Manufacturer's procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the FOL to adhere to this maintenance schedule and to arrange any necessary and prompt service required. Service of the equipment, instruments, tools, gauges, etc. shall be performed to the extent possible by the FOL (or designee). If the service requires a more qualified person, then the supplier or the manufacturer will be contacted for assistance. Logs shall be established by the FOL (or designee) to record maintenance, service procedures, and schedules. Maintenance records will be documented and traceable to the specific equipment, instruments, and gauges.

It will be the responsibility of the FOL (or designee) to inspect all supplies to be used as part of the field program during mobilization and use. Supplies to be inspected include sampling equipment, field meters, and sample containers.

If the FOL encounters any problem with the supplies, he or she will inform the TtNUS PM and the laboratory supplying the containers. The TtNUS PM, in consultation with the Navy RPM and QA/QC officer, will instruct the FOL on any corrective actions that should be implemented.

4.16 SURVEYING

The vertical elevations and horizontal locations of all temporary monitoring wells, soil sampling locations, and important site features will be surveyed by a Maine-licensed surveyor at the completion of the field investigation. Existing benchmarks established during previous surveying activities will be used. All horizontal locations will surveyed to the nearest 0.1 foot. All elevations will be measured to the nearest 0.01 foot. The surveyor will determine elevations for the ground surface, the top of protective casing (if any), and the top of the riser pipe for each of the five temporary monitoring wells. The FOL will provide the correct sample location name to the surveyor so that database nomenclature is consistent with location names in the QAPP and the database. Upon receiving the survey data from the surveyor, the TtNUS Project Manager will check the survey data for consistency with the location names in the QAPP and the database.

TABLE 4-1

SUMMARY OF STANDARD OPERATING PROCEDURES
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

S1	HS-1.0	UTILITY LOCATING AND EXCAVATION CLEARANCE
S2	SA-2.5	DIRECT PUSH TECHNOLOGY
S3	SA-1.3	SOIL SAMPLING
S4	GH-1.5	BOREHOLE AND SAMPLE LOGGING
S5	SA-1-1	GROUNDWATER SAMPLE ACQUISITION AND ON-SITE WATER-QUALITY TESTING
S6	GH-1.2	EVALUATION OF EXISTING MONITORING WELLS AND WATER-LEVEL MEASUREMENTS
S7	SA-6.1	NON-RADIOLOGICAL SAMPLE HANDLING
S8	SA-7.1	DECONTAMINATION OF FIELD EQUIPMENT AND WASTE HANDLING
S9	SA-6.3	FIELD DOCUMENTATION
S10	USEPA REGION 1 LOW-FLOW PURGING AND SAMPLING METHODS	
S11	USEPA REGION 1 DRAFT CALIBRATION OF FIELD INSTRUMENTS	
S12	SA-1.2	SURFACE WATER AND SEDIMENT SAMPLING

TABLE 4-2

SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 2

Analytical Method	Parameter	Container Material	Container Volume(1)	Preservation(2)	Holding Time(3)
AQUEOUS SAMPLES					
SW-846 8260B	TCL VOCs	Glass vials	3 x 40 mL	HCl to pH< 2 Cool to 4°C	14 days to analysis
SW-846 8270C	TCL SVOCs (including PAHs by SW-846 8270C SIM)	Amber glass	1 L	Cool to 4°C	7 days to extraction, 40 days from extraction to analysis
SW-846 8081A/8082	TCL Pesticides/PCBs	Amber glass	2 L	Cool to 4°C	7 days to extraction, 40 days from extraction to analysis
SW-846 6010B/6020	TAL Metals	HDPE or glass	1 L	HNO_3 to pH< 2	180 days to analysis except mercury which is 28 days to analysis
SW-846 9012A	Cyanide	HDPE	250 mL	NaOH to pH >12	14 days to analysis
SW-846 6010B/6020	Filtered TAL Metals	HDPE or glass	1 L	HNO_3 to pH< 2	180 days to analysis except mercury which is 28 days to analysis
EPA 160.2	TSS	HDPE or glass	250 mL	Cool to 4°C	7 days to analysis
SOIL AND ASH SAMPLES					
SW-846 8260B	TCL VOCs	EnCore Samplers	3 (5 grams each)	Cool to 4° C	48 hours to extraction; 14 days to analysis
SW-846 8270C	TCL SVOCs	Clear wide mouth jar	8 oz.	Cool to 4° C	14 days to extraction, 40 days from extraction to analysis
SW-846 6010B/6020	TAL Metals	Clear wide mouth jar	4 oz.	Cool to 4° C	180 days to analysis except mercury which is 28 days to analysis
SW-846 9012A	Cyanide	Clear wide mouth jar	4 oz.	Cool to 4°C	14 days to analysis
SW-846 8081A/8082	TCL Pesticides/PCBs	Clear wide mouth jar	8 oz.	Cool to 4°C	7 days to extraction, 40 days from extraction to analysis
SW-846 8290	Dioxins	Clear wide mouth jar	4 oz.	Cool to 4°C	30 days to extraction, 45 days from extraction to analysis

TABLE 4-2

SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 2

Analytical Method	Parameter	Container Material	Container Volume(1)	Preservation(2)	Holding Time(3)
ASH SAMPLES ONLY					
SW-846 8270C SIM	TCL PAHs (including alkylated PAHs)	Clear wide mouth jar	4 oz.	Cool to 4°C	14 days to extraction, 40 days from extraction to analysis
ASTM D422	Grain Size	Shelby tube section or Zip lock bag	Not specified	Not specified	Not Specified
ASTM D2937-00	Bulk Density	Burlap or Tyvek bag	5 to 10 lbs	NA	Not Specified
FREE PRODUCT SAMPLE					
ASTM D-240	Heat of Combustion	Clear wide mouth jar	Not specified	Not specified	Not specified
EPA 418.1	Total Recoverable Petroleum Hydrocarbons	Clear wide mouth jar	Not specified	Acidify	28 days
SEDIMENT SAMPLES					
SW-846 8081A	TCL Pesticides	Clear wide mouth jar	8 oz.	Cool to 4°C	7 days to extraction; 40 days to analysis

1 Container volume may vary based on laboratory.
2 HNO_3 - Nitric acid
3 Measured from time of sample collection.

HPDE	High Density Polyethylene Bottle	TAL	Target Analyte List
TBD	To Be Determined	TCL	Target Compound List
TOC	Total Organic Carbon	VOCs	Volatile organic compounds
SVOCs	Semivolatile Organic Carbon	ASTM	American Society of Testing Materials
PCBs	Polychlorinated Biphenyls	HCl	Hydrochloric acid
NaOH	Sodium Hydroxide	TSS	Total Suspended Solids
PAHs	Polycyclic Aromatic Hydrocarbons		

TABLE 4-3

SUMMARY OF SOIL, ASH AND SEDIMENT SAMPLING
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 3

Sample Location	Sample ID	Sample Depth (ft bgs)	TCL VOCs	TCL SVOCs	TAL Inorganics and Cyanide	TCL Pesticides /PCBs	Engineering Parameters[1]
Soil/Ash Samples							
34-01 [3]	34SS010001	0 to 1	X	X	X	X	
	34SB010206	2 to 6	X	X	X	X	
	34SB010610	6 to 10	X	X	X	X	
34-02	34SS020002	0 to 2		X[2]	X[10]		
	34SB020206	2 to 6		X[2]	X[10]		
	34SB020610	6 to 10		X[2]	X[10]		
34-03 [3]	34SS030001	0 to 1	X	X	X	X	
	34SB030206	2 to 6	X	X	X	X	
	34SB030610	6 to 10	X	X	X	X	
34-04 [3]	34SS040001	0 to 1	X	X	X	X	
	34SB040206	2 to 6	X	X	X	X	
	34SB040206	6 to 10	X	X	X	X	
34-05[3,7]	34SS050002	0 to 2	X	X	X	X	
	34SB050204	2 to 4	X	X	X	X	
	34SB050406	4 to 6	X	X	X	X	
	34SB050608	6 to 8	X	X	X	X	
	34SB050810	8 to 10	X	X	X	X	
34-06[4,5,6]	34CP06????	Ash to Natural Soil					X
34-07[4,5,6]	34CP07????	Ash to Natural Soil					X
34-08[4,5,6]	34CP08????	Ash to Natural Soil					X
34-09[4,5,6]	34CP09????	Ash to Natural Soil					X
34-10[4,5,6]	34CP10????	Ash to Natural Soil					X
34-11[4,5,6]	34CP11????	Ash to Natural Soil					X

TABLE 4-3

SUMMARY OF SOIL, ASH AND SEDIMENT SAMPLING
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 3

Sample Location	Sample ID	Sample Depth (ft bgs)	TCL VOCs	TCL SVOCs	TAL Inorganics and Cyanide	TCL Pesticides /PCBs	Engineering Parameters[1]
Soil/Ash Samples							
34-12 [3,7]	34SS120002	0 to 2	X	X	X	X	
	34SB120204	2 to 4	X	X	X	X	
	34SB120406	4 to 6	X	X	X	X	
	34SB120608	6 to 8	X	X	X	X	
	34SB120810	8 to 10	X	X	X	X	
34-13 [3,7]	34SS130002	0 to 2	X	X	X	X	
	34SB130204	2 to 4	X	X	X	X	
	34SB130406	4 to 6	X	X	X	X	
	34SB130608	6 to 8	X	X	X	X	
	34SB130810	8 to 10	X	X	X	X	
34-14	34SS140002	0 to 2		X[2]	X[10]		
	34SB140206	2 to 6		X[2]	X[10]		
	34SB140610	6 to 10		X[2]	X[10]		
34-15 [3]	34SS150001	0 to 1	X	X	X	X	
	34SB150206	2 to 6	X	X	X	X	
	34SB150610	6 to 10	X	X	X	X	
34-16	34SS160001	0 to 1				X[9]	
	34SB160206	2 to 6				X[9]	
	34SB160610	6 to 10				X[9]	
34-17	34SS170002	0 to 2		X[2]	X[10]		
	34SB170206	2 to 6		X[2]	X[10]		
	34SB170610	6 to 10		X[2]	X[10]		
Sediment Samples							
34-18 (SD-01)	34SD010001	0 to 0.3				X[8]	
34-19 (SD-02)	34SD020001	0 to 0.3				X[8]	
34-20 (SD-03)	34SD030001	0 to 0.3				X[8]	

Notes:

1 Engineering parameters: Grain-size and bulk density from three locations for ash. TPH and Heat of Combustion of free product will be analyzed, if present within the ash area.
2 Analysis for PAHs only.

TABLE 4-3

**SUMMARY OF SOIL, ASH AND SEDIMENT SAMPLING
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 3 OF 3**

3 Additional analyses could include dioxins depending on ash characterization. Samples for dioxin analyses will be placed on hold at the laboratory until ash characterization is completed. Cyanide analysis will be included for soil samples, if ash samples are selected for cyanide analysis.
4 Sample depth to be determined in the field, following the requirements for representativeness discussed on Page 4-3.
5 Composite samples from each of three locations (total of 3) will be selected in the field for the engineering parameters except bulk density. For bulk density, three intact samples from these locations will be selected in the field and collected using shelby tubes.
6 One composite ash sample from each of three locations (total of 3) among the six locations will be analyzed for a full suite (consisting of TCL SVOCs including alkylated PAHs, TCL Pesticides/PCBs and TAL inorganics), and dioxins. Samples containing limestone or woodchips with prussian blue coloration will also be analyzed for cyanide. Discrete samples of ash will be scanned for VOCs using a photoionization detector (PID) before making composites and three grab samples (each from a different location) exhibiting the highest presence of VOCs will be selected for TCL VOCs analysis.
7 Sample depths for soil at these locations will begin with 0 feet bgs representing the soil immediately beneath the ash pile.
8 Sediment samples will be analyzed for TCL pesticides only.
9 Samples will be analyzed for TCL pesticides only.
10 Samples will be analyzed for TAL inorganics only.

TABLE 4-4

SUMMARY OF GROUNDWATER SAMPLING
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

Sample Location	Sample ID[1]	Strata Monitored	Analytical Parameters
34-01 (Well number TW01)	34GWTW014031 34GWTW010403F	Shallow Overburden	TCL VOCs, TCL SVOCs, TAL Inorganics, Cyanide[2], Pesticides, PCBs, TSS
34-03 (Well number TW02)	34GWTW020403 34GWTW020403F	Shallow Overburden	TCL VOCs, TCL SVOCs, TAL Inorganics, Cyanide[2], Pesticides, PCBs, TSS
34-04 (Well number TW03)	34GWTW030403 34GWTW030403F	Shallow Overburden	TCL VOCs, TCL SVOCs, TAL Inorganics, Cyanide[2], Pesticides, PCBs, TSS
34-05 (Well number TW04)	34GWTW040403 34GWTW040403F	Shallow Overburden	TCL VOCs, TCL SVOCs, TAL Inorganics, Cyanide[2], Pesticides, PCBs, TSS
34-15 (Well number TW05)	34GWTW050403 34GWTW050403F	Shallow Overburden	TCL VOCs, TCL SVOCs, TAL Inorganics, Cyanide[2], Pesticides, PCBs, TSS

Notes:
1 Groundwater analyses for filtered and unfiltered samples for TAL inorganics only, and all other analyses will be on unfiltered samples.
2 Cyanide analysis will be included if ash samples are selected for cyanide analysis.

TABLE 4-5

SOLID AND AQUEOUS VOLATILES, SEMIVOLATILES AND PESTICIDES/PCB FIELD SAMPLING QC
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Field QC:	Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Blanks/Rinsate Blanks	1 per day	No target analyte ≥ QL	Qualify data. Re-sample	Data validator, field sampler	Accuracy/bias contamination	No target analyte ≥QL
Cooler Temperature Blanks	1 per cooler	4° C, ± 2°C	Re-sample or qualify the data	Data validator, field sampler	Accuracy/bias/ preservation	4° C, ± 2° C
Field Duplicate Pairs (Duplicate Samples)	1 per 10 samples	< 50% RPD-Solid samples < 35% RPD – Aqueous Samples	Qualify data	Data validator	Precision	< 50% RPD-Solid Samples < 35% RPD – Aqueous Samples

Note:
QC - Quality Control
RPD - Relative Percent Difference
TAL - Target Analyte List
QL – Quantitation Limit

Performance Evaluation Samples (PES) are not required for this project because the selected laboratory (Katahdin Analytical) participated in and passed an NFESC audit in 2001, which required evaluation of PES. Results of the evaluation are available from the laboratory.

1 Rinsate blanks will be collected at a rate of one per day, but only 50 percent will be analyzed.

TABLE 4-6

SOLID DIOXIN FIELD SAMPLING QC
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Field QC:	Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Blanks/Rinsate Blanks	1 per day	No target analyte ≥ QL	Qualify data. Re-sample	Data validator, field sampler	Accuracy/bias contamination	No target analyte ≥QL
Cooler Temperature Blanks	1 per cooler	4° C, ± 2°C	Re-sample or qualify the data	Data validator, field sampler	Accuracy/bias/ preservation	4° C, ± 2° C
Field Duplicate Pairs (Duplicate Samples)	1 per 10 samples	< 25% RPD	Qualify data	Data validator	Precision	< 25% RPD

Note:
QC - Quality Control
RPD - Relative Percent Difference
TAL - Target Analyte List
QL – Quantitation Limit

1 Rinsate blanks will be collected at a rate of one per day, but only 50 percent will be analyzed.

TABLE 4-7

SOLID AND AQUEOUS METALS FIELD SAMPLING QC
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Field QC:	Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Blanks/Rinsate Blanks	1 per day	No target analyte ≥ QL	Qualify data. Re-sample	Data validator, field sampler	Accuracy/bias contamination	No target analyte ≥ QL
Cooler Temperature Blanks	1 per cooler	4° C, ± 2°C	Re-sample or qualify the data	Data validator, field sampler	Accuracy/bias/ preservation	4° C, ± 2° C
Field Duplicate Pairs (Duplicate Samples)	1 per 10 samples	< 50% RPD-Solid samples < 30% RPD – Aqueous Samples	Qualify data	Data validator	Precision	< 50% RPD-Solid Samples < 30% RPD – Aqueous Samples

Note:
QC - Quality Control
RPD - Relative Percent Difference
TAL - Target Analyte List
QL – Quantitation Limit

Performance Evaluation Samples (PES) are not required for this project because the selected laboratory (Katahdin Analytical) participated in and passed an NFESC audit in 2001, which required evaluation of PES. Results of the evaluation are available from the laboratory.

1 Rinsate blanks will be collected at a rate of one per day, but only 50 percent will be analyzed.

TABLE 4-8

SUMMARY OF QA/QC SAMPLES AND ANALYSIS
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
PAGE 1 OF 2

Analysis	Method	Environmental Samples	Field Duplicates	Rinsate Blanks	MS/MSD Samples	Source Blanks[1]
GROUNDWATER						
TCL VOC	SW-846 8260B	5	1	TBD[3]	1	1
TCL SVOC (including PAHs by SIM)	SW-846 8270C	5	1	TBD	1	1
TCL Pesticides/PCBs	SW-846 8081A/8082	5	1	TBD	1	1
TAL Metals (filtered)	SW-846 6010B/6020	5	1	TBD	1	1
TAL Metals (unfiltered)	SW-846 6010B/6020	5	1	TBD	1	1
Cyanide[2] (unfiltered)	SW-846 9012A	5	1	TBD	1	1
Field Parameters [5]	TtNUS SOP (S5)	5	1	NA[4]	NA	NA
TSS	EPA 160.2	5	1	NA	1	NA
SOIL						
TCL VOC	SW-846 8260B	27	3	TBD	2	1
TCL SVOC	SW-846 8270C	27	3	TBD	2	1
PAHs	SW-846 8270C	9	1	TBD	1	1
TCL Pesticides/PCBs	SW-846 8081A/8082	30	3	TBD	2	1
TAL Metals	SW-846 6010B/6020	36	4	TBD	2	1
Cyanide[2]	SW-846 9012A	TBD	TBD	TBD	TBD	TBD
Dioxins	SW-846 8290	TBD	TBD	TBD	TBD	1

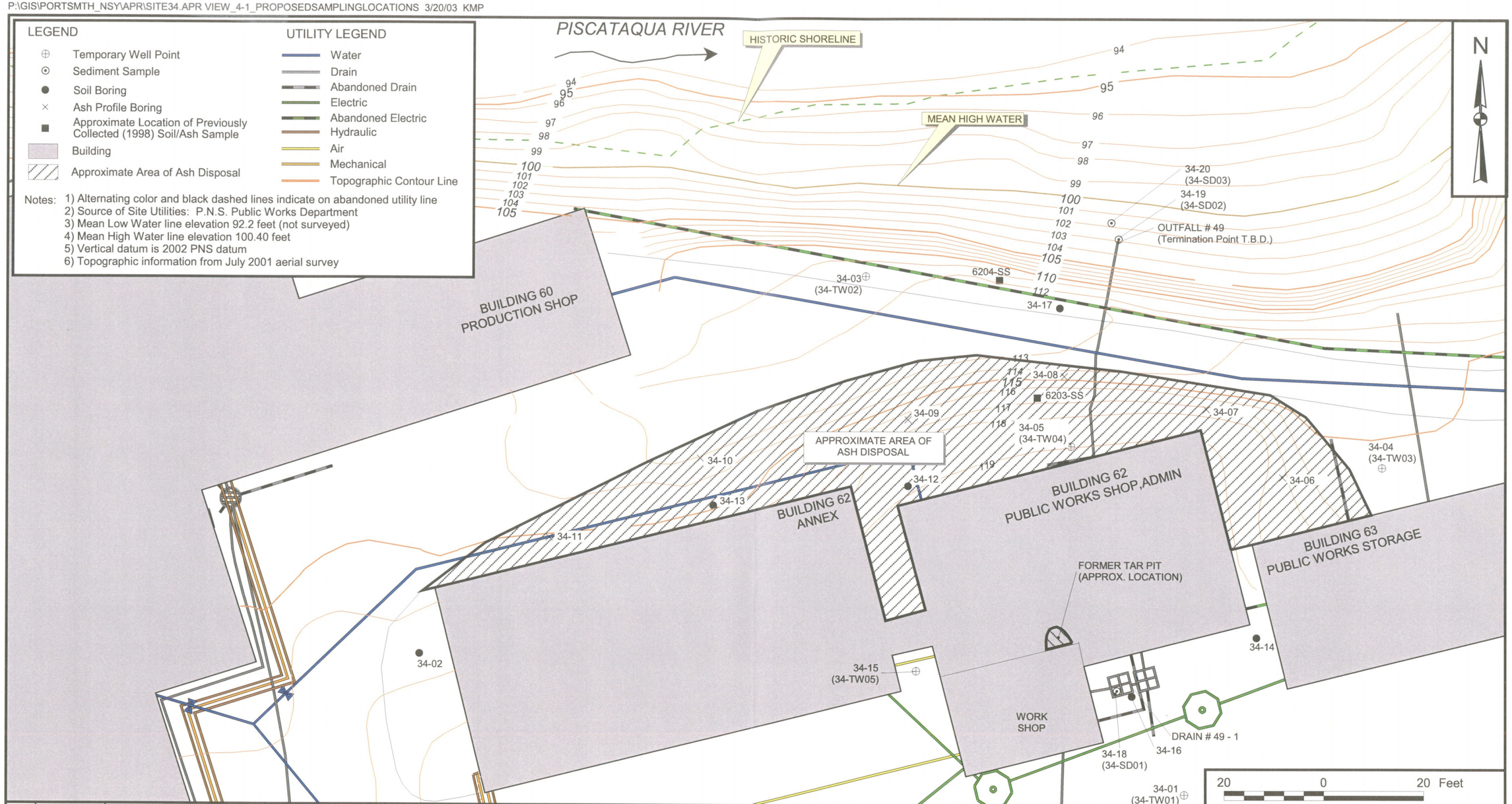
TABLE 4-8

SUMMARY OF QA/QC SAMPLES AND ANALYSIS
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
PAGE 2 OF 2

Analysis	Method	Environmental Samples	Field Duplicates	Rinsate Blanks	MS/MSD Samples	Source Blanks[1]
ASH						
Engineering Parameters[6]	ASTM D2937.00 ASTM D422	3	0	NA	NA	NA
TCL VOC	SW-846 8260B	TBD	TBD	TBD	1	
TCL SVOC	SW-846 8270C	3	1	TBD	1	
PAHs (including alkylated PAHs)	SW-846 8270C SIM	3	1	TBD	1	1
TCL Pesticides/PCBs	SW-846 8081A/8082	3	1	TBD	1	
TAL Metals	SW-846 6010B/6020	3	1	TBD	1	
Cyanide[7]	SW-846 9012A	3	1	TBD	1	
Dioxins	SW-846 8290	3	1	TBD	1	
SEDIMENT						
TCL Pesticides	SW-846 8081A	3	1	TBD	1	NA

1 Source water blanks will be generated at a rate of one per decontamination water source (e.g., deionized and potable water).
2 Cyanide analysis will be included only if ash samples are selected for cyanide analysis.
3 TBD-To Be Determined; rinsate blanks will be generated at a minimum rate of one per day of sampling per matrix. If pre-cleaned, dedicated, or disposable equipment is used, one rinsate blank per type of equipment used will be collected as a "batch blank." Disposable equipment requiring a "batch blank" are expected to be as follows: (1) acetate liner from DPT sampling equipment, (2) sediment sapling spatula or trowel, and (3) groundwater purging/sampling tube and filter. Also, other equipment requiring rinsate blanks are expected to be mixing bowl and spoon.
4 NA-Not Applicable.
5 Field parameters include temperature, pH, specific conductivity, turbidity, salinity, and dissolved oxygen.
6 Engineering parameters consist of bulk density (ASTM D2937) and grain size (ASTM D422) on ash samples. TPH (EPA 418.1) and Heat of Combustion (ASTM D240) will be conducted on free product samples, if present.
7 Cyanide analysis will be conducted only if field observations indicate such a need.

P:\GIS\PORTSMTH_NSY\APR\SITE34.APR VIEW_4-1_PROPOSEDSAMPLINGLOCATIONS 3/20/03 KMP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY K. PEILA	DATE 5/31/02
CHECKED BY J.P. KUMAR	DATE 8/19/02
COST/SCHEDULE-AREA	
SCALE AS NOTED	

Tetra Tech NUS, Inc.

PROPOSED SAMPLE LOCATIONS
SITE 34 - SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

CONTRACT NUMBER 4089	OWNER NUMBER 825
APPROVED BY —	DATE —
APPROVED BY —	DATE —
DRAWING NO. FIGURE 4 - 1	REV 0

5.0 FIXED LABORATORY ANALYTICAL PLAN

This section of the QAPP describes the analytical techniques that will be used by the fixed laboratory to generate definitive data for the project. The section documents the fixed laboratory analytical methods and SOPs that will be used to meet measurement performance criteria and to achieve project-required quantitation limits for the site-related contaminants and other target compounds.

5.1 METHOD DETECTION/QUANTITATION LIMITS

The analytical methods to be used for analysis of the samples were selected based on the existing analytical data. The suite of analyses includes TCL VOCs by SW-846 8260B, TCL SVOCs by SW-846 8270C (including aqueous PAHs by SW-846 8270C SIM and alkylated PAHs by SW-846 8270C SIM for ash samples), TAL metals by SW-846 6010B and 6020, cyanide by SW-846 9012A, pesticides by SW-846 8081A and PCBs by SW-846 8082, dioxins/furans by SW-846 8290 (see Table 4-3 for specific locations and analyses).

The aforementioned parameters will be used to define the nature and extent of contamination and to evaluate the impacts to groundwater and soil. Groundwater samples will be analyzed for TSS. Soils will be analyzed for bulk density and grain size. If an organic free product is noted in the field, then heat of combustion, and TPH analyses will be conducted. Tables 5-1 through 5-11 provide a summary of all target analytes and associated practical quantitation limits (PQLs), instrument detection limits (IDLs), and method detection limits (MDLs). Analytical methods are further discussed in Section 5.2.

5.2 ANALYTICAL METHODS/SOPs AND MODIFICATION

Analytical methods to be used by Katahdin Analytical Services and their associated SOPs for the soil/sediment and groundwater are presented in Table 5-12, as are the analytical SOPs to be used by Geo Testing Express, Inc. for the bulk density and grain size analyses of soil samples and analytical SOPs to be used by Triangle Laboratories, Inc. for the dioxin analyses. Analytical laboratory SOPs have already been provided under a separate cover.

The analysis of TCL VOCs, TAL metals plus cyanide, TCL SVOCs, pesticides/PCBs, dioxins/furans, bulk density, and grain size will be performed without modification to the standard analytical methods.

5.3 CALIBRATION AND PREVENTATIVE MAINTENANCE OF LABORATORY INSTRUMENTS

To ensure that the methods performed by the laboratories meet the project requirements for selective, sensitive, accurate, and precise detection and quantitation of the chemicals at Site 34, the calibration procedures will follow the requirements summarized in Table 5-13.

The procedures will be followed by Katahdin Analytical Services, Geo Testing Express, Inc., and Triangle Laboratories, Inc. to ensure that the laboratory instruments are available and in working order to meet the required turn-around time of these analyses. The procedures are included in SOPs listed in Table 5-12, and the instrument and equipment, maintenance, testing, and inspection requirements are in Table 5-13 of this QAPP.

The laboratories check the instruments used for the analyses, as described in Table 5-13 of this QAPP. The instruments are monitored daily for potential failure. The analysis of internal blanks and control standards at the start and at the end of the day provides real-time information to the analyst on the conditions of the instruments. Equipment maintenance logs are maintained for the ICP and all instruments used.

5.4 INTERNAL QUALITY CONTROL CHECKS

Katahdin Analytical Services, Geo Testing Express, Inc., and Triangle Laboratories, Inc. operate QC programs that assure data users of the reliability and validity of the analyses performed at the laboratory. Each laboratory's QA plan describes the policies, organization, objectives, QC activities, and specific QA functions used by that laboratory. All analytical procedures are documented as SOPs. Each analytical SOP specifies minimum QC requirements for the procedure. As previously noted, SOPs for all analyses to be performed during this investigation will be provided under a separate cover. Table 5-12 lists the SOPs associated with each analytical procedure. In addition, the laboratories maintain SOPs regarding general laboratory QA operations.

Internal laboratory analytical QC requirements beyond those used for instrument calibration QC are highlighted in the remainder of this section. Additional QC requirements, specific to the Naval Facilities Engineering Service Center (NFESC) QA Program, are also specified, as applicable, for each of the QC checks. Target precision and accuracy values (control limits) are presented in Tables 5-14 and 5-15. The applicable analytical SOPs should be consulted for calibration QC measures.

5.4.1 Laboratory Control Samples

Laboratory control samples (LCSs) provide a means to monitor the overall performance of each step during the analysis, including the sample preparation. These are solid samples (soil analyses) or blank spikes (water analyses) that contain concentrations of analytes that are known with a specified degree of certainty.

Based on the requirements of the NFESC QA Program, LCSs for metals analyses must contain all analytes of interest.

Based on NFESC QA Program requirements, if recovery of an LCS falls outside the control limits, the laboratory will reject the data for the analytical batch and take corrective action. The associated samples, extracts, or digestates may be reanalyzed a single time, and, if the LCS recoveries meet acceptance criteria, the data will be reported. If LCS analyte recovery is still outside the acceptance limits, the associated samples in the preparation batch will be reprocessed, if sufficient sample is available and holding times have not lapsed. If re-preparation or reanalysis is not possible, the data will be flagged and the sample delivery group (SDG) narrative will include details of the failed LCS.

5.4.2 Laboratory Duplicates

Laboratory duplicates will be analyzed for metals to measure the cumulative uncertainty (i.e., precision) of the sample handling, subsampling, preparation, laboratory storage, and analysis operations within the laboratory, as well as sample heterogeneity that is not eliminated through simple mixing in the laboratory. Laboratory duplicates are two subsamples obtained by the laboratory analyst after the sample is mixed. If chemical analysis relative percent difference (RPD) values exceed QC limits for laboratory duplicates, the analytical process will be investigated to assess whether the observed RPD is an indication of a deficient analytical system or of excess sample heterogeneity.

5.4.3 Laboratory Method Blanks

Laboratory method blanks or preparation blanks are an analyte-free matrix prepared and analyzed in accordance with the analytical method employed to determine whether contaminants originating from laboratory sources have been introduced and have affected environmental sample analyses. Analyte-free water is used as a blank for water analyses. Native soils devoid of acid leachable metals do not exist. Therefore, a method blank for soil sample analysis consists of an aliquot of analyte-free water that is subjected to the same preparation and analysis procedures as the environmental samples undergoing analysis. The aqueous results are normalized to a fictitious soil sample and presented on a dry-weight basis, assuming 100 percent solids.

Acceptance criteria for laboratory method blanks and corrective actions for non-compliant results are described in the applicable analytical SOPs, which will be provided under a separate cover. Under no circumstances should laboratory method blank contaminant values be subtracted from environmental sample analytical results.

5.4.4 Matrix Spikes

Matrix spikes (MSs) are environmental samples to which known quantities of analytes are added prior to sample preparation (digestion or extraction). These samples provide information about the heterogeneity of the samples as well as the effect of the sample matrix on the sample digestion and measurement methodology.

To conform to NFESC requirements, matrix spikes will contain as many representative analytes as practicable. For many analyses, the spiking list will consist of most or all the target analytes.

If the MS recovery is not within applicable control limits, the laboratory will assess the batch to determine whether the spike results are attributable to a matrix effect or are the result of other problems in the analytical process. Based on NFESC requirements, if all the batch QC elements that are not affected by the sample matrix are in control (e.g., method blank, LCS, calibration checks) and if no evidence shows that spiking was not properly performed, the poor spike recovery may be attributed to matrix effects. In this case, the associated data will be flagged, but repreparation and reanalysis will not be required. If any of the batch QC elements that are not affected by the sample matrix are out of control, or if any evidence shows that spiking may have been improperly performed, the MS sample will be reprocessed through the entire analytical sequence. If insufficient sample is available, or if holding times have passed, the laboratory will flag the associated data. Details of noncompliant and laboratory duplicate results will be included in the SDG narrative.

5.4.5 Post-Digestion Spikes

Post-digestion spikes (PDSs) are similar to MSs except that the sample digestate, rather than the original soil sample, is spiked. These spikes are analyzed only for metal target analytes if the matrix spike recovery falls outside control limits. Comparing percent recoveries for PDSs and MSs helps to identify where in the analytical process accuracy problems are occurring. PDSs will contain all target analytes of interest and will be used to assist in determining whether unacceptable MS recoveries are a result of matrix effects.

5.4.6 Performance Evaluation (PE) Samples

Katahdin Analytical Services is the fixed-based laboratory analyzing the samples. The selected laboratory recently went through the NFESC audit (in 2001) (requiring evaluation of PE samples), which included the analyses being performed in this investigation. The laboratory passed the audit; therefore, further testing of PE samples by the laboratory is not required for the Site 34 QAPP. Results of the PE evaluation are available from the laboratory.

5.5 REQUIREMENTS FOR SUPPLIES/SAMPLE CONTAINERS

All supplies used by the laboratories will be free of contaminants of concern, other target compounds, and interferences. Method blanks will be performed at the rate specified in each method to ensure that reagents and equipment are free of contamination. The corrective actions specified in the laboratory statements of work will be followed if laboratory contamination is detected.

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TABLE 5-1

QUANTITATION LIMITS FOR VOLATILE PARAMETERS FOR SOIL/ASH
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 2

Parameter	PQL[1] (µg/kg)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/Kg)	Foot Note Ref	Basis of Minimum Screening Level Source
1,1,1-Trichloroethane	10.0	6.91	100	Sat	SSL
1,1,2-Trichloro-1,2,2-trifluoroethane	10.0	6.47	5600000	Sat	R9RES
1,1,2,2-Tetrachloroethane	10.0	5.82	0.2	C	SSL
1,1,2-Trichloroethane	10.0	5.53	0.9	C	SSL
1,1-Dichloroethane	10.0	6.2	1000	C	SSL
1,1-Dichloroethene	10.0	7.19	3	C	SSL
1,2,4-Trichlorobenzene	10.0	8.14	300	N	SSL
1,2-Dibromo-3-chloropropane	10.0	6.52	450	C	R9RES
1,2-Dibromoethane	10.0	5.46	6.9	C	R9RES
1,2-Dichloroethane	10.0	6.16	1.0	C	SSL
1,2-Dichlorobenzene	10.0	5.85	900	Sat	SSL
1,2-Dichloropropane	10.0	6.51	1.0	C	SSL
1,3-Dichlorobenzene	10.0	7.01	1300	N	R9RES
1,4-Dichlorobenzene	10.0	5.79	100	C	SSL
2-Butanone	10.0	8.09	730000	N	R9RES
2-Hexanone	10.0	7.41	NC	NA	NA
4-Methyl-2-pentanone	10.0	5.22	79000	N	R9RES
Acetone	10.0	5.0	800	N	SSL
Benzene	10.0	6.06	2	C	SSL
Bromodichloromethane	10.0	5.77	30	C	SSL
Bromoform	10.0	5.4	40	C	SSL
Bromomethane	10.0	6.22	10	N	SSL
Carbon Disulfide	10.0	6.89	2000	N	SSL
Carbon Tetrachloride	10.0	7.17	3	C	SSL
Chlorobenzene	10.0	6.79	70	N	SSL
Chloroethane	10.0	7.19	3000	C	R9RES
Chloroform	10.0	6.5	30	C	SSL
Chloromethane	10.0	6.85	1200	C	R9RES
Cis-1,2-dichloroethene	10.0	7.35	20	N	SSL
Cis-1,3-dichloropropene	10.0	5.69	0.2	C	SSL
Cyclohexane	10.0	8.23	140,000	Sat	R9RES
Dibromochloromethane	10.0	5.38	20	C	SSL

TABLE 5-1

QUANTITATION LIMITS FOR VOLATILE PARAMETERS FOR SOIL/ASH
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 2

Parameter	PQL[1] (µg/kg)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/Kg)	Foot Note Ref	Basis of Minimum Screening Level Source
Dichlorodifluoromethane	10.0	8.36	9400	N	R9RES
Ethylbenzene	10.0	6.9	700	C	SSL
Isopropylbenzene	10.0	7.2	57000	N	NA
Methyl acetate	10.0	5.37	2200000	N	R9RES
Methylcyclohexane	10.0	9.09	260000	N	R9RES
Methylene chloride	10.0	6.06	1.0	C	SSL
Methyl tert-butyl ether	10.0	6.63	17000	C	R9RES
Styrene	10.0	6.35	200	Sat	SSL
Tetrachloroethene	10.0	7.49	3.0	C	SSL
Toluene	10.0	6.71	600	Sat	SSL
Trans-1,2-dichloroethene	10.0	7.28	30	N	SSL
Trans-1,3-dichloropropene	10.0	5.69	0.2	C	SSL
Trichloroethene	10.0	5.94	3.0	C	SSL
Trichlorofluoromethane	10.0	8.08	39000	N	R9RES
Vinyl chloride	10.0	7.25	0.7	C	SSL
Xylenes (total)	10.0	6.5	10000	N	SSL

Notes:
C = Carcinogen.
NA = Not applicable.
NC = No Criteria.
N = Non-carcinogen.
Sat = Soil saturation, Not a risk based number.
Max = Ceiling limit, Not a risk based number.

R9RES = USEPA Region 9 Preliminary Remediation Goals.
SSL = Soil Screening Level.

1 PQL- Practical quantitation limit provided by Katahdin Analytical Services.
2 MDLs provided by Katahdin Analytical Services. MDLs are from SW846 method 8260B. The laboratory will report nondetected values down to an adjusted MDL which will be agreed upon by the laboratory and TtNUS and will be below the PQL.
3 Refer to Table 2-1.

TABLE 5-2

QUANTITATION LIMITS FOR VOLATILE PARAMETERS FOR GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 2

Parameter	PQL[1] (µg/L)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/L)	Foot Note Ref	Basis of Minimum Screening Level Source
1,1,1-Trichloroethane	10.0	1.5	320	N	r9_tap
1,1,2-Trichloro-1,2,2-trifluoroethane	10.0	1.26	5900	N	r9_tap
1,1,2,2-Tetrachloroethane	10.0	0.63	0.055	C	r9_tap
1,1,2-Trichloroethane	10.0	3.58	0.2	C	r9_tap
1,1-Dichloroethane	10.0	1.59	81	N	r9_tap
1,1-Dichloroethene	10.0	2.22	34	N	r9_tap
1,2,4-Trichlorobenzene	10.0	0.71	19	N	r9_tap
1,2-Dibromo-3-chloropropane	10.0	2.97	0.048	C	r9_tap
1,2-Dibromoethane	10.0	0.43	0.00076	C	r9_tap
1,2-Dichloroethane	10.0	0.91	0.12	C	r9_tap
1,2-Dichlorobenzene	10.0	1.08	37	N	r9_tap
1,2-Dichloropropane	10.0	1.48	0.16	C	r9_tap
1,3-Dichlorobenzene	10.0	1.19	0.55	N	r9_tap
1,4-Dichlorobenzene	10.0	0.81	0.5	C	r9_tap
2-Butanone	10.0	4.65	190	N	r9_tap
2-Hexanone	10.0	3.41	NC	NA	NA
4-Methyl-2-pentanone	10.0	1.84	16	NA	r9_tap
Acetone	10.0	1.86	61	N	r9_tap
Benzene	10.0	2.01	0.35	C	r9_tap
Bromodichloromethane	10.0	1.43	0.18	C	r9_tap
Bromoform	10.0	0.77	8.5	C	r9_tap
Bromomethane	10.0	2.13	0.87	N	r9_tap
Carbon Disulfide	10.0	3.05	100	N	r9_tap
Carbon Tetrachloride	10.0	1.99	0.17	C	r9_tap
Chlorobenzene	10.0	1.22	11	N	r9_tap
Chloroethane	10.0	2.67	4.6	C	r9_tap
Chloroform	10.0	1.37	6.2	C	r9_tap
Chloromethane	10.0	3.74	1.5	C	r9_tap
Cis-1,2-dichloroethene	10.0	1.78	6.1	N	r9_tap
Cis-1,3-dichloropropene	10.0	0.82	0.4	C	r9_tap
Cyclohexane	10.0	1.17	3,500	N	r9_tap
Dibromochloromethane	10.0	0.76	0.13	C	r9_tap

TABLE 5-2

QUANTITATION LIMITS FOR VOLATILE PARAMETERS FOR GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 2

Parameter	PQL[1] (µg/L)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/L)	Foot Note Ref	Basis of Minimum Screening Level Source
Dichlorodifluoromethane	10.0	1.21	39	N	r9_tap
Ethylbenzene	10.0	1.88	2.9	C	r9_tap
Isopropylbenzene	10.0	1.71	66	N	r9_tap
Methyl acetate	10.0	4.58	610	N	r9_tap
Methylcyclohexane	10.0	1.49	520	N	r9_tap
Methylene chloride	10.0	0.67	4.3	C	r9_tap
Methyl tert-butyl ether	10.0	0.83	13	C	r9_tap
Styrene	10.0	0.95	160	N	r9_tap
Tetrachloroethene	10.0	1.9	0.66	C	r9_tap
Toluene	10.0	1.77	72	N	r9_tap
Trans-1,2-dichloroethene	10.0	1.74	12	N	r9_tap
Trans-1,3-dichloropropene	10.0	1.02	0.4	C	r9_tap
Trichloroethene	10.0	2.18	0.028	C	r9_tap
Trichlorofluoromethane	10.0	1.08	130	N	r9_tap
Vinyl chloride	10.0	2.24	0.02	C	r9_tap
Xylenes (total)	10.0	1.5	21	N	r9_tap

Notes:
C = Carcinogenic risk.
N = Non-carcinogenic risk.
NA = Not applicable.
NC = No Criteria
R9_tap = USEPA, October, 2002. "Region 9 Tapwater Preliminary Remediation Goals (PRGs)".

1 PQL - Practical quantitation limit provided by Katahdin Analytical Services.
2 MDLs provided by Katahdin Laboratory Services. MDLs are from SW846 method 8260B. The laboratory will report nondetected values down to an adjusted MDL which will be agreed upon by the laboratory and TtNUS and will be below the PQL.
3 Refer to Table 2-2.

TABLE 5-3

QUANTITATION LIMITS FOR SEMIVOLATILE PARAMETERS FOR SOIL/ASH
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 3

Parameter	PQL[1] (µg/kg)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/kg)	Foot Note Ref	Basis of Minimum Screening Level Source
Acenaphthene	330	14.9	29000	N	SSL
Acenaphthylene	330	14.57	29000[4]	N	SSL
Anthracene	330	8.54	590000	N	SSL
Benzo(a)anthracene	330	10.64	80	C	SSL
Benzo(a)pyrene	330	13.73	62	C	R9RES
Benzo(b)fluoranthene	330	13.99	200	C	SSL
Benzo(g,h,i)perylene	330	12.22	NC	N	NA
Benzo(k)fluoranthene	330	23.82	2000	C	R9RES
Bis(2-chloroethoxy)methane	330	17.46	NC	NA	NA
Bis(2-chloroethyl)ether	330	11.81	0.02	C	SSL
Bis(2-ethylhexyl)phthalate	330	25.06	35000	C	R9RES
4-Bromophenyl-phenylether	330	12.18	NC	NA	NA
Butylbenzylphthalate	330	18.05	810000	N	SSL
Carbazole	330	17.7	30	C	SSL
4-Chloro-3-methylphenol	330	32.74	NC	NA	NA
4-Chloroaniline	330	49.35	30	N	SSL
2-Chloronaphthalene	330	19.35	390000	N	R9RES
2-Chlorophenol	330	27.6	200	N	SSL
4-Chlorophenyl-phenylether	330	15.94	NC	NA	NA
Chrysene	330	21.03	8000	C	SSL
Dibenz(a,h)anthracene	330	9.72	62	C	R9RES
Dibenzofuran	330	7.33	29000	N	SSL
3,3'-Dichlorobenzidine	330	29.27	0.3	C	SSL
Diethylphthalate	330	15.63	4900000	N	R9RES
Di-n-butylphthalate	330	95.28	270000	N	SSL
Di-n-octylphthalate	330	14.25	240000	N	R9RES
4,6-Dinitro-2-methylphenol	830	67.8	NC	NA	NA
2,4-Dinitrophenol	830	84.6	10	N	SSL
2,4-Dinitrotoluene	330	9.96	0.04	N	SSL
2,4-Dichlorophenol	330	28.18	50	N	SSL
Dimethylphthalate	330	18.25	100000000	N	R9RES
2,4-Dimethylphenol	330	33.02	400	N	R9RES
2,6-Dinitrotoluene	330	15.45	0.03	N	SSL
Fluoranthene	330	11.28	210000	N	SSL
Fluorene	330	12.88	28000	N	SSL

TABLE 5-3

QUANTITATION LIMITS FOR SEMIVOLATILE PARAMETERS FOR SOIL/ASH
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 3

Parameter	PQL[1] (µg/kg)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/kg)	Foot Note Ref	Basis of Minimum Screening Level Source
Hexachlorobenzene	330	15.3	100	C	SSL
Hexachlorobutadiene	330	18.37	100	C	SSL
Hexachlorocyclopentadiene	330	18.52	20000	N	SSL
Hexachloroethane	330	27.5	20	C	SSL
Indeno(1,2,3-cd)pyrene	330	12.89	620	C	R9RES
Isophorone	330	13.84	30	C	SSL
2-Methylnaphthalene	330	16.38	5600	N	R9RES
2-Methylphenol	330	28.16	800	N	SSL
4-Methylphenol	330	20.76	31000	N	R9RES
Naphthalene	330	10.97	4000	N	SSL
2-Nitroaniline	830	31.1	170	N	R9RES
3-Nitroaniline	830	33.1	170	N	R9RES
4-Nitroaniline	830	54.89	170	N	R9RES
Nitrobenzene	330	9.75	7	N	SSL
2-Nitrophenol	330	29.43	NC	N	NA
4-Nitrophenol	830	131.57	NC	NA	NA
N-nitroso-di-n-propylamine	330	28.84	0.002	C	SSL
N-nitrosodiphenylamine	330	24.66	60	C	SSL
2,2'-Oxybis(1-chloropropane)	330	16.94	2900	C	R9RES
Pentachlorophenol	830	187.7	1	C	SSL
Phenanthrene	330	11.52	210000[5]	N	SSL
Phenol	330	18.28	5000	N	SSL
Pyrene	330	20.24	210000	N	SSL
2,4,5-Trichlorophenol	830	20.81	14000	N	SSL
2,4,6-Trichlorophenol	330	18.93	8	C	SSL
C1-Chrysenes[6]	5	NA	NC	NA	NA
C2-Chrysenes[6]	5	NA	NC	NA	NA
C3-Chrysenes[6]	5	NA	NC	NA	NA
C4-Chrysenes[6]	5	NA	NC	NA	NA
C1-Dibenzothiophenes[6]	5	NA	NC	NA	NA
C2-Dibenzothiophenes[6]	5	NA	NC	NA	NA
C3-Dibenzothiophenes[6]	5	NA	NC	NA	NA
C1-Fluoranthenes/Pyrenes[6]	5	NA	NC	NA	NA
C1-Fluorenes[6]	5	NA	NC	NA	NA
C2-Fluorenes[6]	5	NA	NC	NA	NA

TABLE 5-3

QUANTITATION LIMITS FOR SEMIVOLATILE PARAMETERS FOR SOIL/ASH
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 3 OF 3

Parameter	PQL(1) (µg/kg)	Achievable Laboratory MDLs(2)	Minimum Screening Levels(3) (µg/kg)	Foot Note Ref	Basis of Minimum Screening Level Source
C3-Fluorenes(6)	5	NA	NC	NA	NA
C2-Naphthalenes(6)	5	NA	NC	NA	NA
C3-Naphthalenes(6)	5	NA	NC	NA	NA
C4-Naphthalenes(6)	5	NA	NC	NA	NA
C1-Phenanthrenes/Anthracenes(6)	5	NA	NC	NA	NA
C2-Phenanthrenes/Anthracenes(6)	5	NA	NC	NA	NA
C3-Phenanthrenes/Anthracenes(6)	5	NA	NC	NA	NA
C4-Phenanthrenes/Anthracenes(6)	5	NA	NC	NA	NA

Notes:
C = Carcinogenic risk.
N = Non-carcinogenic risk.
NA = Not applicable.
NC = No criteria.
R9RES = USEPA Region 9 Residential Preliminary Remediation Goal. One-tenth the PRG value is presented for non-carcinogens.
SSL = Soil Screening Level.

1 PQL- Practical quantitation limit provided by Kathdin Analytical Services.
2 MDLs provided by Katahdin Analytical Services. MDLs are from SW846 method 8270. The laboratory will report nondetected values down to an adjusted MDL which will be agreed upon by the laboratory and TtNUS and will be below the PQL.
3 Refer to Table 2-1.
4 Value listed is for the surrogate acenaphthene.
5 Value listed is for the surrogate pyrene.
6 Analysis for ash samples only.

TABLE 5-4

QUANTITATION LIMITS FOR SEMIVOLATILE PARAMETERS FOR GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 3

Parameter	PQL[1] (µg/L)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/L)	Foot Note Ref	Basis of Minimum Screening Level Source
Acenaphthene	10.0	0.54	37	N	r9_tap
Acenaphthene-SIM 8270	0.2	0.05	37.0	N	r9_tap
Acenaphthylene	10.0	0.63	37	N	r9_tap
Acenaphthylene-SIM 8270	0.2	0.05	37.0	N	r9_tap
Anthracene	10.0	0.57	180	N	r9_tap
Anthracene-SIM 8270	0.2	0.06	180	N	r9_tap
Benzo(a)anthracene	10.0	0.77	0.092	C	r9_tap
Benzo(a)anthracene-SIM 8270	0.2	0.12	0.092	C	r9_tap
Benzo(a)pyrene	10.0	1.11	0.0092	C	r9_tap
Benzo(a)pyrene-SIM 8270	0.2	0.09	0.0092	C	r9_tap
Benzo(b)fluoranthene	10.0	0.71	0.092	C	r9_tap
Benzo(b)fluoranthene-SIM 8270	0.2	0.09	0.092	C	r9_tap
Benzo(g,h,i)perylene	10.0	1.1	18	N	r9_tap
Benzo(g,h,i)perylene-SIM 8270	0.2	0.08	18.0	N	r9_tap
Benzo(k)fluoranthene	10.0	1.67	0.92	C	r9_tap
Benzo(k)fluoranthene-SIM 8270	0.2	0.06	0.92	C	r9_tap
Bis(2-chloroethoxy)methane	10.0	0.75	270	NA	r9_tap
Bis(2-chloroethyl)ether	10.0	1.13	0.0098	C	r9_tap
Bis(2-ethylhexyl)phthalate	10.0	0.41	4.8	C	r9_tap
4-Bromophenyl-phenylether	10.0	0.79	NC	NA	NA
Butylbenzylphthalate	10.0	0.81	730	N	r9_tap
Carbazole	10.0	0.77	3.4	C	r9_tap
4-Chloro-3-methylphenol	10.0	3.17	NC	NA	NA
4-Chloroaniline	10.0	0.68	15	N	r9_tap
2-Chloronaphthalene	10.0	1.08	49	N	r9_tap
2-Chlorophenol	10.0	2.24	3	N	r9_tap
4-Chlorophenyl-phenylether	10.0	0.46	NC	NA	NA
Chrysene	10.0	0.55	9.2	C	r9_tap
Dibenz(a,h)anthracene	10.0	0.82	0.0092	C	r9_tap
Dibenz(a,h)anthracene-SIM 8270	0.2	0.06	0.0092	C	r9_tap
Dibenzofuran	10.0	0.64	2.4	N	r9_tap
3,3'-Dichlorobenzidine	10.0	5.34	0.15	C	r9_tap
Diethylphthalate	10.0	0.53	2900	N	r9_tap
Di-n-butylphthalate	10.0	0.99	360	N	r9_tap

TABLE 5-4

QUANTITATION LIMITS FOR SEMIVOLATILE PARAMETERS FOR GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 3

Parameter	PQL[1] (µg/L)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/L)	Foot Note Ref	Basis of Minimum Screening Level Source
Di-n-octylphthalate	10.0	0.4	150	N	r9_tap
4,6-Dinitro-2-methylphenol	25	3.68	22	N	cw_rbc
2,4-Dinitrophenol	25	7.12	7.3	N	r9_tap
2,4-Dinitrotoluene	10.0	0.56	7.3	N	r9_tap
2,4-Dichlorophenol	10.0	1.37	11	N	r9_tap
Dimethylphthalate	10.0	0.58	36000	N	r9_tap
2,4-Dimethylphenol	10.0	1.98	73	N	r9_tap
2,6-Dinitrotoluene	10.0	3.85	3.6	N	r9_tap
Fluoranthene	10.0	0.69	121	N	cw_rbc
Fluoranthene-SIM 8270	0.2	0.09	121	N	cw_rbc
Fluorene	10.0	0.45	24	N	r9_tap
Fluorene-SIM 8270	0.2	0.04	24	N	r9_tap
Hexachlorobenzene	10.0	0.64	0.042	C	r9_tap
Hexachlorobutadiene	10.0	0.84	0.86	C	r9_tap
Hexachlorocyclopentadiene	10.0	0.35	22	N	r9_tap
Hexachloroethane	10.0	1.46	4.8	C	r9_tap
Indeno(1,2,3-cd)pyrene	10.0	0.81	0.092	C	r9_tap
Indeno(1,2,3-cd)pyrene-SIM 8270	0.2	0.10	0.092	C	r9_tap
Isophorone	10.0	0.84	71	C	r9_tap
2-Methylnaphthalene	10.0	0.7	0.62	NA	r9_tap
2-Methylnaphthalene-SIM 8270	0.2	0.07	6.2	N	r9_tap
2-Methylphenol	10.0	3.75	180	N	r9_tap
4-Methylphenol	10.0	3.45	18	N	r9_tap
Naphthalene	10.0	1.1	0.62	N	r9_tap
Naphthalene-SIM 8270	0.2	0.04	0.62	N	r9_tap
2-Nitroaniline	25	0.48	0.1	N	r9_tap
3-Nitroaniline	25	0.95	0.1	N	r9_tap
4-Nitroaniline	25	4.74	0.1	N	r9_tap
Nitrobenzene	10.0	1.32	0.34	N	r9_tap
2-Nitrophenol	10.0	0.79	1910	N	cw_rbc
4-Nitrophenol	25	1.07	1600	N	cw_rbc
N-nitroso-di-n-propylamine	10.0	0.86	0.0096	C	r9_tap
N-nitrosodiphenylamine	10.0	1.74	14	C	r9_tap
2,2'-Oxybis(1-chloropropane)	10.0	1.06	0.27	C	r9_tap

TABLE 5-4

QUANTITATION LIMITS FOR SEMIVOLATILE PARAMETERS FOR GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 3 OF 3

Parameter	PQL[1] (µg/L)	Achievable Laboratory MDLs[2]	Minimum Screening Levels[3] (µg/L)	Foot Note Ref	Basis of Minimum Screening Level Source
Pentachlorophenol	25	7.53	0.56	C	r9_tap
Phenanthrene	10.0	0.54	18	N	r9_tap
Phenanthrene-SIM 8270	0.2	0.05	18	N	r9_tap
Phenol	10.0	1.75	2200	N	r9_tap
Pyrene	10.0	0.74	18	N	r9_tap
Pyrene-SIM 8270	0.2	0.09	18	N	r9_tap
2,4,5-Trichlorophenol	25	0.6	360	N	r9_tap
2,4,6-Trichlorophenol	10.0	1.08	0.36	N	r9_tap

Notes:
C = Carcinogenic risk.
N = Non-carcinogenic risk.
NA = Not applicable.
NC = No criteria.

r9_tap = USEPA Region 9 Tap Water PRGs.
Cw_rbc = Calculated Construction Worker RBC. Value presented in 1/10th the calculated RBC for non-carcinogens.

1 PQL- Practical quantitation limit provided by Katahdin Analytical Services.
2 MDLs provided by Katahdin Laboratory Services. MDLs are from SW846 method 8270 and SIM 8270C. The SIM method will be used for PAHs. The laboratory will report nondetected values down to an adjusted MDL which will be agreed upon by the laboratory and TtNUS and will be below the PQL.
3 Refer to Table 2-2.

TABLE 5-5

QUANTITATION LIMITS FOR PESTICIDE/PCB PARAMETERS FOR SOIL, ASH, AND SEDIMENT
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 2

Parameter	PQL(1) (µg/kg)	Achievable Laboratory MDLs(2)	Minimum Screening Levels(3) (µg/kg)	Foot Note Ref	Basis of Minimum Screening Level Source
Aldrin	1.7	0.406	20	C	SSL
alpha-BHC	1.7	0.497	0.03	C	SSL
alpha-Chlordane	1.7	0.36	500	C	SSL
beta-BHC	1.7	0.549	0.1	C	SSL
4,4'-DDE	3.3	0.302	1700	C	R9RES
4,4'-DDD	3.3	0.603	800	C	SSL
4,4'-DDT	3.3	0.546	1700	C	R9RES
delta-BHC	1.7	0.368	0.03	C	SSL
Dieldrin	3.3	0.385	0.2	C	SSL
Endosulfan I	1.7	0.394	900	N	SSL
Endosulfan II	3.3	0.292	900	N	SSL
Endosulfan sulfate	3.3	0.469	900	N	SSL
Endrin	3.3	0.337	50	N	SSL
Endrin aldehyde	3.3	0.553	50	N	SSL
Endrin ketone	3.3	0.414	50	N	SSL
gamma-BHC (Lindane)	1.7	0.486	0.5	C	SSL
gamma-Chlordane	1.7	0.882	500	C	SSL
Heptachlor	1.7	0.306	110	C	R9RES
Heptachlor epoxide	1.7	0.346	30	C	SSL
Methoxychlor	17	0.724	8000	N	SSL
Toxaphene	170	9.49	440	C	R9RES
Aroclor-1016 (4)	33	4.24	3900	C	R9RES
Aroclor-1221 (4)	67	2.96	220	C	R9RES
Aroclor-1232 (4)	33	4.19	220	C	R9RES
Aroclor-1242 (4)	33	5.34	220	C	R9RES
Aroclor-1248 (4)	33	3.16	220	C	R9RES
Aroclor-1254 (4)	33	3.95	220	C	R9RES
Aroclor-1260 (4)	33	3.69	220	C	R9RES

Notes:
C = Carcinogenic risk.
N = Non-carcinogenic risk.
NA = Not applicable.
R9RES = USEPA Region 9 Residential PRG.
SSL = Soil Screening Level.

TABLE 5-5

QUANTITATION LIMITS FOR PESTICIDE/PCB PARAMETERS FOR SOIL, ASH, AND SEDIMENT
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 2

1 PQL- Practical quantitation limit provided by Katahdin Analytical Services.
2 MDLs provided by Katahdin Analytical Services. MDLs are from SW846 methods 8081A and 8082. The laboratory will report nondetected values down to an adjusted MDL which will be agreed upon by the laboratory and TtNUS and will be below the PQL.
3 See Table 2-1.
4 PCBs will only be analyzed for the soil and ash samples.

TABLE 5-6

QUANTITATION LIMITS FOR PESTICIDE/PCB PARAMETERS FOR GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 2

Parameter	PQL(1) (µg/L)	Achievable Laboratory MDLs(2)	Minimum Screening Levels(3) (µg/L)	Foot Note Ref	Basis of Minimum Screening Level Source
Aldrin	0.05	0.0084	0.004	C	r9_tap
alpha-BHC	0.05	0.0052	0.011	C	r9_tap
alpha-Chlordane	0.05	0.0081	0.004	C	sw_chronic
beta-BHC	0.05	0.0069	0.037	C	r9_tap
4,4'-DDE	0.10	0.0051	0.2	C	r9_tap
4,4'-DDD	0.10	0.0087	0.28	C	r9_tap
4,4'-DDT	0.10	0.0061	0.001	C	sw_chronic
delta-BHC	0.05	0.0034	0.011	C	r9_tap
Dieldrin	0.10	0.0062	0.0019	C	sw_chronic
Endosulfan I	0.05	0.0072	0.0087	N	sw_chronic
Endosulfan II	0.10	0.0054	0.0087	N	sw_chronic
Endosulfan sulfate	0.10	0.0044	0.0087	N	sw_chronic
Endrin	0.10	0.0058	0.0023	N	sw_chronic
Endrin aldehyde	0.10	0.0043	0.0023	N	sw_chronic
Endrin ketone	0.10	0.0044	0.0023	N	sw_chronic
gamma-BHC (Lindane)	0.05	0.0044	0.052	C	r9_tap
gamma-Chlordane	0.05	0.0093	0.19	C	r9_tap
Heptachlor	0.05	0.0058	0.0036	C	sw_chronic
Heptachlor epoxide	0.05	0.0076	0.0036	C	sw_chronic
Methoxychlor	0.50	0.0114	0.03	N	sw_chronic
Toxaphene	5.0	0.21	0.0002	C	sw_chronic
Aroclor-1016	0.2	0.25	0.03	C	swchronic
Aroclor-1221	0.4	0.25	0.03	C	swchronic
Aroclor-1232	0.2	0.36	0.03	C	swchronic
Aroclor-1242	0.2	0.25	0.03	C	swchronic
Aroclor-1248	0.2	0.28	0.03	C	swchronic

TABLE 5-6

QUANTITATION LIMITS FOR PESTICIDE/PCB PARAMETERS FOR GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 2

Parameter	PQL(1) (µg/L)	Achievable Laboratory MDLs(2)	Minimum Screening Levels(3) (µg/L)	Foot Note Ref	Basis of Minimum Screening Level Source
Aroclor-1254	0.2	0.28	0.03	C	swchronic
Aroclor-1260	0.2	0.26	0.03	C	swchronic

Notes:
C = Carcinogenic risk.
N = Non-carcinogenic risk.
NA = Not applicable.
NC = Not criteria.
r9_tap = USEPA Region 9 Tap Water PRG.
Sw_chronic = Surface Water Chronic or CCC values.

1 PQL- Practical quantitation limit provided by Katahdin Analytical Services.
2 MDLs provided by Katahdin Analytical Services. MDLs are from SW846 methods 8081A and 8082. The laboratory will report nondetected values down to an adjusted MDL which will be agreed upon by the laboratory and TtNUS and will be below the PQL.
3 See Table 2-2.

TABLE 5-7

QUANTITATION LIMITS FOR METALS FOR SOIL/ASH
SITE 34 SITE INVESTIGATION QAPP
PORTSMOUTH NAVAL SHIPYARD, KITTERY MAINE

Analytes	Achievable Laboratory IDLs[1] (mg/kg)	Minimum Screening Levels[2] (mg/kg)	Foot Note Ref	Basis of Minimum Screening Level Source
Aluminum	2.519	7600	N	R9RES
Antimony	0.237	0.3	N	SSL
Arsenic	0.188	0.39	C	R9RES
Barium	0.021	82	N	SSL
Beryllium	0.019	3	N	SSL
Cadmium	0.03	0.4	N	SSL
Calcium	0.721	NC	NA	NA
Chromium	0.084	2	C	SSL
Cobalt	0.091	140[3]	N	R9RES
Copper	0.095	290	N	R9RES
Iron	2.085	2300	N	R9RES
Lead	0.189	400	N	R9RES
Magnesium	1.006	NC	NA	NA
Manganese	0.024	180	N	R9RES
Mercury	0.0052	2.3	N	R9RES
Nickel	0.12	7	N	SSL
Potassium	39.124	NC	NA	NA
Selenium	0.313	0.3	N	SSL
Silver	0.14	2	N	SSL
Sodium	1.81	NC	NA	NA
Thallium	0.0019	0.52	N	R9RES
Vanadium	0.11	55	N	R9RES
Zinc	0.039	620	N	SSL

Notes:
C=Carcinogenic risk.
N=Noncarcinogenic risk.
IDL=Instrument detection limit.
ICP=Inductively coupled plasma.
ICP-MS=Inductively Coupled Plasma-Mass Spectroscopy.
NA = Not Applicable.
R9res = Region 9 Residential PRG (USEPA, October 2002). One-tenth the PRG value is presented for non-carcinogens.
SSL = Soil Screening Level.

1. Concentrations will be reported to adjusted IDLs. IDLs in the table are provided by Katahdin Analytical Services. Actual reporting limits will vary depending on dilutions and other factors. The laboratory IDLs are identical to the analytical method IDLs. The laboraotry is required to report to IDLs but the IDLs are expected to be adjusted upwards by as much as a factor of 5 because of interferences.
2. See Table 2-1.
3. Value is for the combined residential pathways with a target hazard quotient of 0.1 (USEPA, Region 9, October 2002).

TABLE 5-8

QUANTITATON LIMITS FOR GROUNDWATER - METALS
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Analytes	Achievable Laboratory IDLs[1] (ug/L)	Minimum Screening Levels [2] (ug/L)	Foot Note Ref	Basis of Minimum Screening Level Source
Aluminum	25.19	3,600	N	r9_tap
Antimony	2.37	1.5	N	r9_tap
Arsenic	1.88	0.045	C	r9_tap
Barium	0.21	260	N	r9_tap
Beryllium	0.19	7.3	N	r9_tap
Cadmium	0.3	1.8	N	r9_tap
Calcium	7.21	NC	NA	NA
Chromium	0.84	11[3]	N	r9_tap
Cobalt	0.91	73	N	r9_tap
Copper	0.95	3.1	N	sw_chronic
Iron	20.85	1,100	N	r9_tap
Lead	1.89	8.1	NA	sw_chronic
Magnesium	10.06	NC	NA	NA
Manganese	0.24	88	N	r9_tap
Mercury	0.031	0.94	N	sw_chronic
Nickel	1.2	8.2	N	sw_chronic
Potassium	391.24	NC	NA	NA
Selenium	3.13	18	N	r9_tap
Silver	1.4	0.79	N	sw_chronic
Sodium	18.1	NC	NA	NA
Thallium	0.019[4]	0.24 [5]	N	r9_tap
Vanadium	1.1	26	N	r9_tap
Zinc	0.39	81	N	sw_chronic

Notes:
IDL=Instrument detection limit.
C-Carcinogenic risk.
N=Non-carcinogenic risk.
NA= Not applicable.
r9_tap = USEPA Region 9 Tap Water PRGs.
sw_chronic = Surface Water Chronic or CCC values.

ICP=Inductively Coupled Plasma
ICP-MS=Inductivey Coupled Plasm-Mass Spectroscopy

1. Concentrations will be reported to adjusted IDLs. IDLs in the table are provided by Katahdin Analytical Services. Actual reporting limits will vary depending on dilutions and other factors. The laboratory IDLs are identical to analytical method IDLs. The laboratory is required to report IDLs but IDLs are expected to be adjusted upward by as much as a factor of 5 because of interferences due to salinity.
2. See Table 2-2.
3. Value for hexavalent chromium presented.
4. The IDL for thallium is for ICP-MS analysis.
5. The value for thallium and compounds is presented.

TABLE 5-9

QUANTITATION LIMITS FOR DIOXIN/FURAN PARAMETERS FOR SOIL/ASH
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 2

Parameter	PQL [1] Soil Samples (ng/kg)	MDLs [2] Soil Samples (ng/kg)	Minimum Screening Levels [3] (ng/kg)	Basis of Minimum Screening Levels
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	1	0.64	3.9	R9RES
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-PeCDD)	5	1.9	3.9	R9RES
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,6,7,8-HxCDD)	5	1.5	39	R9RES
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-HxCDD)	5	1.8	39	R9RES
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-HxCDD)	5	2.2	39	R9RES
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD)	5	1.4	390	R9RES
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (1,2,3,4,6,7,8,9-OCDD)	10	3.3	39000	R9RES
2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF)	1	0.77	39	R9RES
1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-PeCDF)	5	1.8	7.8	R9RES
2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF)	5	1.8	7.8	R9RES
1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-HxCDF)	5	1.7	39	R9RES
1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-HxCDF)	5	4.8	39	R9RES
1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF)	5	1.8	39	R9RES
2,3,4,6,7,8-Hexachlorodibenzofuran (2,3,4,6,7,8-HxCDF)	5	3.2	39	R9RES
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-HpCDF)	5	2.0	390	R9RES
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-HpCDF)	5	2.7	390	R9RES
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (1,2,3,4,6,7,8,9-OCDF)	10	2.5	39000	R9RES
Total Tetrachlorodibenzo-p-dioxin (Total TCDD)	1	0.64	NC	NA
Total Pentachlorodibenzo-p-dioxin (Total PeCDD)	5	1.9	NC	NA
Total Hexachlorodibenzo-p-dioxin (Total HxCDD)	5	1.8	NC	NA
Total Heptachlorodibenzo-p-dioxin (Total HpCDD)	5	1.4	NC	NA
Total Tetrachlorodibenzofuran (Total TCDF)	1	0.77	NC	NA

TABLE 5-9

QUANTITATION LIMITS FOR DIOXIN/FURAN PARAMETERS FOR SOIL/ASH
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 2

Parameter	PQL (1) Soil Samples (ng/kg)	MDLs (2) Soil Samples (ng/kg)	Minimum Screening Levels (3) (ng/kg)	Basis of Minimum Screening Levels
Total Pentachlorodibenzofuran (Total PeCDF)	5	1.8	NC	NA
Total Hexachlorodibenzofuran (Total HxCDF)	5	4.8	NC	NA
Total Heptachlorodibenzofuran (Total HpCDF)	5	2.7	NC	NA

NC = No criteria
NA = Not applicable
R9RES = Region 9 Residential PRG.

1 PQL - Typical Practical Quantitation Limit; the tabulated PQL is taken from the USEPA SW-846 Method 8290.
2 MDLs are provided by Triangle Laboratory.
3 Soil screening levels are the USEPA Region 9 PRG values at an incremental cancer risk of 1X10-6. See Table 2-1.

TABLE 5-10

QUANTITATION LIMITS FOR MISCELLANEOUS PARAMETERS FOR SOIL/ASH SITE 34 SITE INVESTIGATION PORTSMOUTH NAVAL SHIPYARD KITTERY, MAINE

Analytes	Minimum Screening Level (mg/kg)	Achievable Laboratory Method Detection Limits (mg/kg)	Achievable Laboratory Limits QLs (mg/kg)
Grain Size[1]	NA	NA	NA
Bulk Density[2]	NA	NA	NA
Cyanide[3]	1.1	NA	NA

Notes:
1. ASTM. Standard Test Method for Particle Size Analysis of Soils, D422.
2. ASTM, 2000. Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method, D2937-00.
3. See Table 2-1 for basis of minimum screening level.

QL=Quantitation Limit
NA = Not applicable.

TABLE 5-11

QUANTITATION LIMITS FOR MISCELLANEOUS PARAMETERS
FOR GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

Analytes	Minimum Screening Level (mg/L)	Achievable Laboratory Method Detection Limits (mg/L)	Achievable Laboratory Limits QLs (mg/L)
Cyanide	0.001	0.0021	NA
TSS	NA	NA	4.0

Notes:
MDL provided by Katahdin Analytical Services.

QL=Quantitation Limit
NA = Not applicable.
TSS = Total suspended solids

TABLE 5-12

LABORATORY ANALYTICAL METHOD / SOP REFERENCE TABLE
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
PAGE 1 OF 2

Reference Number	Fixed Laboratory Performing Analysis	Title, Revision Date and / or Number	Definitive or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrument	Modified for Project Work (Y or N)
L1	Katahdin Analytical Services	Equipment Maintenance, CA-101	NA	NA	Metals	ICP, CVAA, ICP MS, IC	N
L2	Katahdin Analytical Services	Balance Calibration, CA-102	NA	NA	All	Balance	N
L3	Katahdin Analytical Services	Calibration of Adjustable Pipettors, CA-103	NA	NA	All	Pipettors	N
L4	Katahdin Analytical Services	Use of Laboratory Water System, CA-104	NA	NA	All	NA	N
L5	Katahdin Analytical Services	Reagent and Solvent Handling, CA-105	NA	NA	All	NA	N
L6	Katahdin Analytical Services	Standard Preparation, Documentation and Traceability, CA-106	NA	NA	All	NA	N
L7	Katahdin Analytical Services	Total Mercury Digestion and Analysis of Aqueous Samples by Manual Cold Vapor Atomic Absorption Spectrophotometry, CA-610	Definitive	NA	Mercury	CVAA	N
L8	Katahdin Analytical Services	Digestion and Analysis of Solid Samples for Total Mercury by Manual Cold Vapor Atomic Absorption Spectrophotometry, USEPA Method 7471A, CA-611	Definitive	NA	Mercury	CVAA	N
L9	Katahdin Analytical Services	Trace Metals Analysis by ICP-MS using USEPA Method 6020	Definitive	NA	Thallium	ICP-MS	N
L10	Katahdin Analytical Services	Acid Digestion of Aqueous Samples for ICP Metals Analysis	NA	NA	Metals	NA	N
L11	Katahdin Analytical Services	Acid Digestion of Soil / Sediment Samples for ICP Metals Analysis	NA	NA	Metals	NA	N
L12	Katahdin Analytical Services	Trace Metals Analysis by ICP Spectroscopy using Method 200.7	Definitive	NA	Metals (except mercury and thallium)	ICP	N
L13	Katahdin Analytical Services	Preparation and Maintenance of SOPS, QA-800	NA	NA	All	NA	N
L14	Katahdin Analytical Services	Laboratory QA: Self – Inspection System, QA-803	NA	NA	All	NA	N
L15	Katahdin Analytical Services	Document Control for Standard Operating Procedures, QA-804	NA	NA	All	NA	N
L16	Katahdin Analytical Services	Laboratory Technical Personnel Training, QA-805	NA	NA	All	NA	N
L17	Katahdin Analytical Services	MDL and IDL Studies, QA-806	NA	NA	Metals	ICP, CVAA	N
L18	Katahdin Analytical Services	Method Performance / Precision and Accuracy Requirements, QA-807	NA	NA	All	NA	N
L19	Katahdin Analytical Services	Generation and Implementation of Statistical QC Limits and / or Control Charts, QA-808	NA	NA	All	NA	N
L20	Katahdin Analytical Services	Calibration of Thermometers, QA-809	NA	NA	All	Thermometers	N
L21	Katahdin Analytical Services	Communication of Client / Project Specific Information, QA-810	NA	NA	All	NA	N
L22	Katahdin Analytical Services	Subcontracting Analyses, SD-900	NA	NA	Dioxins/Misc.	NA	N
L23	Katahdin Analytical Services	Sample Container Preparation and Shipment, SD-901	NA	NA	All	NA	N
L24	Katahdin Analytical Services	Sample Receipt and Internal Control, SD-902	NA	NA	All	NA	N
L25	Katahdin Analytical Services	Sample Disposal, SD-903	NA	NA	All	NA	N
L26	Katahdin Analytical Services	Analysis of Semivolatile organic Compounds by Capillary Column GC/MS CA-206	Definitive	NA	Semivolatiles	GC/MS	N
L27	Katahdin Analytical Services	Analysis of Volatile Organic Compounds	Definitive	NA	Volatiles	GC/MS	N

TABLE 5-12

LABORATORY ANALYTICAL METHOD / SOP REFERENCE TABLE
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
PAGE 2 OF 2

Reference Number	Fixed Laboratory Performing Analysis	Title, Revision Date and / or Number	Definitive or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrument	Modified for Project Work (Y or N)
L28	Katahdin Analytical Services	Data Reduction and Validation, SD-904	NA	NA	All	NA	N
L29	Katahdin Analytical Services	Data Report Assembly, SD-905	NA	NA	All	NA	N
L30	Katahdin Analytical Services	Software Quality Assurance, SD-906	NA	NA	All	NA	N
L31	Katahdin Analytical Services	Data Back-up, Archival and Restoration, SD-913	NA	NA	All	NA	N
L32	Katahdin Analytical Services	Analysis of Pesticides and PCBs in Extracts of Soil and Water	Definitive	NA	Pesticides/PCBs	GC/ECD	N
L33	Katahdin Analytical Services	Labware Cleaning, CA-100	NA	NA	All	NA	N
L34	Geo Testing Express	Method: ASTM D422, SOP for Particle Size Analysis of Soils, LM-SL-D422	Definitive	ASTMD422	Grain Size	NA	N
L35	Geo Testing Express	Method: ASTM D2937-00 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method	Definitive	NA	Bulk Density	Drive-cylinder	N
L36	Triangle Laboratories, Inc.	PCDDs and PCDFs by HRGC/HRMS - Method 8290	Definitive	NA	Dioxins/Furans	NA	N
L37	Triangle Laboratories, Inc.	Preventative Maintenance of Laboratory Equipment	Definitive	NA	Dioxins/Furans	NA	N
L38	Katahdin Analytical Services	Preparation and Analysis of Samples for cyanide using MIDI-Distillation followed by flow injection analysis SW 846 9012A, CA-751.	Definitive	NA	Cyanide	Lachat Ion Analyzer	N
L39	Katahdin Analytical Services	Total Suspended Solids, EPA 160.2, CA-720	Definitive	NA	TSS	NA	N
L40	TBD	Polycyclid Aromatic Hydrocarbons by GC/MS Selective Ion Monitoring - EPA Method 8270 SIM	Definitife	NA	PAHs	GC/MS	N

CVAA - Cold vapor atomic absorption.
IC - Ion chromatograph.
ICV - Initial calibration verification.
IDL - Instrument detection limit.
NA - Not applicable.
GC/MS - Gas chromatograph / mass spectrometer.
ASTM - American Society for the Testing of Materials.
PAHs - Polycyclic Aromatic Hydrocarbons

Definitive - An analytical method generating data of known quality.

ICP-MS - Inductively coupled plasma - mass spectrometry.
ICP - Inductively coupled plasma.
MDL - Method detection limit.
SOP - Standard operating procedure.
USEPA - United States Environmental Protection Agency.
GC/ECD - Gas chromatograph / electron capture detector.
PCDD - Polychlorodibenzodioxin.
PCDF - Polychlorodibenzofuran.
HRGC - High resolution gas chromatography.
HRMS - High-resolution mass spectrometry.
TSS - Total suspended solids

TABLE 5-13

FIXED LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 4

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference[1]
ICP	ICP Metals	Clean torch assembly and spray chamber when discolored or when degradation in data quality, clean nebulizer, check argon, replace peristaltic pump tubing.	ICAL – At the beginning of each day or if QC does not meet criteria	NA	Recalibrate	Analyst/ Supervisor	L1, L12
			ICV – Immediately after every ICAL	90 – 110%	Recalibrate or reanalyze affected data	Analyst/ Supervisor	
			CCV – Every 10 samples or every two hours and at end of run	90 – 110%	Recalibrate or reanalyze affected data	Analyst/ Supervisor	
CVAA	Mercury	Replace peristaltic pump tubing, replace mercury lamp as necessary, clean optical cell, clean liquid/gas separator as needed.	ICAL – At the beginning of each day or if QC does not meet criteria	Correlation coefficient greater than or equal to 0.995	Recalibrate	Analyst/ Supervisor	L1, L7, L8
			ICV – Immediately after every ICAL	80-120%	Recalibrate or reanalyze affected data	Analyst/ Supervisor	
			CCV – Every 10 samples or every two hours and at end of run	90 – 110%	Recalibrate or reanalyze affected data	Analyst/ Supervisor	

TABLE 5-13

FIXED LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 4

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference[1]
ICP-MS	Thallium	Clean torch assembly and spray chamber when degradation in data quality, clean nebulizer, check argon, replace peristaltic pump tubing, clean cones, clean extraction lenses as needed.	ICAL – At the beginning of each day or if QC does not meet criteria	Correlation coefficient greater than or equal to 0.995	Recalibrate	Analyst/ Supervisor	L1, L9
			ICV – Immediately after every ICAL	90 – 110%	Recalibrate or reanalyze affected data	Analyst/ Supervisor	
			CCV – Every 10 samples or every two hours and at end of run	90 – 110%	Recalibrate or reanalyze affected data	Analyst/ Supervisor	
			Check instrument tune immediately before ICAL	RSD <5% Mass calibration: ± 0.1 amu Mass Resolution: <0.9 amu at 10% peak height	Recalibrate	Analyst/ Supervisor	
Oven	Bulk Density	Visual Inspection	Not specified (Daily)	Refer to GTX-12 (Temperature checked to be 110° C.)	Repair or Replace Parts as needed	Laboratory Manager	L35
Balance	Bulk Density	Visual Inspection	1/12 months (1/3 months)	Outside Agency/Refer to GTX-1 (Checked for accuracy against dead weight)	Repair or replace parts as needed	Laboratory Manager	L35

TABLE 5-13

FIXED LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 3 OF 4

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference[1]
GC	Pesticide Analysis	Change septa. Replace or cut GC column at minimum.	ICAL – Minimum 5 point of INDAB mix with mid-pt cal of Toxaphene and Chlordane	ICAL – Minimum 5 point calibration coefficient of determination ≥ 0.990	(1) Repeat Initial calibration (2) If single pt cal Toxaphene or Chlordane is identified in analysis of sample, minimum 5 point calibration run of identified compound with reanalysis of sample	Analyst/ Supervisor	L32
			CCV– Daily prior to sample analysis and at intervals of not less than once every 20 samples or every 12 hours, whichever is more frequent.	± 15% D	Reanalyze all samples after the first failing CCV.		
GC/MS	Volatile and Semivolatile Analysis	Cut column, change liner and replace septa if soils run in prior batch or as needed. Manual tune if DFTPP not in criteria.	ICAL – Instrument receipt, instrument change (new column, source cleaning, etc.), when CCV is out of criteria. Minimum 5 point initial calibration for all analytes	Average RRF ≥0.050; %RSD ≤30; Average %RSD < 15% for all compounds.	Repeat calibration if criterion is not met	Analyst/ Supervisor	L26, L27

TABLE 5-13

FIXED LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 4 OF 4

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference[1]
GC/MS (Continued)	Volatile and Semivolatile Analysis (Continued)		CCV – at the beginning of each 12 hour shift immediately after DFTPP tune.	CCVs ≤ 25%D; RRF ≥0.050	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification		
HRGC/ HRMS	Dioxins/ Furans	Refer to TLI SOP 6.0.01 v 4	1/6 months	Refer to SOP L42	Recalibrate or re-analyze affected data	Lab Manager	L36, L37
Lachat Ion Analyzeer	Cyanide	Refer to SOP L38	ICAL - prior to analysis ICV - one per analytical batch CCV - one per 10 samples	ICAL - linear regression correlation coefficient >0.995 ICV - 85-115% R CCV 0 85-115% R	Recalibrate	Analyst/Supervisor	L38

Notes:

CCV	Continuing calibration verification.	INDAB	Individual solution AB.
CVAA	Cold vapor atomic absorption.	DFTPP	Decafluorotriphenylphosphine.
IC	Ion chromatograph.	amu	Atomic mass units.
ICAL	Initial calibration.	ICV	Initial calibration verification.
ICP	Inductively coupled plasma.	%D	Percent Difference.
SOP	Standard operating procedure.	GC	Gas chromatograph.
RRF	Relative response factor.	MS	Mass spectrometer.
RSD	Relative standard deviation.	QC	Quality Control.
HRGC	High resolution gas chromatography.	HRMS	High resolution mass spectroscopy.
GTX-n	Reference to SOP where n is a number identifying the SOP.	%R	Percent Recovery

Refer to Table 5-12 for Method/SOP Reference

TABLE 5-14

LABORATORY ANALYTICAL QC SAMPLE TABLE – VOLATILES, SEMIVOLATILES, AND PESTICIDE / PCBs
SOLID MATRICES AND GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 2

Laboratory QC:	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	No target analyte ≥ QL	Qualify data	Data validator	Accuracy/bias contamination	No target analyte ≥QL
Reagent Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Storage Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Instrument Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Laboratory Duplicate	NA	NA	NA	NA	Precision	NA
Laboratory Matrix Spike	1 per 20 samples	Within laboratory established limits	Qualify data	Data validator	Accuracy/bias	Within laboratory established limits
Matrix Spike Duplicate	1 per 20 samples	Within laboratory established limits	Qualify data	Data validator	Precision	Within laboratory established limits
LCS	1 per 20 samples	Within laboratory established limits	Reanalyze after appropriate corrective action has been taken	Laboratory Analyst	Accuracy/Bias	Within laboratory established limits
Surrogates	8 per each sample (SVOCs), 3 per each sample (VOCs), 2 per each sample (Pests)	Within method established limits	Re-extract and reanalyze, then qualify data	Laboratory Analyst / Data Validator	Accuracy/bias	Within method established limits

TABLE 5-14

LABORATORY ANALYTICAL QC SAMPLE TABLE – VOLATILES, SEMIVOLATILES, AND PESTICIDE / PCBs
SOLID MATRICES AND GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 2

Laboratory QC:	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standards	6 per each sample (SVOCs), 3 per each sample (VOCs)	+/- 50% internal standard area	Re-extract and reanalyze, then qualify data	Laboratory Analyst / Data Validator	Accuracy	+/- 50% internal standard area

1 Refer to Table 5-13 for Method/SOP References

LCS Laboratory control sample.
NA Not applicable.
QC Quality control.
RPD Relative percent difference.
QL Quantitation limit.
SVOC Semivolatile organic compounds.
VOC Volatile organic compounds.
PEST Pesticides.

TABLE 5-15

LABORATORY ANALYTICAL QC SAMPLE TABLE – METALS, SOLID MATRICES AND GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 2

Laboratory QC:	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	No target analyte ≥ QL	Qualify data	Data validator	Accuracy/bias contamination	No target analyte ≥QL
Reagent Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Storage Blank	NA	NA	NA	NA	Accuracy/bias contamination	NA
Instrument Blank	1 every 10 samples and as needed	No target analyte ≥ QL	Qualify data	Data validator	Accuracy/bias contamination	No target analyte ≥ QL
Laboratory Duplicate	1 per 20 samples	<35% RPD Soil <20% RPD Aqueous	Qualify data	Data validator	Precision	<35% RPD, Soil <20% RPD, Aqueous
Laboratory Matrix Spike	1 per 20 samples	+/-25% Recovery	Qualify data	Data validator	Accuracy/bias	+/-25% Recovery
Matrix Spike Duplicate	NA	NA	NA	NA	Precision	NA
LCS	1 per 20 samples	+/-20% Recovery	Reanalyze after appropriate corrective action has been taken	Laboratory Analyst	Bias	+/-20% Recovery
Internal Standards	Each sample	NA	NA	Laboratory Analyst / Data Validator	Instrument Response	NA

TABLE 5-15

LABORATORY ANALYTICAL QC SAMPLE TABLE – METALS, SOLID MATRICES AND GROUNDWATER
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 2

1 Refer to Table 5-10 for Method/SOP References

LCS Laboratory control sample.
NA Not applicable.
QC Quality control.
RPD Relative percent difference.
TAL Target Analyte List.
QL Quantitation limit.

6.0 DATA MANAGEMENT AND QUALITY ASSESSMENT PLAN

6.1 DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

This section describes how all project information will be managed, organized, and maintained for efficient use by project personnel. The information management process is outlined from the point of data generation to ultimate storage.

6.1.1 Project Documentation and Records

A summary of Site 34 site records and documentation to be generated and stored in the TtNUS project files is provided in Table 6-1. Information to be maintained in the laboratory files is outlined in Section 6.1.3 of this QAPP.

6.1.2 Field Analysis Data Package Deliverables

No field screening will be performed. The only field measurements to be collected are monitoring well development, purging, and water-level measurement data, which will be recorded on field log sheets as described in Section 4.0. The only other field measurements to be collected are photoionization detector (PID) readings for health and safety purposes (as required by the HASP for the investigation). These readings will be recorded on field sampling sheets, boring logs, or field logbooks.

6.1.3 Fixed Laboratory Data Package Deliverables

A turn-around time of 28 days will be requested for all the data. CLP like electronic deliverables, formatted according to the requirements stated in the laboratory subcontracts, will be provided by the laboratories.

6.1.4 Data Reporting Formats

Field data will be recorded in the field logbooks and field forms. All logbook and log sheet entries must be made in indelible ink (black pen is preferred). No erasures or liquid paper or white out are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark, initialed, and dated. The field personnel will sign and date the logbook pages and field forms. Examples of the forms to be used in the field are presented in Appendix C of this QAPP.

The equivalent of CLP data reporting forms 1 through 14 required in CLP SOW for inorganic and organic analyses and, to the extent relevant, for miscellaneous parameters will be submitted by the laboratories for the soil and groundwater sample results.

6.1.5 Data Handling and Management

The data-handling procedures to be followed by the laboratories will meet the requirements in the laboratory subcontracts. All analytical and field data will be maintained in the project files. The project files will contain hard copies of the chain-of-custody forms, sample log forms, and sample location maps and documentation of quality assurance of data manipulation.

6.1.6 Data Tracking and Control

A “cradle-to-grave” sample tracking system will be used from the beginning to the end of the investigation. The sample identification system will consist of the format described in detail in Section 4.0. Before field mobilization, the FOL will coordinate with the sample management coordinator (SMC) to initiate the sample tracking process. All sample numbers, requested laboratory analyses, and preservative information will be entered into a sample tracking database before each sampling event. The SMC will use the database to print sample jar labels, if necessary, before field sampling. The FOL and project chemist will review the labels for completeness of information and adherence to work plan requirements, as well as for accuracy. The SMC will also send an advance paper copy of labels and the sample tracking database to the laboratories.

When field sampling is underway, the FOL will forward the chain-of-custody forms to the SMC via facsimile at the end of each day. The project chemist will compare the entries on the chain-of-custody forms with the sample tracking database and enter the sample date and other sample information as appropriate. The project chemist will also confirm that the chain-of-custody forms provide the information required by the work plan. This will allow for early detection of errors made in the field so that adjustments can be made while the crew is mobilized. After successful completion of all requested analyses, the laboratory will submit an electronic deliverable for every SDG. When all electronic deliverables have been received from the laboratory, queries will be run versus the pre-field effort database of sample labels and sample collection information to ensure that the laboratory performed all the requested analyses. The TtNUS PM will be notified of any discrepancies. Ideally, discrepancies can be noted early enough so that all samples can be analyzed within the prescribed holding times.

6.1.6.1 Sample Information

Data from field measurements will be recorded directly in field notebooks or on sample logs. Reduction of field data entails the summarization and presentation of these data in tabular form. The reduction of laboratory data entails the manipulation of raw data instrument output into reportable results. Field data (e.g., dissolved oxygen and salinity measured) will be verified on a daily basis by the FOL. Laboratory data will be verified by the group supervisor and then by the laboratory's QC/Documentation Department.

Before electronic files are received from the laboratory, all sample-specific information will be entered into the data management system. The sample information file will allow the analytical results to be grouped together properly for statistical purposes. The data will be managed in one data structure. For field data, the FOL will coordinate with the geographical information system (GIS) leader to ensure that all survey technical specifications are consistent with the underlying coordinate system in the GIS.

Electronic data arriving from the laboratory will pass through the SMC to the Data Validation Manager (DVM) for database compilation and validation. The DVM will compile all the formatted laboratory electronic deliverables into a working project database. Data that are to be validated will be printed as data packages, which include the samples as part of each SDG and the appropriate analytical fraction. The data packages will be distributed to the appropriate data validators. The data validators will enter all data qualifiers and qualifier codes into the database and print out a hard copy and return it to the DVM. The DVM will check the data qualifiers and qualifier codes in the project database and print the final validated data for incorporation into the data validation letter. When all samples and analyses have been accounted for and validated, the DVM will forward the project database to the management information system (MIS) department, which will incorporate the analytical data into the relational database, which is located on the Local Area Network (LAN) in the TtNUS Pittsburgh office.

6.1.6.2 Project Data Compilation

The analytical laboratory subcontractor(s) will generate a pdf file of the analytical data packages, as well as electronic database deliverables. The electronic database will be checked against hard-copy results from the pdf file provided by the laboratory and updated as required, based on data qualifier flags applied during the data validation process. The data generated under this interim monitoring program will be incorporated into the PNS database and GIS. All data, such as units of measure and chemical nomenclature, will be manipulated to maintain consistency with the project database. The project database is a relational database that ensures data structure integrity and data quality for all PNS data.

6.1.6.3 Geographical Information System (GIS)

Data management systems consist of a relational database and GIS that are being used to manage environmental information pertaining to PNS. The relational database stores chemical, geological, hydrogeological, and other environmental data collected during environmental investigations. The GIS is built from the relational database and contains subsets of the larger data pool. Using the GIS, environmental data can be posted on base mapping to provide a graphical representation of the information.

Upon compilation of sample, chemical, biological, and positional data, the data will be incorporated into the PNS GIS. The GIS system can be used to generate various maps for PNS data including site location maps, sample location maps, and contaminant tag maps, as needed. ARC View is the GIS software that will be used. The sampling locations will be assigned coordinates based on North American Datum (NAD) 83 for Maine State Planar Coordinates. The 2002 PNS Vertical datum will be used for elevation.

6.2 DATA VERIFICATION AND VALIDATION

Data verification is a process of evaluating the completeness, correctness, and contractual compliance of a data set against the method standard, SOP, or contract requirements documented in this QAPP. Data validation is an analyte- and sample-specific process that extends the qualification of data beyond data verification to determine the quality of a specific data set.

The internal data verification requirements for this project include the maintenance and periodic review of field documentation (site logbooks, instrument calibration logs, chain-of-custody forms, field summary reports, and field modification records) and laboratory analytical data packages.

Data validation is a systematic review of the analytical data package with respect to sample receipt and handling, compliance with required analytical methods, data reporting and deliverables, and document control. A qualified chemist will review the analytical data packages using USEPA procedures. One hundred percent of the environmental samples will be validated.

After receipt of analytical results, TtNUS will perform data validation according to the most recent Region I guidelines to ensure that the analytical results meet the data quality objectives for risk assessment. Inorganic results will be validated according to the USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (USEPA, 1988), with consideration given to Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 1994). Organic results will be validated according to the USEPA Region I Laboratory Data Validation Functional

Guidelines for Evaluating Organic Analyses (USEPA, December 1996), with consideration given to Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, October 1999b). All parameters will be reviewed using applicable sections of the aforementioned guidelines and the laboratory SOPs.

After the data are validated, a list of nonconformities will be generated. Nonconformities require data qualifiers, which are used to alert the data user to inaccurate or imprecise data. For situations in which several quality control criteria are out of specification with regard to the limits specified in the Navy Installation Restoration Chemical Data Quality Manual (IRCDQM), (NFESC, 1999), the data validator may make professional judgments and/or comments on the validity of the overall data package. In situations where the validity of an entire data package is in question, it may be necessary for the sample(s) to be reanalyzed. The reviewer will then prepare a technical memorandum presenting changes in the data, if necessary, and the rationale for making such changes.

The net result is a data package that has been carefully reviewed for its adherence to prescribed requirements and is suitable for its intended use. Data validation therefore plays a major role in determining the confidence with which key technical evaluations may be made.

The Tier III data validation reports for all parameters will be generated according to the requirements described in Attachment B of the USEPA – New England Data Validation Functional Guidelines for Evaluating Environmental Analyses (USEPA, December 1996). The final data validation report will include a technical memorandum, qualified analytical results, results reported by the laboratory, Region I worksheets (where appropriate), and documentation to support data qualification. All data will be flagged by an appropriate qualifying symbol.

The data and field records will also be reviewed by project personnel to ensure that the samples represent the intended sampling conditions and populations. Data qualified during validation will be reviewed to assess the impact of the qualifiers on the attainment of project objectives.

6.2.1 Verification

Verification includes field data verification and laboratory data verification.

6.2.1.1 Field Measurement Data Verification

The data verification process for this project includes the maintenance and periodic review of field documentation, including the following:

- Field logbook
- Instrument calibration log
- Chain-of-custody form
- Field summary report
- Field modification record
- Field log sheets

Field audits and laboratory internal data reviews are important elements of the data verification process.

Field data will be generated as a result of real-time measurement for health and safety monitoring and through on-site water-quality testing for monitoring well stabilization indicator parameters including pH, specific conductance, ORP, salinity, turbidity, and dissolved oxygen. Field data will not be generated using a field laboratory.

The field parameters will be recorded in the site logbook and on sample logsheets immediately after the measurements are taken and later encoded in the PNS database for presentation in the report. If an error is made in the logbook, the error will be legibly crossed out (single-line strikeout), initialed, and dated by the field member and corrected in a space adjacent to the original (erroneous) entry. No calculations will be necessary to reduce these data for inclusion in report. Field data will be entered in the electronic database manually, and the entries will be verified by an independent reviewer to make sure that no transcription errors occurred. Field measurements will be recorded and reported in the following units:

- Hydrogen ion concentration - standard pH units
- Temperature - degrees Celsius
- Specific conductance - micromhos/centimeter (cm) or microSiemens/cm
- Turbidity - nephelometric turbidity units (NTU)
- Dissolved oxygen – milligrams per liter (mg/L)
- Salinity – percent (%)
- Oxidation/reduction potential – millivolts (mV)

Standard pH units, as specified above, are the negative logarithm (base 10) of the hydronium ion concentration in moles per liter.

6.2.1.2 Laboratory Data Verification

Data reduction for laboratory analytical data generated via the USEPA SW-846 analytical protocol, quality assurance requirements, and reporting procedures (TCL VOCs, TAL metals plus cyanide, TCL SVOCs, and pesticides/PCBs) will be conducted in accordance with the most current statement of work (SOW) for multi-concentration inorganic and organic analyses, as identified in previous sections of this QAPP.

Laboratory analytical data will be reported using standard concentration units to ensure comparability with regulatory standards and guidelines and previous analytical results. Reporting units for aqueous and solid matrices for the classes of chemicals under consideration are as follows:

Groundwater samples

- TAL metals (total and dissolved) plus cyanide - µg/L
- TCL VOCs - µg/L
- TCL SVOCs (including TCL PAHs) - µg/L
- Pesticides/PCBs - µg/L
- TSS - mg/L

Solid samples

- TAL metals plus cyanide - mg/kg
- TCL VOCs - µg/kg
- TCL SVOCs - µg/kg
- Pesticides - µg/kg
- Dioxins/furans - ng/kg
- Bulk density - pound (lb)/cubic foot
- Grain size - %
- Heat of Combustion - British Thermal Unit (Btu)/lb
- Total Petroleum Hydrocarbons (mg/kg)

Field QC sample results will be included in the database for PNS. Specifically, the analytical results for field duplicates, field and source water blanks, and rinsate blanks will be provided. The results for field QC samples will be considered during the course of data validation (in concert with laboratory method blanks) to eliminate false positive results according to the “5 times” rules specified in the National Functional Guidelines for Inorganic and Organic Data Review. The results for laboratory QC samples such as method blanks will not be presented in the database.

6.2.2 Data Validation

Validation of field measurements and laboratory analytical data is discussed in this section. Validation of field data will be limited to real-time checks in the field as data are generated, whereas laboratory analytical data will be validated in accordance with current USEPA guidance. Validation of field measurements is discussed in Section 6.2.2.1. Validation of laboratory analytical data is discussed in Section 6.2.2.2.

6.2.2.1 Field Measurement Data Validation

Field measurements will not be subjected to a formal data validation process. However, field technicians will ensure that the equipment used for field measurement is performing accurately via calibration, as discussed in Section 4.0 of this QAPP. As described in Section 6.2.1.1, all field data entered into the electronic database will be independently reviewed for transcription errors. The FOL will review the data to provide assurance that the data are generated in the required manner and that the recorded data are indicative of field conditions.

6.2.2.2 Analytical Laboratory Data Validation

One hundred percent of the laboratory data from chemical analyses will be validated. Validation of analytical data will be conducted by the TtNUS chemistry department, located in TtNUS's Pittsburgh, Pennsylvania office. Final review and approval of validation deliverables will be completed by the department's data validation coordinator. All laboratory analytical data will be subjected to validation in accordance with the most recent Region I validation guidelines with consideration given to the National Functional Guidelines for Inorganic and Organic Data Review to the greatest extent practicable. The components of laboratory data validation are provided in Table 6-2.

As part of the validation process, the validator will check that the laboratory has provided all the documentation required to support the reported analytical results. If any documentation is missing from the data package, the data validator will contact the laboratory to request a resubmittal. If the laboratory fails to resubmit the requested information, the data validator will note this on the data validation cover letter. The usability of such data will then be determined by the project manager and the Navy, as discussed in Section 6.3.

Data validation will be completed to ensure that the data are of evidentiary quality. Particular emphasis will be placed on holding time compliance, equipment calibration, spike recoveries, and blank results, although all required elements of the validation process will be considered.

6.2.2.3 Geotechnical Laboratory Verification

At GeoTesting Express, Inc., the test data used to create a report are checked by the laboratory manager or quality manager. Final reports are checked, signed, and dated by the laboratory manager, quality manager, or chief engineer before they are delivered to the client. Laboratory work sheets and test reports have a "comments" section where any out-of-the-ordinary, pertinent information is included concerning the test.

If an error is detected in the test data, the laboratory manager performs a preliminary investigation. If the preliminary investigation finds and resolves the problem, re-testing is performed. If, upon the preliminary investigation, there is no acceptable reason found for the error, the quality manager is consulted and a more in-depth investigation is performed. Findings and resolutions are documented.

Nonconforming reports identified by the client are corrected, checked by the laboratory manager, and shipped to the client. Both the re-submitted report and the nonconforming report are kept in the project file. If re-testing is required to remedy the situation, it is done at no cost to the client. Again, nonconforming data and/or reports require documentation in the form of a corrective action report. Customer complaints require documentation by way of the corrective action report.

When the laboratory data are received at TtNUS, they will be verified for completeness, correctness, and contractual compliance against the method standard, SOP, and contract requirements documented in this QAPP. Completeness will entail a check for results from all requested tests for all samples in each environmental matrix of interest. Correctness and contractual compliance will be verified by comparing the test conditions and parameters against the ASTM standards for each test or laboratory SOP. Any graphical plots of data will be verified against raw data for obvious errors. All calculations will be checked for arithmetic correctness, units, and conversion factors.

6.3 DATA USABILITY AND RECONCILIATION WITH PROJECT QUALITY OBJECTIVES

6.3.1 <u>The PARCC Parameters</u>

The PARCC parameters are precision, accuracy, representativeness, comparability, and completeness. Each of these parameters is described below.

6.3.1.1 Precision

The precision goals described below will be evaluated. Field duplicate sample results, laboratory duplicate results, sampling procedures, sample transport problems (if any), sample matrix problems (if any), and sample heterogeneity will be considered, as appropriate, to evaluate the overall data precision.

For example, field duplicate precision will be compared to laboratory precision. The RPD between a sample or MS (Sample 1) and its duplicate or MSD (Sample 2) is calculated for chemical analyses using to the following formula:

$$\text{RPD} = \frac{|\text{Amount in Sample 1} - \text{Amount in Sample 2}|}{0.5\,(\text{Amount in Sample 1} + \text{Amount in Sample 2})} \text{ X } 100\,\%$$

6.3.1.2 Accuracy

The data validator evaluates the potential for adverse impacts to the accuracy of data by reviewing laboratory blanks, field blanks, laboratory control samples, matrix spikes, and quality control check standards. The data validation process during which these evaluations are made is described in Sections 6.1 and 6.2. Calculation of accuracy is described below.

Control charts are plotted by the laboratory for each target analyte and are kept on matrix- and analyte-specific bases. The percent recovery (%R) for a spiked sample is calculated by using the following formula:

$$\%\text{R} = \frac{\text{Amount in Spiked Sample} - \text{Amount in Sample}}{\text{Known Amount Added}} \text{ X } 100\,\%$$

LCSs and surrogate spikes are also analyzed to assess accuracy. The %R calculation for LCSs and surrogate spikes is as follows:

$$\%\text{R} = \frac{\text{Experimental Concentration}}{\text{Certified or Known Concentration}} \text{ X } 100\,\%$$

During data validation, any data not meeting accuracy specifications are identified to the data user through the use of data qualifiers. The field and laboratory blanks provide indications of the potential for having contaminated samples before or during analysis, respectively. Each type of blank will be evaluated for its impact on the sampling or the analytical processes, as appropriate. Laboratory control standards and check standards indicate whether analyte quantitation is accurate, and whether the analytical system was capable of generating results within the project accuracy specifications. Matrix spike recoveries indicate and will be evaluated to assess the impact of specific sample matrices on the accuracy of project data.

6.3.1.3 Sample Representativeness

Sampling and analysis methods and procedures were selected during project planning to provide data representing environmental media at Site 34 without bias, except when a bias was intended. Whether biases were intended and how bias was used to an advantage are described in Sections 2.0 and 4.0. To evaluate representativeness of the Site 34 data, the actual samples collected will be compared to the samples that were intended to be collected. Furthermore, the data verifications and validations will be reviewed to ensure that data have met project specifications for precision and accuracy. The degree to which project specifications have been met will provide a qualitative assessment of the representativeness of the Site 34 data.

6.3.1.4 Comparability

Compliance with the selected methods of sample collection and analyses will produce data of suitable comparability with past and future investigations, as well as within this investigation. Therefore, compliance with the selected methods will be evaluated by reviewing field notes and data validation reports generated during data verification and validation. Data from each matrix collected at the site will be compared with historical and expected data results, based on the geology and hydrogeology of the site.

6.3.1.5 Completeness

Completeness will be computed in accordance with the following equation:

$$\%\,\text{Completeness} = \frac{(\text{number of valid measurements})}{(\text{number of measurements planned})} \text{ x } 100\%$$

Completeness is a measure of the amount of valid data obtained from the measurement program, compared to the total amount collected. Valid data are defined as data that have not been rejected or considered unusable during validation or data review. Percent completeness is expressed as the ratio of the number of validated data points to the number of planned data points. For relatively clean, homogeneous matrices, 100 percent completeness is expected. However, as matrix complexity and heterogeneity increase, completeness may decrease. Where analysis is precluded or where DQOs are compromised, the ability to achieve project objectives will be evaluated. Whether any particular sample is critical (absolutely necessary for the attainment of project objectives) to the investigation will be evaluated in terms of the sample location, the parameter in question, the intended data use, and the risk associated with the error.

Critical data points may not be identified until all the analytical results are evaluated. If in the evaluation of results it becomes apparent that the data for a specific medium are of insufficient quality (minimum of 95 percent completeness), either with respect to the number of samples or an individual analysis, resampling to replace the deficient data points may be necessary. The Navy and TtNUS will determine whether resampling is necessary.

6.3.1.6 Sensitivity and Quantitation Limits

The quantitation and detection limits that are required to ensure attainment of project action levels specified in Section 5.0 will be evaluated. The sample quantitation limits, the low point instrument calibration standard, matrix interferences, and sample dilutions will be evaluated to assess whether the sensitivity goals were met. Any deviations that are significant will be indicated during the data validation and overall data review processes.

6.3.2 Data Quality Assessment

After data validation and an overall review of data quality indicators, the data will be reconciled with DQOs to determine whether sufficient data of acceptable quality are available for decision making. A series of inspections and statistical analyses will be performed to estimate several of the data set characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as the maximum concentration, minimum concentration, number of samples exhibiting no detectable analyte, the number of samples exhibiting detectable analytes, and the proportion of samples with detectable and undetectable analytes. The data will be presented in a tabular format. These inspections and statistical analyses will be designed to:

- Identify deviations, if any, from the field sampling SOPs.
- Identify deviations, if any, from the laboratory analytical SOPs.
- Identify deviations, if any, from the QAPP.
- Identify deviations, if any, from the data validation process.
- Evaluate effects of the above-listed deviations from planned procedures and processes on the interpretation and utility of the data (statistics, as applicable).
- Identify elevated detection limits and explain their impacts on the attainment of project objectives.

- Identify unusable data (i.e., data qualified as “R”).
- Evaluate project assumptions.
- Characterize data set distributions (e.g., Shapiro-Wilk W test) if enough data are available (statistics).
- Identify unanticipated data set characteristics such as a laboratory variance greater than the sampling variance (i.e., ANOVA, *t*-test) if enough data are available (statistics).
- Identify and evaluate potential data outliers (95 percent confidence goodness-of-fit test on probability plot data). The plotted data will be transformed, if necessary, depending on the observed distribution (statistics).
- Evaluate adherence to investigation objectives and decision rules (statistics, as applicable).
- Ensure completion of corrective actions.
- Identify the existence of remaining data gaps (statistics).

For statistical comparisons and mathematical manipulations, non-detect values will be represented by a concentration equal to one-half the sample-specific reporting limit. Duplicate results (original and duplicate) will not be averaged for the purpose of representing the range of concentrations. However, the average of the original and duplicate will be used to represent the concentration at that sample location.

Statistical tests for outliers will be conducted using standard statistical techniques appropriate for this task. Potential outliers will be removed if a review of field and laboratory documents indicates that the results are true outliers. If no physical cause for a statistical outlier can be identified, the data point will not be removed from the data set. However, if the data point is found to truly represent a physical quantity that is different from the rest of the data set, it will be removed.

The suitability of any given statistical test will be assessed based on the completeness of the data sets and the conditions observed at the site. For example, when a single data value is available for soils or water samples at a given sampling location, statistical tests cannot be conducted for that individual sampling location. However, pooling of data across sampling locations may be possible and, if logical to do so, may be implemented at the discretion of the project manager. Statistical testing will generally be conducted at the 5 percent significance level. Statistical testing at other significance levels may also be

warranted to provide perspective on the results of testing at a 5 percent significance. If other significance levels are used, they will be supported with rationales for their use.

After all data evaluations are completed, any limitations on the use of data will be known and the limitations will be considered during decision making. If necessary, investigation objectives may be revised in anticipation of additional data collection in order to meet project objectives for the site.

TABLE 6-1

PROJECT DOCUMENTATION AND RECORDS
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

Sample Collection Records	Fixed Laboratory Records	Data Assessment Records	Other
Field Logbooks	Sample receipt, custody and tracking records	Audit report and quality notices	All versions of QAPP
Sample Log Sheet-Soil	Standards traceability logs	Data validation report	Health and safety plan
Sample Log Sheet-"Low Flow" Groundwater	Equipment calibration logs		All versions of project reports
Boring Logs	Sample prep logs		
Well Construction Logs	Sample analysis logs		
Well Development Logs	Equipment maintenance and testing logs		
Chain-of-Custody Records	Corrective action forms		
Telephone Logs	Data results forms		
Field Modification Records	Reported results for standards, QC checks, and QC samples		
Field Instrument Calibration Logs	Instrument print-outs for samples and standards		
	Data verification check list		
	Sample disposal records		
	Telephone logs		

TABLE 6-2

DATA VALIDATION SUMMARY TABLE / MODIFICATION
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 1 OF 3

Medium/ Matrix	Analytical Parameter	Concentration Level	Validation Criteria	Validation Criteria Modified	Data Validation Tier Level Used	Modified Tier Level Used	Data Validator (Name, Title, and Organizational Affiliation)	Responsibility for Data Validations (Name, Title, and Organizational Affiliation)
Soil/GW	TAL Metals plus cyanide	Low/Medium	EPA Region I Functional Guidelines for Evaluating Inorganic Analyses, February 1988; as relevant, National Functional Guidelines for Inorganic Review, July 2002, as relevant; the NFESC document entitled Navy Installation Restoration Chemical Data Quality Manual. (September, 1999) as relevant.	N	Tier III	N	TBD[1]	Joe Samchuck, data validation coordinator, TtNUS Voice: (412) 921-8510 Fax: (412) 921-4040
Ash/GW	Bulk Density, Grain Size, TSS	Low/Medium	EPA Region I Functional Guidelines for Evaluating Inorganic Analyses, February 1988 as relevant; National Functional Guidelines for Inorganic Review, July 2002, as relevant; the NFESC document entitled Navy Installation Restoration Chemical Data Quality Manual. (September, 1999) as relevant; and laboratory SOPs.	N	Tier III	N	TBD[1]	Joe Samchuck, data validation coordinator, TtNUS Voice: (412) 921-8510 Fax: (412) 921-4040

TABLE 6-2

DATA VALIDATION SUMMARY TABLE / MODIFICATION
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 2 OF 3

Medium/ Matrix	Analytical Parameter	Concentration Level	Validation Criteria	Validation Criteria Modified	Data Validation Tier Level Used	Modified Tier Level Used	Data Validator (Name, Title, and Organizational Affiliation)	Responsibility for Data Validations (Name, Title, and Organizational Affiliation)
Soil/GW	VOCs, SVOCs, Pesticides/PCBs	Low/Medium	EPA Region I Functional Guidelines for Evaluating Organic Analyses, December 1996, as relevant; National Functional Guidelines for Organic Review, October 1999b, as relevant; the NFESC document entitled Navy Installation Restoration Chemical Data Quality Manual, (September, 1999) as relevant.	N	Tier III	N	TBD[1]	Joe Samchuck, data validation coordinator, TtNUS Voice: (412) 921-8510 Fax: (412) 921-4040
Soil/Ash	Dioxins/Furans	Low/Medium	National Functional Guidelines for Dioxin/Furan Data Validation, January 1996.	N	Tier III	N	TBD[1]	Joe Samchuck, data validation coordinator, TtNUS Voice: (412) 921-8510 Fax: (412) 921-4040

TABLE 6-2

DATA VALIDATION SUMMARY TABLE / MODIFICATION
SITE 34 SITE INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
PAGE 3 OF 3

Medium/ Matrix	Analytical Parameter	Concentration Level	Validation Criteria	Validation Criteria Modified	Data Validation Tier Level Used	Modified Tier Level Used	Data Validator (Name, Title, and Organizational Affiliation)	Responsibility for Data Validations (Name, Title, and Organizational Affiliation)
Sediment	Pesticides/PCBs	Low/Medium	EPA Region I Functional Guidelines for Evaluating Organic Analyses, December 1996, as relevant; National Functional Guidelines for Organic Review, October 1999b, as relevant; the NFESC document entitled Navy Installation Restoration Chemical Data Quality Manual. (September, 1999) as relevant.	N	Tier III	N	TBD[1]	Joe Samchuck, data validation coordinator, TtNUS Voice: (412) 921-8510 Fax: (412) 921-4040

1 Data validator will be determined when the pdf data deliverables arrive from the laboratory.

GW Groundwater.
TAL Target Analyte List.
TBD To be determined.
NFESC Naval Facilities Engineering Service Center.
VOCs Volatile organic compounds.
SVOCs Semivolatile organic compounds.
PCBs Polychlorinated biphenyls.
TSS Total Suspended Solids.

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APPENDIX A

INFORMATION FROM PREVIOUS SITE ACTIVITIES

-Ash-Contaminated Soil Excavation Report (FWENC)

-Letter Report for 1998 Soil/Ash and Offshore Sediment Data (Navy Correspondence)

-Sample Logs from 1998 Sampling for Soil/Ash and Offshore Sediment

U.S. NAVY NORTHERN DIVISION
REMEDIAL ACTION CONTRACT (RAC)
CONTRACT NO. N62472-94-D-0398
DELIVERY ORDER NO. 0037

CONTRACTOR'S FINAL REPORT FOR ASH CONTAMINATED SOIL EXCAVATION AT BUILDING 62

PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

April 1999

Prepared by

Foster Wheeler Environmental Corporation
470 Atlantic Avenue
Boston, Massachusetts 02210

ND99-060
4/20/99

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- 2.2 Project Objectives 1

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5.0 TRANSPORTATION AND DISPOSAL 4

6.0 SITE RESTORATION 4

LIST OF FIGURES

Figure 2-1 Site Location Map 2

Figure 2-2 Site Map 3

ATTACHMENT

Attachment 1 Soil Excavation Site Drawing

1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler) was contracted by the Northern Division, Naval Facilities Engineering Command to provide various remedial actions at the Portsmouth Naval Shipyard (PNSY) in Kittery, Maine. This final report describes the field activities involving excavation of ash contaminated soil at Building 62. This final report has been prepared to satisfy requirements of the Remedial Action Contract (RAC) No. N62472-94-D-0398, Delivery Order No. 0037.

2.0 SITE DESCRIPTION

2.1 Project Location

PNSY is located on Seavey Island in Kittery, Maine along the New Hampshire border. The Piscataqua River surrounds the facility on all sides (Figure 2-1). The site (Bldg. 62) is located in the northwest section of the facility between Gate Nos. 1 and 2 (Figure 2-2).

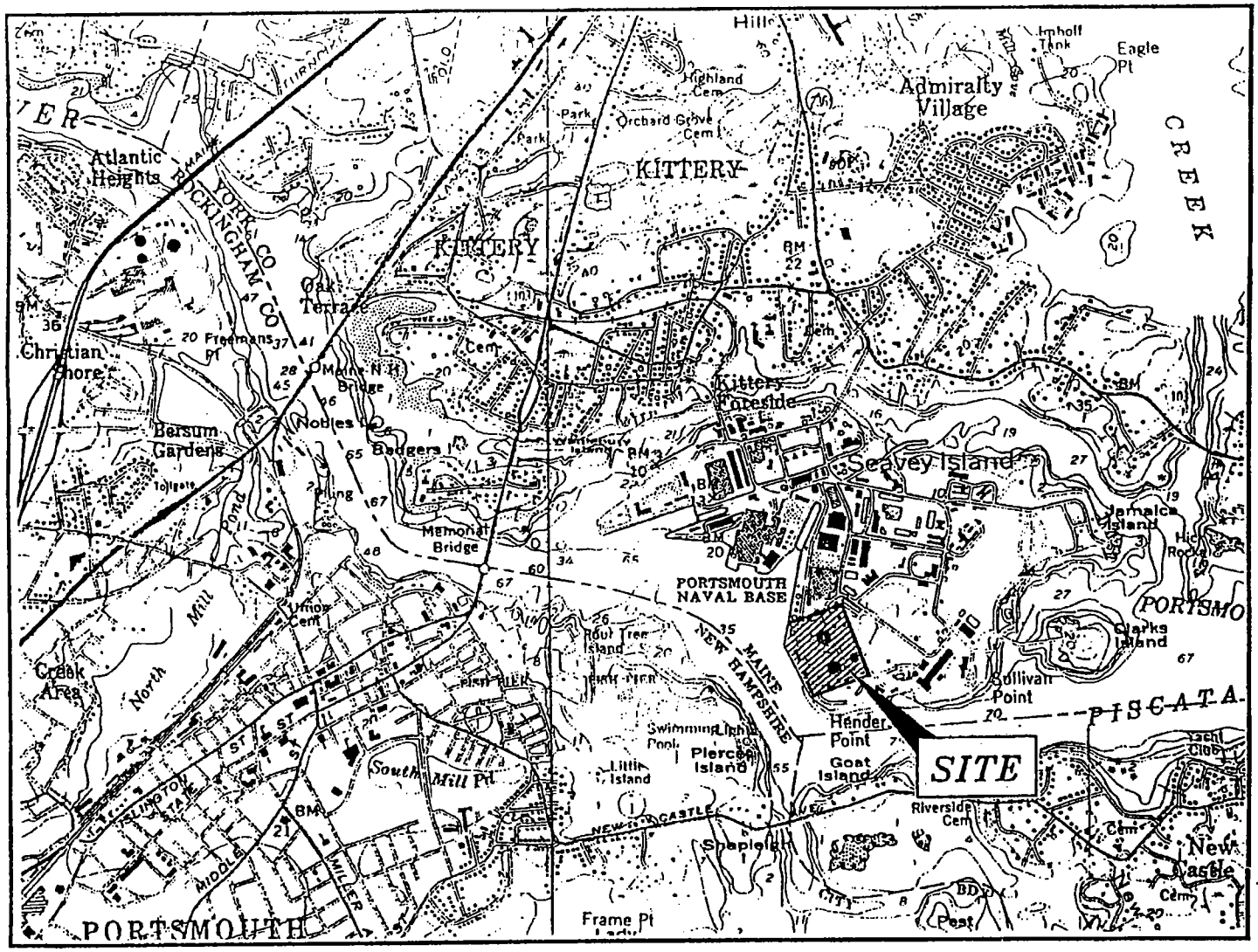
2.2 Project Objectives

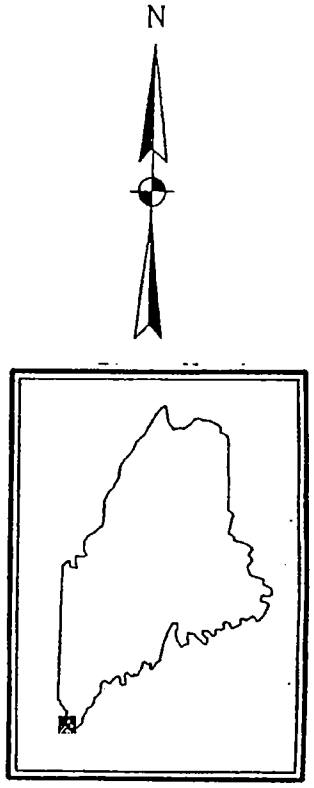
The general objective of the remediation was to remove ash contaminated soil, perform conformation sampling and restore area with topsoil and seed.

3.0 REMEDIAL ACTIONS

Foster Wheeler performed excavation activities on February 3, 1999. Foster Wheeler secured the area with caution tape to eliminate personnel from entering the work area. Pre-excavation activities also included a Health & Safety briefing conducted by Tom Hawthorne. Foster Wheeler utilized a JD710 backhoe to perform the excavation, all material was directly placed in 55-gallon 17H drums for disposal. Foster Wheeler performed air monitoring, along with applying water in the work area to eliminate dust exposure to workers and the public. Foster Wheeler personnel used Level D protection during this entire activity.

The request for proposal (RFP) dated December 21, 1998 stated that Foster Wheeler excavate a small amount of material (two 55 gallon drums) from behind Building 62. Once Foster Wheeler began excavation, it was clear to Kevin White (Site Superintendent) that the Navy request to excavate two 55-gallon drums would not be sufficient, Foster Wheeler continued beyond the two drums and excavated a total of six (6) 55-gallon drums. At this point it was further apparent that this excavation would not terminate at six drums. The excavation still contained visible ash contamination on all four sidewalls and the base of the excavation. The excavation area was 6' wide x 6' long x 2'5" deep (Attachment 1) and was not visually clean. At this time, Foster Wheeler chose to terminate this excavation and await direction from the Navy. Foster Wheeler performed decontamination of the backhoe bucket by removing all visible soil and replaced the hermculite cover over the excavation area.





MAINE
QUADRANGLE LOCATION

SOURCE:

PORTSMOUTH, MAINE – NEW HAMPSHIRE
KITTERY, MAINE – NEW HAMPSHIRE
TOPOGRAPHIC MAP
PHOTOREVISED 1988

NOTE:

PLAN WAS COMPILED FROM FIGURE 1-2A, ENTITLED "SITE LOCATION, HYDROGEOLOGIC INVESTIGATION, PORTSMOUTH NAVAL SHIPYARD", PREPARED BY STERNS & WHEELER, MAY 1995, JOB NO. 2775.

PREPARED BY:

FOSTER WHEELER ENVIRONMENTAL CORPORATION
470 ATLANTIC AVENUE, BOSTON, MA 02210

2000' 1000' 0 2000'

SCALE IN FEET

FIGURE 2-1

HYDROGEOLOGIC INVESTIGATION
PORTSMOUTH NAVAL SHIPYARD

SITE LOCATION MAP

SCALE: AS SHOWN

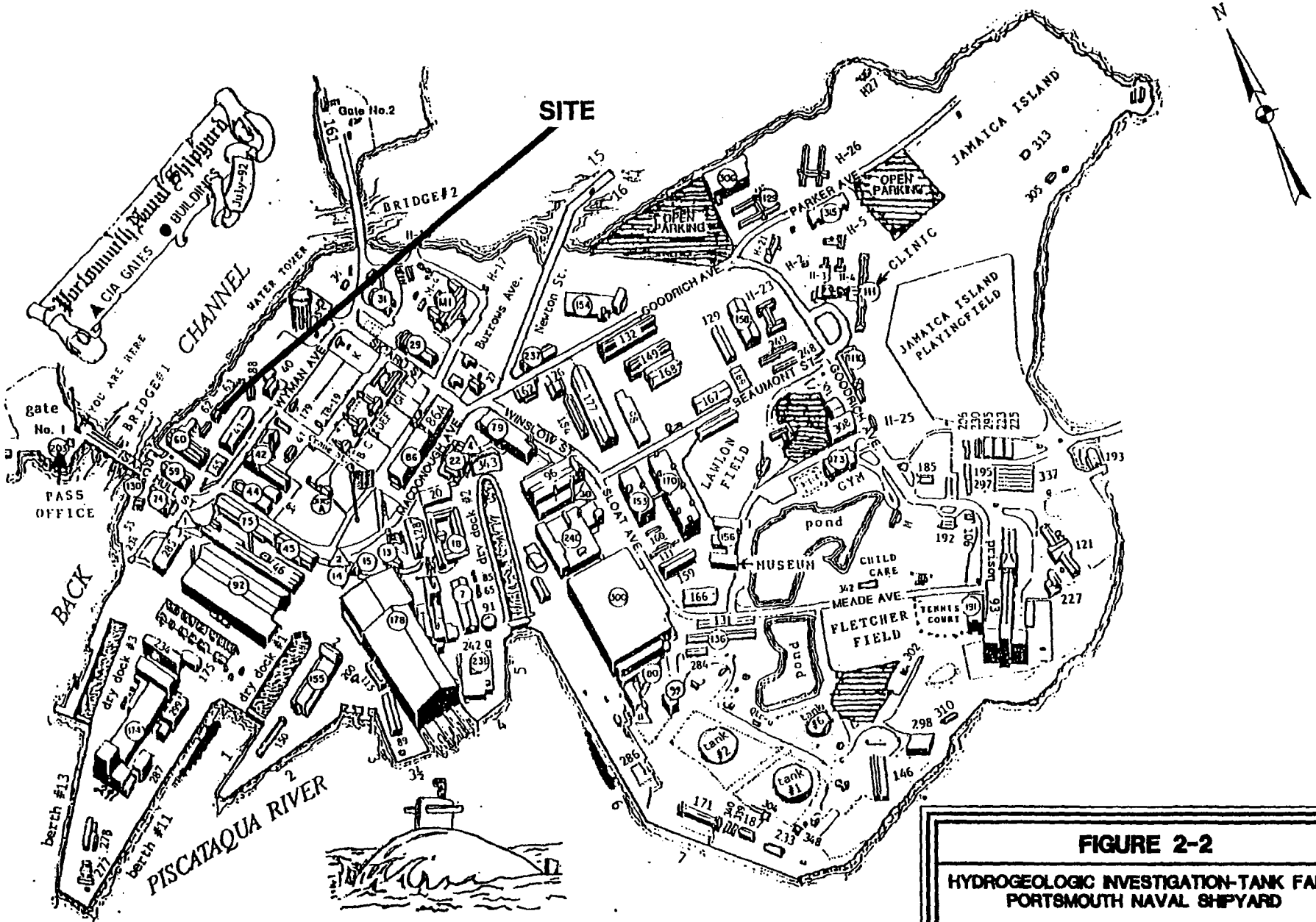


FIGURE 2-2

HYDROGEOLOGIC INVESTIGATION-TANK FARM
PORTSMOUTH NAVAL SHIPYARD

SITE PLAN

NOT TO SCALE

4.0 SAMPLING ACTIVITIES

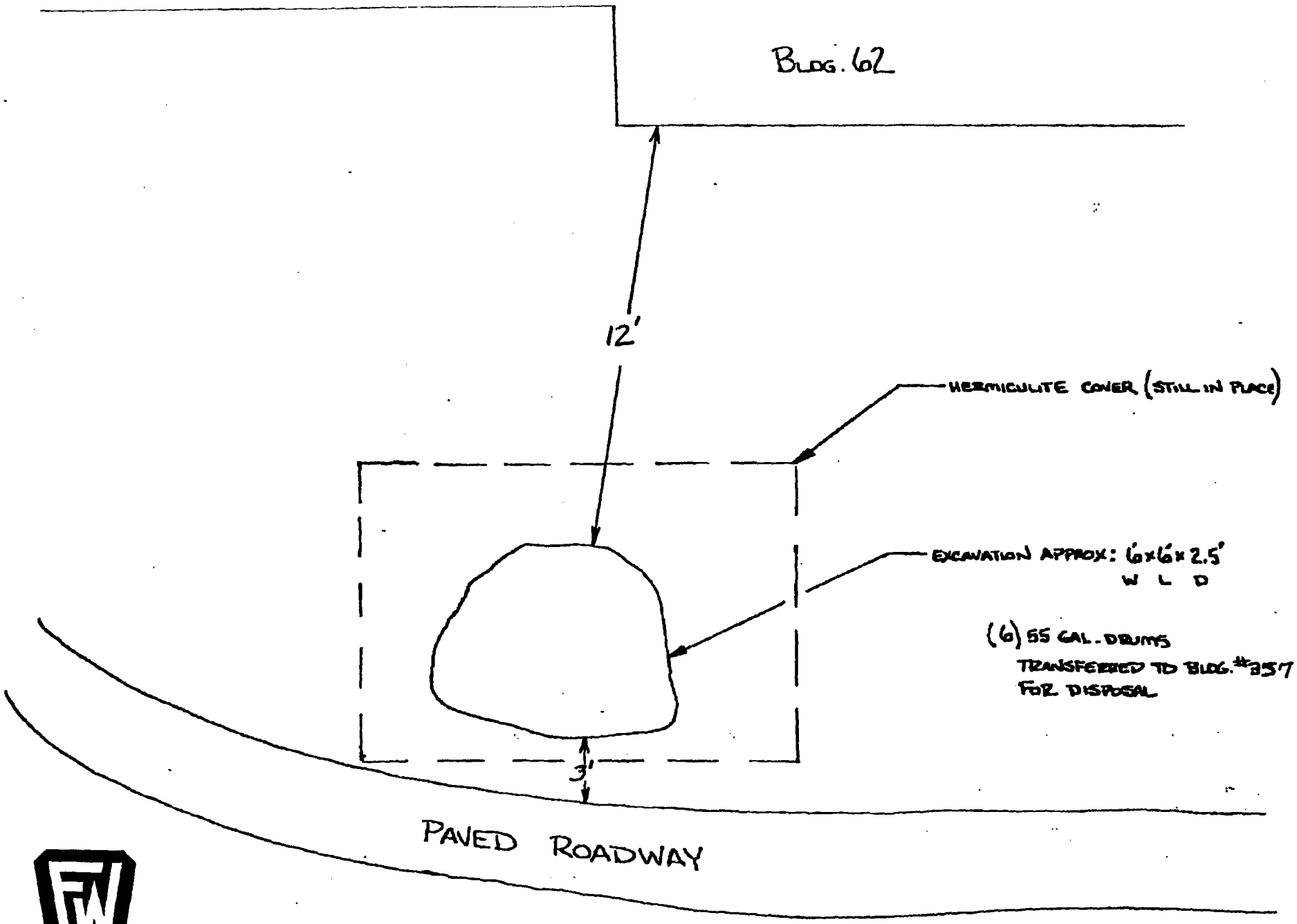
Foster Wheeler did not perform any conformation sampling due to the fact that excavation still contained visibly contaminated soil.

5.0 TRANSPORTATION AND DISPOSAL

Upon completion of excavation activities, Foster Wheeler transported the six (6) drums to the PNSY Hazardous Waste Building (#357) for transportation and disposal. Foster Wheeler was not responsible for any off-site disposal of the material, this task was performed by the Navy.

6.0 SITE RESTORATION

Foster Wheeler did not perform any site restoration activities at this time. If requested by the Navy, Foster Wheeler will continue the excavation and at that time perform site restoration activities as required by the RFP.



BLDG. 62 ASH CONTAMINATED
SOIL EXCAVATION
2/3/99

0801

DEPARTMENT OF THE NAVY
NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
MAIIL STOP, #82
LESTER, PA 19113-2090

IN REPLY REFER TO
5090
Code 1823/FE

06 JAN 1999

Ms. Meghan Cassidy
U.S. Environmental Protection Agency, Region I
JFK Federal Building HBT
Boston, MA 02203-2211

Mr. Iver McLeod
Maine Department of Environmental Protection
State House Station 17
Augusta, ME 04333-0017

Subj: FORMER OIL GASIFICATION PLANT, BUILDING 62, AT PORTSMOUTH NAVAL SHIPYARD, KITTERY, ME

Dear Ms. Cassidy/ Mr. McLeod:

Enclosed are the laboratory results for two surface soil samples and two sediment samples taken near Building 62. One of the two surface soil samples was taken from some ash located immediately behind the building. The ash has been covered with a tarp to prevent further erosion. In the spring, the ash will be removed, classified for disposal, and additional surface soil samples will be taken.

If additional information is required, please contact me at 610-595-0567, x159.

For the Community Restoration Advisory Board (RAB) members; if you have any comments or questions on these issues, they can be provided to the Navy at a RAB meeting, by calling the Public Affairs Office at (207) 438-1140 or by writing to:

Portsmouth Naval Shipyard
Code 106.3R Bldg 44
Attn Marty Raymond
Portsmouth, NH 03804-5000

Subj: Former Oil Gasification Plant, Building 62, at Portsmouth Naval Shipyard, Kittery, ME

Sincerely,

Frederick J. Evans

FREDERICK J. EVANS, P.E.
Remedial Project Manager
By direction of the
Commanding Officer

Copy to:
NOAA (K. Finkelstein)
US Fish & Wildlife Service (K. Munney)
ME Dept. of Marine Resources (D. Card)
NH Fish & Game (J. Nelson)
PNS (Code 106.3R, M. Raymond)
Ms. Juanita Bell
Mr. Jeff Clifford
Ms. Eileen Foley
Mr. Phil McCarthy
Mr. Onil Roy
Ms. Carolyn Lepage
TetraTech NUS (L. Klink, B. Horne)
COMSUBGRU TWO (R. Jones)
Mr. Doug Bogen
Ms. Michele Dionne
Ms. Mary Marshall
Mr. Jack McKenna
Mr. Peter Vandermark
PNS Code 100PAO w/o encl

(2)

CTO232 - PORTSMOUTH
SOIL DATA
KATAHDIN
PNSG10

SAMPLE NUMBER:	BC-6201-SD-0898			BC-6202-SD-0898			BC-6203-SS-0001			BC-6204-SS-0001		
SAMPLE DATE:	08/05/98			08/05/98			08/05/98			08/05/98		
LABORATORY ID:	WO2308-1			WO2308-2			WO2308-3			WO2308-4		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	80.0 %			79.0 %			90.0 %			88.0 %		
UNITS:	ug/Kg			ug/Kg			ug/Kg			ug/Kg		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
1,1,1-TRICHLOROETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
1,1,2,2-TETRACHLOROETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
1,1,2-TRICHLOROETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
1,1-DICHLOROETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
1,1-DICHLOROETHENE	12	U		13	U		11	UJ	RN	11	UJ	RN
1,2-DICHLOROETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
1,2-DICHLOROETHENE (TOTAL)	12	U		13	U		11	UJ	RN	11	UJ	RN
1,2-DICHLOROPROPANE	12	U		13	U		11	UJ	RN	11	UJ	RN
2-BUTANONE	12	U		13	U		11	UJ	RN	11	UJ	RN
2-HEXANONE	12	U		13	U		11	UJ	RN	11	UU	RN
4-METHYL-2-PENTANONE	12	U		13	U		11	UJ	RN	11	UJ	RN
ACETONE	12	U	A	13	U	A	11	U	A	11	U	A
BENZENE	12	U		13	U		11	UJ	RN	11	UJ	RN
BROMODICHLOROMETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
BROMOFORM	12	U		13	U		11	UJ	RN	11	UJ	RN
BROMOMETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
CARBON DISULFIDE	12	U		13	U		11	UJ	RN	11	UJ	RN
CARBON TETRACHLORIDE	12	U		13	U		11	UJ	RN	11	UJ	RN
CHLOROBENZENE	12	U		13	U		11	UJ	RN	11	UJ	RN
CHLOROETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
CHLOROFORM	12	U		13	U		11	UJ	RN	11	UJ	RN
CHLOROMETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
CIS-1,3-DICHLOROPROPENE	12	U		13	U		11	UJ	RN	11	UJ	RN
DIBROMOCHLOROMETHANE	12	U		13	U		11	UJ	RN	11	UJ	RN
ETHYLBENZENE	12	U		13	U		11	UJ	RN	11	UJ	RN
FREON-113	12	U		13	U		11	UJ	RN	11	UJ	RN
METHYLENE CHLORIDE	12	U	A	14	U	A	43	U	A	24	U	A
STYRENE	12	U		13	U		11	UJ	RN	11	UJ	RN
TETRACHLOROETHENE	12	U		13	U		11	UJ	RN	11	UJ	RN
TOLUENE	12	U		3	J		11	UJ	RN	11	UJ	RN
TRANS-1,3-DICHLOROPROPENE	12	U		13	U		11	UJ	RN	11	UJ	RN
TRICHLOROETHENE	12	U		13	U		11	UJ	RN	11	UJ	RN
VINYL CHLORIDE	12	U		13	U		11	UJ	RN	11	UJ	RN
XYLENES, TOTAL	12	U		13	U		11	UJ	RN	11	UJ	RN

CTO232 - PORTSMOUTH
SOIL DATA
KATAHDIN
PNSG10

SAMPLE NUMBER:	BC-6201-SD-0898			BC-6202-SD-0898			BC-6203-SS-0001			BC-6204-SS-0001		
SAMPLE DATE:	/ /			/ /			/ /			/ /		
LABORATORY ID:	WO2308-1			WO2308-2			WO2308-3			WO2308-4		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	80.0 %			79.0 %			90.0 %			88.0 %		
UNITS:	ug/Kg			ug/Kg			ug/Kg			ug/Kg		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
SEMIVOLATILES												
1,2,4-TRICHLOROBENZENE	100	J	P	430	U		360	U		360	U	
1,2-DICHLOROBENZENE	400	U		430	U		360	U		360	U	
1,3-DICHLOROBENZENE	400	U		430	U		360	U		360	U	
1,4-DICHLOROBENZENE	94	J	P	430	U		360	U		360	U	
2,2'-OXYBIS(1-CHLOROPROPANE)	400	U		430	U		360	U		360	U	
2,4,5-TRICHLOROPHENOL	1000	U		1100	U		910	UJ	C	910	U	
2,4,6-TRICHLOROPHENOL	400	U		430	U		360	U		360	U	
2,4-DICHLOROPHENOL	400	U		430	U		360	U		360	U	
2,4-DIMETHYLPHENOL	400	U		430	U		1100			360	U	
2,4-DINITROPHENOL	1000	UJ	C	1100	UJ	C	910	U		910	UJ	C
2,4-DINITROTOLUENE	400	U		430	U		360	U		360	U	
2,6-DINITROTOLUENE	400	U		430	U		360	U		360	U	
2-CHLORONAPHTHALENE	400	U		430	U		360	U		360	U	
2-CHLOROPHENOL	400	U		430	U		360	U		360	U	
2-METHYLNAPHTHALENE	260	J	P	360	J	P	11000			1300		
2-METHYLPHENOL	400	U		430	U		480			20	J	P
2-NITROANILINE	1000	U		1100	U		910	U		910	U	
2-NITROPHENOL	400	U		430	U		360	U		360	U	
3,3'-DICHLOROBENZIDINE	400	UJ	C	430	UJ	C	360	UJ	C	1700	J	C
3-NITROANILINE	1000	UJ	C	1100	UJ	C	910	UJ	C	910	UJ	C
4,6-DINITRO-2-METHYLPHENOL	1000	U		1100	U		910	U		910	U	
4-BROMOPHENYL PHENYL ETHER	400	U		430	U		360	U		360	U	
4-CHLORO-3-METHYLPHENOL	400	UJ	C	430	UJ	E	360	UJ	E	360	UJ	E
4-CHLOROANILINE	400	U		430	U		360	U		360	U	
4-CHLOROPHENYL PHENYL ETHER	400	U		430	U		360	U		360	U	
4-METHYLPHENOL	400	U		430	U		1400			54	J	P
4-NITROANILINE	1000	UJ	C	1100	UJ	C	910	UJ	C	910	UJ	C
4-NITROPHENOL	1000	UJ	C	1100	UJ	C	910	UJ	C	910	UJ	C
ACENAPHTHENE	300	J	P	170	J	P	28000			1100		
ACENAPHTHYLENE	940			2900			4000			1400		
ANTHRACENE	1700			1600			360	U		2200		
BENZO(A)ANTHRACENE	4200			9200			85000	J	N	9500		
BENZO(A)PYRENE	2100			6600			51000	J	N	5300		
BENZO(B)FLUORANTHENE	2300			7100			46000	J	N	9000		

CTO232 - PORTSMOUTH
SOIL DATA
KATAHDIN
PNSG10

Diag 66 of 5

SAMPLE NUMBER:	BC-6201-SD-0898			BC-6202-SD-0898			BC-6203-SS-0001			BC-6204-SS-0001		
SAMPLE DATE:	/ /			/ /			/ /			/ /		
LABORATORY ID:	WO2308-1			WO2308-2			WO2308-3			WO2308-4		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	80.0 %			79.0 %			90.0 %			88.0 %		
UNITS:	ug/Kg			ug/Kg			ug/Kg			ug/Kg		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
SEMIVOLATILES												
BENZO(G,H,I)PERYLENE	400	U		430	U		3500	J	N	360	U	
BENZO(K)FLUORANTHENE	2700			6500			60000	J	N	5300		
BIS(2-CHLOROETHOXY)METHANE	400	U		430	U		360	U		360	U	
BIS(2-CHLOROETHYL)ETHER	400	U		430	U		360	U		360	U	
BIS(2-ETHYLHEXYL)PHTHALATE	400	U	A	430	U	A	360	U		360	U	A
BUTYLBENZYL PHTHALATE	400	U		430	U		360	U		360	U	
CARBAZOLE	400	U		430	U		19000	J	N	910		
CHRYSENE	4500			10000			83000	J	N	11000		
DI-N-BUTYL PHTHALATE	400	U		430	U		360	U		30	J	P
DI-N-OCTYL PHTHALATE	400	U		430	U		36000	UJ	N	360	U	
DIBENZO(A,H)ANTHRACENE	1100			2500			20000	J	N	1700		
DIBENZOFURAN	400	U		430	U		27000			870		
DIETHYL PHTHALATE	400	U		430	U		360	U		360	U	
DIMETHYL PHTHALATE	400	U		430	U		360	U		360	U	
FLUORANTHENE	5200			6000			170000	J	N	10000		
FLUORENE	1100			890			34000			1700		
HEXACHLOROBENZENE	400	U		430	U		360	U		360	U	
HEXACHLOROBUTADIENE	400	U		430	U		360	U		360	U	
HEXACHLOROCYCLOPENTADIENE	400	U		430	U		360	U		360	U	
HEXACHLOROETHANE	400	UJ	C	430	UJ	C	360	UJ	C	360	UJ	C
INDENO(1,2,3-CD)PYRENE	2200			7200			38000	J	N	6700		
ISOPHORONE	400	U		430	U		360	U		360	U	
N-NITROSO-DI-N-PROPYLAMINE	400	U		430	U		360	U		360	U	
N-NITROSODIPHENYLAMINE	400	U		430	U		360	U		360	U	
NAPHTHALENE	410			480			18000			820		
NITROBENZENE	400	U		430	U		360	U		360	U	
PENTACHLOROPHENOL	86	J	C	1100	UJ	C	910	UJ	C	910	UJ	C
PHENANTHRENE	6400			2100			180000	J	N	8700		
PHENOL	400	UJ	C	430	UJ	E	420	J	E	360	UJ	E
PYRENE	8500			12000			140000	J	N	20000		

(92)

CTO232 - PORTSMOUTH
SOIL DATA
KATAHDIN
PNSG10

SAMPLE NUMBER:	BC-6201-SD-0898			BC-6202-SD-0898			BC-6203-SS-0001			BC-6204-SS-0001		
SAMPLE DATE:	08/05/98			08/05/98			08/05/98			08/05/98		
LABORATORY ID:	WO2308-1			WO2308-2			WO2308-3			WO2308-4		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	80.0 %			79.0 %			90.0 %			88.0 %		
UNITS:	UG/KG			UG/KG			UG/KG			UG/KG		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
PESTICIDES/PCBs												
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4,4'-DDE	8.2	U		8.4	U		7.3	UJ	R	180	J	R
4,4'-DDT	62	J	R	8.4	U		390	J	RU	420	R	R
ALDRIN	4.2	U		12	R	RU	99	R	RU	8.9	J	RU
ALPHA-BHC	4.2	U		4.3	U		3.8	UJ	R	3.8	U	
ALPHA-CHLORDANE	16	J	RU	4.3	U		3.8	UJ	R	8.6	R	RU
AROCLOR-1016	82	U		84	U		73	UJ	R	74	U	
AROCLOR-1221	170	U		170	U		150	UJ	R	150	U	
AROCLOR-1232	82	U		84	U		73	UJ	R	74	U	
AROCLOR-1242	82	U		84	U		73	UJ	R	74	U	
AROCLOR-1248	82	U		84	U		73	UJ	R	74	U	
AROCLOR-1254	82	U		84	U		73	UJ	R	74	U	
AROCLOR-1260	82	U		84	U		73	UJ	R	74	U	
BETA-BHC	4.2	U		4.3	U		3.8	UJ	R	3.8	U	
DELTA-BHC	4.2	UJ	C	4.3	UJ	C	3.8	UJ	RC	3.8	UJ	C
DIELDRIN	8.2	U		8.4	U		7.3	UJ	R	7.4	U	
ENDOSULFAN I	4.2	U		4.3	U		3.8	UJ	R	3.8	U	
ENDOSULFAN II	8.2	U		8.4	U		7.3	UJ	R	7.4	U	
ENDOSULFAN SULFATE	8.2	U		8.4	U		7.3	UJ	R	7.4	U	
ENDRIN	8.2	U		8.4	U		7.3	UJ	R	7.4	U	
ENDRIN ALDEHYDE	8.2	U		8.4	U		7.3	UJ	R	7.4	U	
ENDRIN KETONE	8.2	U		8.4	U		7.3	UJ	R	7.4	U	
GAMMA-BHC (LINDANE)	4.2	U		4.3	U		3.8	UJ	R	3.8	U	
GAMMA-CHLORDANE	16	J	R	4.3	U		3.8	UJ	R	3.8	U	
HEPTACHLOR	4.2	U		4.3	U		3.8	UJ	R	3.8	U	
HEPTACHLOR EPOXIDE	4.2	U		4.3	U		3.8	UJ	R	3.8	U	
METHOXYCHLOR	42	U		43	U		38	UJ	R	38	U	
TOXAPHENE	420	U		430	U		380	UJ	R	380	U	

2

CTO232 - PORTSMOUTH
SOIL DATA
KATAHDIN
PNSG10

SAMPLE NUMBER:	BC-6201-SD-0898			BC-6202-SD-0898			BC-6203-SS-0001			BC-6204-SS-0001		
SAMPLE DATE:	08/05/98			08/05/98			08/05/98			08/05/98		
LABORATORY ID:	WO2308-1			WO2308-2			WO2308-3			WO2308-4		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	80.4 %			79.4 %			90.3 %			88.4 %		
UNITS:	MG/KG			MG/KG			MG/KG			MG/KG		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
INORGANICS												
ALUMINUM	4800	J	DF	5900	J	DF	6350	J	DF	15600	J	DF
ANTIMONY	1.0	U	A	0.48	U	A	231	J	D	12.3	J	D
ARSENIC	8.0			6.9			16.5			17.6		
BARIUM	15.2	J	F	20.2	J	F	140	J	F	176	J	F
BERYLLIUM	0.34	U	A	0.40	U	A	0.52	U	A	0.83		
CADMIUM	0.38	U		0.48	U		3.6	J	C	1.1	J	C
CALCIUM	1410	J	F	3230	J	F	2600	J	F	6760	J	F
CHROMIUM	26.5			33.4			88.0			55.7		
COBALT	4.7			3.9			14.7			21.5		
COPPER	25.7	J	D	132	J	D	317	J	D	85.4	J	D
IRON	14800	J	F	12600	J	F	18500	J	F	37000	J	F
LEAD	76.9			181			5450			485		
MAGNESIUM	3430	J	F	3680	J	F	3140	J	F	11400	J	F
MANGANESE	102			114			178			405		
MERCURY	0.07	J	D	0.07	J	P	1.7	J	D	0.66	J	P
NICKEL	19.4	J	F	12.2	J	F	26.0	J	F	70.7	J	F
POTASSIUM	1270			1640			1360			2880		
SELENIUM	0.54	UJ	D	0.66	UJ	D	1.9	J	D	0.56	UJ	DK
SILVER	0.45	U		0.55	U		0.49	U		0.47	U	
SODIUM	2400			3390			141			143		
THALLIUM	0.54	UJ	D	0.67	UJ	D	0.59	UJ	D	0.57	UJ	DK
VANADIUM	17.3			19.7			21.9			60.4		
ZINC	68.5			69.4			4190			1060		

CTO232 - PORTSMOUTH
SOIL DATA
KATAHDIN
PNSG10

SAMPLE NUMBER:	BC-6201-SD-0898			BC-6202-SD-0898			BC-6203-SS-0001			BC-6204-SS-0001		
SAMPLE DATE:	08/05/98			08/05/98			08/05/98			08/05/98		
LABORATORY ID:	WO2308-1			WO2308-2			WO2308-3			WO2308-4		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	80.0 %			79.0 %			90.0 %			88.0 %		
UNITS:	MG/KG			MG/KG			MG/KG			MG/KG		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
INORGANICS												
CYANIDE	1	U		1	U		1	U		1	U	

— End —

(8)

SOIL / SEDIMENT SAMPLE LOG SHEET

Project Site Name: PNSY
Project No.: 6515

Sample ID No.: BC-6203-SS-0001
Sample Location: 6203 / Bldg 62
Sampled By: TE / KJ
C.O.C. No.: PNS29

[X] Surface Soil
[ ] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Type of Sample:
[X] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 8/5/98			
Time: 1645	0-8"	DK Brn	F Sand Tr F Gravel &
Method: SS Hand Auger			Anthracite Coal, & Silt (Org)
Monitor Reading (ppm): 0.0			Tr roots

COMPOSITE SAMPLE DATA

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
			NA	
Monitor Readings (Range in ppm):				

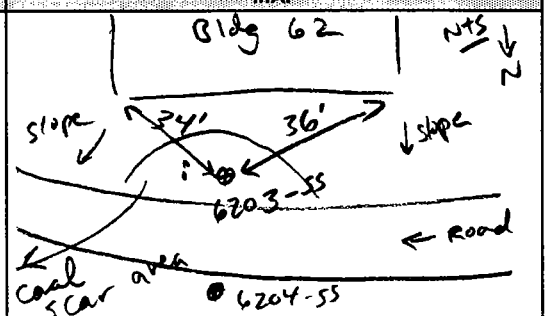
SAMPLE COLLECTION INFORMATION

Analysis	Container Requirements	Collected	Other
TCL VOC	2 oz glass	✓	
TCL SVOC	4 oz glass	✓	
TCL Pesticide / PCB	↓	✓	
TAL metal		✓	
CN		✓	

OBSERVATIONS / NOTES

Collected w/in area of no vegetation on North side of Bldg 62

MAP



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [illegible]

SOIL / SEDIMENT SAMPLE LOG SHEET

Project Site Name: PNSY
Project No.: 6515

Sample ID No.: BC-6204-SS-0001
Sample Location: 6204 / Bldg 62
Sampled By: TE / KJ
C.O.C. No.: PNS29

[X] Surface Soil
[ ] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Type of Sample:
[X] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 8/5/98			
Time: 1715	0-12"	Brn to Black	F-M sand Tr Root, organics
Method: Hand Auger			F. Gravel, Silt & anthracite
Monitor Reading (ppm): 0.0			coal (Dry)

COMPOSITE SAMPLE DATA

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
		NA		
Monitor Readings (Range in ppm):				

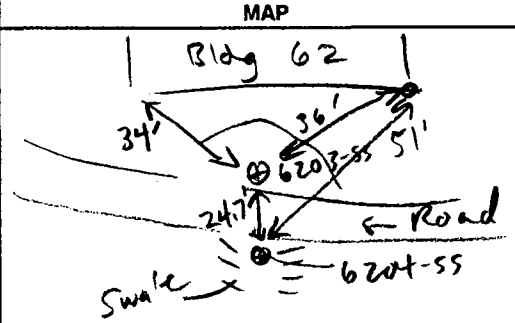
SAMPLE COLLECTION INFORMATION

Analysis	Container Requirements	Collected	Other
TCL VOC	2 oz glass	✓	
TCL SVOC	4 oz glass	✓	
TCL pesticides / PCB	↓	✓	
TAL Metals	↓	✓	
CN	↓	✓	

OBSERVATIONS / NOTES

Collected from swale drainage across from area of no vegetation

MAP



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [illegible]

SOIL / SEDIMENT SAMPLE LOG SHEET

Project Site Name: PNSY
Project No.: 6515

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: BC-6201-SD-0597
Sample Location: Back Channel
Sampled By: TE / KJ
C.O.C. No.: PNS 29

Type of Sample:
[X] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 8/5/98			
Time: 1555	0-4"	Brn	F-M Sand Some Cobbles
Method: SS Trowel/Bowl			
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
			NA	
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION

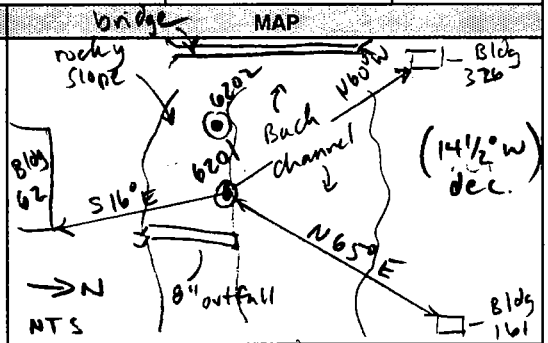
Analysis	Container Requirements	Collected	Other
TCL VOC	2 oz glass	✓	
TCL SVOC	4 oz glass	✓	
TAL Metals	↓	✓	
TCL pesticides / PCB	↓	✓	
CN		✓	

OBSERVATIONS / NOTES

Biota: Ab.: Fucus sp. (rockweed), blue mussels, periwinkles
Tr.: limpets, barnacles

Low Tide @ 1555 hrs

MAP



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [illegible]

SOIL / SEDIMENT SAMPLE LOG SHEET

Project Site Name: PNSY
Project No.:

[ ] Surface Soil
[ ] Subsurface Soil
[X] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: BC-6202-SD-0897
Sample Location: Back Channel
Sampled By: TE / KJ
C.O.C. No.: PNS29

Type of Sample:
[X] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 8/5/98			
Time: 1615	0-4"	Black (@ surface)	Clayey silt & F Sand
Method: SS Trowel / Bowl		to Brn	
Monitor Reading (ppm): —			

COMPOSITE SAMPLE DATA

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
			NA	
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION

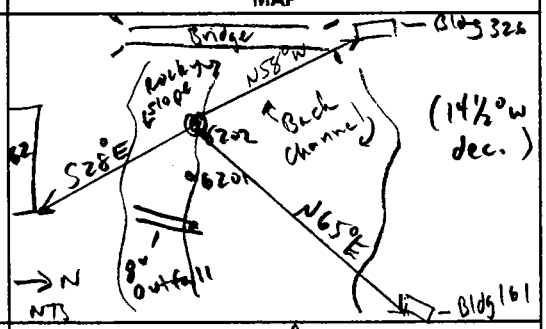
Analysis	Container Requirements	Collected	Other
TCL VOC	2 oz glass	✓	
TCL SVOC	4 oz glass	✓	
TCL Pesticides / PCB	↓	✓	
TAL Metals		✓	
CN	↓	✓	

OBSERVATIONS / NOTES

- Petro odor
- Sheen of water in dug hole
- Same biota as 6201

low Tide @ 1555 hrs

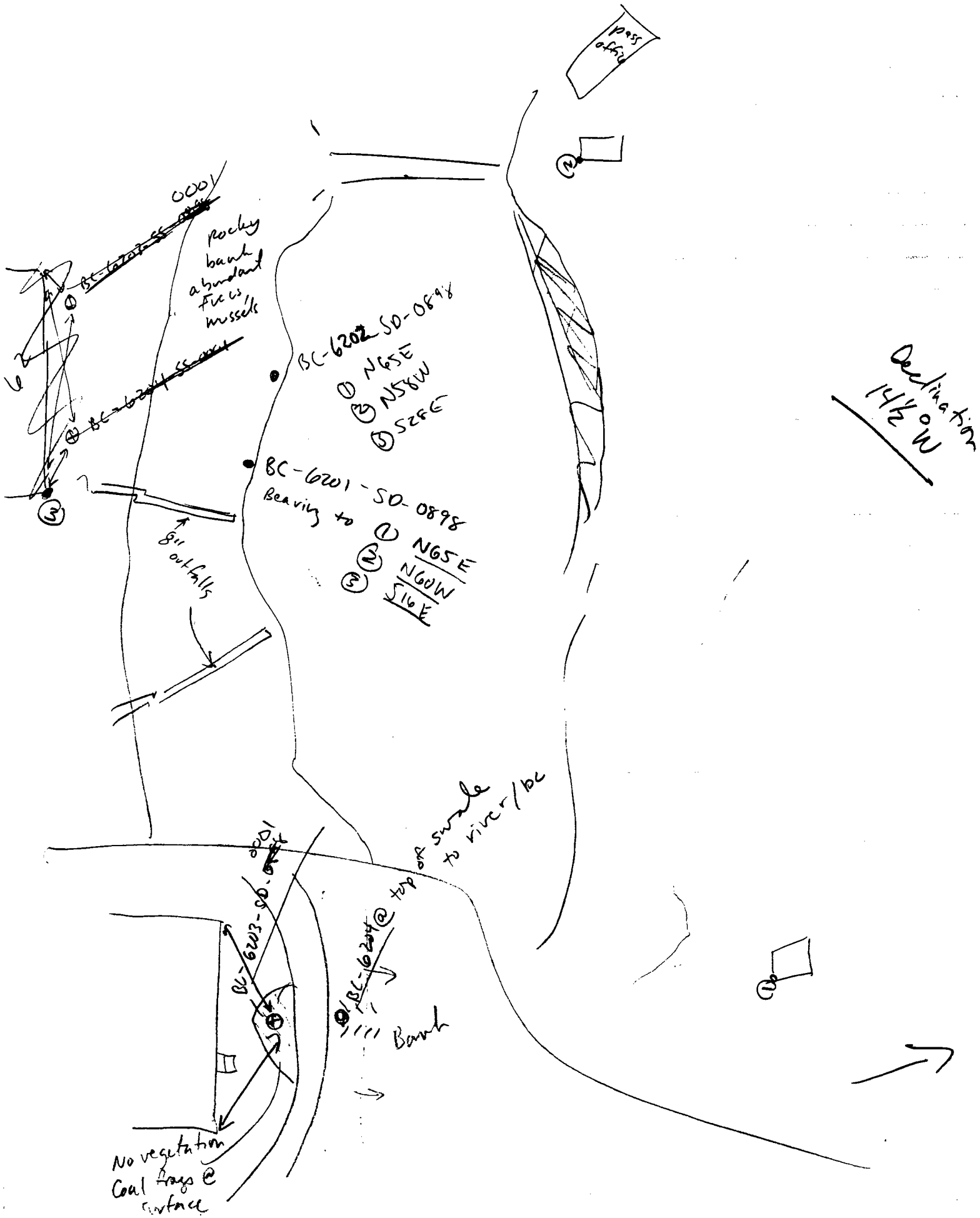
MAP



Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): [signature]


pass affig
0001
Rocky bank abundant Fucus, mussels
BC-6202 SD-0898
① N65E
② N58W
③ S28E
BC-6201 - SD-0898
Bearing to ① N65E
② N60W
③ S16E
Declination 14½° W
8" outfalls
top of swale to river/bc
0001
BC-6203-SD-0898
BC-6204 @
Bank
No vegetation
Coal tags @ surface

APPENDIX B

DATA QUALITY OBJECTIVES

Final Data Quality Objectives (DQOs) for Site 34 Investigation
Portsmouth Naval Shipyard, Kittery, Maine

The following provides the Navy's final Data Quality Objectives (DQOs) for the investigation of Site 34, Former Oil Gasification Plant, at Portsmouth Naval Shipyard (PNS), Kittery, Maine. The intent of the investigation is to collect data to support a non-time critical removal action for the ash pile and to support the site screening evaluation for the site. The DQOs were developed using the U.S. Environmental Protection Agency (USEPA) DQO process. This process requires a concise description of the problem to be solved, a specification of the decisions that must be made to solve the problem, and a formulation of the data collection approach necessary to provide inputs for making the decisions. When appropriate, a statistically based specification of the tolerance for making decision errors is also undertaken. For this investigation a statistical approach was not used (see the discussion under DQO step 6).

The Navy's preliminary outputs for DQO steps 1 through 7 were provided for review on March 26, 2002. The DQOs were revised based on comments from the regulators and Restoration Advisory Board (RAB) on the preliminary draft DQOs and the draft Quality Assurance Project Plan (QAPP) was prepared based on the revised DQOs. The draft DQOs were further revised based on regulatory and RAB comments on the draft QAPP, and the final DQOs are provided herein. Tables and figures originally prepared to support the DQOs that are included in the QAPP are not repeated in these DQOs. A reference to the appropriate QAPP tables and figures are provided in these DQOs. The response to comments (RTC) on the preliminary draft DQOs and the draft QAPP are provided in Appendix D of the QAPP.

Site screening (SS) refers to the mechanism, adopted by the Navy in accordance with the Federal Facility Agreement for PNS (FFA), for providing preliminary information about an area of concern (referred to as a Site Screening Area) to determine whether further action is necessary (i.e., Remedial Investigation/Feasibility Study [RI/FS] or Removal Action) or whether no further action is required for the identified Site Screening Areas at PNS. As part of the site screening process, historical operational information for the site is reviewed to determine whether storage, release, or disposal of hazardous substances may have occurred. For areas where hazardous substance-related activities may have occurred, sampling and analysis is then conducted to determine whether the hazardous substances may have contaminated the environmental media at the site. The sampling targets the most likely locations to find contamination from the site operations. For Site 34, the Navy has already determined that a removal action is needed for the ash pile at Site 34 based on available data (from 1998); however, the environmental media that may be impacted by the ash pile and other sources at the site have not been evaluated in the site screening process. Therefore, the investigation for Site 34 focuses on collecting information to support a removal action for the ash pile and the site screening for the other environmental media at Site 34.

It is noted that a non-time critical removal action refers to a remedial action taken for a site prior to a final remedial action. Removal alternatives are identified and evaluated in an Engineering Evaluation/Cost Analysis (EE/CA) report to identify alternatives that will remove or reduce risks associated with a site. Although it is referred to as a "removal action," alternatives that do not include physical removal of materials can also be considered in the EE/CA. Therefore, in the DQOs for Site 34, "removal action" does not necessarily mean physical removal of materials.

Data Quality Objective Step 1: State the Problem

Participants in DQO Development:

- Navy (EFANE): Fred Evans (Remedial Project Manager, Civil Engineer), Jason Speicher (Risk Assessor)

- PNS: Marty Raymond (IRP Coordinator)

- TtNUS (Navy Consultant): Debbie Cohen (Project Manager, DQO lead), Tom Johnston (Lead Chemist, DQO Advisor), J.P. Kumar (Engineer), Aaron Bernhardt (Risk Assessor), Angie Scheetz (Project Chemist); Charles Race (Maine CG, Lead Hydrogeologist); David Zwastetzky (Project Geologist)

- USEPA: Meghan Cassidy (Remedial Project Manager until August 2002) (via comments dated April 8, 2002 on the Preliminary DQOs); Michael Barry (Remedial Project Manager since September 2002) (via comments dated October 10, 2002 and December 24, 2002 on the draft QAPP)

- MEDEP: Iver McLeod (Remedial Project Manager, Biologist) (via comments dated April 10, 2002 on the Preliminary DQOs and via comments dated October 16, 2002 and December 23, 2002 on the draft QAPP)

- Other: Carolyn Lepage (TAG consultant to SAPL, hydrogeologist) (via comments dated April 12, 2002 on the Preliminary DQOs and via comments dated October 19, 2002 and December 29, 2002 on the draft QAPP)

Regulatory Environment:

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly referred to as Superfund)

The Navy will prepare an EE/CA to evaluate alternatives for a non-time critical removal action associated with the ash pile located at Site 34. The site investigation (SI) is focused on collecting information necessary to support the EE/CA for the ash as well as on collecting information to support the site screening (SS) for the site following the removal action. The information to support an EE/CA focuses on the extent of the ash pile. The site screening focuses on determining whether unacceptable risk could be present at the site from hazardous substance activities conducted at the site. To determine the potential for unacceptable risk at the site, the most likely media and locations where storage, release, and/or disposal activities may have occurred are primarily targeted for sampling and analysis. The data are then compared with facility background and screening levels to determine the potential for risk for site-related contaminants. If the chemical concentrations are less than facility background and screening levels, there is no unacceptable condition. If chemical concentrations exceed background and screening levels, the site is likely to require additional action (i.e., RI/FS or removal action). Some of the information from the investigation to support the EE/CA will also be used for the site screening evaluation. However, it is anticipated that the site screening evaluation cannot be completed until the EE/CA and removal action has been completed. Furthermore, because of the potential presence of ash or tar beneath the buildings, the Navy will evaluate methods to investigate whether the tar pit is still present. The scope of the current investigation does not include the investigation of the tar pit or ash beneath the buildings.

Site History:
Site 34 is the referred to as the Former Oil Gasification Plant, Building 62. The site is located on the northern portion of PNS, along the shore of the Back Channel of the Piscataqua River. Figure 1-2 in the QAPP shows the location of the site and Figure 1-3 in the QAPP shows the site layout.

Limited information is available on the site history. The majority of the history of the site has been obtained from the "Industrial History of Building 62 (Former Gas Manufacturing Plant), by James Dolph and Dennis Turpin, October 1996)" and from general literature describing similar plants that were historically located at several cities around the country. From the 1870s to the early 1900s, the building housed a process that converted kerosene to illuminating gas, which was piped to various locations on the shipyard. Coal was used to provide heat for the process wherein kerosene was subjected to fractional volatilization in equipment called retorts. Tar was produced as a residue from the volatilization process. The heavier fraction of kerosene was deposited in a tar pit within the building. The tar would have contained polycyclic aromatic hydrocarbons (PAHs). The tar pit shown on the operations floor plan (approximately 5 feet by 5 feet) is expected to be where the tar was deposited within the building. Information is not available on the quantity of tar produced or whether any of the tar produced was disposed offsite. Ash, assumed to be from the combustion of coal, appears to be present outside the building in an area that is approximately 100 feet long (along the length of Building 62 and the Building 62 Annex) and 30 feet wide, i.e., up to the edge of the road that runs east-west parallel to the northern side of the buildings. The depth of the ash pile below ground surface is unknown. The ash from coal combustion would likely contain heavy metals from the mineral origin of the coal and PAHs from the partial combustion of coal. A gas purifier may have been used to remove the corrosive gases from the oil gas, which may have led to the production of woodchip waste and limestone waste that would have contained other chemicals such as PAHs, and heavy metals. Cyanides are not expected to be found because the process apparently did not employ coal gasification, however, if wastes (wood chips or stones) bearing a prussian blue color are noted then cyanide analysis would be prudent, as suggested in "Analysis of Site and Waste Conditions and Suggested Site & Waste Characterization Work Plan for the Former Oil-Gas Plant, Portsmouth Naval Shipyard, New Hampshire" (Hathaway, A., March 29, 1998).

It is reported by Dolph and Turpin (October 1996) that between 1901 and 1912, the plant was closed and all of the machinery was removed and a concrete floor was laid. (It is not known whether the tar pit was removed when the concrete floor slab was constructed.) This source also reports that between 1915 and 1930, the building was used as a blacksmith shop by the Public Works Department, during which time (in 1919), the building was gutted by a fire. The ash pile outside the building could also contain remains of the old building that was burnt down in 1919.

Very little information is available on the uses of Building 62 after 1930. The report by Dolph and Turpin indicates that the addition to Building 62 was built in 1945 and the building was used by public works for storage in 1957 (based on the 1957 existing conditions map). Review of other existing conditions maps (for 1967, 1982, and 1998) indicate that the building was used for public works storage and/or administration. The figures also show that a railroad that once ran along the road was likely removed sometime in the 1950s (likely when the addition to Building 60 was built).
Building 62 was used for pesticide storage by public works from approximately the 1960s to 1985. The pesticide storage was reportedly conducted in the southern portion of the original Building 62 (on the Smoot Street side of the building). Reportedly a steam line on the exterior of the building was used for flushing equipment and washing coveralls that were used for the

pesticide shop. Building 62 did not meet all the requirements for pesticide storage (venting, building materials, and other uses of the building at the time of storage); therefore, a new pesticide control shop was built in 1985 (Building 314 formerly located at Site 29) and pesticide storage activities at Building 62 ended. A bermed concrete pad (not currently in use based on the amount of debris in the pad) is located on the south side of the building near a former steam line and drains that are part of the Outfall 49 drain system. These were potentially used as part of the flushing activities; although historical records of this level of precision are not available.

Information on the historical use of pesticides (collated by the Shipyard) indicated that the following pesticides/insecticides/herbicides were used at PNS in the 1980s: Diazinon (organophosphate), Dursban (Clorpyrifos), Baygon (carbamate), Malthion (organophosphate), Bromacil (herbicide), Biotrol (bacterium), Carbaryl (carbamate), and Avitrol (pyridine compound). Building 62 was used for storage and mixing of these pesticides. Other pesticides may have also been stored and mixed at the site; however, no information supporting or refuting this practice is available. Note, the IAS (Weston, 1983) indicates good management practices (including triple rinsing of sprayers and empty cans and bottles and reusing the rinse water in diluting the next batch of pesticides).

In 1997, the Navy contracted Foster Wheeler Environmental Corporation (FWENC) to remove a small quantity of ash observed on the slope on the northside of Building 62. However, after 6 drums of ash were removed, the action was stopped because it became apparent that a much larger quantity of ash was present behind Building 62. The excavation was 6 feet wide by 6 feet long and 2.5 feet deep, and ash was visible on all four sidewalls and at the base of the excavation. The excavation was covered with a herculite cover. Appendix A of the QAPP contains the results of this activity.

The building is currently used as a bobcat (mini-bulldozer) shop and storage. Buildings 60 and 63 are located on the northwestern and eastern sides of Building 62, respectively. Building 60 was constructed in the 1902-1904 period and has historically been used for the building of small ships. Building 63 was constructed in 1874 as a cart and wheel shed, and is currently used for public works storage. A floor plan dated July 1994 (included in the report by Dolph and Turpin) shows that Building 62 is about a quarter office space, a quarter workshop space, and half storage space, with a restroom in the approximate location of the tar pit (from the former gasification operations). The 1994 floor plan shows the annex is mostly storage space; with about a third occupied by a locker room and lunch room.

Previous Investigations at/offshore of Site 34:

- Estuarine Ecological Risk Assessment (for Operable Unit 4) (sampling in 1991 to 1993) included sampling locations in the offshore area near Site 34 referred to as the Back Channel Area of Concern (AOC).
- In 1998, TtNUS collected two solid samples (one within the ash pile and one soil sample across the road from Building 62). At that time, TtNUS also collected two sediment samples in the intertidal zone.
- Interim Offshore Monitoring (Rounds 1 through 5, 1999 to 2001) includes a monitoring station offshore of Site 34. [Note that Round 6 was conducted in August 2002].

The offshore area adjacent to Site 34 is part of the Back Channel AOC of Operable Unit 4 (OU4). Risks associated with OU4 have been evaluated as part of the Human Health Risk Assessment for Offshore Media (HHRA, McLaren/Hart, 1994) and the Estuarine Ecological Risk Assessment (EERA, NCCOSC, 2000). The EERA evaluated OU4 by AOCs. Based on

the Interim Record of Decision (ROD) for OU4 Navy, 1999), only offshore ecological risks pose a potential concern for OU4. Specifically for the Back Channel AOC, intermediate risk to ecological receptors from exposure to sediment was identified. Only one sampling station for the Back Channel AOC was located in the near vicinity of the area offshore of Site 34 and this station was a mussel sampling location (EERA Station 169). The Interim Offshore Monitoring Program (see subsequent discussion of the monitoring program) provides more comprehensive and recent information for the Site 34 offshore area. Therefore, the EERA results are not specifically applicable to the Site 34 investigation.

In 1998, samples were collected at Site 34 and in the intertidal area of Site 34 to support the Navy's relative risk ranking. One sample was collected from the ash, one sample was collected from the soil north of the road on the north side of Building 62, and two sediment samples were collected from the intertidal area. These data are validated and will be used for assessing the nature and extent of contamination.

As part of the interim offshore monitoring program for OU4 (TtNUS, October 1999), it was determined that sediment monitoring was required for OU4. Consideration for locations of IRP sites was used as part of the rationale for location of monitoring stations as part of the program. One monitoring station (MS-01) is located offshore of Site 34. Sediment, mussel, and juvenile lobster samples were collected from this monitoring station in the first 5 rounds of monitoring. The first four rounds of data were evaluated in the Baseline Interim Offshore Monitoring Report. Three sediment sampling locations are included within monitoring station MS-01; two subtidal stations (stations 1 and 3) and one intertidal station (station 2).

Previous soil and sediment sampling locations at Site 34 are shown on Figure 1-4 of the QAPP. These sampling locations were not surveyed; therefore, they are approximately identified using field notes.

Site Geology/Hydrogeology:
Site-specific information on the site geology and hydrogeology has not been collected. The site is located within 100 feet of the Piscataqua River shoreline. Site 34 is located within the historical area of PNS along the northern shoreline of the original Dennett's Island near the back channel. Based on the facility-wide investigation performed during the RFI Data Gap (Halliburton NUS, 1995), the ground surface of Dennett's Island slopes moderately from the south of Buildings 62/62A towards the north. Further north past the road, the ground surface rapidly drops toward the back channel. Depth to bedrock along original island boundaries is typically 5 to 15 feet. Natural overburden materials are expected to consist of fractured or weathered bedrock, glacial till, or river/tidal deposits. Fresh groundwater is expected to flow from the recharge area located in the central portion of Dennett's Island and discharge to the back channel. Because Site 34 is located within 100 feet of the back channel shoreline, the groundwater in the surficial aquifer may be tidally influenced. However, tidal influence needs to be confirmed. Brackish to saline groundwater conditions are expected in the overburden groundwater (if present) and shallow bedrock groundwater. Deeper bedrock groundwater is expected to be brackish or saline but depends on the hydraulic connections between the recharge area and the back channel.

Historical Site Chemical Data:
The sample of the ash and the sample of the soil from a location within 30 to 40 feet from the north side of the building collected in 1998 were analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs), TCL Semi-volatile Organic Compounds (SVOCs), TCL

pesticides/PCBs, Target Analyte List (TAL) metals, and cyanide. A comparison of the data to human health risk screening levels and the representative facility background concentrations (from the Facility Background Report, TtNUS, May 2000) is provided in Table 1-3 of the QAPP. The following is a brief summary:

- VOCs were not detected in these samples.
- Except for 4,4'-DDT, 4,4-DDE, and aldrin none of the other pesticides or PCBs analyzed were detected. The three pesticides were detected at concentrations less than their residential screening levels.
- Among SVOCs, the most significant detections were PAHs in the range of 1,100 to 180,000 µg/kg in the ash sample; with significantly (one or more orders of magnitude) lower levels of the same compounds in the soil sample. Some of these PAHs are present at concentrations that exceed residential screening levels.
- Among inorganics, the following metals were detected in the ash sample at concentrations that were significantly (order of magnitude) greater than their respective facility background levels and also exceeded their respective residential screening levels: antimony, lead, and zinc. Cyanide was not detected in either sample.

During the 1998 sampling event, two samples of intertidal area sediment were also collected and analyzed for the same constituents as the solid samples. No VOCs were detected. No pesticides/PCBs except 4,4'-DDT, alpha-chlordane, and gamma-chlordane were detected. Among SVOCs, similar PAHs as those that were detected in the soil samples were also detected in the sediment samples, however at levels that were significantly (order of magnitude or greater) less than their levels in the ash/soil samples. Also, several metals were detected at an order of magnitude or lower levels in the sediment samples compared to the ash samples.

As presented in the Baseline Interim Offshore Monitoring Report (TtNUS, July 2002), PAHs were the only chemicals that exceeded Interim Remediation Goals (IRGs) for sediments in the offshore at monitoring station M01 (TtNUS, December 2001). Acenaphthylene exceeded the IRG in Rounds 2, 3, and 4, while fluorene and HMW PAHs exceeded the IRGs only in Round 4. The exceedences of IRGs were based on averaging the PAH concentrations across all three sample locations within that monitoring station. Of the three sample locations at M01, the samples from M01-3 consistently had the greatest PAH levels across all four rounds, although the other two locations at M01 also had elevated PAH levels in some of the rounds. During the development of IRGs, sediment samples were collected from two of the three locations at M01 during Round 2 for toxicity testing (TtNUS, November 2001). Neither sample was toxic in the whole sediment amphipod toxicity test. However, the sample from M01-3 was toxic in the sediment pore water toxicity test for sea urchin development. The sample from M01-2 was not toxic in the sea urchin development test. The presence of one or more sources of PAHs (ash pile and tar pit) indicates that the site may be a source of the offshore PAH contamination, although a definitive link cannot be established with the available data.

A comparison of the sediment data to ecological screening levels is provided in Table 1-4 of the QAPP. The data indicates that certain PAHs, DDT (in one sample) and arsenic (which was similar to reference station levels) exceeded screening levels. Details of the evaluation are presented in Section 1.0 of the QAPP.

Although PAHs and inorganics, are the obvious target chemicals based on the main source (ash and tar pit) at the site,, samples that will be used to support the site screening evaluation need to be analyzed for a full suite, i.e., the complete TAL metal and TCL organic analyte list (TCL

VOCs, SVOCs, and pesticide/PCBs. Therefore, environmental media at the site at selected locations where the source is most likely to have impacted these media, will need to be analyzed for the full suite.

Also, because the ash is expected to have been deposited from various sources (i.e., coal combustion for oil gasification, foundry operations, building destruction in fire, etc.), and the only sample from the 1998 sampling event may not be adequately representative of the ash composition for source characterization (for the SS), a full suite of analysis of the ash samples will be required. It is not expected that dioxins and cyanide are present in the ash. (Dioxins are typically a product of incomplete combustion of chlorinated cyclic organic compounds and cyanide is typically a product of coal gasification.) However, to confirm that these compounds are indeed not present, a few samples of ash will need to be analyzed for these compounds. Based on the results of the ash analysis, the need for sampling/analysis of other media for dioxins and cyanide will be determined, as discussed further on in these DQOs.

Land Use (current):
PNS is a military facility with restricted access. The current land use for Site 34 is by Public Works as the bobcat shop and storage. Building 62 (including the annex) is considered a historical building. Recreational users cannot easily access the shoreline at Site 34 because of the steep shoreline.

Land Use (future):
The site uses are likely to remain as they are currently. However, unrestricted residential, recreational, commercial, or industrial use of the site may be possible scenarios if the Shipyard were to close.

Conceptual Site Model:
The following is a discussion of the current understanding of the potential sources and the potential contamination end points.

A preliminary site visit indicated that the ash pile is mounded along the northern side of Building 62 in between the building wall and street, as shown on Figure 1-3 of the QAPP. The southern side of the building is on Smoot Street, which is at a higher elevation than the street on the northern side. The land on the northern side of the street slopes steeply to the water's edge at the back channel of the Piscataqua River. The ash pile apparently continues past the western end of Building 62 within a narrow strip of land between Building 62-Annex and the street on the northern side. It is not known if any ash exists beneath Building 62-Annex.

The wash pad is approximately 10 feet by 10 feet in area adjacent to the southern wall of the building with no obvious signs of any release to the adjacent soil or breach in the concrete. However, if the drain 49-1 is the inlet that leads to the Outfall 49, this is a conduit that might have existed for the discharge of wastewater from the pad to the offshore.

Contaminants present in the potential sources at the site (ash pile, tar within the tar pit if present, pesticide rinse area) could have caused contamination of the underlying soil and groundwater. PAH contamination of the offshore could have occurred via erosion of the exposed ash pile or transport of dissolved PAHs in the groundwater from the site. Rather than conduct further studies to try to establish the link between the PAHs in the offshore with the site sources, the Navy has determined that a removal action to address the more obvious source of

PAH contamination (the ash pile) is appropriate. Therefore, investigation of potential contaminant transport pathways for PAHs is not required.

Ash, tar, etc., that may be present under the buildings are not of current concern for direct exposure to potential receptors. They may be of concern for future potential exposure if the buildings are removed, however, these sources will not be included in the scope of the current investigation, as discussed above.

A potential location of an onshore release of pesticides (if any), is the wash pad area. Pesticide storage and handling activities occurred decades after the ash disposal occurred, therefore, pesticides are not expected to be found in the soil beneath the ash pile. Therefore, an onshore pesticide impact (if one exists) should be evident in the soil under or around the wash pad location, and/or in the groundwater at that location. Pesticide impact to the offshore due to drainage of rinse water from the wash pad (via the drain system to Outfall 49) should be evident in the sediment trapped within the system and sediment at the discharge location of the outfall. Note that offshore sediment data are available from monitoring stations M01 located offshore of the site, as discussed earlier. However, sediment data are necessary to provide an indication of whether discharges from the previous pesticide handling/storage activities in Building 62 through the storm sewer system to Outfall 49 may have impacted the offshore. Therefore, limited sediment data focused around the storm sewer system/Outfall 49 will be included in the scope of the current investigation.

Human health exposure to sediments under a recreational scenario to in the offshore at Site 34 is not of concern because the steep shoreline directly adjoining the site minimizes the likelihood of access from the site. However, because access to the sediments from adjacent areas to the site may be possible, exposure to a recreational user will be considered during evaluation of potential site risks. [Note for SS, ecological screening levels, which are more stringent than human health screening levels, will be used to evaluate the sediment data as discussed further in DQOs.]

Groundwater has not been investigated at this site. A limited soil sampling has been conducted in relation to the ash disposal. Soil and groundwater sampling at or near potential sources at the site is needed for evaluating potential impacts to support the onshore site screening evaluation. Offshore sediment analysis should target the more toxic, and persistent pesticides.

Information on extent of the ash pile and impacted soil is necessary to support the EE/CA.

A conceptual site model for exposure to potential receptors is not required for the EE/CA or for site screening at this time because a risk assessment is not required at this point. However, the potential receptors that may be exposed to the site media are the following: residential and industrial receptors to soil and groundwater, and ecological receptors to the offshore sediment. Therefore, the screening levels for the EE/CA and SS are based on these potential exposure scenarios.

Problem Statement

Based on the available information for the site and considering the conceptual site model, the following are the problem statements that were developed for this investigation:

- Data on the nature and extent of contamination is needed to support an EE/CA for a removal action of the ash source area.

- Data on soil, and groundwater, at the site, and limited data on offshore sediment are also needed to determine the potential that site sources may have impacted environment media for the site screening evaluation.

Data Quality Objective Step 2: State the Decision(s)

Study Questions:

Principal Study Question for the EE/CA:

- What are the chemical contaminants, where are they present, and what are their concentrations in ash/soil pile and associated contaminated soil at Site 34?

Principal Study Question for SS:

- Has groundwater, soil, or offshore sediment been affected by Site 34 potential sources?

Secondary Study Question for EE/CA:

- Is sufficient information available to evaluate alternatives in the EE/CA?

There are no secondary study questions for the SS.

Potential Actions:

Potential Actions for EE/CA Principal Question:

Conduct an EE/CA for the ash/soil. Evaluate the following potential general response actions:

- No Action
- Limited action (monitoring and land use controls)
- Containment
- Excavation and On-site or Off-site Treatment/Disposal
- In-situ Treatment

Potential Actions for SS Principal Question:

- Determine whether an impact of one or more contaminant sources has occurred on the soil, groundwater, and sediment. Propose one of the following actions:
  - No Action
  - Enter the Remedial Investigation/Feasibility Study process
  - Interim Action or Removal Action

(Note that it is assumed that the removal action to address the ash and impacted soil has been completed before the site screening evaluation is conducted.)

Potential Actions for Secondary EE/CA Question:

Evaluate the data and all available information and propose one of the following actions:

- Continue with development of the EE/CA
- Recommend further investigation/data collection to support the EE/CA

(Note: If analytical data indicate the necessity, treatability studies may be necessary to complete the EE/CA.)

Decision Statements:

Principal Decision for EE/CA:

- Determine whether the data are sufficient to determine the nature and extent of contamination associated with the ash pile. If it is, then conduct an EE/CA. If not, recommend additional data collection before conducting the EE/CA.

Principal Decision for SS:

- Determine whether groundwater, soil, or offshore sediment has been contaminated by Site 34 sources. If any of these media has been contaminated, proceed to an RI/FS or an interim action/removal action. If none of these media has been contaminated, take no further action for the current site conditions. (Again it is assumed that the removal action for the ash will be complete before the site screening evaluation is completed.)

Secondary Decision for EE/CA:

- Determine whether adequate site-specific engineering input-related information is available to conduct an EE/CA. If it is, then conduct the EE/CA, if not then recommend additional data collection before conducting the EE/CA. (Note that this decision will occur in conjunction with the evaluation of the nature and extent information in the principal study decision.)

Data Quality Objective Step 3: Specify Inputs to the Decision(s)

Inputs to Principal Decision:

Data required for nature and extent of ash contamination determination for the EE/CA:

- Extent of ash by visual identification of the presence of ash
- Ash characterization to confirm the COCs (i.e., PAHs and metals) to be targeted for removal action, and to evaluate removal action alternatives. Ash characterization will also be used for determining analytical parameters for other site media as discussed under the SS data inputs.
  - Nature of ash using a full suite of analysis (TCL VOCs, SVOCs, Pesticides /PCBs), dioxins, and cyanide. Gas purifier wastes (wood chips and limestone) may be mixed with the ash. Cyanide analysis of ash will be included only if a prussian blue coloration is noted.
  - The 1998 ash samples will be included to evaluate the chemical nature of the ash.
- Soil chemistry data
  - PAHs and metals from soil beneath the ash pile and around the ash pile near the perimeter where visually ash is absent
  - No VOCs, PCBs, pesticides or SVOCs (other than PAHs) are required because the ash is not expected to contain any of these constituents. (Historical knowledge of the ash generation does not support the possibility of their presence.) Note: PAHs and metals are considered as indicator chemicals for ash contamination. (However, the other parameters noted above are considered under the SS data requirement.)
  - Include existing soil data from 2 locations collected in 1998

Data required for groundwater, soil, and sediment impact assessment for the SS:

- Source characterization (for ash) using a full suite of analysis as discussed above.
- TCL VOCs, SVOCs, pesticides/PCBs, and TAL metals, from selected locations where sources (ash pile and wash pad where pesticide rinse operations are suspected to have occurred) are likely to have impacted the environmental media. Dioxin analysis will be included for soil if conditions meet the "Decision Tree for Analysis of Dioxin in Soil and Sediment Samples at Site 34", provided in Attachment 1 to the DQOs. Cyanide analysis will be included for soil and groundwater samples if the field observations of ash samples indicates the possible presence of cyanides, i.e., if a Prussian blue color is noted in the ash.
- Soil samples collected from the groundwater sampling locations will be analyzed for the same parameters as those of the groundwater samples to provide some understanding of the link between the two media.
- Data to be included for the SS from a removal action confirmatory sampling plan will be identified in the removal action work plan.
- Groundwater levels to determine groundwater flow direction from potential sources to downgradient locations.
- TCL Pesticides in offshore sediment near the outfall (OF-49) discharge location. TCL Pesticides are considered more toxic and more persistent, and therefore conservative indicators of pesticide contamination. [See the attachment to the Navy's responses to comments on the draft QAPP dated November 22, 2002, included in Appendix D of the QAPP, for additional information on toxicity and persistence of pesticides.] These samples do not need to be analyzed for other chemicals because the intent is to obtain an indication of the pesticide connection to Bldg 62. Also, sediment in other locations in the offshore area of Site 34 (M01) is monitored for the chemicals of interest for the offshore (SVOCs, pesticide/PCBs, and metals) as part of the interim offshore monitoring program.

For all of the above data collection requirements, the following apply:

- Tidal study to establish effects of tide on groundwater levels and to establish optimum sampling times. For a preliminary indication of tidal influence of selection of a suitable sampling time, manual readings of water levels (at 15 minute intervals) within a 2-3 hour interval around the time of low tide and high tide of the river water will be adequate.
- Use facility background data as one of the components for evaluating nature and extent of contamination for soil and as one of the components for evaluating impacts to soil and groundwater
- Land survey of all sampling locations

Inputs to Secondary EE/CA Decision:

- Data required to evaluate alternatives in an EE/CA (aside from nature and extent):
  - Bulk density for soil/ash
  - Grain size (sieve analysis) for soil/ash

- If an organic free product is noted in the field, then a sample will be collected for, heat of combustion, and total petroleum hydrocarbon (TPH) analysis for an indication of potential disposal options.

Sampling and Field Measurement Methods for EE/CA and SS:

- Sampling:
  - Soil sampling for bulk density requires shelby tubes. All others can be regular split-spoons or macro cores
  - Groundwater sampling from temporary wells (hydro punches) using low-flow purge method. Temporary wells are adequate because until an impact to the groundwater at the most likely locations is known and the hydrogeology is understood, the locations and construction of permanent monitoring wells would be questionable.
  - Sediment sampling within wash-pad drain system, Outfall 49, and offshore area below the Outfall 49 outlet.
- Analyses:
  CLP methods will be adequate for all media. For soil and groundwater, detection limits will be compared against human health risk screening levels or water quality criteria, as discussed under Decision Rules. For sediment, detection limits will be compared against ecological screening criteria as discussed under Decision Rules.

Data Quality Objective Step 4: Establish the Study Boundaries

EE/CA Principal Decision Study Spatial Boundaries:

The spatial and temporal boundaries for investigation to obtain the inputs for the principal decision are as follows:

Two populations of ash/soil are expected as noted below:

- Ash pile (sometimes mixed with soil), which should be visually contaminated (dark/burnt, remainders of coal, and debris mixed in with soil) and odoriferous (like coal and phenolic material). Limestone and wood chips mixed with the ash, especially if prussian blue coloration is noted. Ash/soil associated with the limestone and wood chips would be a population within the ash pile.
- Soil outside/beneath the ash pile that could be contaminated with constituents from the ash pile would be another population

Lateral distribution of ash and soil contamination outside the ash pile:

The ash pile is present in the area immediately adjacent to the northern wall of Building 62. The lateral variability of soil beneath the ash pile should be investigated at locations corresponding to the expected horizontal variability of ash composition, which is discussed below under ash characterization. The soil adjacent to the ash pile could be contaminated from the edge of the ash pile to the northern shoreline. It is assumed that this contamination could have spread laterally approximately 10 feet to the east and west of the ash pile. It is also assumed that no impact of chemical contamination from the ash could have occurred on the south side of Building 62, however, it would be worthwhile to confirm this assumption. There are no temporal considerations for investigation of the lateral distribution of contamination.

Vertical distribution of the ash and soil contamination under the ash pile:

There is no need for vertical profiling of the ash pile contamination through chemical analysis. However, the contamination in the soil below the ash pile would require profiling. Sampling at two-foot intervals beneath the ash pile would be suitable for estimating the volume of contaminated soil for the EE/CA. The locations for vertical profiling of soil should coincide with those noted above for the lateral variability of soil. It is assumed that contamination to a depth of 10 feet bgs (the presumed depth to groundwater at low tide) would need to be investigated. Therefore, the samples near the groundwater table would need to be collected at or near the

low tide time of the river. The lag time between the groundwater table at the site and the river is expected to be minimal (i.e., less than 1 hour) because of the proximity of the site (less than 100 feet away) to the river.

The soil contamination outside the ash pile is expected to be mainly limited to the surface soil. However, because this assumption has a critical bearing on the estimation of the volume of contamination, selected locations will be vertically profiled for contamination up to the depth of the water table to verify the assumption.

EE/CA Secondary Decision Study Spatial Boundaries:
The spatial boundaries for the secondary question are within those of the principal question. No temporal boundaries are needed for the EE/CA secondary decision study.

SS Study Question Spatial Boundaries:
The SS is focused on detecting whether the sources at the site have impacted the environmental media at the locations where the currently available evidence suggests that such an impact is most likely to have occurred. Therefore, the locations should be selected at, or sufficiently near the known or suspected sources of contamination at the site. It is not necessary to determine the extent of the contamination for the SS. For example, the size of a groundwater plume (if one exists) is not required information for the SS. However, data collected to define the extent of contamination for a removal action can be used for the SS. This is because data can be included in the SS to provide an indication if the concentrations across the whole site exceed facility background levels and screening levels. Given this understanding, the following spatial study boundaries are defined for the environmental media at the site:

- Ash characterization:
  The horizontal variability of the ash composition is of greater concern for the SS because the information will help understand the spatial distribution of chemicals in other media across the site. The variation in ash composition is expected to occur along the longitudinal direction (east-west) along the edge of Building 62 based on the most likely pattern of ash disposal that might have occurred. The ash dimensions in the north-south direction are relatively small and suggest that less variability of ash composition can be expected in this direction. Considerations for the number of locations to represent the spatial variability are the following: (1) three possible historical sources of ash (the oil gasification process, black smithy, and the building fire), and (2) the disposal occurred during at least two distinct and large time periods, i.e., because the building fire would have been over a relatively very short-term in duration. The three sources of ash suggests that three layers (i.e., oldest at the bottom and more recent at the top) may be present. The two distinct and large time periods of the ash disposal suggests two general zones of ash in the horizontal direction. Therefore, at any location, a composite of three depths should be adequately indicative of the average composition of the ash at that location. A minimum of two locations (near the northern and southern ends of Building 62) should be adequate to represent the two zones of ash expected in the horizontal direction. A third location in the center of these two locations would provide useful additional information regarding the horizontal variability of the ash composition.

- Surface and Subsurface soil:
  - Surface soil is defined as 0 to 2 feet below ground surface (bgs). Subsurface soil will be any soil between 2 feet bgs and the water table or 10 feet bgs, whichever is shallower. The subsurface soil data will be used to compare to residential risk-screening levels, which is a very conservative approach considering that the potential exposure would be to a construction worker. Therefore, sampling at 4-foot intervals should be adequate to determine whether the subsurface soil has been impacted, rather than 2-foot intervals. (Note that any uncertainty in the difference in concentrations between the two 2-foot sections within a 4-foot section, compared to the concentrations in the composite 4-foot section should be minor considering the conservative nature of the risk-screening levels). The soil underneath the ash pile and within 10 to 20 feet of the perimeter of the ash pile is considered to be the spatial boundary of its affected area. The surface soil and subsurface soil near the wash pad may also indicate whether contamination has occurred at the release location.
  - The footprint of the site underneath buildings will not be sampled at this time. It is believed that the groundwater contamination and groundwater potentiometric surface will be sufficient to deduce whether or not contaminants are originating under buildings. This information will also indicate if pesticide operations have impacted the subsurface soil and groundwater.

- Groundwater:
  - Groundwater beneath the building and downgradient of the building will be considered as one population for this investigation to check for impact caused by the ash pile, sources within the building, and the pesticide rinse operations.
  - Groundwater data previously collected from facility background locations will be used as the reference to indicate whether or not the site groundwater has been impacted.
  - Groundwater upgradient of Bldg 62 (and located upgradient of the wash pad) will be considered the reference for assessing whether the Site 34 sources have impacted the groundwater.
  - Site groundwater will include the area side gradient to and downgradient of Building 62. Side gradient groundwater should be sampled close to Building 62 to increase the potential for detecting groundwater contamination.

- Sediment:
  - Samples should be collected in the offshore under Outfall 49. Sampling depth will be 0 to 10 cm, which will be consistent with the sampling program for the monitoring stations under the interim offshore monitoring program.
  - Any sediment present within the catch basin of the wash pad and any sediment present within the Outfall 49 pipe outlet should also be sampled, if possible.

SS Study Question Temporal Boundaries:

- Current impacts to the soil and groundwater from past releases are of primary concern.
- Groundwater is expected to be tidally influenced and the diurnal tidal effect on the groundwater is expected to be more significant than any seasonal effect. Sampling at low tide is expected to yield contaminant levels more representative of the impact to groundwater than high tide when dilution from surface water intrusion would occur.
- All of the sample collection for the SI will occur during one field event, however, the analyses will be phased with due consideration for analytical holding times. This phased

approach will control the analytical costs. (For example, if ash samples do not contain dioxins at levels that warrant their analyses in the soil.)

Data Quality Objective Step 5: Decision Rules

EE/CA Principal Decision Rule:
The decision rules for the EE/CA are intended to reduce the risk at the site and not for a complete risk assessment, which the Navy will conduct as part of an RI if the SS decision rules following the removal action determine the need.

The following table summarizes the steps to be followed for the EE/CA principal decision rule for extent of removal action.

EE/CA DECISION RULE TABLE

Medium	Condition	Action	Comment
Soil (beneath or around ash pile)	Ash/cinders present	Include that sample location/depth in removal action extent	Sample logs and professional judgement will be used.
Soil (beneath or around ash pile)	Any PAH or inorganic concentration exceeds background (1) and its concentration at any individual location exceeds its screening level for EE/CA (2)	Include that sample location/depth in estimating extent of contamination (2)	Additional sampling locations away from the ash pile may be required to better estimate the extent of contamination.
Soil (beneath or around ash pile)	Any PAH or inorganic concentrations exceeds background (1) but its concentration at any individual location does not exceed screening level for EE/CA (2) Or PAH or inorganic concentrations do not exceed background (1)	Extent of contamination is defined at that location.	Additional sampling is not required for EE/CA. Include that location for residual contamination for site screening
Soil (beneath or around ash pile)	PAH or inorganic concentrations do not exceed background (1)	Extent of contamination is defined at all locations	Additional sampling is not required for EE/CA. Include all locations for residual contamination for site screening

1. Site data set for each chemical must be shown to exceed facility background data set for that chemical to be considered for the removal action. Background evaluation will be conducted according to the following guidance: "Procedural Guidance for Statistically Analyzing Environmental Background Data" (SWDIV & EFA WEST, 1998) and the accompanying "Handbook for Statistical Analysis of Environmental Background Data" (SWDIV & EFA WEST, 1998).
2. Screening levels as discussed in the text will be used only to determine whether adequate data are available to meet the requirements of the Principal Study Question for the EE/CA. Preliminary

removal action cleanup levels will be developed as necessary to meet remedial action objectives to be defined in the EE/CA. The removal action extent will then be determined based on the preliminary cleanup levels such that the soil will meet acceptable risk levels following a removal action.

Note that for the EE/CA Principal Decision Rule:

- The EE/CA screening levels for selection of soil contaminants to include in the evaluation of removal action alternatives and for determining whether adequate data are available for estimating the extent of contamination in an EE/CA are the USEPA Region 9 Residential PRGs (including a factor of 0.1 for noncarcinogenic chemicals) with consideration of PNS Facility Background (as indicated in the table above).

SS Principal Decision Rule:
The following table summarizes the steps to be taken for the SS decision rule:

Medium	Condition	Action	Comment
Soil	Any chemical concentration exceeds background [1] and residential screening level [2]	Consider soil has been impacted. Recommend removal action or RI.	The soil data set will consist of data to be collected under the current investigation and any appropriate data from the confirmatory sampling at the time of the removal action.
	Any chemical concentration exceeds background [1] but does not exceed residential screening level [2]	Designate soil has not been impacted by that chemical. If soil has not been impacted by any chemical, then recommend no further action for soil outside buildings. Evaluate possible methods to investigate beneath buildings.	
	Any chemical concentration does not exceed background [1]	Designate soil has not been impacted by that chemical. If soil has not been impacted by any chemical, then recommend no further action for soil outside buildings. Evaluate possible methods to investigate beneath buildings.	
Groundwater	Any chemical concentration exceeds background [1] and risk-based screening level [2].	Consider groundwater has been impacted. Recommend removal action or RI.	Site groundwater data set excludes upgradient monitoring well data. However, the upgradient data will be used to evaluate whether the impact is attributable to Site 34 sources.
	Any chemical concentration exceeds background but does not exceed risk-based screening level [3].	Designate groundwater has not been impacted by that chemical. If no chemical has impacted groundwater, then recommend no further action for groundwater.	
(Table Continued on next page)	Any chemical concentration does not exceed background [1].	Designate groundwater has not been impacted by that chemical. If no chemical has impacted groundwater, then recommend no further action for groundwater.	

Sediment	No pesticide concentration exceeds ecological screening levels[2] in the offshore sediment samples	Propose no further action for these chemicals in the offshore of Site 34.	Continue monitoring of other COCs in the offshore as part of the ongoing interim offshore monitoring program.
	Any pesticide concentration exceeds an ecological screening level[2] in the offshore sediment sample only	Propose no further action for these chemicals in the offshore of Site 34.	Continue monitoring of other COCs in the offshore as part of the ongoing interim offshore monitoring program.
	Any pesticide concentration exceeds an ecological screening level[2] in the offshore sediment sample and onshore drain system/outfall sample.	Designate that the sediment may be contaminated by Site 34.	Continue monitoring of other COCs in the offshore as part of the ongoing offshore monitoring program. Evaluate the need for IRGs for the selected pesticides.

1. Site data set for each chemical must be shown to exceed facility background data set by statistical method (SWDIV & EFA WEST, 1998) for that chemical to be considered for the impact assessment. Background evaluation will be conducted according to the following guidance: "Procedural Guidance for Statistically Analyzing Environmental Background Data" (SWDIV & EFA WEST, 1998) and the accompanying "Handbook for Statistical Analysis of Environmental Background Data" (SWDIV & EFA WEST, 1998).
2. Residential and ecological screening levels are discussed in Section 2.0 of the QAPP.
3. Risk-based screening levels for the SS depend on the saline or brackish nature of the groundwater as discussed in Section 2.0 of the QAPP

Note that for the SS Principal Decision Rule:

- Screening levels for the soil are as follows:
    - For each carcinogenic chemical, a residential incremental cancer risk of 10^{-6} will be used.
    - For non-carcinogenic chemicals, a hazard index level of 0.1 will be used
    - For lead, the screening level will be set at the residential PRG level of 400 mg/kg.
- Screening levels for groundwater are as follows:
    - Facility-specific construction worker risk-based concentrations (facility specific RBCs) will be used if the water is saline/brackish. Tap-water PRGs will be used as screening levels if the groundwater is fresh.
    - Federal Water Quality Criteria (National Recommended Water Quality Criteria) (USEPA, April 1999), with a conservative dilution factor of 100 is proposed, for screening purposes.
- Sediment screening levels for pesticides are as follows:
    - OU4 PRGs
    - ER-Ms or similar values from literature and reference station values for other pesticides not included in the OU4 PRGs.

EE/CA Secondary Decision Rules:
To determine whether adequate data has been collected to conduct an EE/CA, the following decision rule applies:

- If a preliminary screening of technologies and process options indicates that an adequate set of alternatives can be developed and evaluated for effectiveness, implementability and cost, then conduct the EE/CA.

  Otherwise
  Collect additional site-specific data (such as treatability studies) before conducting the EE/CA.

Data Quality Objective Step 6: Establish Decision Error Tolerances
This step is not used for this project because a biased samping plan is required to meet the decision inputs.

Data Quality Objective Step 7: Sampling Plan Design

It is assumed that the ash is contaminated and must be addressed in the removal action. Therefore, visual evidence of the predominance of ash in any sample is adequate to determine that the sample is contaminated. Based on this conservative assumption, the primary sampling objective for the removal action is to determine the horizontal and vertical extent of the soil contamination that was caused by the constituents in the ash. The secondary objective for the removal action is sampling of the ash to obtain characteristics to aid in the engineering evaluation of remedial options. The primary sampling objective for the SS is to investigate whether soil, groundwater, and sediment contamination has occurred because of the sources at the site. Some of the data collected for the removal action on the vertical and horizontal extent of soil contamination can also be used for the SS because they may be representative of the site following the removal action. Also, data to be collected from the confirmatory sampling after a removal action (which is not included in this investigation) may be used for the SS.

The following is a discussion of the rationale for the sampling and analytical plan for the current investigation. Please refer to Figure 4-1 in the QAPP for the areas discussed below.

Ash Pile Characterization
Additional information on the chemical characterization of the ash (for an indication of the variability of the contaminant levels) is needed to meet the needs of the SS. Given the relatively small area covered by the ash pile (approximately 90 feet long by 15 to 30 feet wide), and the rationale based on an understanding of the sources of ash generation discussed in DQO Step 4, it is expected that samples from three locations should adequately characterize the horizontal variability of the ash composition. The three samples should be collected from a minimum depth of 2 feet below the surface of the ash pile in order to include VOCs, if any. A full suite of analyses (TCL organics-VOCs, SVOCs, pesticides, PCBs, and TAL inorganics) will be conducted. Analyses of dioxins will also be conducted. Analysis of cyanide will be included if a Prussian blue color is noted in the ash. The sample from each location will be a composite of soil from three depths, except for VOCs analysis, which will require discrete samples. However, based on the historical knowledge of the ash generation, it is unlikely that VOCs will be prevalent, therefore only three of the nine discrete samples will be selected for VOCs analysis based on field screening.

Within the ash pile, additional sampling locations will be used for vertical profiling of the ash. These samples will be collected for engineering parameters to support the removal action will also be required, and these are discussed further later on.

Soil Contamination Beneath Ash Pile

For the removal action, the vertical extent of soil contamination beneath the ash pile is required. Three locations should be adequate for characterizing the horizontal variability of soil contamination beneath the ash pile, for the reasons stated above for the ash pile characterization. For soil sampling, the boring will proceed from the top of the ash pile with visual determination of the physical characteristics of the ash, until the underlying soil is encountered. When a visual determination is made that soil has been encountered, then samples of soil will be collected at discrete sampling depths until groundwater is encountered or 10 feet below ground surface (whichever is shallower). Soil analyses for PAHs and metals will suffice for the analytical data needed to support the removal action. Sampling intervals of 2 feet will be useful to estimate the volume of soil contamination with adequate accuracy. This data will provide the vertical "profiling" of soil for the estimation of contaminated soil volume to be included in the removal action.

For the SS, additional analyses of a full suite (TCL organics-VOCs, SVOCs, pesticides, PCBs, and TAL inorganics) will be conducted. Sampling intervals can be broader than those required for the volume estimation, and therefore a 4-foot interval is adequate. (Note that for estimation of vertical extent, the data from the 2-foot sampling intervals from under the ash pile can be extrapolated to the locations outside the ash pile. This extrapolation should be adequate for the preliminary purposes of an EE/CA). Samples for dioxin analyses will be put on hold until the ash characterization results are available. The decision to analyze for dioxins in the soil samples will follow the decision tree attached to the DQOs (Attachment 1). . Soil samples will be analyzed for cyanide if one or more ash samples are selected for cyanide analysis based on field observations, as noted above.

Note that samples considered "clean" for defining the vertical extent for removal action can be used for the SS. The analytical requirements for the confirmatory sampling will be determined in a work plan for the removal action. These samples may also be used to supplement the data for the SS.

Soil Contamination Outside Ash Pile

For the removal action, the horizontal extent of contamination in the soil is required. Considering typical historical filling and waste disposal practices, it is likely that disposal of the waste occurred adjacent to the building in the beginning of the plant operations and continued in an outwardly direction over time. Visual information of the presence of ash indicates that the disposal did not extend beyond what is currently known to be Storer Street. However, surface soil contamination (in the 0 to 1 foot bgs depth) has been noted in samples taken from the northern side of this street in 1998, which is expected to have been caused by erosion of the ash pile surface followed by deposition. Therefore, subsurface soil contamination is not expected to be found in the area north of Storer Street, which needs to be verified. Similarly, based on visual information, the ash disposal seems to have ended at a distance of approximately 23 feet beyond the eastern end of Building 62, with a limited area of ash disposal in the space between Building 62 and Building 63. Also based on visual information, the western edge of the ash disposal seems to be near the end of Building 62-Annex. A limited area of disposal also appears to exist between Building 62 and Building 62-Annex. These five visual observations of the horizontal extent of the ash also need to be verified. Although five

locations may suffice, a sixth additional location is proposed to provide more confidence on the extent of soil contamination north of the ash pile, therefore yielding a total of six locations.

At these six locations, soil samples will be taken at discrete sampling depths until groundwater is encountered or 10 feet below ground surface (whichever is shallower) for chemical analysis, which will be used to verify that the location is "clean". It is acknowledged that surface soil sampling alone will not suffice at these six locations because contaminants could have leached from the adjacent ash and migrated into the subsurface soil while the surface soil may not have been impacted. Therefore, subsurface soil sampling is required at these six locations. At these locations, the sampling will begin at the depth where the fraction of ash in comparison to the soil is no longer predominant in a sample. Analyses to support the removal action only require PAHs and metals. The area of contamination outside the ash pile is expected to be limited; therefore a 2-foot resolution in sampling depth is not required for a more precise estimation of volume. A 4-foot sampling interval will suffice especially because the vertical profiling beneath the ash pile can be used to extrapolate the depth of soil contamination outside the ash pile.

Soil samples for the SS will be obtained from the same location as those noted above for the ash pile. If one or more of these samples yield data that are considered "clean" for defining the horizontal extent for removal action, then those samples can be used for the SS. If one of more of these locations yield data that are not considered "clean" for defining the horizontal extent for removal action, then additional sampling locations may need to be reconsidered in a subsequent sampling event. Analyses to support the SS will consist of a full suite, as noted previously. A 4-foot soil sampling interval will be adequate, as discussed earlier under spatial boundaries. Samples for dioxin analyses will be put on hold until the ash characterization results are available. The decision to analyze for dioxins in the soil samples will follow the decision tree provided in Attachment 1 of the DQOs. Soil samples will be analyzed for cyanide if one or more ash samples are selected for cyanide analysis based on field observations, as noted above.

In addition, soil samples will also be collected from the pesticide rinse area. Analyses of soil samples from this location will be limited to pesticides.

Groundwater Impact Investigation

In order to investigate whether the groundwater has been impacted, the subsurface zone directly beneath or downgradient of the sources (ash pile, tar pit inside Building 62, wash pad outside the Building 62) will be investigated. A monitoring point will also be required in a location upgradient of the source to provide a perspective on the groundwater contamination beneath the source. From past knowledge of hydrogeology at PNS, the general groundwater flow direction is known to be towards the Piscataqua River. Therefore the upgradient monitoring well will be located on the Smoot Street side of Building 62. Three other monitoring points (east and west sidegradient locations, and north downgradient location) will be located near the ash pile and Building 62. Soil sample locations selected to meet the needs discussed previously can be converted to groundwater monitoring points.

It is also noted that the groundwater may be tidally influenced at this site because of its proximity (i.e., less than 100 feet) from the shoreline. Therefore, the groundwater flow direction is expected to reverse at high tide. To verify the groundwater flow direction at low tide, additional groundwater elevation information is also required. The five monitoring points proposed above will be used to obtain the required information. Unless a determination has been made that there has been an impact to the groundwater at this site, it is not necessary to

install permanent monitoring wells. Moreover, because of the rapidly changing terrain at the proposed locations of some of the monitoring wells (in the ash pile and downgradient), a well point (i.e., a small diameter well of temporary construction using a truck-mounted drill rig) would be easier to install. Therefore, all of the monitoring wells will be installed as temporary well points.

To meet the SS objective, the groundwater samples from the five locations will be analyzed for the full suite, i.e., TCL VOCs, TCL SVOCs, TAL metals, and TCL pesticides/PCBs,. Cyanide will be included if the ash and soil samples are selected for cyanide analysis based on the field observation for Prussian blue coloration, as noted previously. Dioxins have a low propensity for migration in the soil environment due to dissolution. Therefore, evidence of dioxin presence in subsurface soil would be needed before groundwater sampling is considered.

Sediment Impact Investigation

Sediment sampling for this investigation will focus on determining whether discharges from previous pesticide storage and handling activities in Building 62 through the storm sewer system to Outfall 49 has potentially impacted the offshore.

- Samples should be collected in the offshore under Outfall 49. Sampling depth will be 0 to 10 cm, which will be consistent with the sampling program for the monitoring stations under the interim offshore monitoring program.
- Any sediment present within the catch basin of the wash pad and any sediment present within the Outfall 49 pipe outlet should also be sampled, if possible.
- TCL Pesticides analysis will be conducted.

Secondary Data to Support EE/CA

To meet the secondary objective, additional sampling locations in a row between the edge of the ash pile and the borings used for profiling will be required. These sampling locations will be used for visual identification of the depth of the ash only, and will terminate when the interface with the soil is encountered. For confirmation that the bottom of the ash pile has been encountered, the lack of a predominance of ash in comparison to the soil fraction will be used as the indicator. For engineering parameters, a few samples representative of the ash will be needed. Composite samples selected in the field to be representative of the variability in type of material will be collected for grain-size (sieve analysis) and intact samples using Shelby tubes will be collected from the same locations for bulk density testing. If adequate recovery cannot be obtained (i.e., 24 inches), then a composite will be taken and laboratory instructed to recompact the material for bulk density measurement. The laboratory will also be instructed to measure a bulk density of the material without compaction in a loosely filled container. The two readings will be used to obtain a range of bulk densities for engineering purposes. If a sample containing a free product is noted (i.e., oily appearance and odor), then that sample will be collected for TPH and heating value.

The following table summarizes the sampling and analytical rationale based on the above discussion.

SITE 34 SITE INVESTIGATION SAMPLE SUMMARY

Sample Location	Sample Matrix/Sampling Interval/Analytical program	Proposed Use of Data		Summary of Rationale for Data Usage
		EE/CA	SS	
34-01 (TW-01)	Groundwater/Shallow overburden/Full Suite[1]		X	• Upgradient to assess impact on site groundwater
34-01	Soil (0-2, 2-6, 6-10 ft bgs or to water table) / Full Suite[1]		X	• SS of soil
34-02	Soil (0-2, 2-6, 6-10 ft bgs or to water table) / PAHs, metals	X		• Horizontal Extent for EE/CA
34-03 (TW-02)	Groundwater/Shallow overburden/Full Suite[1]		X	• Downgradient impact on site groundwater north of source
34-03	Soil (0-2, 2-6, 6-10 ft bgs or to water table) / Full Suite[1]	X	X	• Horizontal Extent for EE/CA • SS of soil
34-04 (TW-03)	Groundwater/Shallow overburden/Full Suite[1]		X	• Sidegradient impact on site groundwater east of source
34-04	Soil (0-2, 2-6, 6-10 ft bgs or to water table) / Full Suite[1]	X	X	• Horizontal Extent for EE/CA • SS of soil
34-05 (TW-04)	Groundwater/Shallow overburden/Full Suite[1]		X	• Source impact on site groundwater
34-05	Soil under ash pile (0-2, 2-4, 4-6, 6-8, 8-10 ft bgs or to water table) [3] /Full Suite[1]	X	X	• Vertical Extent for EE/CA • SS of soil
34-06	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-07	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-08	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-09	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-10	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization

SITE 34 SITE INVESTIGATION SAMPLE SUMMARY

Sample Location	Sample Matrix/Sampling Interval/Analytical program	Proposed Use of Data		Summary of Rationale for Data Usage
		EE/CA	SS	
34-11	Ash /To natural soil/Engineering parameters [2,4]/Chemical characterization [5]	X	X	• Ash volume and evaluation of removal action alternatives • Source characterization
34-12	Soil under ash pile (0-2, 2-4, 4-6, 6-8, 8-10 ft bgs or to water table) [3] /Full Suite [1]	X	X	• Vertical Extent for EE/CA • SS of soil
34-13	Soil under ash pile (0-2, 2-4, 4-6, 6-8, 8-10 ft bgs or to water table) [3] /Full Suite[1]	X	X	• Vertical Extent for EE/CA • SS of soil
34-14	Soil outside ash pile (0-2, 2-6, 6-10 ft bgs, or to water table) / PAHs, metals	X		• Horizontal Extent for EE/CA
34-15	Soil outside ash pile (0-2, 2-6, 6-10 ft bgs, or to water table) / Full Suite [1]	X	X	• Horizontal Extent for EE/CA • SS of soil
34-15 (TW-05)	Groundwater/Shallow overburden/Full Suite[1]		X	• Side gradient impact on site groundwater west of source
34-16	Soil under wash pad (0-2, 2-6, 6-10 ft bgs, or to water table)/Pesticides,		X	• Impact of pesticide operations for SS of soil
34-17	Soil outside ash pile (0-2, 2-6, 6-10 ft bgs, or to water table)/PAHs, metals	X		• Horizontal extent for EE/CA
34-18 (SD-01)	Sediment sample from catch basin at wash pad (Pesticides)		X	• Impact of pesticide operations for SS of sediment
34-19 (SD-02)	Sediment sample from Outfall 49 outlet (Pesticides)		X	• Impact of pesticide operations for SS of sediment
34-20 (SD-03)	Sediment sample from offshore underneath Outfall 49 (Pesticides)		X	• Impact of pesticide operations for SS of sediment

Note: X indicates that the data from the sample will be used for the purpose indicated in the appropriate column header, i.e., EE/CA or SS. A blank entry indicates that the data will not be used for purpose indicated in the header.

1. Full suite: TCL VOCs, TCL SVOCs, TAL inorganics, and TCL Pesticides/PCBs. Groundwater analyses for filtered and unfiltered samples for TAL metals only, and all other analyses will be on unfiltered samples. Dioxin analysis will not be included for groundwater samples. Dioxin analysis will be placed on hold for soil samples. Cyanide analysis will be included on all soil and groundwater samples if ash samples are selected in the field (see footnote 5) for cyanide analysis.
2. Engineering parameters: Grain-size, bulk density, and heat of combustion of free product, if present.

3. Soil sampling intervals at this location start at 0 feet bgs= beginning at the surface soil beneath the ash pile.
4. Composite samples from three of these locations will be selected in the field for the engineering parameters except bulk density. For bulk density, three intact samples from these locations will be selected in the field and collected using a shelby tube.
5. One composite ash sample from 3 of the 6 locations (total of 3 composite samples) will be analyzed for a full suite, and dioxins. Cyanide analysis will be conducted if limestone or woodchips are present with a prussian blue coloration. For VOC analysis, field screening will be used to select a discrete ash grab sample from each location prior to compositing.

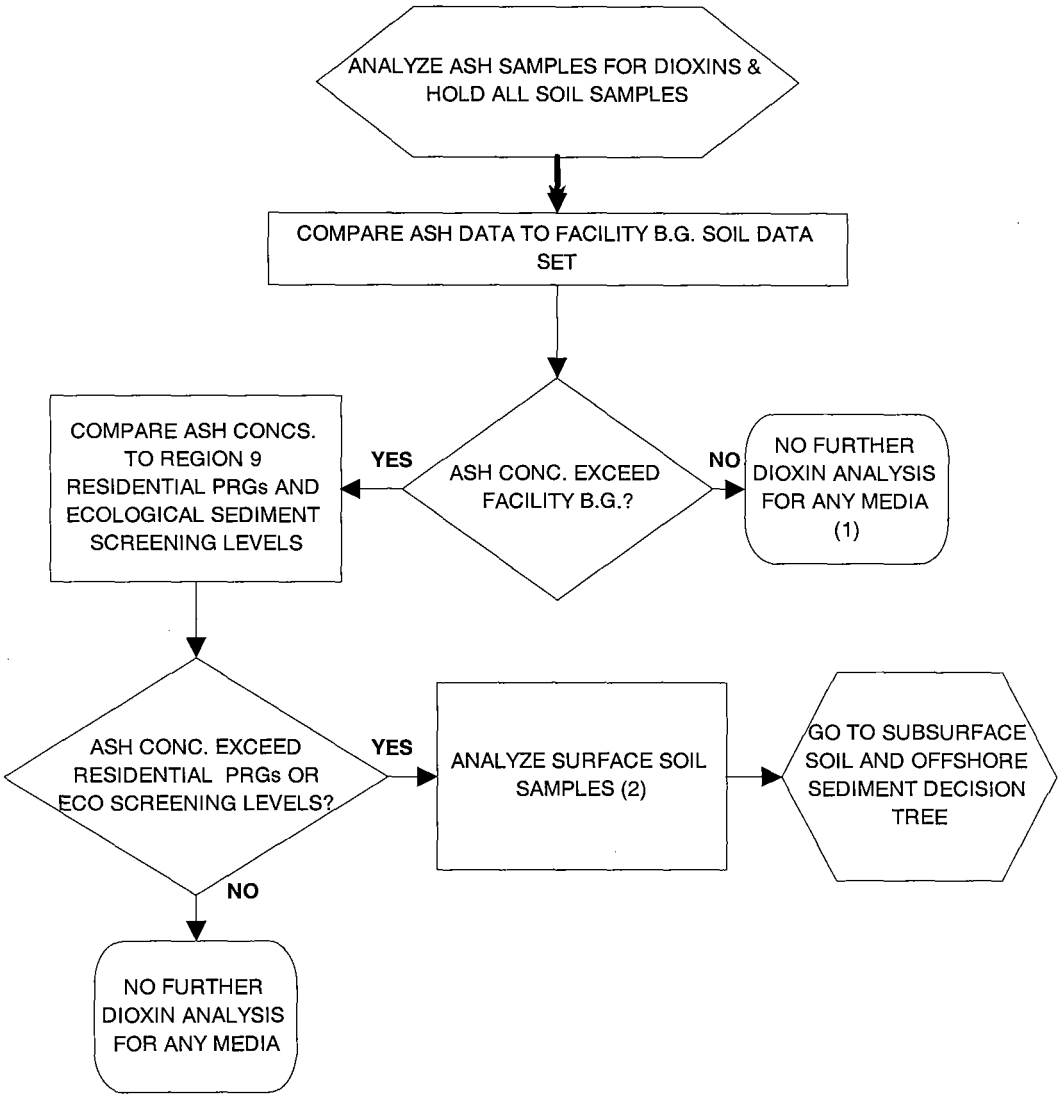
ATTACHMENT 1
Decision Tree for Analysis of Dioxin in Soil and Sediment Samples at Site 34

DECISION TREE FOR ANALYSIS OF DIOXIN IN SUBSURFACE SOIL AND OFFSHORE SEDIMENT AT SITE 34, PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

The decision tree consists of a step-by-step evaluation of potential findings of dioxin levels in the ash to make decisions to analyze other media that could be impacted by the ash. The conceptual pathway of dioxin migration from the ash pile (if indeed the ash contains dioxins), is via erosion to the surface soil, followed by further erosion to the offshore sediment or vertical migration to subsurface soil. For example, unless the ash contains dioxins above human health risk-screening levels and facility soil background levels, it is unlikely for surface soil or subsurface soil to be impacted above the same levels, and therefore it is unnecessary to analyze the soil samples for dioxins. Similarly, unless the surface soil is impacted above ecological screening levels and facility soil background levels, it is should not be expected to have potentially impacted offshore sediment above the ecological screening levels. The screening levels that will be used for determining whether or not to analyze for dioxin, are the following: (1) USEPA Region 9 Residential PRGs for human health risk-screening and, (2) USEPA ecological screening levels obtained from literature (USEPA, 1993 "Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife") that were used in the Baseline Interim Offshore Monitoring Report for Operable Unit 4 (TtNUS, July 2002), and (3) PNS Facility Background concentrations to be collected as part of the Site 32 Remedial Investigation. While these screening levels will be used as conservative indicators in the dioxin analysis decisions, it must be noted that they do not necessarily apply to the human health risk screening and the ecological risk screening for all media. For example, although the ecological screening levels are used for the dioxin analysis decision making for ash, the dioxin data to be obtained from the ash will not be used to make site screening decisions for the offshore sediment. The dioxin data for the sediment (if obtained), will be used to make such decisions for the offshore sediment.

Groundwater sampling and analysis for dioxin will not be conducted until there is evidence indicating the migration of dioxins from the source and surface soils at the site to subsurface soils at the site. The need for dioxin data for site groundwater will be determined based on the results of the subsurface soil dioxin data (if subsurface soil need to be analyzed for dioxin) and the Navy will propose the additional sampling requirements for groundwater at that time.

DECISION TREE FOR ANALYSIS OF DIOXIN IN SURFACE SOIL SAMPLES AT SITE 34 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

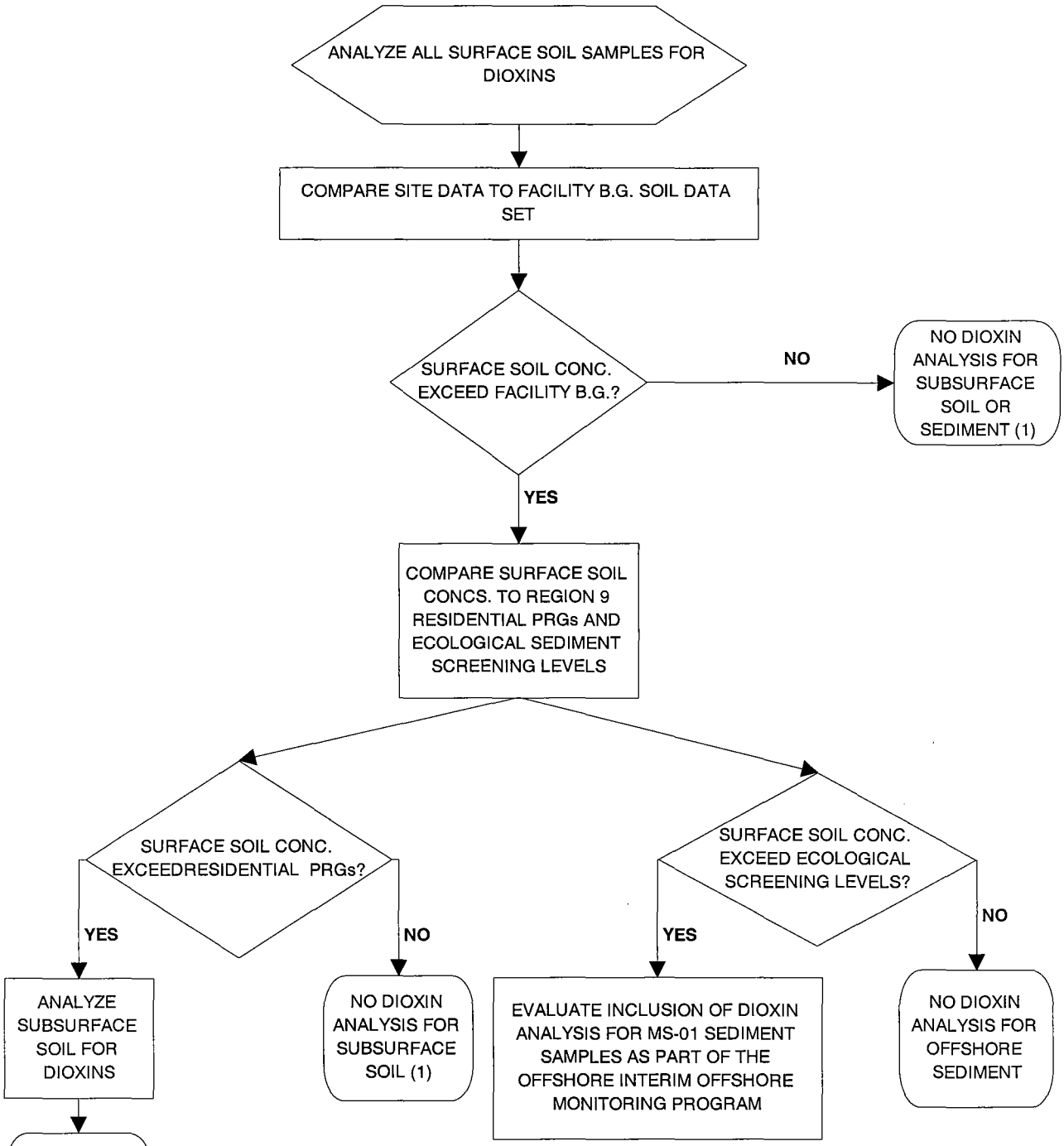


Footnotes:

(1) Analysis of dioxins in surface soils, subsurface soils, and sediment will not be cnducted. However, the site screening evaluation will continue using the remaining data following the decision rules discussed in the DQOs, and summarized in Section 2.0

(2) Surface soil samples will be collected from the 0-2 ft bgs depth at locations outside the ash pile. Under the ash pile, the surface soil sample depth begins beneath the bottom of the ash pile as discussed in the QAPP

DECISION TREE FOR ANALYSIS OF DIOXIN IN SUBSURFACE SOIL AND OFFSHORE SEDIMENT SAMPLES AT SITE 34 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE



Footnotes:

(1) The site screening evaluation will continue using the remaining data and surface soil dioxin data following the decision rules discussed in the DQOs, and summarized in Section 2.0

(2) The site screening evaluation will continue using the remaining data and the dioxin data for surface soil and subsurface soil, following the decision rules discussed in the DQOs, and summarized in Section 2.0. The need for groundwater sampling and analysis for dioxins will be determined based on the results of the subsurface samples.

APPENDIX C

STANDARD OPERATING PROCEDURES & FIELD DOCUMENTATION FORMS

S1 HS-1.0 UTILITY LOCATING AND EXCAVATION CLEARANCE

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1.0 PURPOSE

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations. Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility locating services. It is the policy of Tetra Tech NUS, Inc. (TtNUS) to provide a safe and healthful work environment for the protection of our employees. The purpose of this Standard Operating Procedure (SOP) is to aid in achieving the objectives of the TtNUS Utility Locating and Clearance Policy. The TtNUS Utility Locating and Clearance Policy must be reviewed by anyone potentially involved with underground or overhead utility services.

2.0 SCOPE

This procedure applies to all TtNUS field activities where there may be potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of typical methods used to determine the presence or absence of utility services. This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to the development of detailed operating procedures. This guidance is not intended to provide a detailed description of methodology and instrument operation. Specialized expertise during both planning and execution of several of the geophysical methods may also be required.

3.0 GLOSSARY

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Magnetometer – A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey – A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal Detection – A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

Vertical Gradiometer – A magnetometer equipped with two sensors that are vertically separated by a fixed distance. It is best suited to map near surface features and is less susceptible to deep geologic features.

Ground Penetrating Radar – Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture.

4.0 RESPONSIBILITIES

Project Manager (PM)/Task Order Manager (TOM) - Responsible for ensuring that all field activities are conducted in accordance with this procedure and the TtNUS Utility Locating and Clearance Policy.

Site Manager (SM)/Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Site Health & Safety Officer (SHSO) – Responsible to provide technical assistance and verify full compliance with this SOP and the TtNUS Utility Locating and Clearance Policy. The SHSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager (HSM) and to the PM/TOM.

Health & Safety Manager (HSM) – Responsible for preparing, implementing, and modifying corporate health and safety policy.

Site Personnel – Responsible for understanding and implementing this SOP and the TtNUS Utility Locating and Clearance Policy.

5.0 PROCEDURES

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed individually from a buried and overhead standpoint.

5.1 Buried Utilities

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown or incorrectly known on client properties. The following procedure must be followed prior to beginning any excavation that might potentially be in the vicinity of underground utility services. In addition, the Utility Clearance Form (Attachment 3) must be completed for every location or cluster of locations where intrusive activities will occur.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM/TOM is responsible for arranging for the procurement of a qualified, experienced, utility locating subcontractor who will accomplish the utility location and demarcation duties specified herein.

1. A comprehensive review must be made of any available property maps, blue lines, or as-builts prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities. Information regarding utility locations shall be added to project maps upon completion of this exercise.

2., A visual site inspection must be performed to compare the site plan information to actual field conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation or other subsurface activities must be marked at the site in white paint or pin flags to identify those locations of the proposed intrusive activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, electrical service vaults/panels, asphalt/concrete scares and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information regarding utility locations shall be added to project maps upon completion of this exercise and returned to the PM/TOM.

3. If the planned work is to be conducted on private property (e.g., military installations, manufacturing facilities, etc.) the FOL must identify and contact appropriate facility personnel (e.g., public works or facility engineering) before any intrusive work begins to inquire about (and comply with) property owner requirements. It is important to note that private property owners may require several days to several weeks advance notice prior to locating utilities.

4. If the work location is on public property, the state agency that performs utility clearances must be notified (see Attachment 1). State "one-call" services must be notified prior to commencing fieldwork per their requirements. Most one-call services require, by law, 48- to 72-hour advance notice prior to beginning any excavation. Such services typically assign a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again. The utility service will notify utility representatives who then mark their respective lines within the specified time frame. It should be noted that most military installations own their own utilities but may lease service and maintenance from area providers. Given this situation, "one call" systems may still be required to provide location services on military installations.

5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other accepted means. The location of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code:

white	excavation/subsurface investigation location
red	electrical
yellow	gas, oil, steam
orange	telephone, communications
blue	water, irrigation, slurry
green	sewer, drain

6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., the work area must be thoroughly investigated prior to beginning the excavation. In these situations, utilities must be identified using such methods as passive and intrusive surveys, physical probing, or hand augering. Each method has advantages and disadvantages including complexity, applicability, and price. It also should be noted that in many states, initial excavation is required by hand to a specified depth.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment, and where utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed with a hand auger or pole (tile probe) made of non-conductive material. If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.

8. All utilities uncovered or undermined during excavation must be structurally supported to prevent potential damage. Unless necessary as an emergency corrective measure, TtNUS shall not make any repairs or modifications to existing utility lines without prior permission of the utility owner, property owner, and Corporate HSM. All repairs require that the line be locked-out/tagged-out prior to work.

5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be

adequate to prevent employees from contacting such lines directly with any part of their body or indirectly though conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

Nominal Voltage	Minimum Clearance
0 -50 kV	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

6.0 UNDERGROUND LOCATING TECHNIQUES

6.1 Geophysical Methods

Geophysical methods include electromagnetic induction, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic induction, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References (Section 8.0).

Electromagnetic Induction

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is an EM-61.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

Magnetics

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

Ground Penetrating Radar

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

6.2 Passive Detection Surveys

Acoustic Surveys

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

Thermal Imaging

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

Hand-auger Surveys

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other methods, borings must be hand-augered for all locations where there is a potential to impact buried utilities. The minimum hand-auger depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the

placement of buried utilities is influenced by frost line depths that vary by geographical region. Attachment 2 presents frost line depths for the regions of the contiguous United States. At a minimum, hand-auger depths must be at least to the frost line depth plus two (2) feet, but never less than 4 feet below ground surface (bgs). For augering, the hole must be reamed by hand to at least the diameter of the drill rig auger or bit prior to drilling. For soil gas surveys, the survey probe shall be placed as close as possible to the cleared hand-auger. It is important to note that a post-hole digger must not be used in place of a hand-auger.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, tile probes may be used instead of or in addition to hand-augers. Tile probes must be performed to the same depth requirements as hand-augers. Depending upon the site conditions and intended probe usage, tile probes should be made of non-conductive material such as fiberglass.

7.0 INTRUSIVE ACTIVITIES SUMMARY

The following list summarizes the activities that must be performed prior to beginning subsurface activities:

1. Map and mark all subsurface locations and excavation boundaries using white paint or markers specified by the client or property owner.

2. Notify the property owner and/or client that the locations are marked. At this point, drawings of locations or excavation boundaries shall be provided to the property owner and/or client so they may initiate (if applicable) utility clearance.

   Note: Drawings with confirmed locations should be provided to the property owner and/or client as soon as possible to reduce potential time delays.

3. Notify "One Call" service. If possible, arrange for an appointment to show the One Call representative the subsurface locations or excavation boundaries in person. This will provide a better location designation to the utilities they represent. You should have additional drawings should you need to provide plot plans to the One Call service.

4. Complete Attachment 3, Utility Clearance Form. This form should be completed for each excavation location. In situations where multiple subsurface locations exist within the close proximity of one another, one form may be used for multiple locations provided those locations are noted on the Utility Clearance Form. Upon completion, the Utility Clearance Form and revised/annotated utility location map becomes part of the project file.

8.0 REFERENCES

TtNUS Utility Locating and Clearance Policy
TtNUS SOP GH-3.1; Resistivity and Electromagnetic Induction
TtNUS SOP GH-3.2; Magnetic and Metal Detection Surveys
TtNUS SOP GH-3.4; Ground-penetrating Radar Surveys

ATTACHMENT 1
LISTING OF UNDERGROUND UTILITY CLEARANCE RESOURCES

ALABAMA
Alabama Line Location (800) 292-8525

Tucson Blue Stake Center (800) 782-5348

Alaska
Locate Call Center of Alaska Inc. (800) 478-3121

Arizona
Arizona Blue Stake Inc. (800) 782-5348

Arkansas
Arkansas One Call System Inc. (800) 482-8998

California
Underground Service Alert North (800) 227-2600

Underground Service Alert South (800) 227-2600

Colorado
Utility Notification Center of Colorado
(800) 922-1987

Connecticut
Call Before You Dig (800) 922-4455

Delaware
Miss Utility of Delmarva
(800) 282-8555

District of Columbia
Miss Utility (800) 257-7777

Florida
Call Sunshine (800) 432-4770

Georgia
Utilities Protection Center Inc.
(800) 282-7411

Idaho
Palouse Empire Underground Coordinating Council
(800) 882-1974

Utilities Underground Location Center
(800) 424-5555

Kootenai Country Utility Coordinating Council
(800) 428-4950

Shoshone County One Call (800) 398-3285

Dig Line (800) 342-1585

One Call Concepts (800) 626-4950

Illinois
Julie Inc. (800) 892-0123

Digger (Chicago Utility Alert Network)
(312) 744-7000

Indiana
Indiana Underground Plant Protection Services
(800) 382-5544

Iowa
Underground Plant Location Service Inc.
(800) 292-8989

Kansas
Kansas One-Call Center (800) 344-7233

Kentucky
Kentucky Underground Protection Inc.
(800) 752-6007

Louisiana
Louisiana One Call (800) 272-3020

Maine
Dig Safe – Maine (800) 225-4977

Maryland
Miss Utility (800) 257-777

Miss Utility of Delmarva (800) 282-8555

Massachusetts
Dig Safe – Massachusetts (800) 322-4844

Michigan
Miss Dig System (800) 482-7171

Minnesota
Gopher State One Call (800) 252-1166

Mississippi
Mississippi One-Call System Inc. (800) 227-6477

Missouri
Missouri One Call System Inc. (800) 344-7483

Montana
Utilities Underground Location Center
(800) 424-5555

Montana One Call Center (800) 551-8344

Nebraska
Diggers Hotline of Nebraska (800) 331-5666

Nevada
Underground Service Alert North (800) 227-2600

New Hampshire
Dig Safe – New Hampshire (800) 225-4977

New Jersey
New Jersey One Call (800) 272-1000

New Mexico
New Mexico One Call System Inc.
(800) 321-ALERT

Las Cruces-Dona Utility Council (505) 526-0400

New York
Underground Facilities Protection Organization
(800) 962-7962

New York City: Long Island One Call Center
(800) 272-4480

North Carolina
The North Carolina One-Call Center Inc.
(800) 632-4949

North Dakota
Utilities Underground Location Center
(800) 795-0555

Ohio
Ohio Utilities Protection Service
(800) 362-2764

Oil & Gas Producers Underground Protection Service
(800) 925-0988

Oklahoma
Call Okie (800) 522-6543

Oregon
Utilities Underground Location Center
(800) 424-5555

Douglas Utilities Coordinating Council
(503) 673-6676

Josephine Utilities Coordinating Council
(503) 476-6676

Rogue Basin Utility Coordinating Council
(503) 779-6676

Utilities Notification Center
(800) 332-2344

Pennsylvania
Pennsylvania One Call System Inc.
(800) 242-1776

Rhode Island
Dig Safe – Rhode Island (800) 225-4977

South Carolina
Palmetto Utility Protection Service Inc.
(800) 922-0983

South Dakota
South Dakota One Call (800) 781-7474

Tennessee
Tennessee One-Call System (800) 351-1111

Texas
Texas One Call System (800) 245-4545

Texas Excavation Safety System (800) 344-8377

Lone Star Notification Center (800) 669-8344

Utah
Blue Stakes Location Center (800) 662-4111

Vermont
Dig Safe – Vermont (800) 225-4977

Virginia
Miss Utility of Virginia (800) 552-7001

Miss Utility (800) 257-7777

Miss Utility of Delmarva (800) 441-8355

Washington
Utilities Underground Location Center
(800) 424-5555

Grays Harbor & Pacific County
Utility Coordinating Council
(206) 535-3550

Utilities County of Cowlitz County
(360) 425-2506

Chelan-Douglas Utilities Coordinating Council
(509) 663-6111

Upper Yakima County
Underground Utilities Council
(800) 553-4344

Inland Empire Utility Coordinating Council
(509) 456-8000

Palouse Empire Utilities Coordinating Council
(800) 822-1974

Utilities Notification Center (800) 332-2344

West Virginia
Miss Utility of West Virginia Inc. (800) 245-4848

Wisconsin
Diggers Hotline Inc. (800) 242-8511

Wyoming
West Park Utility Coordinating Council
(307) 587-4800

Call-In Dig-In Safety Council (800) 300-9811

Fremont County Utility Coordinating Council
(800) 489-8023

Central Wyoming Utilities Coordinating Council
(800) 759-8035

Southwest Wyoming One Call (307) 362-8888

Carbon County Utility
Utility Coordinating Council (307) 324-6666

Albany County Utility Coordinating Council
(307) 742-3615

Southeast Wyoming Utilities Coordinating Council
(307) 638-6666

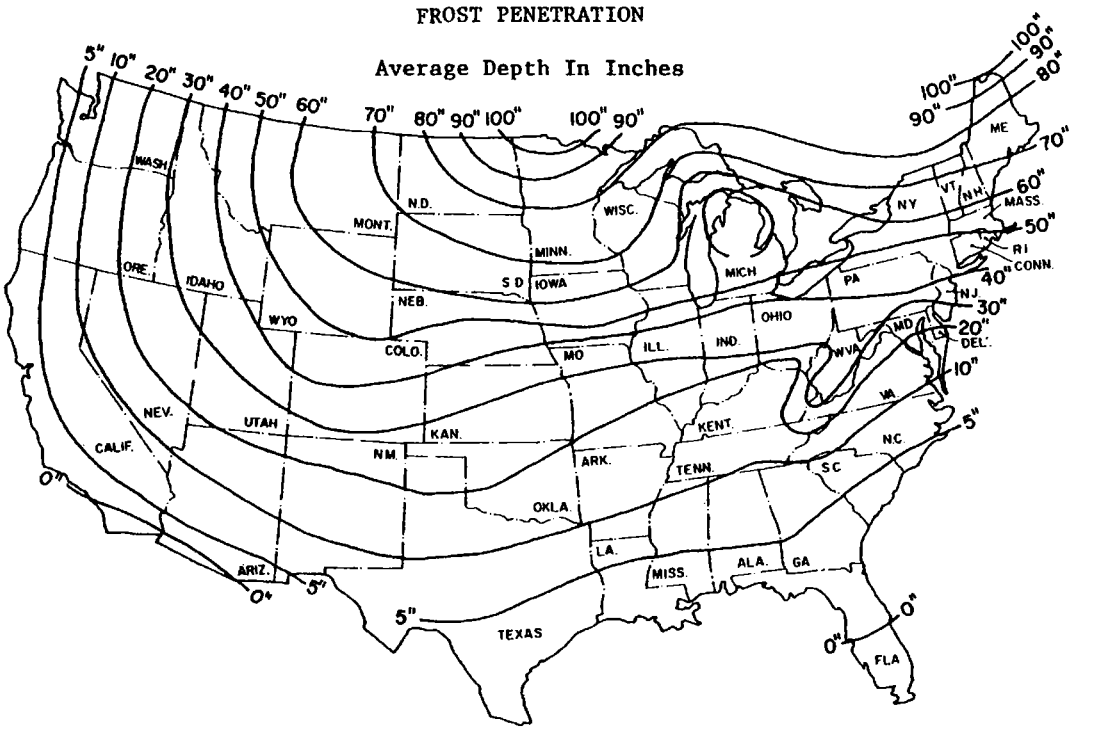
Wyoming One-Call
(800) 348-1030

Utilities Underground Location Center
(800) 454-5555

Converse County Utility Coordination Council
(800) 562-5561

ATTACHMENT 2

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



Courtesy U.S. Department Of Commerce

ATTACHMENT 3
UTILITY CLEARANCE FORM

Client: _____ Project Name: _____

Project No.: _____ Completed By: _____

Location Name: _____ Work Date: _____

Excavation Method/Overhead Equipment: _____

1. Underground Utilities — Circle One

a)	Review of existing maps?	yes no N/A
b)	Interview local personnel?	yes no N/A
c)	Site visit and inspection?	yes no N/A
d)	Excavation areas marked in the field?	yes no N/A
e)	Utilities located in the field?	yes no N/A
f)	Located utilities marked/added to site maps?	yes no N/A
g)	Client contact notified Name _____ Telephone: _____ Date: _____	yes no N/A
g)	State One-Call agency called? Caller: _____ Ticket Number: _____ Date: _____	yes no N/A
h)	Geophysical survey performed? Survey performed by: _____ Method: _____ Date: _____	yes no N/A
i)	Hand augering performed? Augering completed by: _____ Total depth: _____ feet Date: _____	yes no N/A
j)	Trench/excavation probed? Probing completed by: _____ Depth/frequency: _____ Date: _____	yes no N/A

2. Overhead Utilities — Present Absent

a)	Determination of nominal voltage	yes no N/A
b)	Marked on site maps	yes no N/A
c)	Necessary to lockout/insulate/re-route	yes no N/A
d)	Document procedures used to lockout/insulate/re-route	yes no N/A
e)	Minimum acceptable clearance (SOP Section 5.2): _____	

3. Notes:

_____

_____

_____

Approval:

_____ _____

Site Manager/Field Operations Leader Date

c: PM/Project File
Program File

S2 SA-2.5 DIRECT PUSH TECHNOLOGY

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1.0 PURPOSE

The purpose of this procedure is to provide general reference information on Direct Push Technology (DPT). DPT is designed to collect soil, groundwater, and soil gas samples without using conventional drilling techniques. The advantage of using DPT over conventional drilling includes the generation of little or no drill cuttings, sampling in locations with difficult accessibility, reduced overhead clearance requirements, no fluid introduction during probing, and typical lower costs per sample than with conventional techniques. Disadvantages include a maximum penetration depth of approximately 15 to 40 feet in dense soils (although it may be as much as 60 to 80 feet in certain types of geological environments), reduced capability of obtaining accurate water-level measurements, and the inability to install permanent groundwater monitoring wells. The methods and equipment described herein are for collection of surface and subsurface soil samples and groundwater samples. Soil gas sampling is discussed in SOP SA-2.4.

2.0 SCOPE

This procedure provides information on proper sampling equipment and techniques for DPT. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methodology.

3.0 GLOSSARY

Direct Push Technology (DPT) - DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. A primary advantage of DPT over conventional drilling techniques is that DPT results in the generation of little or no investigation derived waste.

Geoprobe® - Geoprobe® is a manufacturer of a hydraulically-powered, percussion/probing machines utilizing DPT to collect subsurface environmental samples. Geoprobe® relies on a relatively small amount of static weight (vehicle) combined with percussion as the energy for advancement of a tool string. The Geoprobe® equipment can be mounted in a multitude of vehicles for access to all types of environmental sites.

HydroPunch™ - HydroPunch™ is a manufacturer of stainless steel and Teflon® sampling tools that are capable of collecting representative groundwater and/or soil samples without requiring the installation of a groundwater monitoring well or conventional soil boring. HydroPunch™ is an example of DPT sampling equipment.

Flame Ionization Detector (FID) - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing a flame as the energizing source.

Photo Ionization Detector (PID) - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing ultraviolet radiation as the energizing source.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for selecting and/or reviewing the appropriate DPT drilling procedure required to support the project objectives.

Field Operations Leader (FOL)- The FOL is primarily responsible for performing the DPT in accordance with the project-specific plan.

5.0 SOIL SAMPLING PROCEDURES

5.1 General

The common methodology for the investigation of the vadose zone is soil boring drilling and soil sampling. However, drilling soil borings can be very expensive. Generally the advantage of DPT for subsurface soil sampling is the reduced cost of disposal of drilling cuttings and shorter sampling times.

5.2 Sampling Equipment

Equipment needed for conducting DPT drilling for subsurface soil sampling includes, but is not limited to, the following:

- Geoprobe® Sampling Kit
- Cut-resistant gloves
- 4-foot x 1.5-inch diameter macrocore sampler
- Probe sampling adapters
- Roto-hammer with 1.5-inch bit
- Disposable acetate liners for soil macrocore sampler
- Cast aluminum or steel drive points
- Geoprobe® AT-660 Series Large Bore Soil Sampler, or equivalent
- Standard decontamination equipment and solutions

For health and safety equipment and procedures, follow the direction provided in the Safe Work Permit in Attachment 1, or the more detailed directions provided in the project's Health and Safety Plan.

5.3 DPT Sampling Methodology

There are several methods for the collection of soil samples using DPT drilling. The most common method is discussed in the following section. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project-specific plan.

- Macrocore samplers fitted with detachable aluminum or steel drive points are driven into the ground using hydraulic pressure. If there is concrete or pavement over a sampling location, a Roto-hammer is used to drill a minimum 1.5-inch diameter hole through the surface material. A Roto-hammer may also be used if very dense soils are encountered.

- The sampler is advanced continuously in 4-foot intervals or less if desired. No soil cuttings are generated because the soil which is not collected in the sampler is displaced within the formation.

- The sampler is retracted from the hole, and the 4-foot continuous sample is removed from the outer coring tube. The sample is contained within an inner acetate liner.

- Attach the metal trough from the Geoprobe® Sampling Kit firmly to the tail gate of a vehicle. If a vehicle with a tail gate is not available, secure the trough on another suitable surface.

- Place the acetate liner containing the soils in the trough.

- While wearing cut-resistant gloves (constructed of leather or other suitable material), but the acetate liner through its entire length using the double-bladed knife that accompanies the Geoprobe® Sampling Kit. Then remove the strip of acetate from the trough to gain access to the collected soils. Do not attempt to cut the acetate liner while holding it in your hand.

- Field screen the sample with an FID or PID, and observe/examine the sample (according to SOP GH-1.3). If appropriate, transfer the sample to sample bottles for laboratory analysis. If additional volume is required, push an additional boring adjacent to the first and composite/mix the same interval. Field compositing is usually not acceptable for sample requiring volatile organics analysis.

- Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes should be finished smooth to existing grade.

- In the event the direct push van/truck cannot be driven to a remote location or a sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with battery/electric operated equipment (e.g., jack hammer).

- Sampling equipment is decontaminated prior to collecting the next sample.

6.0 GROUNDWATER SAMPLING PROCEDURES

6.1 General

The most common methodology for the investigation of groundwater is the installation and sampling of permanent monitoring wells. If only groundwater screening is required, the installation and sampling of temporary well points may be performed. The advantage of temporary well point installation using DPT is reduced cost due to no or minimal disposal of drilling cuttings and well construction materials, and shorter installation/times sampling.

Two disadvantages of DPT drilling for well point installation are:

- In aquifers with low yields, well points may have to be sampled without purging or development.
- If volume requirements are high, this method can be time consuming for low yield aquifers.

6.2 Sampling Equipment

Equipment needed for temporary well installation and sampling using DPT includes, but is not limited, to the following:

- 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point
- Connecting rods
- Roto-hammer with 1.5-inch bit
- Mechanical jack
- 1/4-inch OD polyethylene tubing
- 3/8-inch OD polyethylene tubing
- Peristaltic pump
- Standard decontamination equipment and solutions

6.3 DPT Temporary Well Point Installation and Sampling Methodology

There are several methods for the installation and sampling of temporary well points using DPT. The most common methodology is discussed below. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project specific plan.

- A 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point attached to connecting rods is driven into the ground to the desired depth using a rotary electric hammer or other direct push drill rig. If there is concrete or pavement over a sampling location, a Roto-hammer or electric coring machine is used to drill a hole through the surface material.

- The well point will be allowed to equilibrate for at least 15 minutes, after which a measurement of the static water level will be taken. The initial measurement of the water level will be used to assess the amount of water which is present in the well point and to determine the amount of silt and sand infiltration that may have occurred.

- The well point will be developed using a peristaltic pump and polyethylene tubing to remove silt and sand which may have entered the well point. The well point is developed by inserting polyethylene tubing to the bottom of the well point and lifting and lowering the tubing slightly while the pump is operating. The pump will be operated at a maximum rate of approximately 2 liters per minute. After removal of sediment from the bottom of the well point, the well point will be vigorously pumped at maximum capacity until discharge water is visibly clear and no further sediments are being generated. Measurements of pH, specific conductance, temperature, and turbidity shall be recorded every 5 minutes during the purging process. After two consistent readings of pH, specific conductance, temperature and turbidity ($\pm$10 percent), the well may be sampled.

- A sample will be collected using the peristaltic pump set at the same or reduced speed as during well development. Samples (with the exception of the samples to be analyzed for volatile organic compounds, VOCs) will be collected directly from the pump discharge. Sample containers for VOCs will be filled by (first shutting off the pump) crimping the discharge end of the sample tubing when filled, removing the inlet end of the sample tubing from the well, suspending the inlet tubing above the vial, and allowing water to fill each vial by gravity flow.

- Once the groundwater sample has been collected, the connecting rods and well point will be removed from the hole with the direct push rig hydraulics. The hole will be backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch will be used to cap holes through paved or concrete areas. All holes will be finished smooth to existing grade.

- In the event the direct push van/truck cannot be driven to a remote location or sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with battery/electric-operated equipment (e.g., jack hammer).

- Decontaminate the equipment before moving to the next location.

7.0 RECORDS

A record of all field procedures, tests, and observations must be recorded in the field logbook, boring logs, and sample log sheets, as needed. Entries should include all pertinent data regarding the investigation. The use of sketches and field landmarks will help to supplement the investigation and evaluation.

ATTACHMENT 1
SAFE WORK PERMIT FOR DPT OPERATIONS

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): **Monitoring well drilling and installation through direct push technology**

II. Required Monitoring Instruments: _____

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required
Full face APR ☐ Escape Pack ☐
Half face APR ☐ SCBA ☐
SKA-PAC SAR ☐ Bottle Trailer ☐
Skid Rig ☐ None ☒

Level D Minimum Requirements: Sleeved shirt and long pants, safety footwear, and work gloves. Safety glasses, hard hats, and hearing protection will be worn when working near or sampling in the vicinity of the DPT rig.

Modifications/Exceptions.

VI. Chemicals of Concern | Action Level(s) | Response Measures

VII. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio	☐ Yes	☒ No
Splash Shield	☐ Yes	☒ No	Barricades	☒ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type - _____)	☐ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/warming regimen	☐ Yes	☐ No

Modifications/Exceptions: Reflective vests for high traffic areas.

VIII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☒	Emergency alarms	☐	☐
Daily tail gate meetings	☒	☐	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

IX. Site Preparation

Utility Clearances obtained for areas of subsurface investigation	☐ Yes	☐ No
Physical hazards removed or blockaded	☐ Yes	☐ No
Site control boundaries demarcated/signage	☐ Yes	☐ No

X. Equipment Preparation

	Yes	NA
Equipment drained/depressurized	☐	☒
Equipment purged/cleaned	☐	☒
Isolation checklist completed	☐	☒
Electrical lockout required/field switch tested	☐	☒
Blinds/misalignments/blocks & bleeds in place	☐	☒
Hazardous materials on walls/behind liners considered	☐	☒

XI. Additional Permits required (Hot work, confined space entry). ☐ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

XII. Special instructions, precautions:
_____
_____

Permit Issued by: _____ Permit Accepted by: _____

S3 SA-1.3 SOIL SAMPLING

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1.0 PURPOSE

This procedure discusses the methods used to collect surface, near surface, and subsurface soil samples. Additionally, it describes the method for sampling of test pits and trenches to determine subsurface soil and rock conditions, and recover small-volume or bulk samples.

2.0 SCOPE

This procedure is applicable to the collection of surface, near surface and subsurface soils for laboratory testing, which are exposed through hand digging, hand augering, drilling, or machine excavating at hazardous substance sites.

3.0 GLOSSARY

Composite Sample - A composite sample exists as a combination of more than one sample at various locations and/or depths and times, which is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples are not to be collected for volatile organics analysis.

Grab Sample - One sample collected at one location and at one specific time.

Non-Volatile Sample - A non-volatile sample includes all other chemical parameters (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

Hand Auger - A sampling device used to extract soil from the ground in a relatively undisturbed form.

Thin-Walled Tube Sampler - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches outside diameter (OD) and from 18 to 54 inches in length.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2-inch OD to 3-1/2 inch OD. The larger sizes are commonly used when a larger volume of sample material is required.

Test Pit and Trench - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine the shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher excavator, or bulldozer).

Confined Space - As stipulated in 29 CFR 1910.146, a confined space means a space that: 1) is large enough and so configured that an employee can bodily enter and perform assigned work; 2) has limited or restricted means for entry or exit (for example tanks, vessels, silos, storage bins, hoppers, vaults, and pits, and excavations are spaces that may have limited means of entry.); and 3) is not designed for continuous employee occupancy. TtNUS considers all confined space as permit-required confined spaces.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for determining sampling objectives, as well as, the field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches, and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan. This will include (but not be limited to) performing air quality monitoring during sampling, boring and excavation activities, and to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the FOL on other safety-related matters regarding boring, excavation and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - The FOL is responsible for finalizing the location of surface, near surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits and trenches, and for adherence to OSHA regulations during these operations.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of soil samples and the completion of all required paperwork (i.e., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms).

Competent Person - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

5.0 PROCEDURES

5.1 Overview

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they have migrated into the water table, and can establish the amount of contamination sorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during the sampling operations, particularly noting the location, depth, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. As a result, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. Often this information on soil properties can be obtained from published soil

surveys available through the U.S. Geological Surveys and other government or farm agencies. It is the intent of this procedure to present the most commonly employed soil sampling methods used at hazardous waste sites.

5.2 Soil Sample Collection

5.2.1 Procedure for Collecting Soil Samples for Volatile Organic Compounds

The above described traditional sampling techniques, used for the collection of soil samples for volatile organic analysis, have recently been evaluated by the scientific community and determined to be ineffective in producing accurate results (biased low) due to the loss of volatile organics in the sampling stages and microbial degradation of aromatic volatiles. One of the newly adopted sampling procedures for collecting soil samples includes the field preservation of samples with methanol or sodium bisulfate to minimize volatilization and biodegradation. These preservation methods may be performed either in the field or laboratory, depending on the sampling methodology employed.

Soil samples to be preserved by the laboratory are currently being performed using method SW-846, 5035. Laboratories are currently performing low level analyses (sodium bisulfate preservation) and high level analyses (methanol preservation) depending on the end users needs.

It should be noted that a major disadvantage of the methanol preservation method is that the laboratory reporting limits will be higher than conventional testing. The reporting levels using the new method for most analytes are 0.5 µg/g for GC/MS and 0.05 µg/g for GC methods.

The alternative preservation method for collecting soil samples is with sodium bisulfate. This method is more complex to perform in the field and therefore is not preferred for field crews. It should also be noted that currently, not all laboratories have the capabilities to perform this analysis. The advantage to this method is that the reporting limits (0.001 µg/g for GC/PID or GC/ELCD, or 0.010 for GC/MS) are lower than those described above.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

5.2.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for volatile organics that are to be preserved at the laboratory will be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample will be obtained using a reusable sampling handle provided with the EnCore™ sampler. The sample is collected by pushing the EnCore™ sampler directly into the soil, ensuring that the sampler is packed tight with soil, leaving zero headspace. Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives.

Once the sample is collected, it should be placed on ice immediately and shipped to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

If the lower detection limits are necessary, an option would be to collect several EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

5.2.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) method and medium-level (methanol preservation) method.

Methanol Preservation (Medium Level):

Soil samples to be preserved in the field with methanol will utilize 40-60 mL glass vials with septum lids. Each sample bottle will be filled with 25 mL of demonstrated analyte-free purge and trap grade methanol. Bottles may be prespiked with methanol in the laboratory or prepared in the field.

Soil will be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol preserved sample bottle. Calibration of the scale should be performed prior to use and intermittently throughout the day according to the manufacturers requirements.

The sample should be collected by pulling the plunger back and inserting the syringe into the soil to be sampled. The top several inches of soil should be removed before collecting the sample. Approximately 10 grams $\pm$2g (8-12 grams) of soil should be collected. The sample should be weighed and adjusted until obtaining the required amount of sample. The sample weight should be recorded to the nearest 0.01 gram in the field logbook and/or sample log sheet. The soil should then be extruded into the methanol preserved sample bottle taking care not to contact the sample container with the syringe. The threads of the bottle and cap must be free of soil particles.

After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

Sodium Bisulfate Preservation (Low Level):

Samples to be preserved using the sodium bisulfate method are to be prepared as follows:

Add 1 gram of sodium bisulfate to 5 mL of laboratory grade deionized water in a 40-60 mL glass vial with septum lid. Bottles may be prespiked in the laboratory or prepared in the field. The soil sample should be collected in a manner as described above and added to the sample container. The sample should be weighed to nearest 0.01 gram as described above and recorded in field logbook or sample log sheet.

Care should be taken when adding the soil to the sodium bisulfate solution. A chemical reaction of soils containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode.

When preparing samples using the sodium bisulfate preservation method, duplicate samples must be collected using the methanol preservation method on a one for one sample basis. The reason for this is because it is necessary for the laboratory to perform both the low level and medium level analyses. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

If the lower detection limits are necessary, an option to field preserving with sodium bisulfate would be to collect 3 EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

5.2.2 Procedure for Collecting Non-Volatile Soil Samples

Non-volatile soil samples may be collected as either grab or composite samples. The non-volatile soil sample is thoroughly mixed in a stainless steel or disposable, inert plastic tray, using a stainless steel trowel or other approved tool, then transferred into the appropriate sample container(s). Head space is permitted in a non-volatile soil sample container to allow for sample expansion.

5.2.3 Procedure for Collecting Undisturbed Soil Samples (ASTM D1587-83)

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) will be employed. The following method will be used:

1. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and clean out the borehole to the sampling depth, being careful to minimize the chance for disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.

2. The use of bottom discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Use of any side-discharge bits is permitted.

3. A stationary piston-type sampler may be required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.

4. To minimize chemical reaction between the sample and the sampling tube, brass tubes may be required, especially if the tube is stored for an extended time prior to testing. While steel tubes coated with shellac are less expensive than brass, they're more reactive, and shall only be used when the sample will be tested within a few days after sampling or if chemical reaction is not anticipated. With the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.

5. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material in the upper end of the tube and measure the length of sample again. After removing at least an inch of soil from the lower end and after inserting an impervious disk, seal both ends of the tube with at least a 1/2-inch thickness of wax applied in a way that will prevent the wax from entering the sample. Clean filler must be placed in voids at either end of the tube prior to sealing with wax. Place plastic caps on the ends of the sample tube, tape the caps in place, and dip the ends in wax.

6. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label. Mark the "up" direction on the side of the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody and other required forms (see SOP SA-6.3). Do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the

ground, (i.e., top of sample is up) in a cool place out of the sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

Thin-walled undisturbed tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs, and therefore their use shall be weighed against the need for acquiring an undisturbed sample.

5.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples (most commonly collected to a depth of 6 inches) for subsequent analysis is by use of a stainless steel trowel. Surface soils are considered 0-12 inches bgs.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Real-time air monitoring instrument (e.g., PID, FID, etc.).
- Latex gloves.
- Required Personal Protective Equipment (PPE).
- Required paperwork.
- Required decontamination equipment.
- Required sample container(s).
- Wooden stakes or pin flags.
- Sealable polyethylene bags (i.e., Ziploc® baggies).
- Heavy duty cooler.
- Ice (if required) double-bagged in sealable polyethylene bags.
- Chain-of-custody records and custody seals.

When acquiring surface soil samples, the following procedure shall be used:

1. Carefully remove vegetation, roots, twigs, litter, etc., to expose an adequate soil surface area to accommodate sample volume requirements.

2. Using a decontaminated stainless steel trowel, follow the procedure cited in Section 5.2.1 for collecting a volatile soil sample. Surface soil samples for volatile organic analysis should be collected from 6-12 inches bgs only.

3. Thoroughly mix (in-situ) a sufficient amount of soil to fill the remaining sample containers and transfer the sample into those containers utilizing the same stainless steel trowel employed above. Cap and securely tighten all sample containers.

4. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.

5. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

5.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6-18 inches) can be accomplished with tools such as shovels and stainless steel or pre-cleaned disposable trowels.

The following equipment is necessary to collect near surface soil samples:

- Clean shovel.
- The equipment listed under Section 5.3 of this procedure.
- Hand auger.

To obtain near-surface soil samples, the following protocol shall be observed:

1. With a clean shovel, make a series of vertical cuts to the depth required in the soil to form a square approximately 1 foot by 1 foot.

2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.

3. Follow steps 2 through 5 listed under Section 5.3 of this procedure.

5.5 Subsurface Soil Sampling With a Hand Auger

A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e., cylinders 6-1/2" long, and 2-3/4", 3-1/4", and 4" in diameter), a series of extension rods (available in 2', 3', 4' and 5' lengths), and a cross handle. A larger diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then withdrawn. In turn, the larger diameter bit is replaced with a smaller diameter bit, lowered down the hole, and slowly turned into the soil at the completion depth (approximately 6"). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil both from the surface, or to depths in excess of 12 feet. However, the presence of rock layers and the collapse of the borehole normally contribute to its limiting factors.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes).
- Stainless steel mixing bowls.
- The equipment listed under Section 5.3 of this procedure.

To obtain soil samples using a hand auger, the following procedure shall be followed:

1. Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.

2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).

3. Begin augering (periodically removing accumulated soils from the bucket bit) and add additional rod extensions as necessary. Also, note (in a field notebook or on standardized data sheets) any changes in the color, texture or odor of the soil.

4. After reaching the desired depth, slowly and carefully withdraw the apparatus from the borehole.

5. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is commonly smaller in diameter than the bucket bit employed to initiate the borehole.

6. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.

7. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.

8. Discard the top of the core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the sample material.

9. Fill volatile sample container(s), using a properly decontaminated stainless steel trowel, with sample material directly from the bucket bit. Refer to Section 5.2.1 of this procedure.

10. Utilizing the above trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl and thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.

11. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

5.6 Subsurface Soil Sampling With a Split-Barrel Sampler (ASTM D1586-84)

Split-barrel (split-spoon) samplers consist of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment A). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-lb. or larger casing driver.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (O.D. 2 inches, I.D. 1-3/8 inches, either 20 inches or 26 inches long); Larger O.D. samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-lb. weight, driving head and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls.
- Equipment listed under Section 5.3 of this procedure.

The following steps shall be followed to obtain split-barrel samples:

1. Remove the drive head and nosepiece, and open the sampler to reveal the soil sample. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.). Carefully separate the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.

2. Collect the volatile sample from the center of the core where elevated readings occurred. If no elevated readings where encountered the sample material should still be collected from the core's center (this area represents the least disturbed area with minimal atmospheric contact). Refer to Section 5.2.1 of this procedure.

3. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl. Thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.

4. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

5.7 Subsurface Sol Sampling Using Direct Push Technology

Subsurface soil samples can be collected to depths of 40+ feet using direct push technology (DPT). DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

5.8 Excavation and Sampling of Test Pits and Trenches

5.8.1 Applicability

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise which control the method of excavation. No personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P - Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is still required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden or steel support structures. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments. Any entry may constitute a Confined Space and must be done in conformance with all applicable regulations. In these cases, substantial air monitoring is required before entry, and appropriate respiratory gear and protective clothing is mandatory. There must be at least two persons present at the immediate site before entry by one of the investigators. The reader shall refer to OSHA regulations 29 CFR 1926, 29 CFR 1910.120, 29 CFR 1910.134, AND 29 CFR 1910.146.

Excavations are generally not practical where a depth of more than about 15 feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If data on soils at depths greater than 15 feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

5.8.2 Test Pit and Trench Excavation

These procedures describe the methods for excavating and logging test pits and trenches excavated to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented as described in SOP SA-6.3.

Test pits and trenches may be excavated by hand or by power equipment to permit detailed description of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration.
- The space required for efficient excavation.
- The chemicals of concern.
- The economics and efficiency of available equipment.

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table, which is based on equipment efficiencies, gives a rough guide for design consideration:

Equipment	Typical Widths, in Feet
Trenching machine	2
Backhoe	2-6
Track dozer	10
Track loader	10
Excavator	10
Scraper	20

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous waste materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, field conditions may necessitate revisions to the initial plans. The final depth and construction method shall be determined by the field geologist. The actual layout of each test pit, temporary staging area, and spoils pile will be predicated based on site conditions and wind direction at the time the test pit is made. Prior to excavation, the area can be surveyed by magnetometer or metal detector to identify the presence of underground utilities or drums.

As mentioned previously, no personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is still required, Occupational Safety and Health Administration (OSHA) requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be in the hole at all times, and a temporary guardrail must be placed along the surface of the hole before entry). It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example, samples of leachate, groundwater, or sidewall soils can be taken with telescoping poles, etc.

Dewatering may be required to assure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation dry. This is an important consideration for excavations in cohesionless material below the groundwater table. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

5.8.3 Sampling in Test Pits and Trenches

5.8.3.1 General

Test pits and trenches are usually logged as they are excavated. Records of each test pit/trench will be made as described in SOP SA-6.3. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable Health and Safety and OSHA requirements have been met.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information would include soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples, which can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

5.8.3.2 Sampling Equipment

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

- Backhoe or other excavating machinery.
- Shovels, picks and hand augers, stainless steel trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottleware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.

- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps and right angle adapter for conduit (see Attachment B).

5.8.3.3 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 5.7.3.4.

- Excavate trench or pit in several depth increments. After each increment, the operator will wait while the sampler inspects the test pit from grade level to decide if conditions are appropriate for sampling. (Monitoring of volatiles by the SSO will also be used to evaluate the need for sampling.) Practical depth increments range from 2 to 4 feet.

- The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:

- Any fluid phase or groundwater seepage is encountered in the test pit.

- Any drums, other potential waste containers, obstructions or utility lines are encountered.

- Distinct changes of material are encountered.

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending upon the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Remove loose material to the greatest extent possible with backhoe.

- Secure walls of pit if necessary. (There is seldom any need to enter a pit or trench which would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)

- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material once it has been deposited on the ground. The sampler or Field Operations Leader directs the backhoe operator to remove material from the selected depth or location within the test pit/trench. The bucket is brought to the surface and moved away from the pit. The sampler and/or SSO then approaches the bucket and monitors its contents with a photoionization or flame ionization detector. The sample is collected from the center of the bucket or pile and placed in sample containers using a decontaminated stainless steel trowel or spatula.

- If a composite sample is desired, several depths or locations within the pit/trench are selected and a bucket is filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.

- Using the remote sampler shown in Attachment B, samples can be taken at the desired depth from the side wall or bottom of the pit. The face of the pit/trench shall first be scraped (using a long-

handled shovel or hoe) to remove the smeared zone that has contacted the backhoe bucket. The sample shall then be collected directly into the sample jar, by scraping with the jar edge, eliminating the need to utilize samplers and minimizing the likelihood of cross-contamination. The sample jar is then capped, removed from the assembly, and packaged for shipment.

- Complete documentation as described in SOP SA-6.3.

5.8.3.4 In-Pit Sampling

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soils or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

- There is no practical alternative means of obtaining such data.
- The Site Safety Officer and Competent Person determines that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of volatile organics, explosive gases and available oxygen).
- A Company-designated Competent Person determines that the pit/trench is stable or is made stable (by grading the sidewalls or using shoring) prior to entrance of any personnel. OSHA requirements must be strictly observed.

If these conditions are satisfied, one person will enter the pit/trench. On potentially hazardous waste sites, this individual will be dressed in safety gear as required by the conditions in the pit, usually Level B. He/she will be affixed to a safety rope and continuously monitored while in the pit.

A second individual will be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations. The individual entering the pit will remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon. As an added precaution, it is advisable to keep the backhoe bucket in the test pit when personnel are working below grade. Such personnel can either stand in or near the bucket while performing sample operations. In the event of a cave-in they can either be lifted clear in the bucket, or at least climb up on the backhoe arm to reach safety.

5.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 5.7.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., open tube samplers), which can be pushed or driven into the floor of the test pit.

- Suitable driving (i.e., a sledge hammer) or pushing (i.e., the backhoe bucket) equipment which is used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

Disturbed grab or bulk geotechnical soil samples may be collected for most soils in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification, while larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soils using open tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe, rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the sampler when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 5.7.3.4 of this procedure must be followed. The open tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate, because the sample will not have the correct orientation.

A sledge hammer or the backhoe may be used to drive or push the sampler or tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry of the test pit, the requirements in Section 5.7.3.4 of this procedure must be followed. Prepare, label, pack and transport the sample in the required manner, as described in SOP SA-6.3.

5.8.4 Backfilling of Trenches and Test Pits

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew shall photograph all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL.

If a low permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

5.9 Records

The appropriate sample log sheet (see SOP SA-6.3; Field Documentation) must be completed by the site geologist/sampler. All soil sampling locations must be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see SOP SA-6.3; Field Documentation) shall contain a sketch of pit conditions. In addition, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

Other data to be recorded in the field logbook include the following:

- Name and location of job.
- Date of boring and excavation.
- Approximate surface elevation.
- Total depth of boring and excavation.
- Dimensions of pit.
- Method of sample acquisition.
- Type and size of samples.
- Soil and rock descriptions.
- Photographs.
- Groundwater levels.
- Organic gas or methane levels.
- Other pertinent information, such as waste material encountered.

6.0 REFERENCES

American Society for Testing and Materials, 1987. ASTM Standards D1587-83 and D1586-84. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

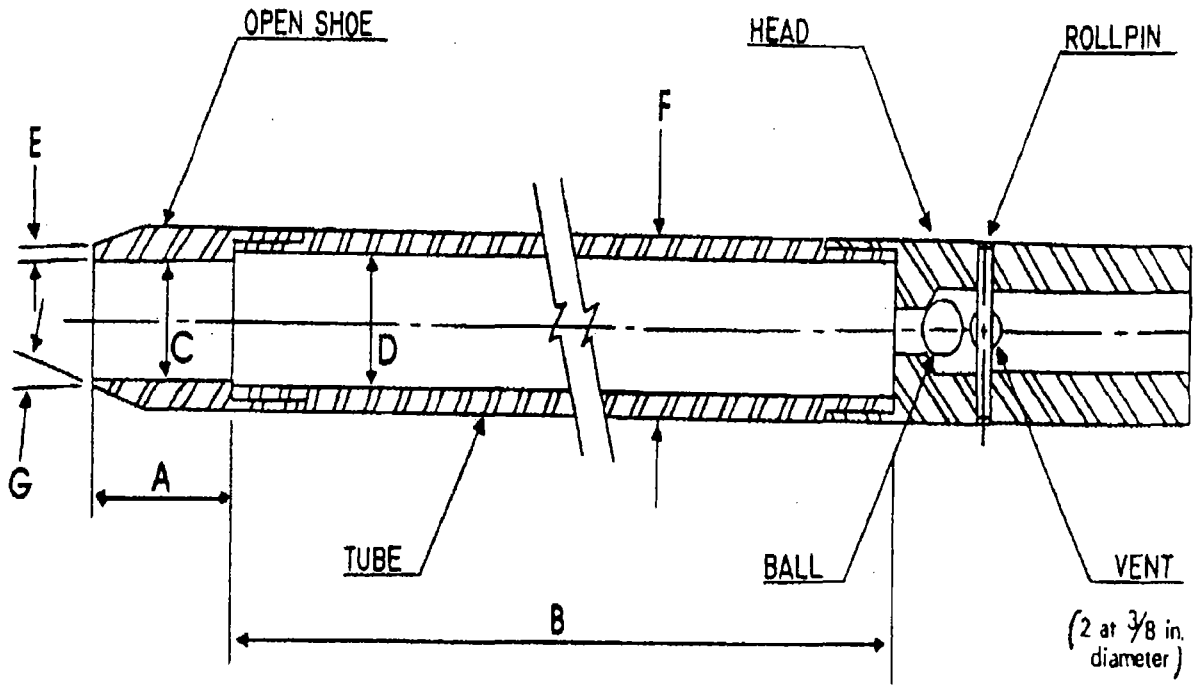
NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

OSHA, Confined Space Entry 29 CFR 1910.146.

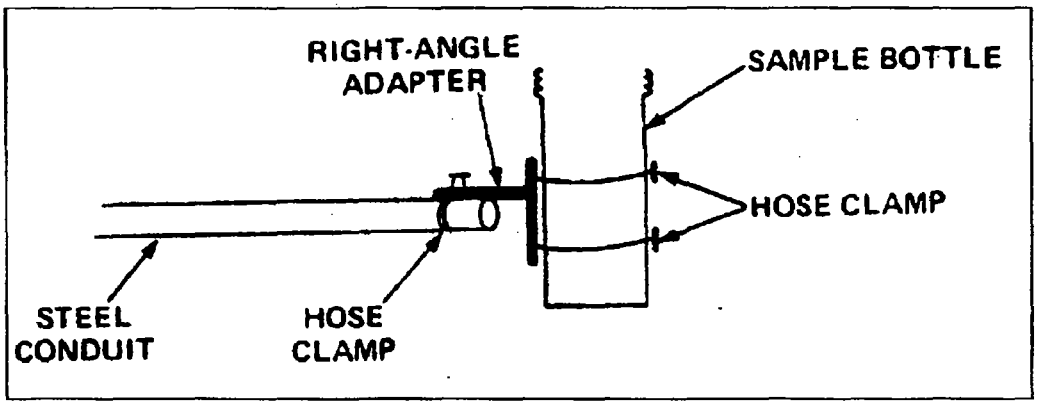
ATTACHMENT A
SPLIT-SPOON SAMPLER



A = 1.0 to 2.0 in. (25 to 50 mm)
B = 18.0 to 30.0 in. (0.457 to 0.762 m)
C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
D = 1.50 ± 0.05 – 0.00 in. (38.1 ± 1.3 – 0.0 mm)
E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
F = 2.00 ± 0.05 – 0.00 in. (50.8 ± 1.3 – 0.0 mm)
G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

ATTACHMENT B
REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING



S4 GH-1.5 BOREHOLE AND SAMPLE LOGGING

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1.0 PURPOSE

The purpose of this document is to establish standard procedures and technical guidance on borehole and sample logging.

2.0 SCOPE

These procedures provide descriptions of the standard techniques for borehole and sample logging. These techniques shall be used for each boring logged to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist/engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Geologist. Responsible for supervising all boring activities and assuring that each borehole is completely logged. If more than one rig is being used on site, the Site Geologist must make sure that each field geologist is properly trained in logging procedures. A brief review or training session may be necessary prior to the start up of the field program and/or upon completion of the first boring.

5.0 PROCEDURES

The classification of soil and rocks is one of the most important jobs of the field geologist/engineer. To maintain a consistent flow of information, it is imperative that the field geologist/engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

5.1 Materials Needed

When logging soil and rock samples, the geologist or engineer may be equipped with the following:

- Rock hammer
- Knife
- Camera
- Dilute hydrochloric acid (HCl)
- Ruler (marked in tenths and hundredths of feet)
- Hand Lens

5.2 Classification of Soils

All data shall be written directly on the boring log (Figure 1) or in a field notebook if more space is needed. Details on filling out the boring log are discussed in Section 5.5.

FIGURE 1
BORING LOG (EXAMPLE)

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING NUMBER: _____
PROJECT NUMBER: _____ DATE: _____
DRILLING COMPANY: _____ GEOLOGIST: _____
DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: _____

Drilling Area Background (ppm): [ ]

Converted to Well: Yes _____ No _____ Well I.D. #: _____

FIGURE 1 (CONTINUED)

SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

COARSE-GRAINED SOILS More Than Half of Material Is LARGER Than No. 200 Sieve Size					FINE-GRAINED SOILS More Than Half of Material is SMALLER Than			
FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			
					Identification Procedures on Fraction Smaller than No. 40 Sieve Size			
						DRY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)
GRAVELS (50%(+)>1/4"Ø)	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel-sand mixtures little or no fines	SILTS AND CLAYS Liquid Limit <50	None to Slight	Quick to Slow	None
		Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels gravel-sand mixtures little or no fines		Medium to High	None to Very Slow	Medium
	GRAVELS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures		Slight to Medium	Slow	Slight
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures	SILTS AND CLAYS Liquid Limit >50	Slight to Medium	Slow to None	Slight to Medium
SANDS 50%(+)<1/4"Ø)	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	SW	Well graded sand, gravelly sands, little or no fines		High to Very High	None	High
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines		Medium to High	None to Very Slow	Slight to Medium
	SANDS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see MCL)	SM	Silty sands, poorly graded sand-silt mixtures	HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture		
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.				

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Dense	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNC COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT	
Very Soft	Less than 0.25	0 to 2	Easily penetra
Soft	0.25 to 0.50	2 to 4	Easily penetra
Medium Stiff	0.50 to 1.0	4 to 8	Can be penet
Stiff	1.0 to 2.0	8 to 15	Readily indent
Very Stiff	2.0 to 4.0	15 to 30	Readily indent
Hard	More than 4.0	Over 30	Indented with

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENNESS		
Descriptive Terms	Screwdriver or Knife Effects	Hammer Effects	Descriptive Terms	Abbreviation	Spacing
Soft	Easily Gouged	Crushes when pressed with hammer	Very Broken	(V. Br.)	0-2"
Medium Soft	Can be Gouged	Breaks (one blow); crumbly edges	Broken	(Br.)	2"-1'
Medium Hard	Can be scratched	Breaks (one blow); sharp edges	Blocky	(Bk.)	1'-3'
Hard	Cannot be scratched	Breaks consecutively (several blows); sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES	ROCK SAMPLES - TYPES	WATER LEVELS
5-2" Split-Barrel Sample	X-NX (Conventional) Core (~2-1/8" O.D.)	12/18
		▽ 12'6" Initial Level w/Date & Depth
ST-3" O.D. Undisturbed Sample	Q-NQ (Wireline) Core (~1-7/8" O.D.)	
O - Other Samples, Specify in Remarks	Z - Other Core Sizes, Specify in Remarks	12/18
		▽ 12'6" Stabilized Level w/Date & Depth

5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).
This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as "(1/4 inchΦ-1/2 inchΦ)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

5.2.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

Soil Color Charts shall not be used unless specified by the project manager.

5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split-barrel sampling performed according to the methods detailed in Standard Operating Procedures GH-1.3 and SA-1.3. Those designations are:

Designation	Standard Penetration Resistance (Blows per Foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-inch outside diameter 12 inches into the material using a 140-pound hammer falling freely through 30 inches. The sampler is driven through an 18-inch sample interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This shall be noted on the log and referenced to the sample number. Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined either by blow counts, a pocket penetrometer (values listed in the table as Unconfined Compressive Strength), or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample in the split-barrel sampler. The sample shall be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. Consistency shall not be determined solely by blow counts. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

5.2.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent

FIGURE 2

CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

5.2.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory tests for water content shall be performed if the natural water content is important.

5.2.6 Stratification

Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is depending on grain size and composition. The classification to be used for stratification description is shown in Figure 3.

5.2.7 Texture/Fabric/Bedding

The texture/fabric/bedding of the soil shall be described. Texture is described as the relative angularity of the particles: rounded, subrounded, subangular, and angular. Fabric shall be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure shall also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

5.2.8 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Stratification
- Texture, fabric, bedding
- Other distinguishing features

FIGURE 3

BEDDING THICKNESS CLASSIFICATION

Thickness (metric)	Thickness (Approximate English Equivalent)	Classification
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick Bedded
10 cm - 30 cm	4" - 1.0'	Medium Bedded
3 cm - 10 cm	1" - 4"	Thin Bedded
1 cm - 3 cm	2/5" - 1"	Very Thin Bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly Laminated
< 1 mm	<1/32"	Micro Laminated

(Weir, 1973 and Ingram, 1954)

5.3 Classification of Rocks

Rocks are grouped into three main divisions: sedimentary, igneous and metamorphic. Sedimentary rocks are by far the predominant type exposed at the earth's surface. The following basic names are applied to the types of rocks found in sedimentary sequences:

- Sandstone - Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.
- Siltstone - Made up of granular materials less than 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.
- Claystone - Very fine-grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.
- Shale - A fissile very fine-grained rock. Fractures along bedding planes.
- Limestone - Rock made up predominantly of calcite ($CaCO_3$). Effervesces strongly upon the application of dilute hydrochloric acid.
- Coal - Rock consisting mainly of organic remains.
- Others - Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record. The local abundance of any of these rock types is dependent upon the depositional history of the area. Conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

In classifying a sedimentary rock the following hierarchy shall be noted:

- Rock type
- Color
- Bedding thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

5.3.1 Rock Type

As described above, there are numerous types of sedimentary rocks. In most cases, a rock will be a combination of several grain types, therefore, a modifier such as a sandy siltstone, or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain size is the basis for the classification of clastic sedimentary rocks. Figure 4 is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks. For example, the division between siltstone and claystone may not be measurable in the field. The boundary shall be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a claystone.

FIGURE 4

GRAIN SIZE CLASSIFICATION FOR ROCKS

Particle Name	Grain Size Diameter
Cobbles	> 64 mm
Pebbles	4 - 64 mm
Granules	2 - 4 mm
Very Coarse Sand	1 - 2 mm
Coarse Sand	0.5 - 1 mm
Medium Sand	0.25 - 0.5 mm
Fine Sand	0.125 - 0.25 mm
Very Fine Sand	0.0625 - 0.125 mm
Silt	0.0039 - 0.0625 mm

After Wentworth, 1922

5.3.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples shall be classified while wet, when possible, and air cored samples shall be scraped clean of cuttings prior to color classifications.

Rock color charts shall not be used unless specified by the Project Manager.

5.3.3 Bedding Thickness

The bedding thickness designations applied to soil classification (see Figure 3) will also be used for rock classification.

5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

- Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).

- Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.

- Medium hard - No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.

- Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the works "scratch" and "gouge." A scratch shall be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

5.3.5 Fracturing

The degree of fracturing or brokenness of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

- Very broken (V. BR.) - Less than 2-inch spacing between fractures
- Broken (BR.) - 2-inch to 1-foot spacing between fractures
- Blocky (BL.) - 1- to 3-foot spacing between fractures
- Massive (M.) - 3 to 10-foot spacing between fractures

The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run, to obtain a percentage.

Method of Calculating RQD
(After Deere, 1964)

$$RQD\ \% = r/l \times 100$$

r = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.

l = Total length of the coring run.

5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

- Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.
- Slight - Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.
- Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.
- Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

5.3.7 Other Characteristics

The following items shall be included in the rock description:

- Description of contact between two rock units. These can be sharp or gradational.
- Stratification (parallel, cross stratified).
- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic).
- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs shall be neat to the point where it can be reproduced on a copy machine for report presentation. The data shall be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

- Seam - Thin (12 inches or less), probably continuous layer.
- Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."
- Few - Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."
- Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."
- Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

The preceding sections describe the classification of sedimentary rocks. The following are some basic names that are applied to igneous rocks:

- Basalt - A fine-grained extrusive rock composed primarily of calcic plagioclase and pyroxene.
- Rhyolite - A fine-grained volcanic rock containing abundant quartz and orthoclase. The fine-grained equivalent of a granite.
- Granite - A coarse-grained plutonic rock consisting essentially of alkali feldspar and quartz.
- Diorite - A coarse-grained plutonic rock consisting essentially of sodic plagioclase and hornblende.
- Gabbro - A coarse-grained plutonic rock consisting of calcic plagioclase and clinopyroxene. Loosely used for any coarse-grained dark igneous rock.

The following are some basic names that are applied to metamorphic rocks:

- Slate - A very fine-grained foliated rock possessing a well developed slaty cleavage. Contains predominantly chlorite, mica, quartz, and sericite.
- Phyllite - A fine-grained foliated rock that splits into thin flaky sheets with a silky sheen on cleavage surface.
- Schist - A medium to coarse-grained foliated rock with subparallel arrangement of the micaceous minerals which dominate its composition.
- Gneiss - A coarse-grained foliated rock with bands rich in granular and platy minerals.
- Quartzite - A fine- to coarse-grained nonfoliated rock breaking across grains, consisting essentially of quartz sand with silica cement.

5.4 Abbreviations

Abbreviations may be used in the description of a rock or soil. However, they shall be kept at a minimum. Following are some of the abbreviations that may be used:

C - Coarse	Lt - Light	Yl - Yellow
Med - Medium	BR - Broken	Or - Orange
F - Fine	BL - Blocky	SS - Sandstone
V - Very	M - Massive	Sh - Shale
Sl - Slight	Br - Brown	LS - Limestone
Occ - Occasional	Bl - Black	Fgr - Fine-grained
Tr - Trace		

5.5 Boring Logs and Documentation

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections shall be used to complete the logs. A sample boring log has been provided as Figure 5.

The field geologist/engineer shall use this example as a guide in completing each boring log. Each boring log shall be fully described by the geologist/engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided either on the back of the boring log or on a separate sheet, for field use.

5.5.1 Soil Classification

- Identify site name, boring number, job number, etc. Elevations and water level data to be entered when surveyed data is available.

- Enter sample number (from SPT) under appropriate column. Enter depth sample was taken from (1 block = 1 foot). Fractional footages, i.e., change of lithology at 13.7 feet, shall be lined off at the proportional location between the 13- and 14-foot marks. Enter blow counts (Standard Penetration Resistance) diagonally (as shown). Standard penetration resistance is covered in Section 5.2.3.

- Determine sample recovery/sample length as shown. Measure the total length of sample recovered from the split-spoon sampler, including material in the drive shoe. Do not include cuttings or wash material that may be in the upper portion of the sample tube.

- Indicate any change in lithology by drawing a line at the appropriate depth. For example, if clayey silt was encountered from 0 to 5.5 feet and shale from 5.5 to 6.0 feet, a line shall be drawn at this increment. This information is helpful in the construction of cross-sections. As an alternative, symbols may be used to identify each change in lithology.

- The density of granular soils is obtained by adding the number of blows for the last two increments. Refer to Density of Granular Soils Chart on back of log sheet. For consistency of cohesive soils refer also to the back of log sheet - Consistency of Cohesive Soils. Enter this information under the appropriate column. Refer to Section 5.2.3.

FIGURE 5
COMPLETED BORING LOG (EXAMPLE)

BORING LOG

Page 1 of 1

PROJECT NAME: NSB- SITE
PROJECT NUMBER: 9594
DRILLING COMPANY: SOILTEST CO.
DRILLING RIG: CME-55
BORING NUMBER: SB/MW 1
DATE: 3/8/96
GEOLOGIST: SJ CONTI
DRILLER: R. ROCK

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0.0	7/6	1.5/2.0		M DENSE	BRN	SILTY SAND - SOME	SM	MOIST SL. ORG.	5	0	0	0
@ 0800	2.0	9/10				TO BLK	ROCK FR: TR BRICKS		ODOR				
							(FILL)		FILL TO 4'±				
	4.0			4.0									
S-2 @		5/7	2.0/2.0		M DENSE	BRN	SILTY SAND - TR FINE	SM	MDIST - W ODOR	10	0	-	-
0810	6.0	9/8					GRAVEL		NAT. MATL. TOOK SAMPLE				
	•			7'▽ ±					SB01-0406 FOR ANALYSIS				
	8.0			8.0									
S-3 @		6/8	1.9/2.0		DENSE	TAN BRN	FINE TO COARSE SAND	SW	WET	0	0	0	0
0820	10.0	17/16					TR. F. GRAVEL		HIT WATER: 7'±				
	12.0			12.0									
S-4 @		7/6	1.6/2.0		STIFF	GRAY	SILTY CLAY	CL	MOIST → WET	0	.5	-	-
0830	14.0	5/8											
	15.0			15.0					AUGER REF @ 15'				
				LINE 16	M HARD	BRN	SILTSTONE	VER	WEATHERED				
									LO ∡ JNTS @ 15.5				
9/5	①		4.0/5.0						WATER STAINS @ 16.5, 17.1, 17.5	0	0	0	0
				19'					LOSING SOME				
	20.0				HARD	GRAY	SANDSTONE - SOME	BR	DRILL H2O @ 17'±				
							SILTSTONE		SET TEMP 6" CAS TO 15.5				
4.9/5.0	②		5.0/5.0						SET 2" Φ PVC SCREEN 16-25	0	0	0	0
									SAND 14-25				
	25.0			25					PELLETS 12-14				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

• 1-20Z
1-80Z

Drilling Area Background (ppm): 0

Remarks: CME-55 R16, 4 1/4" ID HSA - 9" OD ±
2" SPLIT SPOONS - 140 LB HAMMER - 30" DROP
NX CORE IN BEDROCK RUN ① = 25 min. RUN ② = 15 min

Converted to Well: Yes ✓ No _____ Well I.D. #: MW-1

- Enter color of the material in the appropriate column.
- Describe material using the USCS. Limit this column for sample description only. The predominant material is described last. If the primary soil is silt but has fines (clay) - use clayey silt. Limit soil descriptors to the following:
  - Trace: 0 - 10 percent
  - Some: 11 - 30 percent
  - And/Or: 31 - 50 percent
- Also indicate under Material Classification if the material is fill or natural soils. Indicate roots, organic material, etc.
- Enter USCS symbol - use chart on back of boring log as a guide. If the soils fall into one of two basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example ML/CL or SM/SP.
- The following information shall be entered under the "Remarks" column and shall include, but is not limited by, the following:
  - Moisture - estimate moisture content using the following terms - dry, moist, wet and saturated. These terms are determined by the individual. Whatever method is used to determine moisture, be consistent throughout the log.
  - Angularity - describe angularity of coarse grained particles using the terms angular, subangular, subrounded, or rounded. Refer to ASTM D 2488 or Earth Manual for criteria for these terms.
  - Particle shape - flat, elongated, or flat and elongated.
  - Maximum particle size or dimension.
  - Water level observations.
  - Reaction with HCl - none, weak, or strong.
- Additional comments:
  - Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.
  - Indicate odor and Photoionization Detector (PID) or Flame Ionization Detector (FID) reading if applicable.
  - Indicate any change in lithology by drawing a line through the lithology change column and indicate the depth. This will help when cross-sections are subsequently constructed.
  - At the bottom of the page indicate type of rig, drilling method, hammer size and drop, and any other useful information (i.e., borehole size, casing set, changes in drilling method).

- Vertical lines shall be drawn (as shown in Figure 5) in columns 6 to 8 from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines shall be drawn if there is a change in lithology, then vertical lines drawn to that point.

- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.2 Rock Classification

- Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate RQD, core run number, RQD percent, and core recovery under the appropriate columns.

- Indicate lithology change by drawing a line at the appropriate depth as explained in Section 5.5.1.

- Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.

- Enter color as determined while the core sample is wet; if the sample is cored by air, the core shall be scraped clean prior to describing color.

- Enter rock type based on sedimentary, igneous or metamorphic. For sedimentary rocks use terms as described in Section 5.3. Again, be consistent in classification. Use modifiers and additional terms as needed. For igneous and metamorphic rock types use terms as described in Sections 5.3.8.

- Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M as explained in Section 5.3.5 and as noted on the back of the Boring Log.

- The following information shall be entered under the remarks column. Items shall include but are not limited to the following:

  - Indicate depths of joints, fractures and breaks and also approximate to horizontal angle (such as high, low), i.e., 70° angle from horizontal, high angle.
  - Indicate calcareous zones, description of any cavities or vugs.
  - Indicate any loss or gain of drill water.
  - Indicate drop of drill tools or change in color of drill water.

- Remarks at the bottom of Boring Log shall include:

  - Type and size of core obtained.
  - Depth casing was set.
  - Type of rig used.

- As a final check the boring log shall include the following:

  - Vertical lines shall be drawn as explained for soil classification to indicate consistency of bedrock material.

  - If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying soil and rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that shall be followed when logging cuttings are:

- Obtain cutting samples at approximately 5-foot intervals, sieve the cuttings (if mud rotary drilling) to obtain a cleaner sample, place the sample into a small sample bottle or "zip lock" bag for future reference, and label the jar or bag (i.e. hole number, depth, date, etc.). Cuttings shall be closely examined to determine general lithology.
- Note any change in color of drilling fluid or cuttings, to estimate changes in lithology.
- Note drop or chattering of drilling tools or a change in the rate of drilling, to determine fracture locations or lithologic changes.
- Observe loss or gain of drilling fluids or air (if air rotary methods are used), to identify potential fracture zones.
- Record this and any other useful information onto the boring log as provided in Figure 1.

This logging provides a general description of subsurface lithology and adequate information can be obtained through careful observation of the drilling process. It is recommended that split-barrel and rock core sampling methods be used at selected boring locations during the field investigation to provide detailed information to supplement the less detailed data generated through borings drilled using air/mud rotary methods.

5.6 Review

Upon completion of the borings logs, copies shall be made and reviewed. Items to be reviewed include:

- Checking for consistency of all logs.
- Checking for conformance to the guideline.
- Checking to see that all information is entered in their respective columns and spaces.

6.0 REFERENCES

Unified Soil Classification System (USCS).

ASTM D2488, 1985.

Earth Manual, U.S. Department of the Interior, 1974.

7.0 RECORDS

Originals of the boring logs shall be retained in the project files.

S5 SA-1-1 GROUNDWATER SAMPLE ACQUISTION AND ON-SITE WATER-QUALITY TESTING

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1.0 PURPOSE

The purpose of this procedure is to provide general reference information regarding the sampling of groundwater wells.

2.0 SCOPE

This procedure provides information on proper sampling equipment, onsite water quality testing, and techniques for groundwater sampling. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require modifications to methodology.

3.0 GLOSSARY

Conductivity – Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions, their total concentration, mobility, valence, and relative concentrations, and on temperature of measure. Conductivity is highly dependent on temperature and should be reported at a particular temperature, i.e., 20.2 mS/cm at 14C.

Dissolved Oxygen (DO) – DO levels in natural and wastewater depend on the physical, chemical, and biochemical activities in the water sample.

Oxidation-Reduction Potential (ORP) - A measure of the activity ratio of oxidizing and reducing species as determined by the electromotive force developed by a noble metal electrode, immersed in water, as referenced against a standard hydrogen electrode.

pH - The negative logarithm (base 10) of the hydrogen ion activity. The hydrogen ion activity is related to the hydrogen ion concentration, and, in a relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is a measure of the hydrogen ion concentration.

pH Paper - Indicator paper that turns different colors depending on the pH of the solution to which it is exposed. Comparison with color standards supplied by the manufacturer will then give an indication of the solution's pH.

Salinity – Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved slats in a given mass of solution. Note: most field meters determined salinity automatically from conductivity and temperature. The displayed value will be displayed in either parts per thousand (ppt) or % (e.g., 35 ppt will equal 3.5%).

Turbidity – Turbidity in water is caused by suspended matter, such as clay, silt, fine organic and inorganic matter. Turbidity is an expression the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample.

4.0 RESPONSIBILITIES

Project Hydrogeologist - Responsible for selecting and detailing the specific groundwater sampling techniques, onsite water quality testing (type, frequency, and location), and equipment to be used, and providing detailed input in this regard to the project plan documents. The project hydrogeologist is also responsible for properly briefing and overseeing the performance of the site sampling personnel.

Project Geologist - is primarily responsible for the proper acquisition of the groundwater samples. He/she is also responsible for the actual analyses of onsite water quality samples, as well as instrument calibration, care, and maintenance. When appropriate, such responsibilities may be performed by other qualified personnel (e.g., field technicians).

5.0 PROCEDURES

5.1 General

To be useful and accurate, a groundwater sample must be representative of the particular zone of the water being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of analysis in order to keep any changes in water quality parameters to a minimum.

Methods for withdrawing samples from completed wells include the use of pumps, compressed air, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of the groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water due to sampling techniques. In a non-pumping well, there will be little or no vertical mixing of water in the well pipe or casing, and stratification will occur. The well water in the screened section will mix with the groundwater due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant. To safeguard against collecting non-representative stagnant water in a sample, the following approach shall be followed prior to sample acquisition:

1. All monitoring wells shall be purged prior to obtaining a sample. Evacuation of three to five volumes is recommended prior to sampling. In a high-yielding groundwater formation and where there is no stagnant water in the well above the screened section, extensive evacuation prior to sample withdrawal is not as critical.

2. For wells that can be purged dry, the well shall be evacuated and allowed to recover prior to sample acquisition. If the recovery rate is fairly rapid, evacuation of more than one volume of water is required.

3. For high-yielding monitoring wells which cannot be evacuated to dryness, there is no absolute safeguard against contaminating the sample with stagnant water. One of the following techniques shall be used to minimize this possibility:

   - A submersible pump or the intake line of a surface pump or bailer shall be placed just below the water surface when removing the stagnant water and lowered as the water level drops. Three to five volumes of water shall be removed to provide reasonable assurance that all stagnant water has been evacuated. Once this is accomplished, a bailer or other approved device may be used to collect the sample for analysis.

   - The intake line of the sampling pump (or the submersible pump itself) shall be placed near the bottom of the screened section, and approximately one casing volume of water shall be pumped from the well at a low purge rate, equal to the well's recovery rate (low flow sampling).

Stratification of contaminants may exist in the aquifer. Concentration gradients as a result of mixing and dispersion processes, layers of variable permeability, and the presence of separate-phase product (i.e.,

floating hydrocarbons) may cause stratification. Excessive pumping or improper sampling methods can dilute or increase the contaminant concentrations in the recovered sample compared to what is representative of the integrated water column as it naturally occurs at that point, thus the result is the collection of a non-representative sample.

5.2 Sampling, Monitoring, and Evacuation Equipment

Sample containers shall conform with the guidelines expressed in SOP SA-6.1.

The following equipment shall be on hand when sampling groundwater wells (reference SOPs SA-6.1 and SA-7.1):

- Sample packaging and shipping equipment - Coolers for sample shipping and cooling, chemical preservatives, appropriate sampling containers and filler, ice, labels and chain-of-custody documents.
- Field tools and instrumentation - Multi-parameters water quality meter capable of measuring ORP, pH, temperature, DO, specific conductance, turbidity and salinity or individual meters (as applicable), pH paper, camera and film (if appropriate), appropriate keys (for locked wells), engineer's rule, water level indicator.
- Pumps
  - Shallow-well pumps: Centrifugal, bladder, suction, or peristaltic pumps with droplines, air-lift apparatus (compressor and tubing) where applicable.
  - Deep-well pumps: Submersible pump and electrical power-generating unit, or bladder pumps where applicable.
- Other sampling equipment - Bailers and inert line with tripod-pulley assembly (if necessary).
- Pails - Plastic, graduated.
- Decontamination solutions - Deionized water, potable water, laboratory detergents, 10% nitric acid solution (as required), and analytical-grade solvent (e.g., pesticide-grade isopropanol), as required.

Ideally, sample withdrawal equipment shall be completely inert, economical, easily cleaned, cleaned prior to use, reusable, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well purging and sample collection.

5.3 Calculations of Well Volume

To insure that the proper volume of water has been removed from the well prior to sampling it is first necessary to know the volume of standing water in the well pipe. This volume can be easily calculated by the following method. Calculations shall be entered in the site logbook or field notebook or on a sample log sheet form (see SOP SA-6.3):

- Obtain all available information on well construction (location, casing, screens, etc.).
- Determine well or casing diameter.
- Measure and record static water level (depth below ground level or top of casing reference point).

- Determine depth of well by sounding using a clean, decontaminated, weighted tape measure.
- Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
- Calculate one static well volume in gallons $V = (0.163)(T)(r^2)1$

where: V	=	Static volume of well in gallons.
T=		Thickness of water table in the well measured in feet (i.e., linear feet of static water).
r	=	Inside radius of well casing in inches.
0.163	=	A constant conversion factor which compensates for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and pi.

- Per evacuation volumes discussed above, determine the minimum amount to be evacuated before sampling.

5.4 Evacuation of Static Water (Purging)

5.4.1 General

The amount of purging a well shall receive prior to sample collection will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer. Alternately the well can be pumped until the parameters such as temperature, specific conductance, pH, and turbidity (as applicable), have stabilized. Onsite measurements of these parameters shall be recorded in the site logbook, field notebook, or on standardized data sheets.

5.4.2 Evacuation Devices

The following discussion is limited to those devices commonly used at hazardous waste sites. Attachment A provides guidance on the proper evacuation device to use for given sampling situations. Note that all of these techniques involve equipment which is portable and readily available.

Bailers

Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of pipe with a sealed bottom (bucket-type bailer) or, as is more useful and favored, with a ball check-valve at the bottom. An inert line is used to lower the bailer and retrieve the sample.

Advantages of bailers include:

- Few limitations on size and materials used for bailers.
- No external power source needed.
- Bailers are inexpensive, and can be dedicated and hung in a well to reduce the chances of cross-contamination.

- There is minimal outgassing of volatile organics while the sample is in the bailer.
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer.
- Transfer of sample may cause aeration.
- Use of bailers is physically demanding, especially in warm temperatures at protection levels above Level D.

Suction Pumps

There are many different types of inexpensive suction pumps including centrifugal, diaphragm, and peristaltic pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low pumping rate. The peristaltic pump is a low volume pump that uses rollers to squeeze a flexible tubing, thereby creating suction. This tubing can be dedicated to a well to prevent cross contamination.

These pumps are all portable, inexpensive and readily available. However, because they are based on suction, their use is restricted to areas with water levels within 20 to 25 feet of the ground surface. A significant limitation is that the vacuum created by these pumps can cause significant loss of dissolved gases and volatile organics.

Air-Lift Samplers

This group of pump samplers uses gas pressure either in the annulus of the well or in a venturi to force the water up a sampling tube. These pumps are also relatively inexpensive. Air (or gas)-lift samplers are more suitable for well development than for sampling because the samples may be aerated, leading to pH changes and subsequent trace metal precipitation, or loss of volatile organics.

Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. The operation principles vary and the displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-inch-diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include:

- They may have low delivery rates.
- Many models of these pumps are expensive.
- Compressed gas or electric power is needed.
- Sediment in water may cause clogging of the valves or eroding the impellers with some of these pumps.
- Decontamination of internal components can be difficult and time-consuming.

5.5 Onsite Water Quality Testing

This section describes the procedures and equipment required to measure the following parameters of an aqueous sample in the field:

- pH
- Specific Conductance
- Temperature
- Dissolved Oxygen (DO)
- Oxidation Reduction Potential (ORP)
- Certain Dissolved Constituents Using Specific Ion Elements
- Turbidity
- Salinity

This section is applicable for use in an onsite groundwater quality monitoring program to be conducted at a hazardous or nonhazardous site. The procedures and equipment described are applicable to groundwater samples and are not, in general, subject to solution interferences from color, turbidity, and colloidal material or suspended matter.

This section provides general information for measuring the parameters listed above with instruments and techniques in common use. Since instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use.

5.5.1 Measurement of pH

5.5.1.1 General

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment such as acid-base neutralization, water softening, and corrosion control is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken.

Two methods are given for pH measurement: the pH meter and pH indicator paper. The indicator paper is used when only a rough estimate of the pH is required, and the pH meter when a more accurate measurement is needed. The response of a pH meter can be affected to a slight degree by high levels of colloidal or suspended solids, but the effect is usually small and generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. In such cases, use of a pH meter is recommended.

5.5.1.2 Principles of Equipment Operation

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or alkalinity of the solution created by the addition of the water sample reacting with the indicator compound on the paper. Various types of pH papers are available, including litmus (for general acidity or alkalinity determination) and specific pH range hydrion paper.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to (in this instance, hydrogen) ion concentration across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to the ion concentration is generated and measured.

5.5.1.3 Equipment

The following equipment is needed for taking pH measurements:

- Stand-alone portable pH meter, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 610).
- Combination electrode with polymer body to fit the above meter (alternately a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs).
- Buffer solutions, as specified by the manufacturer.
- pH indicator paper, to cover the pH range 2 through 12.
- Manufacturer's operation manual.

5.5.1.4 Measurement Techniques for Field Determination of pH

pH Meter

The following procedure is used for measuring pH with a pH meter (meter standardization is according to manufacturer's instructions):

- Inspect the instrument and batteries prior to initiation of the field effort.
- Check the integrity of the buffer solutions used for field calibration. Buffer solutions need to be changed often as a result of degradation upon exposure to the atmosphere.
- If applicable, make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
- Calibrate on a daily use basis (or as recommended by manufacturer) following manufacturer's instructions. Record calibration data on an equipment calibration log sheet.
- Immerse the electrode(s) in the sample, slowly stirring the probe until the pH stabilizes. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a physical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. This must be clearly noted in the logbook.
- Read and record the pH of the sample. pH shall be recorded to the nearest 0.01 pH unit. Also record the sample temperature.
- Rinse the electrode(s) with deionized water.
- Store the electrode(s) in an appropriate manner when not in use.

Any visual observation of conditions which may interfere with pH measurement, such as oily materials, or turbidity, shall be noted.

pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown the investigation shall start with wide-range paper and proceed with successively narrower range paper until the sample pH is adequately determined.

5.5.2 Measurement of Specific Conductance

5.5.2.1 General

Conductance provides a measure of dissolved ionic species in water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of the ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect the specific conductance.

5.5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, while the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases and salts (such as hydrochloric acid, sodium carbonate, or sodium chloride, respectively) are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not dissociate in aqueous solution, conduct a current very poorly, if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

5.5.2.3 Equipment

The following equipment is needed for taking specific conductance (SC) measurements:

- Stand alone portable conductivity meter, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 610).
- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

A variety of conductivity meters are available which may also be used to monitor salinity and temperature. Probe types and cable lengths vary, so equipment must be obtained to meet the specific requirement of the sampling program.

5.5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate instrument before going into the field.
- Calibrate on a daily use basis (or as recommended by manufacturer), according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet. Potassium chloride solutions with a SC closest to the values expected in the field shall be used for calibration. Attachment B provides guidance in this regard.
- Rinse the cell with one or more portions of the sample to be tested or with deionized water.
- Immerse the electrode in the sample and measure the conductivity. Adjust the temperature setting to the sample temperature (if applicable).
- Read and record the results in a field logbook or sample log sheet.
- Rinse the electrode with deionized water.

If the specific conductance measurements become erratic, recalibrate the instrument and see the manufacturer's instructions for details.

5.5.3 Measurement of Temperature

5.5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in-situ, or as quickly as possible in the field. Collected water samples may rapidly equilibrate with the temperature of their surroundings.

5.5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury filled or dial-type thermometers. In addition, various meters such as specific conductance or dissolved oxygen meters, which have

temperature measurement capabilities, may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

5.5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used to determine the temperature for a water sample:

- Immerse the thermometer in the sample until temperature equilibrium is obtained (1-3 minutes). To avoid the possibility of cross-contamination, the thermometer shall not be inserted into samples which will undergo subsequent chemical analysis.
- Record values in a field logbook or sample log sheet.

If a temperature meter or probe is used, the instrument shall be calibrated according to manufacturer's recommendations.

5.5.4 Measurement of Dissolved Oxygen

5.5.4.1 General

Dissolved oxygen (DO) levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. Conversely, the growth of many aquatic organisms as well as the rate of corrosivity, are dependent on the dissolved oxygen concentration. Thus, analysis for dissolved oxygen is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in-situ, since concentration may show a large change in a short time if the sample is not adequately preserved.

The monitoring method discussed herein is limited to the use of dissolved oxygen meters only. Chemical methods of analysis (i.e., Winkler methods) are available, but require more equipment and greater sample manipulation. Furthermore, DO meters, using a membrane electrode, are suitable for highly polluted waters, because the probe is completely submersible, and is not susceptible to interference caused by color, turbidity, colloidal material or suspended matter.

5.5.4.2 Principles of Equipment Operation

Dissolved oxygen probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH^-) occurs at the cathode surface. An electrical current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode.

Since the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, while leaving the surface of the solution undisturbed.

Dissolved oxygen probes are relatively unaffected by interferences. Interferences that can occur are reactions with oxidizing gases (such as chlorine) or with gases such as hydrogen sulfide, which are not easily depolarized from the indicating electrode. If a gaseous interference is suspected, it shall be noted in the field log book and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic temperature compensation is normally provided by the manufacturer.

5.5.4.3 Equipment

The following equipment is needed to measure dissolved oxygen concentration:

- Stand alone portable dissolved oxygen meter, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 610).
- Sufficient cable to allow the probe to contact the sample.
- Manufacturer's operation manual.

5.5.4.4 Measurement Techniques for Dissolved Oxygen Determination

Probes differ as to specifics of use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure the dissolved oxygen concentration:

- The equipment shall be calibrated and have its batteries checked before going to the field.
- The probe shall be conditioned in a water sample for as long a period as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
- The instrument shall be calibrated in the field according to manufacturer's recommendations or in a freshly air-saturated water sample of known temperature. Dissolved oxygen values for air-saturated water can be determined by consulting a table listing oxygen solubilities as a function of temperature and salinity (see Attachment C).
- Record all pertinent information on an equipment calibration sheet.
- Rinse the probe with deionized water.
- Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane by stirring the sample. Probes without stirrers placed in wells can be moved up and down.
- Record the dissolved oxygen content and temperature of the sample in a field logbook or sample log sheet.
- Rinse the probe with deionized water.
- Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable, since sample handling is not involved. This however, may not always be practical. Be sure to record whether the liquid was analyzed in-situ, or if a sample was taken.

Special care shall be taken during sample collection to avoid turbulence which can lead to increased oxygen solubilization and positive test interferences.

5.5.5 Measurement of Oxidation-Reduction Potential

5.5.5.1 General

The oxidation-reduction potential (ORP) provides a measure of the tendency of organic or inorganic compounds to exist in an oxidized state. The ORP parameter therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of oxidized to reduced species in the sample.

5.5.5.2 Principles of Equipment Operation

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between the two electrodes to be measured and is dependent on the concentration of the ions in solution. By this measurement, the ability to oxidize or reduce species in solution may be determined. Supplemental measurements, such as dissolved oxygen, may be correlated with ORP to provide a knowledge of the quality of the solution, water, or wastewater.

5.5.5.3 Equipment

The following equipment is needed for measuring the oxidation-reduction potential of a solution:

- Portable pH meter or equivalent, with a millivolt scale.
- Platinum electrode to fit above pH meter.
- Reference electrode such as a calomel, silver-silver chloride, or equivalent.
- Reference solution as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.5.4 Measurement Techniques for Oxidation-Reduction Potential

The following procedure is used for measuring oxidation-reduction potential:

- The equipment shall be calibrated and have its batteries checked before going to the field.
- Check that the platinum probe is clean and that the platinum bond or tip is unoxidized. If dirty, polish with emery paper or, if necessary, clean the electrode using aqua regia, nitric acid, or chromic acid, in accordance with manufacturer's instructions.
- Thoroughly rinse the electrode with deionized water.
- Verify the sensitivity of the electrodes by noting the change in millivolt reading when the pH of the test solution is altered. The ORP will increase when the pH of the test solution decreases, and the ORP

will decrease if the test solution pH is increased. Place the sample in a clean container and agitate the sample. Insert the electrodes and note the ORP drops sharply when the caustic is added (i.e., pH is raised) thus indicating the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions. If the ORP does not respond as above when the caustic is added, the electrodes shall be cleaned and the above procedure repeated.

- After the assembly has been checked for sensitivity, wash the electrodes with three changes of water or by means of a flowing stream of deionized water from a wash bottle. Place the sample in a clean container and insert the electrodes. Set temperature compensator throughout the measurement period. Read the millivolt potential of the solution, allowing sufficient time for the system to stabilize and reach temperature equilibrium. Measure successive portions of the sample until readings on two successive portions differ by no more than 10 mV. A system that is very slow to stabilize properly will not yield a meaningful ORP. Record all results in a field logbook or sample logsheet, including ORP (to nearest 10 mV), sample temperature and pH at the time of measurement.

5.5.6 Measurement of Turbidity

5.5.6.1 General

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample. Turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and microscopic organisms, including plankton.

It is important to obtain a turbidity reading immediately after taking a sample, since irreversible changes in turbidity may occur if the sample is stored too long.

5.5.6.2 Principles of Equipment Operation

Turbidity is measured by the Nephelometric Method. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the scattered light intensity, the higher the turbidity.

Formazin polymer is used as the reference turbidity standard suspension because of its ease of preparation combined with a higher reproducibility of its light-scattering properties than clay or turbid natural water. The turbidity of a specified concentration of formazin suspension is defined as 40 nephelometric units. This same suspension has an approximate turbidity of 40 Jackson units when measured on the candle turbidmeter. Therefore, nephelometric turbidity units (NTU) based on the formazin preparation will approximate units derived from the candle turbidimeter but will not be identical to them.

5.5.6.3 Equipment

The following equipment is needed for turbidity measurement:

- Stand alone portable turbidity meter, or combination meter (e.g., Horiba U-10), or combination meter equipped with an in-line sample chamber (e.g., YSI 61).

- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.6.4 Measurement Techniques for Turbidity

The steps involved in taking turbidity measurements are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate instrument before going into the field.
- Check the expiration date (etc.) of the solutions used for field calibration.
- Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet.
- Rinse the cell with one or more portions of the sample to be tested or with deionized water.
- Immerse the probe in the sample and measure the turbidity. The reading must be taken immediately as suspended solids will settle over time resulting in a lower, inaccurate turbidity reading.
- Read and record the results in a field logbook or sample log sheet. Include a physical description of the sample, including color, qualitative estimate of turbidity, etc.
- Rinse the electrode with deionized water.

5.5.7 Measurement of Salinity

5.5.7.1 General

Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved salts in a given mass of solution. Note: Most field meters determined salinity automatically from conductivity and temperature. The displayed value will be displayed in either parts per thousand (ppt) or % (e.g., 35 ppt will equal 3.5%).

5.5.7.2 Principles of Equipment Operation

Salinity is determined automatically from the meter's conductivity and temperature readings according to algorithms (found in *Standard methods for the Examination of Water and Wastewater*). Depending on the meter, the results are displayed in either ppt or %. The salinity measurements are carried out in reference to the conductivity of standard seawater (*corrected to S = 35*).

5.5.7.3 Equipment

The following equipment is needed for Salinity measurements:

- Multi-parameter water quality meter capable of measuring conductive, temperature and converting them to salinity (e.g., Horiba U-10 or YSI 610).
- Calibration Solution, as specified by the manufacturer.
- Manufacturer's operation manual.

5.5.7.4 Measurement Techniques for Salinity

The steps involved in taking Salinity measurements are listed below (standardization is according to manufacturer's instructions):

- Check batteries and calibrate before going into the field.
- Check the expiration date (etc.) of the solutions used for field calibration.
- Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on an equipment calibration log sheet.
- Rinse the cell with the sample to be tested.
- Immerse the probes in the sample and measure the salinity. Read and record the results in a field logbook or sample log sheet.
- Rinse the probes with deionized water.

5.6 Sampling

5.6.1 Sampling Plan

The sampling approach consisting of the following, shall be developed as part of the project plan documents which are approved prior to beginning work in the field:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).
- Intended number, sequence volumes, and types of samples. If the relative degrees of contamination between wells is unknown or insignificant, a sampling sequence which facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells as a result of the sampling procedures.
- Sample preservation requirements.
- Work schedule.
- List of team members.
- List of observers and contacts.
- Other information, such as the necessity for a warrant or permission of entry, requirement for split samples, access problems, location of keys, etc.

5.6.2 Sampling Methods

The collection of a groundwater sample consists of the following steps:

1. The site Health & Safety Officer (or designee) will first open the well cap and use volatile organic detection equipment (PID or FID) on the escaping gases at the well head to determine the need for respiratory protection.

2. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data on a groundwater sampling log sheet (see SOP SA-6.3); then calculate the fluid volume in the well pipe (as previously described in this SOP).

3. Calculate well volume to be removed as stated in Section 5.3.

4. Select the appropriate purging equipment (see Attachment A). If an electric submersible pump with packer is chosen, go to Step 10.

5. Lower the purging equipment or intake into the well to a short distance below the water level and begin water removal. Collect the purged water and dispose of it in an acceptable manner (as applicable). Lower the purging device, as required, to maintain submergence.

6. Measure the rate of discharge frequently. A graduated bucket and stopwatch are most commonly used; other techniques include use of pipe trajectory methods, weir boxes or flow meters.

7. Observe the peristaltic pump intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics.

8. Purge a minimum of three to five casing volumes before sampling. In low-permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Purged water shall be collected in a designated container and disposed in an acceptable manner.

9. If sampling using a pump, lower the pump intake to midscreen (or the middle of the open section in uncased wells) and collect the sample. If sampling with a bailer, lower the bailer to just below the water surface.

10. (For pump and packer assembly only). Lower the assembly into the well so that the packer is positioned just above the screen or open section. Inflate the packer. Purge a volume equal to at least twice the screened interval (or unscreened open section volume below the packer) before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.

11. In the event that recovery time of the well is very slow (e.g., 24 hours or greater), sample collection can be delayed until the following day. If the well has been purged early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record this occurrence in the site logbook.

12. Fill sample containers (preserve and label as described in SOP SA-6.1).

13. Replace the well cap and lock as appropriate. Make sure the well is readily identifiable as the source of the samples.

14. Process sample containers as described in SOP SA-6.1.

15. Decontaminate equipment as described in SOP SA-7.1.

5.7 Low Flow Purging and Sampling

5.7.1 Scope & Application

Low flow purging and sampling techniques are sometimes required for groundwater sampling activities. The purpose of low flow purging and sampling is to collect groundwater samples that contain "representative" amounts of mobile organic and inorganic constituents in the vicinity of the selected open well interval, at near natural flow conditions. The minimum stress procedure emphasizes negligible water level drawdown and low pumping rates in order to collect samples with minimal alterations in water chemistry. This procedure is designed primarily to be used in wells with a casing diameter of 2 inches or more and a saturated screen, or open interval, length of ten feet or less. Samples obtained are suitable for analyses of common types of groundwater contaminants (volatile and semi-volatile organic compounds, pesticides, PCBs, metals and other inorganic ions [cyanide, chloride, sulfate, etc.]). This procedure is not designed to collect non-aqueous phase liquids samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs), using the low flow pumps.

The procedure is flexible for various well construction types and groundwater yields. The goal of the procedure is to obtain a turbidity level of less than 5 NTU and to achieve a water level drawdown of less than 0.3 feet during purging and sampling. If these goals cannot be achieved, sample collection can take place provided the remaining criteria in this procedure are met.

5.7.2 Equipment

The following equipment is required (as applicable) for low flow purging and sampling:

- Adjustable rate, submersible pump (e.g., centrifugal or bladder pump constructed of stainless steel or Teflon).
- Disposable clear plastic bottom filling bailers may be used to check for and obtain samples of LNAPLs or DNAPLs.
- Tubing - Teflon, Teflon-lined polyethylene, polyethylene, PVC, Tygon, stainless steel tubing can be used to collect samples for analysis, depending on the analyses to be performed and regulatory requirements.
- Water level measuring device, 0.01 foot accuracy, (electronic devices are preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies.
- Interface probe, if needed.

- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at a safe distance from the well so that the exhaust fumes do not contaminate the samples.
- Indicator parameter monitoring instruments - pH, turbidity, specific conductance, and temperature. Use of a flow-through cell is recommended. Optional Indicators - ORP and dissolved oxygen, flow-through cell is required. Standards to perform field calibration of instruments.
- Decontamination supplies.
- Logbook(s), and other forms (e.g., well purging forms).
- Sample Bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags and/or labels.
- Well construction data, location map, field data from last sampling event.
- Field Sampling Plan.
- PID or FID instrument for measuring VOCs (volatile organic compounds).

5.7.3 Purging and Sampling Procedure

Use a submersible pump to purge and sample monitoring wells which have a 2.0 inch or greater well casing diameter.

Measure and record the water level immediately prior to placing the pump in the well.

Lower pump, safety cable, tubing and electrical lines slowly into the well so that the pump intake is located at the center of the saturated screen length of the well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of sediment that may be present in the bottom of the well. Collection of turbidity-free water samples may be difficult if there is three feet or less of standing water in the well.

When starting the pump, slowly increase the pump speed until a discharge occurs. Check water level. Adjust pump speed to maintain little or no water level drawdown. The target drawdown should be less than 0.3 feet and it should stabilize. If the target of less than 0.3 feet cannot be achieved or maintained, the sampling is acceptable if remaining criteria in the procedure are met. Subsequent sampling rounds will probably have intake settings and extraction rates that are comparable to those used in the initial sampling rounds.

Monitor water level and pumping rate every five to ten minutes (or as appropriate) during purging. Record pumping rate adjustments and depths to water. Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 l/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During initial pump start-up, drawdown may exceed the 0.3 feet target and then recover as pump flow adjustments are made (minimum purge volume calculations should utilize stabilized drawdown values, not the initial drawdown). If the recharge rate of the well is less than minimum capability of the pump do not

allow the water level to fall to the intake level (if the static water level is above the screen, avoid lowering the water level into the screen). Shut off the pump if either of the above is about to occur and allow the water level to recover. Repeat the process until field indicator parameters stabilize and the minimum purge volume is removed. The minimum purge volume with negligible drawdown (0.3 feet or less) is two saturated screen length volumes. In situations where the drawdown is greater than 0.3 feet and has stabilized, the minimum purge volume is two times the saturated screen volume plus the stabilized drawdown volume. After the minimum purge volume is attained (and field parameters have stabilized) begin sampling. For low yields wells, commence sampling as soon as the well has recovered sufficiently to collect the appropriate volume for all anticipated samples.

During well purging, monitor field indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every five to ten minutes (or as appropriate). Purging is complete and sampling may begin when all field indicator parameters have stabilized (variations in values are within ten percent of each other, pH +/- 0.2 units, for three consecutive readings taken at five to ten minute intervals). If the parameters have stabilized, but turbidity remains above 5 NTU goal, decrease pump flow rate, and continue measurement of parameters every five to ten minutes. If pumping rate cannot be decreased any further and stabilized turbidity values remain above 5 NTU goal record this information. Measurements of field parameters should be obtained (as per Section 5.5) and recorded.

VOC samples are preferably collected first, directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the water column in the pump tubing collapses (water does not completely fill the tubing) before exiting the tubing, use one of the following procedures to collect VOC samples: (1) Collect the non-VOCs samples first, then increase the flow rate incrementally until the water column completely fills the tubing, collect the sample and record the new flow rate; (2) reduce the diameter of the existing tubing until the water column fills the tubing either by adding a connector (Teflon or stainless steel), or clamp which should reduce the flow rate by constricting the end of the tubing; (3) insert a narrow diameter Teflon tube into the pump's tubing so that the end of the tubing is in the water column and the other end of the tubing protrudes beyond the pump's tubing, collect sample from the narrow diameter tubing.

Prepare samples for shipping as per SOP SA-6.1.

6.0 REFERENCES

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ATTACHMENT A

PURGING EQUIPMENT SELECTION

Diameter Casing		Bailer	Peristaltic Pump	Vacuum Pump	Air-lift	Diaphragm "Trash" Pump	Submersible Diaphragm Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
1.25-Inch	Water level <25 feet		X	X	X	X			
	Water Level >25 feet				X				
2-Inch	Water level <25 feet	X	X	X	X	X	X		
	Water Level >25 feet	X			X		X		
4-Inch	Water level <25 feet	X	X	X	X	X	X	X	X
	Water Level >25 feet	X			X		X	X	X
6-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X
8-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X

ATTACHMENT A

PURGING EQUIPMENT SELECTION

PAGE 2

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/Length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
BarCad Systems, Inc.	BarCad Sampler	Dedicated; gas drive (positive displacement)	1.5/16	PE, brass, nylon, aluminum oxide	0-150 with std. tubing	1 liter for each 10-15 feet of submergence	$220-350	Requires compressed gas; custom sizes and materials available; acts as piezometer.
Cole-Parmer Inst. Co.	Master Flex 7570 Portable Sampling Pump	Portable; peristaltic (suction)	<1.0/NA	(not submersible) Tygon®, silicone Viton®	0-30	670 mL/min with 7015-20 pump head	$500-600	AC/DC; variable speed control available; other models may have different flow rates.
ECO Pump Corp.	SAMPLifier	Portable; venturi	<1.5 or <2.0/NA	PP, PE, PVC, SS, Teflon®, Tefzel®	0-100	0-500 mL/min depending on lift	$400-700	AC, DC, or gasoline-driven motors available; must be primed.
Geltek Corp.	Bailer 219-4	Portable; grab (positive displacement)	1.66/38	Teflon®	No limit	1,075 mL	$120-135	Other sizes available.
GeoEngineering, Inc.	GEO-MONITOR	Dedicated; gas drive (positive displacement)	1.5/16	PE, PP, PVC, Viton®	Probably 0-150	Approximately 1 liter for each 10 feet of submergence	$185	Acts as piezometer; requires compressed gas.
Industrial and Environmental Analysts, Inc. (IEA)	Aquarius	Portable; bladder (positive displacement)	1.75/43	SS, Teflon®, Viton®	0-250	0-2,800 mL/min	$1,500-3,000	Requires compressed gas; other models available; AC, DC, manual operation possible.
IEA	Syringe Sampler	Portable; grab (positive displacement)	1.75/43	SS, Teflon®	No limit	850 mL sample volume	$1,100	Requires vacuum and/or pressure from hand pump.
Instrument Specialties Co. (ISCO)	Model 2600 Well Sampler	Portable; bladder (positive displacement)	1.75/50	PC, silicone, Teflon®, PP, PE, Detrin®, acetal	0-150	0-7,500 mL/min	$990	Requires compressed gas (40 psi minimum).
Keck Geophysical Instruments, Inc.	SP-81 Submersible Sampling Pump	Portable; helical rotor (positive displacement)	1.75/25	SS, Teflon®, PP, EPDM, Viton®	0-160	0-4,500 mL/min	$3,500	DC operated.
Leonard Mold and Die Works, Inc.	GeoFilter Small Diameter Well Pump (#0500)	Portable; bladder (positive displacement)	1.75/38	SS, Teflon®, PC, Neoprene®	0-400	0-3,500 mL/min	$1,400-1,500	Requires compressed gas (55 psi minimum); pneumatic or AC/DC control module.
Oil Recovery Systems, Inc.	Surface Sampler	Portable; grab (positive displacement)	1.75/12	acrylic, Detrin®	No limit	Approximately 250 mL	$125-160	Other materials and models available; for measuring thickness of "floating" contaminants.
Q.E.D. Environmental Systems, Inc.	Well Wizard® Monitoring System (P-100)	Dedicated; bladder (positive displacement)	1.66/36	PVC	0-230	0-2,000 mL/min	$300-400	Requires compressed gas; piezometric level indicator; other materials available.

ATTACHMENT A

PURGING EQUIPMENT SELECTION

PAGE 3

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/Length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
Randolph Austin Co.	Model 500 Vari-Flow Pump	Portable; peristaltic (suction)	<0.5/NA	(Not submersible) Rubber, Tygon®, or Neoprene®	0-30	See comments	$1,200-1,300	Flow rate dependent on motor and tubing selected; AC operated; other models available.
Robert Bennett Co.	Model 180	Portable; piston (positive displacement)	1.8/22	SS, Teflon®, Delrin® PP, Viton®, acrylic, PE	0-500	0-1,800 mL/min	$2,600-2,700	Requires compressed gas; water level indicator and flow meter; custom models available.
Slope Indicator Co. (SINCO)	Model 514124 Pneumatic Water Sampler	Portable; gas drive (positive displacement)	1.9/18	PVC, nylon	0-1,100	250 mL/flushing cycle	$250-350	Requires compressed gas; SS available; piezometer model available; dedicated model available.
Solinst Canada Ltd.	5W Water Sampler	Portable; grab (positive displacement)	1.9/27	PVC, brass, nylon, Neoprene®	0-330	500 mL	$1,300-1,800	Requires compressed gas; custom models available.
TIMCO Mfg. Co., Inc.	Std. Bailer	Portable; grab (positive displacement)	1.66/Custom	PVC, PP	No limit	250 mL/ft of bailer	$20-60	Other sizes, materials, models available; optional bottom-emptying device available; no solvents used.
TIMCO	Air or Gas Lift Sampler	Portable; gas drive (positive displacement)	1.66/30	PVC, Tygon®, Teflon®	0-150	350 mL/flushing cycle	$100-200	Requires compressed gas; other sizes, materials, models available; no solvents used.
Tole Devices Co.	Sampling Pump	Portable; bladder (positive displacement)	1.38/48	SS, silicone, Delrin®, Tygon®	0-125	0-4,000 mL/min	$800-1,000	Compressed gas required; DC control module; custom built.

Construction Material Abbreviations:

- PE Polyethylene
- PP Polypropylene
- PVC Polyvinyl chloride
- SS Stainless steel
- PC Polycarbonate
- EPDM Ethylene-propylene diene (synthetic rubber)

Other Abbreviations:

- NA Not applicable
- AC Alternating current
- DC Direct current

NOTE: Other manufacturers market pumping devices which could be used for groundwater sampling, though not expressly designed for this purpose. The list is not meant to be all-inclusive and listing does not constitute endorsement for use. Information in the table is from sales literature and/or personal communication. No skimmer, scavenger-type, or high-capacity pumps are included.

Source: Barcelona et al., 1983.

ATTACHMENT B

SPECIFIC CONDUCTANCE OF 1 MOLAR KCl AT VARIOUS TEMPERATURES[1]

Temperature (°C)	Specific Conductance (umhos/cm)
15	1,147
16	1,173
17	1,199
18	1,225
19	1,251
20	1,278
21	1,305
22	1,332
23	1,359
24	1,368
25	1,413
26	1,441
27	1,468
28	1,496
29	1,524
30	1,552

[1] Data derived from the International Critical Tables 1-3-8.

ATTACHMENT C

VARIATION OF DISSOLVED OXYGEN CONCENTRATION IN WATER AS A FUNCTION OF TEMPERATURE AND SALINITY

Temperature (°C)	Dissolved Oxygen (mg/L)					
	Chloride Concentration in Water					Difference/ 100 mg Chloride
	0	5,000	10,000	15,000	20,000	
0	14.6	13.8	13.0	12.1	11.3	0.017
1	14.2	13.4	12.6	11.8	11.0	0.016
2	13.8	13.1	12.3	11.5	10.8	0.015
3	13.5	12.7	12.0	11.2	10.5	0.015
4	13.1	12.4	11.7	11.0	10.3	0.014
5	12.8	12.1	11.4	10.7	10.0	0.014
6	12.5	11.8	11.1	10.5	9.8	0.014
7	12.2	11.5	10.9	10.2	9.6	0.013
8	11.9	11.2	10.6	10.0	9.4	0.013
9	11.6	11.0	10.4	9.8	9.2	0.012
10	11.3	10.7	10.1	9.6	9.0	0.012
11	11.1	10.5	9.9	9.4	8.8	0.011
12	10.8	10.3	9.7	9.2	8.6	0.011
13	10.6	10.1	9.5	9.0	8.5	0.011
14	10.4	9.9	9.3	8.8	8.3	0.010
15	10.2	9.7	9.1	8.6	8.1	0.010
16	10.0	9.5	9.0	8.5	8.0	0.010
17	9.7	9.3	8.8	8.3	7.8	0.010
18	9.5	9.1	8.6	8.2	7.7	0.009
19	9.4	8.9	8.5	8.0	7.6	0.009
20	9.2	8.7	8.3	7.9	7.4	0.009
21	9.0	8.6	8.1	7.7	7.3	0.009
22	8.8	8.4	8.0	7.6	7.1	0.008
23	8.7	8.3	7.9	7.4	7.0	0.008
24	8.5	8.1	7.7	7.3	6.9	0.008
25	8.4	8.0	7.6	7.2	6.7	0.008

ATTACHMENT C
VARIATION OF DISSOLVED OXYGEN CONCENTRATION IN WATER AS A FUNCTION OF TEMPERATURE AND SALINITY
PAGE TWO

Temperature (°C)	Dissolved Oxygen (mg/L)					
	Chloride Concentration in Water					Difference/ 100 mg Chloride
	0	5,000	10,000	15,000	20,000	
26	8.2	7.8	7.4	7.0	6.6	0.008
27	8.1	7.7	7.3	6.9	6.5	0.008
28	7.9	7.5	7.1	6.8	6.4	0.008
29	7.8	7.4	7.0	6.6	6.3	0.008
30	7.6	7.3	6.9	6.5	6.1	0.008
31	7.5					
32	7.4					
33	7.3					
34	7.2					
35	7.1					
36	7.0					
37	6.9					
38	6.8					
39	6.7					
40	6.6					
41	6.5					
42	6.4					
43	6.3					
44	6.2					
45	6.1					
46	6.0					
47	5.9					
48	5.8					
49	5.7					
50	5.6					

Note: In a chloride solution, conductivity can be roughly related to chloride concentration (and therefore, used to correct measured D.O. concentration) using Attachment B.

S6 GH-1.2 EVALUATION OF EXISTING MONITORING WELLS AND WATER-LEVEL MEASUREMENT

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A GROUNDWATER LEVEL MEASUREMENT SHEET 10

1.0 PURPOSE

The purpose of this procedure is to provide reference information regarding the proper methods for evaluating the physical condition and project utility of existing monitoring wells and determining water levels.

2.0 SCOPE

The procedures described herein are applicable to all existing monitoring wells and, for the most part, are independent of construction materials and methods.

3.0 GLOSSARY

Hydraulic Head - The height to which water will rise in a well.

Water Table - A surface in an unconfined aquifer where groundwater pressure is equal to atmospheric pressure (i.e., the pressure head is zero).

4.0 RESPONSIBILITIES

Site Geologist/Hydrogeologist - Has overall responsibility for the evaluation of existing wells, obtaining water level measurements and developing groundwater contour maps. The site geologist/hydrogeologist (in concurrence with the Project Manager) shall specify the reference point from which water levels are measured (usually a specific point on the upper edge of the inner well casing), the number and location of data points which shall be used for constructing a contour map, and how many complete sets of water levels are required to adequately define groundwater flow directions (e.g., if there are seasonal variations).

Field Personnel - Must have a basic familiarity with the equipment and procedures involved in obtaining water levels and must be aware of any project-specific requirements or objectives.

5.0 PROCEDURES

Accurate, valid and useful groundwater monitoring requires that four important conditions be met:

- Proper characterization of site hydrogeology.
- Proper design of the groundwater monitoring program, including adequate numbers of wells installed at appropriate locations and depths.
- Satisfactory methods of groundwater sampling and analysis to meet the project data quality objectives (DQOs).
- The assurance that specific monitoring well samples are representative of water quality conditions in the monitored interval.

To insure that these conditions are met, adequate descriptions of subsurface geology, well construction methods and well testing results must be available. The following steps will help to insure that the required data are available to permit an evaluation of the utility of existing monitoring wells for collecting additional samples.

5.1 Preliminary Evaluation

A necessary first step in evaluating existing monitoring well data is the study and review of the original work plan for monitoring well installation (if available). This helps to familiarize the site geologist/hydrogeologist with site-specific condition, and will promote an understanding of the original purpose of the monitoring wells.

The next step of the evaluation should involve a review of all available information concerning borehole drilling and well construction. This will allow interpretation of groundwater flow conditions and area geology, and will help to establish consistency between hydraulic properties of the well and physical features of the well or formation. The physical features which should be identified and detailed, if available, include:

- The well identification number, permit number and location by referenced coordinates, the distance from prominent site features, or the location of the well on a map.
- The installation dates, drilling methods, well development methods, and drilling contractors.
- The depth to bedrock -- where rock cores were not taken, auger refusal, drive casing refusal or penetration test results (blow counts for split-barrel sampling) may be used to estimate bedrock interface.
- The soil profile and stratigraphy.
- The borehole depth and diameter.
- The elevation of the top of the protective casing, the top of the well riser, and the ground surface.
- The total depth of the well.
- The type of well materials, screen type, slot size, and length, and the elevation/depths of the screen, interval, and/or monitored interval.
- The elevation/depths of the tops and bottom of the filter pack and well seals and the type and size.

5.2 Field Inspection

During the onsite inspection of existing monitoring wells, features to be noted include:

- The condition of the protective casing, cap and lock.
- The condition of the cement seal surrounding the protective casing.
- The presence of depressions or standing water around the casing.
- The presence of any electrical cable and its connections.
- The presence of a survey mark on the well casing.

If the protective casing, cap and lock have been damaged or the cement collar appears deteriorated, or if there are any depressions around the well casing capable of holding water, surface water may have infiltrated into the well. This may invalidate previous sampling results unless the time when leakage started can be precisely determined.

The routine physical inspection must be followed by a more detailed investigation to identify other potential routes of contamination or sampling equipment malfunction. Any of these occurrences may invalidate previously-collected water quality data. If the monitoring well is to be used in the future, considerations shown in the steps described above should be rectified to rehabilitate the well.

After disconnecting any wires, cables or electrical sources, remove the lock and open the cap. Check for the presence of organic vapors with a photoionization detector (PID) or flame-ionization detector (FID) and combustible gas meter to determine the appropriate worker safety level. The following information should be noted:

- Cap function.
- Physical characteristics and composition of the inner casing or riser, including inner diameter and annular space.
- Presence of grout between the riser and outer protective casing and the existence of drain holes in the protective casing.
- Presence of a riser cap, method of attachment to casing, and venting of the riser.
- Presence of dedicated sampling equipment; if possible, remove such equipment and inspect size, materials of construction and condition.

The final step of the field inspection is to confirm previous hydraulic or physical property data and to obtain data not previously available. This includes the determination of static water levels, total well depth and well obstruction. This may be accomplished using a weighted tape measure which can also be used to check for sediment (the weight will advance slowly if sediment is present, and the presence of sediment on the weight upon removal should be noted). If sediment is present, the well be should be redeveloped before sampling.

Lastly, as a final step, the location, condition and expected water quality of the wells should be reviewed in light of their usefulness for the intended purpose of the investigation.

5.3 Water Level (Hydraulic Head) Measurements

5.3.1 General

Groundwater level measurements can be made in monitoring wells, private or public water wells, piezometers, open boreholes, or test pits (after stabilization). Groundwater measurements should generally not be made in boreholes with drilling rods or auger flights present. If groundwater sampling activities are to occur, groundwater level measurements shall take place prior to well purging or sampling.

All groundwater level measurements shall be made to the nearest 0.01 foot, and recorded in the site geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet (Attachment A), along with the date and time of the reading. The total depth of the well shall be measured and recorded, if not already known. Weather changes that occur over the period of time during which water levels are being taken, such as precipitation and barometric pressure changes, should be noted.

In measuring groundwater levels, there shall be a clearly-established reference point of known elevation, which is normally identified by a mark on the upper edge of the inner well casing. The reference point shall be noted in the field notebook. To be useful, the reference point should be tied in with an

established USGS benchmark or other properly surveyed elevation datum. An arbitrary datum could be used for an isolated group of wells, if necessary.

Cascading water within a borehole or steel well casings can cause false readings with some types of sounding devices (chalked line, electrical). Oil layers may also cause problems in determining the true water level in a well. Special devices (interface probes) are available for measuring the thickness of oil layers and true depth to groundwater, if required.

Water level readings shall be taken regularly, as required by the site geologist/hydrogeologist. Monitoring wells or open-cased boreholes that are subject to tidal fluctuations should be read in conjunction with a tidal chart (or preferably in conjunction with readings of a tide staff or tide level recorder installed in the adjacent water body); the frequency of such readings shall be established by the site hydrogeologist. All water level measurements at a site used to develop a groundwater contour map shall be made in the shortest practical time to minimize affects due to weather changes.

5.3.2 Water Level Measuring Techniques

There are several methods for determining standing or changing water levels in boreholes and monitoring wells. Certain methods have particular advantages and disadvantages depending upon well conditions. A general description of these methods is presented, along with a listing of various advantages and disadvantages of each technique. An effective technique shall be selected for the particular site conditions by the site geologist/hydrogeologist.

In most instances, preparation of accurate potentiometric surface maps require that static water level measurements be obtained to a precision of 0.01 feet. To obtain such measurements in individual accessible wells, chalked tape or electrical water level indicator methods have been found to be best, and thus should be utilized. Other, less precise methods, such as the popper or bell sound, or bailer line methods, should be avoided. When a large number of (or continuous) readings are required, time-consuming individual readings are not usually feasible. In such cases, it is best to use a float recorder or pressure transducer. When conditions in the well limit readings (i.e., turbulence in the water surface or limited access through small diameter tubing), less precise, but appropriate methods such as the air line or capillary tubing methods can be used (see subsequent SOP section for discussion of these devices).

5.3.3 Methods

Water levels can be measured by several different techniques, but the same steps shall be followed in each case. The proper sequence is as follows:

1. Check operation of recording equipment above ground. Prior to opening the well, don personal protective equipment, as required. Never remove an air-tight lock (such as a J-plug) with your face over the well. Pressure changes within the well may explosively force the cap off once loosened.

2. Record all information specified below in the geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet (Attachment A):

   - Well number.
   - Water level (to the nearest 0.01 foot; 0.3 cm). Water levels shall be taken from the surveyed reference mark on the top edge of the inner well casing. If the J-plug was on the well very tightly, it may take several minutes for the water level to stabilize.
   - Time and day of the measurement.

Water level measuring devices with permanently marked intervals shall be used. The devices shall be free of kinks or folds which will affect the ability of the equipment to hang straight in the well pipe.

5.3.4 Water Level Measuring Devices

Chalked Steel Tape

The water level is measured by chalking a weighted steel tape and lowering it a known distance (to any convenient whole foot mark) into the well or borehole. The water level is determined by subtracting the wetted chalked mark from the total length lowered into the hole.

The tape shall be withdrawn quickly from the well because water has a tendency to rise up the chalk due to capillary action. A water finding paste may be used in place of chalk. The paste is spread on the tape the same way as the chalk, and turns red upon contacting water.

Disadvantages to this method include the following: depths are limited by the inconvenience of using heavier weights to properly tension longer tape lengths; ineffective if borehole/well wall is wet or inflow is occurring above the static water level; chalking the tape is time-consuming; difficult to use during periods of precipitation.

Electric Water Level Indicators

These devices consist of a spool of small-diameter cable and a weighted probe attached to the end. When the probe comes in contact with the water, an electrical circuit is closed and a meter, light, and/or buzzer attached to the spool will signal the contact.

There are a number of commercial electric sounders available, none of which is entirely reliable under all conditions likely to occur in a contaminated monitoring well. In conditions where there is oil on the water, groundwater with high specific conductance, water cascading into the well, steel well casing, or a turbulent water surface in the well, measuring with an electric sounder may be difficult.

For accurate readings, the probe shall be lowered slowly into the well. The electric tape is marked at the measuring point where contact with the water surface was indicated. The distance from the mark to the nearest tape band is measured using an engineer's folding ruler or steel tape, and added to the band reading to obtain the depth to water.

Popper or Bell Sounder

A bell- or cup-shaped weight that is hollow on the bottom is attached to a measuring tape and lowered into the well. A "plopping" or "popping" sound is made when the weight strikes the surface of the water. An accurate reading can be determined by lifting and lowering the weight in short strokes, and reading the tape when the weight strikes the water. This method is not sufficiently accurate to obtain water levels to 0.01 feet, and thus is more appropriate for obtaining only approximate water levels quickly.

Float Recorder

A float or an electromechanically actuated water-seeking probe may be used to detect vertical changes of the water surface in the hole. A paper-covered recording chart drum is rotated by the up and down motion of the float via a pulley and reduction gear mechanism, while a clock drive moves a recording pen

horizontally across the chart. To ensure continuous records, the recorder shall be inspected, maintained, and adjusted periodically. This type of device is useful for continuously measuring periodic water level fluctuations, such as tidal fluctuations or influences of pumping wells.

Air Line

An air line is especially useful in pumped wells where water turbulence may preclude the use of other devices. A small-diameter weighted tube of known length is installed from the surface to a depth below the lowest water level expected. Compressed air (from a compressor, bottled air, or air pump) is used to purge the water from the tube, until air begins to escape the lower end of the tube, and is seen (or heard) to be bubbling up through the water in the well. The pressure needed to purge the water from the air line multiplied by 2.307 (feet of water for 1 psi) equals the length in feet of submerged air line. The depth to water below the center of the pressure gauge can be calculated by subtracting the length of air line below the water surface from the total length of the air line.

The disadvantages to this method include the need for an air supply and lower level of accuracy (unless a very accurate air pressure gauge is used, this method cannot be used to obtain water level readings to the nearest 0.01 ft). Another disadvantage includes the introduction of air into a monitoring well. This may not be acceptable to achieve specific project objectives.

Capillary Tubing

In small diameter piezometer tubing, water levels are determined by using a capillary tube. Colored or clear water is placed in a small "U"-shaped loop in one end of the tube (the rest of the tube contains air). The other end of the capillary tube is lowered down the piezometer tubing until the water in the loop moves, indicating that the water level has been reached. The point is then measured from the bottom of the capillary tube or recorded if the capillary tube is calibrated. This is the best method for very small diameter tubing monitoring systems such as Barcad and other multilevel systems. Unless the capillary tube is calibrated, two people may be required to measure the length of capillary tubing used to reach the groundwater. Since the piezometer tubing and capillary tubing usually are somewhat coiled when installed, it is difficult to accurately measure absolute water level elevations using this method. However, the method is useful in accurately measuring differences or changes in water levels (i.e., during pumping tests).

Pressure Transducer

Pressure transducers can be lowered into a well or borehole to measure the pressure of water and therefore the water elevation above the transducer. The transducer is wired into a recorder at the surface to record changes in water level with time. The recorder digitizes the information and can provide a printout or transfer the information to a computer for evaluation (using a well drawdown/recovery model). The pressure transducer should be initially calibrated with another water level measurement technique to ensure accuracy. This technique is very useful for hydraulic conductivity testing in highly permeable material where repeated, accurate water level measurements are required in a very short period of time. A sensitive transducer element is required to measure water levels to 0.01 foot accuracy.

Borehole Geophysics

Approximate water levels can be determined during geophysical logging of the borehole (although this is not the primary purpose for geophysical logging and such logging is not cost effective if used only for this

purpose). Several logging techniques will indicate water level. Commonly-used logs which will indicate saturated/unsaturated conditions include the spontaneous potential (SP) log and the neutron log.

5.3.5 Data Recording

Water level measurements, time, data, and weather conditions shall be recorded in the geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet. All water level measurements shall be measured from a known reference point. The reference point is generally a marked point on the upper edge of the inner well casing that has been surveyed for an elevation. The exact reference point shall be marked with permanent ink on the casing since the top of the casing may not be entirely level. It is important to note changes in weather conditions because changes in the barometric pressure may affect the water level within the well.

5.3.6 Specific Quality Control Procedures for Water Level Measuring Devices

All groundwater level measurement devices must be cleaned before and after each use to prevent cross contamination of wells. Manufacturer's instructions for cleaning the device shall be strictly followed. Some devices used to measure groundwater levels may need to be calibrated. These devices shall be calibrated to 0.01 foot accuracy and any adjustments/corrections shall be recorded in the field logbook/notebook. After the corrections/adjustments are made to the measuring device and entered in the field logbook/notebook, the corrected readings shall be entered onto the Groundwater Level Measurement Sheet (Attachment A). Elevations will be entered on the sheet when they become available.

5.4 Equipment Decontamination

Equipment used for water level measurements provide a mechanism for potentially cross contaminating wells. Therefore, all portions of a device which project down the well casing must be decontaminated prior to advancing to the next well. Decontamination procedures vary based on the project objectives but must be defined prior to conducting any field activities including the collection of water level data. Consult the project planning documents.

5.5 Health and Safety Considerations

Groundwater contaminated by volatile organic compounds may release toxic vapors into the air space inside the well pipe. The release of this air when the well is initially opened is a health/safety hazard which must be considered. Initial monitoring of the well headspace and breathing zone concentrations using a PID (e.g., HNu) or FID (e.g., OVA) and combustible gas meters shall be performed to determine required levels of protection. Under certain conditions, air-tight well caps may explosively fly off the well when the pressure is relieved. Never stand directly over a well when uncapping it.

6.0 RECORDS

A record of all field procedures, tests and observations must be recorded in the site logbook or designated field notebook. Entries in the log/notebook should include the individuals participating in the field effort, and the date and time. The use of annotated sketches may help to supplement the evaluation.

ATTACHMENT A
EXAMPLE GROUNDWATER LEVEL MESUREMENT SHEET

GROUNDWATER LEVEL MEASUREMENT SHEET

Page ___ of ___

PROJECT NAME: _____ LOCATION: _____
PROJECT NUMBER: _____ MEASURING DEVICE: _____
PERSONNEL: _____ ADJUSTMENT FACTOR: _____
DATE: _____ REMARKS: _____
WEATHER CONDITIONS: _____

Well or Piezometer Number	Time	Elevation of Reference Point (Feet)*	Water Level Indicator Reading (Feet)*	Groundwater Elevation (Feet)*	Comments

*Measurements to nearest 0.01 foot.

Signature(s): _____

S7 SA-6.1 NON-RADIOLOGICAL SAMPLE HANDLING

TETRA TECH NUS, INC.	STANDARD OPERATING PROCEDURES	Number SA-6.1	Page 1 of 24
		Effective Date 03/00	Revision 1
		Applicability Tetra Tech NUS, Inc.	
		Prepared Earth Sciences Department	
Subject NON-RADIOLOGICAL SAMPLE HANDLING		Approved D. Senovich	

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure:

- Describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.
- Provides instruction for sample packaging and shipping in accordance with current U.S. Department of Transportation (DOT) and International Air Transportation Association (IATA) regulations. IATA regulates transportation of hazardous materials by air (which is the mode of transportation used for shipping nearly all samples derived during TtNUS projects).

3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (ÿ261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (ÿ261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

ORM - Other regulated material (see DOT 49 CFR 173.144).

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H_2SO_4
- Nitric Acid - HNO_3
- Sodium Hydroxide - NaOH

Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - $Na_2S_2O_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

4.0 RESPONSIBILITIES

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

5.0 PROCEDURES

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

5.1 Sample Containers

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused

containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO_3, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H_2SO_4)	1 part concentrated H_2SO_4: 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO_3)	Undiluted concentrated HNO_3	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.

- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).

- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

  If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

  Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

  The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

  The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

  If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

  Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

5.3 Field Filtration

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter prior to sample collection.

- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

5.4 Sample Packaging and Shipping

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)

- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental and hazardous material samples are outlined in the remainder of this section.

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.

- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.

- Pack with enough noncombustible, absorbent, cushioning materials such as vermiculite (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.

- If cooling is required (see Attachments A and B), double-bag ice in Ziploc baggies and place around sample container shoulders, and on top of absorbent packing material (minimum of 8 pounds of ice for a medium-size cooler).

- Seal (i.e., tape or tie top in knot) large liner bag.

- The original (top, signed copy) and extra carbonless copies of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the first cooler. The COC form should then state how many coolers are included with that shipment.

- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

5.4.2 Hazardous Material Samples

Samples not determined to be environmental samples, or samples known or expected to contain hazardous materials, must be considered hazardous material samples and transported according to the requirements listed below.

NOTE: Packaging and shipping of hazardous materials can only be performed by personnel who have participated in the TtNUS training course "Shipping Hazardous Materials" (or equivalent training approved by Health Sciences).

5.4.2.1 Known Substances

If the substance in the sample is known or can be identified, package, mark, label, and ship according to the specific instructions for that material (if it is listed) in the DOT Hazardous Materials Table (49 CFR 172.101) or the IATA List of Dangerous Goods Table (IATA Dangerous Goods Regulations). DOT Guide for shippers can be found in Attachment D of this document.

To determine the proper shipping name, use the following steps to help locate the shipping name on the Hazardous Materials Table, DOT 49 CFR 172.101.

1. Look first for the chemical or technical name of the material, for example, ethyl alcohol. Note that many chemicals have more than one technical name, for example, perchloroethylene (not listed in 172.101) is listed as tetrachloroethylene (listed 172.101). It may be useful to consult Health Sciences or a chemist for all possible technical names a material can have. If your material is not listed by its technical name, then . . .

2. Look for the chemical family name. For example, pentyl alcohol is not listed but the chemical family name is: alcohol, n.o.s. (not otherwise specified). If the chemical family name is not listed, then . . .

3. Look for a generic name based on end use. For example, Paint, n.o.s. If a generic name based on end use is not listed, then . . .

4. Look for a generic family name based on end use, for example, drugs, n.o.s. or cosmetics, n.o.s. Finally, if your material is not listed by a generic family name but you suspect or know the material is hazardous because it meets the definition of one or more hazardous classes, then . . .

5. You will have to use the general hazard class for a proper shipping name. For example, Flammable Liquid, n.o.s, or Oxidizer, n.o.s.

If you have any doubt regarding the proper shipping name, contact Health Sciences in Pittsburgh, Pennsylvania for assistance.

5.4.2.2 Unknown Substances

For samples of hazardous substances that are not listed on the Hazardous Materials Table, or are of unknown content, the shipper is required to:

1. Determine that the substance is not forbidden for shipment. Items forbidden include explosives (solid and liquid), substances liable to produce a dangerous evolution of heat or gas, and listed "unusual" compounds (which TtNUS fortunately does not typically handle). If the substance is in any way atypical of routine shipments, contact Health Sciences for further information on determining if the substance is forbidden.

2. Classify the substance by assessing whether it is anticipated to exhibit any unusual physical properties as defined by DOT (flammability, explosivity, etc.). If the substance has more than one hazard, follow the hazardous materials classification scheme identified in Attachment C of this SOP.

3. Use the generic or "n.o.s." proper shipping name that most accurately describes the article or substance. There are two types of general proper shipping names:

   - Generic, e.g., Alcohols, n.o.s. *
   - Hazard description, e.g., Flammable liquid, n.o.s.*

   Generic or n.o.s. proper shipping names marked with an "*" require the addition of the technical name in parenthesis () immediately following the proper shipping name. For example, most of our instrument calibration gases are not listed by name and must be declared under the most accurately descriptive name, which is "Compressed Gas, n.o.s. (Mixture Nitrogen and Oxygen)".

The correct shipping classification for an unknown sample is therefore selected through a process of elimination as described above (and detailed in 49 CFR 172.101(c)(11). By using the provisions in this paragraph, the proper shipping name and description will be determined. A step-by-step guide is provided by the DOT and can be found in Attachment D of this SOP. Again, if you have any doubt regarding the proper shipping name, contact Health Sciences for assistance.

5.4.3 Packaging and Shipping of Samples Classified as Flammable Liquid (or Solid)

5.4.3.1 Packaging

Applying the word "flammable" to a sample does not necessarily mean that it is in fact flammable. The word prescribes the class of packaging according to DOT regulations and classification schemes. The DOT defines flammable liquids as substances with a flash point less than 140°F (60°C). For shipping purposes, liquids with a flash point exceeding 95°F (35°C) need not be considered as flammable liquids if they are miscible solutions and have a water content of more than 90% by weight. For solutions classified as flammable liquids:

1. Containerize sample as required (see Attachments A and B). To prevent leakage, fill container no more than 90 percent full. Seal lid with teflon tape or wire.

2. Complete sample label and attach securely to sample container.

3. Seal container and place in 2-mil-thick (or thicker) polyethylene bag (e.g., Ziploc baggie), one sample per bag. Position sample identification label so that it can be read through bag. Seal bag.

4. For soil jars, place sealed bag inside metal can (available from laboratory or laboratory supplier) and cushion it with enough noncombustible, absorbent material (for example, vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to hold can lid securely, tightly and permanently. Mark can as indicated in Paragraph 1 of Section 5.3.4.2, below. Single 1-gallon bottles do not need to be placed in metal cans.

5. Place one or more metal cans (or a single 1-gallon bottle) into a strong outside container, such as a metal picnic cooler or a DOT-approved fiberboard box. Surround cans (or bottle) with noncombustible, absorbent cushioning materials for stability during transport. The absorbent material should be able to absorb the entire contents of the container. Mark container as indicated in Paragraph 2 below.

5.4.3.2 Marking/Labeling

1. Use abbreviations only where specified. Place the following information, either hand-printed or in label form, on the metal can (or 1-gallon bottle):

   - Laboratory name and address.
   - Proper shipping name from the hazardous materials table (DOT Regulation CFR 49 172.101). Example: "Flammable Liquid, n.o.s. (with the technical name in parentheses).

2. Determine packing group. The packing group must be included on the shipping papers in the description section. Packaging groups are classified as follows:

   Group I. Most Hazardous
   Group II. Medium Hazard
   Group III. Least Hazardous

   The packing group will be listed in the hazardous materials table, column 5.

3. Place the following information on outside shipping container per the instructions provided in the "Shipping Hazardous Materials" course:

   - Proper shipping name
   - UN or NA number
   - Proper label(s)
   - Addressee and sender

For flammable liquids, the following are the proper labels to be placed on the outside shipping container:

- DOT "Flammable liquid" label
- Package orientation label (arrows pointing upward) on at least two opposite sides of the package
- "Cargo Aircraft Only" label if shipping more than 30L of flammable liquids in the package.

5.4.3.3 Shipping Papers

Principally because of limitations in sample holding times, TtNUS almost exclusively uses air transportation to ship hazardous materials and other environmental samples. The "Dangerous Goods Airbill" is the shipping paper used to document the information associated with the shipment. As identified previously, only personnel who have participated in "Shipping Hazardous Materials" training (or equivalent course) are authorized to prepare hazardous materials for shipment - including preparation of associated shipping papers. Included in this training are instructions on what specific information is to be provided on the Airbill for hazardous materials typically shipped by TtNUS. Refer to the training course Student Manual or contact Health Sciences for this information.

The properly executed Chain-of-Custody Report must be included in the container. Use custody seals.

Using the Airbill of our common carrier (i.e., Federal Express) as an example, the following instructions apply to the information to be provided under "Transport Details", "Nature and Quantity of Dangerous Goods", and other associated fields.

a) Transport Details

- Select "Passenger and Cargo" or "Cargo Aircraft Only" (This is based on the type and quantity of dangerous goods you are shipping). X-out the non-applicable selection.
- Airport of Departure - Enter the full name of the airport or city of departure.
- Airport of Destination - Enter the full name of the airport or city of destination.

b) Shipment Type – Delete the option that does not apply (Non-Radioactive/Radioactive)

c) Nature and Quantity of Dangerous Goods

1. Dangerous Goods Identification

   - Proper Shipping Name - List the proper shipping name (this is the name as it appears on the List of Dangerous Goods Table and NOT the product or trade name), and if applicable, the technical name in parenthesis.
   - Class or Division - List the class or division number and, if applicable, compatibility group.
   - UN or ID No - List the UN or I.D. number, preceded with "UN" or "I.D." This selection may change when shipping in accordance with 49 CFR regulations that permit the shipment under NA (North American Continental Shipments) designations for certain substances.
   - Packing Group – List the appropriate packing group, if applicable. This is the level of anticipated hazard of the shipment. It does not apply for all shipments. When no information is available, leave the space blank.
   - Subsidiary Risk – List the class or division number of the subsidiary risk, if applicable. The subsidiary risk is any additional hazard beyond the most significant (or primary) hazard. This information is obtained from the List of Dangerous Goods Table.

2. Quantity and Type of Packaging – List the number of packages, the type of package, and the net quantity in each package. The type of packaging you are shipping the hazardous material in is presented first, followed by the amount (Kg, L, etc.). For example, "1 fiberboard box X 2 Kg". When no outer packaging is identified, the packaging selected must provide limited protection of the inner packaging by securing and cushioning during shipment. NOTE: Always use the package that the hazardous material was shipped to the site in. If it is not available, contact the Health Sciences Department in Pittsburgh for further instruction.

3. Packing Instructions – Enter the Packing Instruction number. These instructions are provided in Section 5 of the IATA Dangerous Goods Regulations. They provide the exact type of packaging required by the industry for various hazard classes. When no addition packaging considerations are given, the shipper may use their best judgment for the shipment of an identified substance and/or article.

4. Authorization – List the words " Limited Quantity," if applicable; list any special provision(s) or approval(s) if applicable. This section provides for exceptions to this transportation regulation and the conditions for those exceptions.

d) Additional handling Information - Enter any required special handling information.

e) Prepared for Air Transport according to: Check the ICAO/IATA box.

f) Emergency Telephone Number - Enter the 24-hour emergency contact number. This number is required of all US Origin or Destination Shipments. List the number for InfoTRAC (1-800-535-5053). InfoTRAC is a company retained by TtNUS to provide 24-Hour Emergency Hotline service for dangerous goods shipment. This company has MSDSs for the substances routinely shipped by TtNUS. They provide information to FedEx or any other emergency responders, should situations arise with one of our shipments. In addition, they have telephone numbers of certain Tetra Tech NUS Health Science Department personnel in the Pittsburgh Office in the event of an emergency.

g) Name/Title of the Signatory - Enter name and job title (Field Operations Leader, Geologist, Health & Safety Specialist, etc.)

h) Place and date - Enter the city and date of shipment

i) Signature - Sign the form (must be a complete signature). All alterations must be signed with the same signature used to sign the declaration.

5.4.3.4 Transportation

1. The majority of unknown hazardous substance samples will be classified as flammable liquids. The samples will be transported by rented or common carrier truck, railroad, or express overnight package services. Do not transport samples on any passenger-carrying air transport system, even if the system has cargo-only aircraft. DOT regulations permit regular airline cargo-only aircraft, but difficulties with most suggest avoiding them. Instead, ship by airline carriers that carry only cargo. If unsure of what mode of transportation to use, consult Health Sciences.1

2. For transport by government-owned vehicle, including aircraft, DOT regulations do not apply. However, procedures described above, with the exception of execution of the bill of lading with certification, shall still be followed.

3. Use the hazardous materials shipping check list (Attachment E) as a guidance to ensure that all sample-handling requirements are satisfied.

4. In some cases, various materials may react if they break during shipment. To determine if you are shipping such materials, refer to the DOT compatibility chart in Attachment F.

5.5 Shipment of Lithium Batteries

Monitoring well data are analyzed using either the Hermit SE 1000 or the Hermit SE 2000 environmental data logger. These instruments are typically powered by lithium batteries in sufficient quantity to make the unit subject to hazardous material shipping requirements. The DOT determined that lithium batteries are to be shipped using the following information:

---

1 Note: If you are unsure as how to ship the sample (hazardous or environmental sample), contact Health Sciences so that a decision can be made as to the proper shipping practices. The DOT and IATA penalties for improper shipment of a hazardous material are stringent and may include a prison term for intentional violations.

- Product Designation
  - Hermit SE 1000
  - Hermit SE 2000

- Proper Shipping Name
  - Lithium batteries, contained in equipment, UN3091

- UN No - UN-3091

- Classification or Division
  - Class 9

Shipment of equipment containing lithium batteries must be accompanied by shipping papers completed as indicated in Attachment G. The instrument will be shipped by Federal Express as a Hazardous Material. Place the instrument in the same container in which it was received. This container or case is a DOT-approved shipping container. For Federal Express procedures to ship hazardous materials, call 1-800-238-5355, extension 922-1666. In most cases, the return shipping papers and DOT labels will be shipped to you from the company warehouse or the vendor. An example of the types of labels used for shipment and the wording are shown in Attachment G. These labels will be attached to the outside container and include all the information noted under Section 5.4.3.2. Instead of the Flammable Liquid information, however, the following will be presented with the following wording:

- Lithium Batteries Contained in Equipment
  - UN-3091

- DOT Miscellaneous Hazardous Materials (Class 9) label

- "Cargo Aircraft Only" label

6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

ATTACHMENT A

GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration			Container[1]	Sample Size	Preservation[2]	Holding Time[2]
WATER						
Organics (GC&GC/MS)	VOC	Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to ≤ 2	14 days[9]
	Extractables SVOCs and pesticide/PCBs)	(Low	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals	Low	High-density polyethylene	1 L	HNO_3 to pH ≤2	6 months (Hg-28 days)
		Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide	Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide	Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	14 days
SOIL						
Organics (GC&GC/MS)	VOC		Wide-mouth glass with teflon liner	2 x 4 oz.	Cool to 4°C	14 days
	Extractables SVOCs and pesticides/PCBs)	(Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	7 days until extraction; 40 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction
AIR						
Volatile Organics	Low/Medium		Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended

1 All glass containers should have Teflon cap liners or septa.
2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

ATTACHMENT B

ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container[1]	Preservation[2][3]	Maximum Holding Time[4]
INORGANIC TESTS:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid[5]	14 days[6]
Fluoride	P	None required	28 days
Hardness	P, G	HNO_3 to pH 2; H_2SO_4 to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H_2SO_4 to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE TWO

Parameter Number/Name	Container[1]	Preservation[2][3]	Maximum Holding Time[4]
INORGANIC TESTS (Cont'd):			
Sulfide	P, G	Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4°C	48 hours
METALS:[7]			
Chromium VI (Hexachrome)	P, G	Cool, 4°C	24 hours
Mercury (Hg)	P, G	HNO_3 to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO_3 to pH 2	6 months
ORGANIC TESTS:[8]			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5] HCl to pH 2 [9]	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5] adjust pH to 4-5 [10]	14 days
Phenols[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Benzidines[11], [12]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction[13]
Phthalate esters[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitrosamines[11], [14]	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
PCBs[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs)[11],[14]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Haloethers[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF)[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE THREE

(1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
(2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
(3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
(4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
(5) Should only be used in the presence of residual chlorine.
(6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
(7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
(8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
(9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
(10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
(11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
(12) If 1,2-diphenylthydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.
(13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
(14) For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.
(15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

ATTACHMENT C

DOT HAZARDOUS MATERIAL CLASSIFICATION (49 CFR 173.2a)

1. Radioactive material (except a limited quantity)
2. Division 2.3, Poisonous Gases
3. Division 2.1, Flammable Gas
4. Division 2.2, Nonflammable gas
5. Division 6.1, Poisonous Liquids, Packing Group 1 (poison by inhalation only)
6. Division 4.2, Pyrophoric Material
7. Division 4.1, Self-Reactive Material
8. Class 3, Flammable Liquids*
9. Class 8, Corrosive Material
10. Division 4.1, Flammable Solid*
11. Division 4.2, Spontaneously Combustible Materials*
12. Division 4.3, Dangerous When Wet Materials*
13. Division 5.1, Oxidizers*
14. Division 6.1, Poisonous Liquids or Solids (other than Packing Group 1)*
15. Combustible liquid
16. Class 9, Miscellaneous Hazardous Materials

* If a material has or meets the criteria for more than one hazard class, use the precedence of hazardous table on the following page for Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1, and 6.1. The following table ranks those materials that meet the definition of Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1, and 6.1.

ATTACHMENT C (Continued)

DOT HAZARDOUS MATERIAL CLASSIFICATION (49 CFR 173.2a)

Class	Packing Group	4.2	4.3	5.1 I[a]	5.1 II[a]	5.1 III[a]	6.1 I (Dermal)	6.1 I (Oral)	6.1 II	6.1 III	8 I (Liquid)	8 I (Solid)	8 II (Liquid)	8 II (Solid)	8 III (Liquid)	8 III (Solid)
3	I						3	3	3	3	3	(c)	3	(c)	3	(c)
3	II						3	3	3	3	8	(c)	3	(c)	3	(c)
3	III						6.1	6.1	6.1	3[d]	8	(c)	8	(c)	3	(c)
4.1	II[b]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	4.1	4.1	(c)	8	(c)	4.1	(c)	4.1
4.1	III[b]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	(c)	8	(c)	8	(c)	4.1
4.2	II		4.3	5.1	4.2	4.2	6.1	6.1	4.2	4.2	(c)	8	(c)	4.2	(c)	4.2
4.2	III		4.3	5.1	4.2	4.2	6.1	6.1	6.1	4.2	(c)	8	(c)	8	(c)	4.2
4.3	I			5.1	4.3	4.3	6.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
4.3	II			5.1	4.3	4.3	6.1	4.3	4.3	4.3	8	8	8	4.3	4.3	4.3
4.3	III			5.1	4.3	4.3	6.1	6.1	6.1	4.3	8	8	8	8	4.3	4.3
5.1	I[a]						5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5.1	II[a]						6.1	5.1	5.1	5.1	8	8	8	5.1	5.1	5.1
5.1	III[a]						6.1	6.1	6.1	5.1	8	8	8	8	5.1	5.1
6.1	I, Dermal										8	6.1	6.1	6.1	6.1	6.1
6.1	I, Oral										8	6.1	6.1	6.1	6.1	6.1
6.1	II, Inhalation										8	6.1	6.1	6.1	6.1	6.1
6.1	II, Dermal										8	6.1	8	6.1	6.1	6.1
6.1	II, Oral										8	8	8	6.1	6.1	6.1
6.1	III										8	8	8	8	8	8

(a) There are at present no established criteria for determining Packing Groups for liquids in Division 5.1. At present, the degree of hazard is to be assessed by analogy with listed substances, allocating the substances to Packing Group I, Great; Group II, Medium; or Group III, Minor Danger.

(b) Substances of Division 4.1 other than self-reactive substances.

(c) Denotes an impossible combination.

(d) For pesticides only, where a material has the hazards of Class 3, Packing Group III, and Division 6.1, Packing Group III, the primary hazard is Division 6.1, Packing Group III.

ATTACHMENT D

GUIDE FOR HAZARDOUS MATERIALS SHIPPERS

USE OF GUIDE - This guide is presented as an aid to shippers of hazardous materials. It does not contain or refer to all of the DOT requirements for shipping hazardous materials. For specific details, refer to all of the DOT requirements for shipping hazardous materials, as provided in the Code of Federal Regulations (CFR), Title 49, Transportation, Parts 100-199.

The following is offered as a step-by-step procedure to aid in compliance with the applicable DOT regulations.

STEP 1 - DETERMINE THE PROPER SHIPPING NAME. The shipper must determine the proper shipping name of the materials as listed in the Hazardous Materials Table, 49 CFR 172.101, Column (2).

STEP 2 - DETERMINE THE HAZARD CLASS OR CLASSES.

a. Refer to the Table, 49 CFR 172.101, Column (3), and locate the hazard class of the material.
b. If more than one class is shown for the proper shipping name, determine the proper class by definition.
c. If the materials have more than one hazard, classify the material based on the order of hazards in 49 CFR 173.2.

STEP 3 - SELECT THE PROPER IDENTIFICATION NUMBERS.

a. Refer to the Table, 49 CFR 172.101, Column (3a), and select the Identification Number (ID) that corresponds to the proper shipping name and hazard class.
b. Enter the ID number(s) on the shipping papers and display them, as required, on packagings, placards and/or orange panels.

STEP 4 - DETERMINE THE MODE(S) OF TRANSPORT TO ULTIMATE DESTINATION.

a. As a shipper, you must assure yourself that the shipment complies with various modal requirements.
b. The modal requirements may affect the following: (1) Packaging; (2) Quantity per Package; (3) Marking; (4) Labeling; (5) Shipping Papers; and (6) Certification.

STEP 5 - SELECT THE PROPER LABEL(S) AND APPLY AS REQUIRED.

a. Refer to the Table, 49 CFR 172.101, Column (4) for required labels.
b. For details on labeling refer to (1) Additional Labels, 49 CFR 172.402; (2) Placement of Labels, 49 CFR 172.406; (3) Packagings (Mixed or Consolidated), 49 CFR 172.404(a) and (h); (4) Packages Containing Samples, 49 CFR 172.402(h); (5) Radioactive Materials, 49 CFR 172.403; and (6) Authorized Label Modifications, 49 CFR 172.405.

STEP 6 - DETERMINE AND SELECT THE PROPER PACKAGES.

a. Refer to the Table, 49 CFR 172.101, Column (5a) for exceptions and Column (5b) for specification packagings. Consider the following when selecting an authorized package: Quantity per Package; Cushioning Material, if required; Proper Closure and Reinforcement; Proper Pressure; Outage; etc., as required.
b. If packaged by a prior shipper, make sure the packaging is correct and in proper condition for transportation.

ATTACHMENT D (Continued)
GUIDE FOR HAZARDOUS MATERIALS SHIPPERS

STEP 7 - MARK THE PACKAGING (INCLUDING OVERPACKS).

a. Apply the required markings (49 CFR 172.300); Proper shipping name and ID number, when required (49 CFR 172.301); Name and address of Consignee or Consignor (49 CFR 172.306).
b. For details and other required markings, see 49 CFR 172.300 through 172.338.

STEP 8 - PREPARE THE SHIPPING PAPERS.

a. The basic requirements for preparing shipping papers include Proper Shipping Name; Hazard Class; ID Number; Total Quantity; Shipper's Certification; and Emergency Response Telephone Number.
b. Make all entries on the shipping papers using the information required and in proper sequence (49 CFR 172.202).

STEP 9 - CERTIFICATION.

a. Each shipper must certify by printing (manually or mechanically) on the shipping papers that the materials being offered for shipment are properly classified, described, packaged, marked and labeled, and in proper condition for transportation according to the applicable DOT Regulations (49 CFR 172.202).

STEP 10 - LOADING, BLOCKING, AND BRACING. When hazardous materials are loaded into the transport vehicle or freight container, each package must be loaded, blocked, and braced in accordance with the requirements for mode of transport.

a. If the shipper loads the freight container or transport vehicle, the shipper is responsible for the proper loading, blocking, and bracing of the materials.
b. If the carrier does the loading, the carrier is responsible.

STEP 11 - DETERMINE THE PROPER PLACARD(S). Each person who offers hazardous materials for transportation must determine that the placarding requirements have been met.

a. For Highway, unless the vehicle is already correctly placarded, the shipper must provide the required placard(s) and required ID number(s) (49 CFR 172.506).
b. For Rail, if loaded by the shipper, the shipper must placard the rail car if placards are required (49 CFR 172.508).
c. For Air and Water shipments, the shipper has the responsibility to apply the proper placards.

STEP 12 - HAZARDOUS WASTE/HAZARDOUS SUBSTANCE.

a. If the material is classed as a hazardous waste or hazardous substance, most of the above steps will be applicable.
b. Pertinent Environmental Protection Agency regulations are found in the Code of Federal Regulations, Title 40, Part 262.

As a final check and before offering the shipment for transportation, visually inspect the shipment. The shipper should ensure that emergency response information is on the vehicle for transportation of hazardous materials.

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Revised March 1995.

ATTACHMENT E

HAZARDOUS MATERIALS SHIPPING CHECK LIST

PACKAGING

1. Check DOT 173.24 for appropriate type of package for hazardous substance.
2. Check for container integrity, especially the closure.
3. Check for sufficient absorbent material in package.
4. Check for sample tags and log sheets for each sample and for chain-of-custody record.

SHIPPING PAPERS

1. Check that entries contain only approved DOT abbreviations.
2. Check that entries are in English.
3. Check that hazardous material entries are specially marked to differentiate them from any nonhazardous materials being sent using same shipping paper.
4. Be careful that all hazardous classes are shown for multiclass materials.
5. Check total amounts by weight, quantity, or other measures used.
6. Check that any limited-quantity exemptions are so designated on the shipping paper.
7. Check that certification is signed by shipper.
8. Make certain driver signs for shipment.

RCRA MANIFEST

1. Check that approved state/federal manifests are prepared.
2. Check that transporter has the following: valid EPA identification number, valid driver's license, valid vehicle registration, insurance protection, and proper DOT labels for materials being shipped.
3. Check that destination address is correct.
4. Check that driver knows where shipment is going.
5. Check that the driver is aware of emergency procedures for spills and accidents.
6. Make certain driver signs for shipment.
7. Make certain one copy of executed manifest and shipping document is retained by shipper.

ATTACHMENT F
DOT SEGREGATION AND SEPARATON CHART

Class or Division	Notes	1.1-1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3 gas Zone A*	2.3 gas Zone B*	3	4.1	4.2	4.3	5.1	5.2	6.1 liquids PG-I Zone A*	7	8 liquids only
Explosives... 1.1 and 1.2	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Explosives..... 1.3		*	*	*	*	*	X		X	X	X		X	X	X	X	X		X
Explosives..... 1.4		*	*	*	*	*	O		O	O	O		O				O		O
Very insensitive explosives 1.5	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Extremely insensitive explosives 1.6		*	*	*	*	*													
Flammable gases 2.1		X	X	O	X				X	O							O	O	
Non-toxic, non-flammable gases 2.2		X			X														
Poisonous gas - Zone A** 2.3		X	X	O	X		X				X	X	X	X	X	X			X
Poisonous gas - Zone B** 2.3		X	X	O	X		O				O	O	O	O	O	O			O
Flammable liquids..... 3		X	X	O	X				X	O					O		X		
Flammable solids..... 4.1		X			X				X	O							X		O
Spontaneously combustible materials 4.2		X	X	O	X				X	O							X		X
Dangerous-when-wet materials 4.3		X	X		X				X	O							X		O
Oxidizers..... 5.1	A	X	X		X				X	O	O						X		O
Organic peroxides.... 5.2		X	X		X				X	O							X		O
Poisonous liquids PG I - Zone A** 6.1		X	X	O	X		O				X	X	X	X	X	X			X
Radioactive materials . 7		X			X		O												
Corrosive liquids 8		X	X	O	X				X	O		O	X	O	O	O	X		

No entry means that the materials are compatible (have no restrictions).

X These materials may not be loaded, transported, or stored together in the same vehicle or facility.
O The materials may not be loaded, transported, or stored together in the same vehicle or facility unless they are separated for 4 feet on all sides.
* Check the explosives compatibility chart in 49 CFR 179.848(f).
A Ammonium nitrate fertilizers may be stored with Division 1.1 materials.
** Denotes inhalation hazardous for poisons; consult field team leader or project manager if you encounter a material in this class
1 before shipment.

ATTACHMENT G
LITHIUM BATTERY SHIPPING PAPERS

3224637861

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non applicable)*

[redacted] | CARGO AIRCRAFT ONLY

Airport of Departure

Airport of Destination:
19CYS

Two completed and signed copies of this Declaration must be handed to the operator.

WARNING

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

Shipment type: *(delete non-applicable)*

NON-RADIOACTIVE | [redacted]

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification						
Proper Shipping Name	Class or Division	UN or ID No.	Subsidiary Risk	Quantity and type of packing	Packing Inst.	Authorization
LITHIUM BATTERIES CONTAINED IN EQUIPMENT	9	UN3091		1 PLASTIC BOX X 55 GRAMS	912 II	PER CA-9206009

Additional Handling Information

1 HERMIT SERIES DATALOGGER X 55 GRAMS (11 GRAMS/CELL)

I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in the proper condition for transport by air according to the applicable International and National Government Regulations.

Name/Title of Signatory

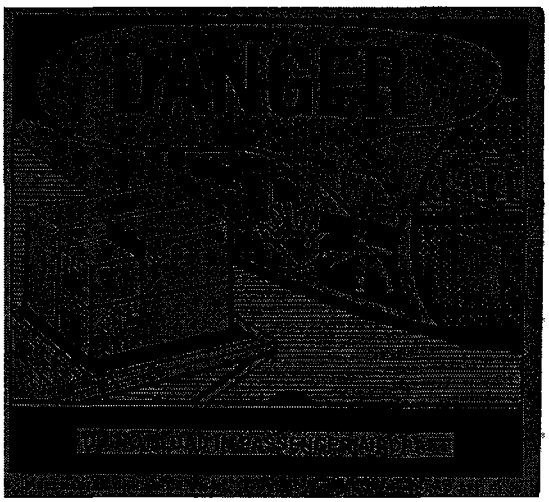
Place and Date

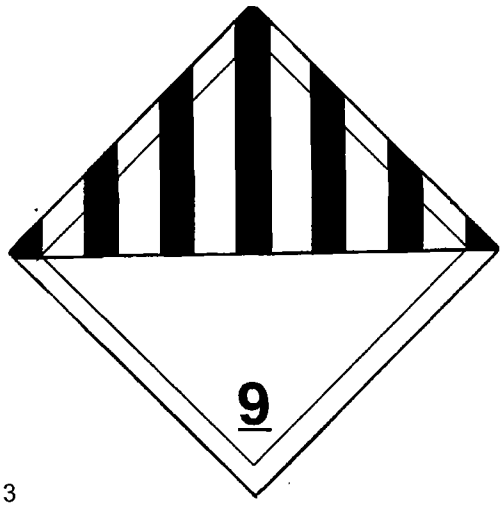
Signature *(see warning above)*

Emergency Telephone Number (Required for US Origin or Destination Shipments)
800-535-5053

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.

ATTACHMENT G (CONTINUED)
LITHIUM BATTERY SHIPPING PAPERS





3

LITHIUM BATTERIES CONTAINED IN EQUIPMENT.
UN-3091.
SHIPPED UNDER CA-9206009

S8 SA-7.1 DECONTAMINATION OF FIELD EQUIPMENT AND WASTE HANDLING

TABLE OF CONTENTS

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1.0 PURPOSE

The purpose of this procedure is to provide guidelines regarding the appropriate procedures to be followed when decontaminating drilling equipment, monitoring well materials, chemical sampling equipment and field analytical equipment.

2.0 SCOPE

This procedure addresses drilling equipment and monitoring well materials decontamination, as well as chemical sampling and field analytical equipment decontamination. This procedure also provides general reference information on the control of contaminated materials.

3.0 GLOSSARY

Acid - For decontamination of equipment when sampling for trace levels of inorganics, a 10% solution of nitric acid in deionized water should be used. Due to the leaching ability of nitric acid, it should not be used on stainless steel.

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

Deionized Water - Deionized (analyte free) water is tap water that has been treated by passing through a standard deionizing resin column. Deionized water should contain no detectable heavy metals or other inorganic compounds at or above the analytical detection limits for the project.

Potable Water - Tap water used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Solvent - The solvent of choice is pesticide-grade Isopropanol. Use of other solvents (methanol, acetone, pesticide-grade hexane, or petroleum ether) may be required for particular projects or for a particular purpose (e.g. for the removal of concentrated waste) and must be justified in the project planning documents. As an example, it may be necessary to use hexane when analyzing for trace levels of pesticides, PCBs, or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on PVC equipment or well construction materials.

4.0 RESPONSIBILITIES

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved Standards Operating Procedures or as otherwise dictated by the approved project plan(s).

5.0 PROCEDURES

To ensure that analytical chemical results reflect actual contaminant concentrations present at sampling locations, the various drilling equipment and chemical sampling and analytical equipment used to acquire the environment sample must be properly decontaminated. Decontamination minimizes the potential for cross-contamination between sampling locations, and the transfer of contamination off site.

5.1 Drilling Equipment

Prior to the initiation of a drilling program, all drilling equipment involved in field sampling activities shall be decontaminated by steam cleaning at a predetermined area. The steam cleaning procedure shall be performed using a high-pressure spray of heated potable water producing a pressurized stream of steam. This steam shall be sprayed directly onto all surfaces of the various equipment which might contact environmental samples. The decontamination procedure shall be performed until all equipment is free of all visible potential contamination (dirt, grease, oil, noticeable odors, etc.) In addition, this decontamination procedure shall be performed at the completion of each sampling and/or drilling location, including soil borings, installation of monitoring wells, test pits, etc. Such equipment shall include drilling rigs, backhoes, downhole tools, augers, well casings, and screens. Where the drilling rig is set to perform multiple borings at a single area of concern, the steam-cleaning of the drilling rig itself may be waived with proper approval. Downhole equipment, however, must always be steam-cleaned between borings. Where PVC well casings are to be installed, decontamination is not required if the manufacturer provides these casings in factory-sealed, protective, plastic sleeves (so long as the protective packaging is not compromised until immediately before use).

The steam cleaning area shall be designed to contain decontamination wastes and waste waters and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be provided which is connected to a holding facility. A shallow above-ground tank may be used or a pumping system with discharge to a waste tank may be installed.

In certain cases such an elaborate decontamination pad is not possible. In such cases, a plastic lined gravel bed pad with a collection system may serve as an adequate decontamination area. Alternately, a lined sloped pad with a collection pump installed at the lower end may be permissible. The location of the steam cleaning area shall be onsite in order to minimize potential impacts at certain sites.

Guidance to be used when decontaminating drilling equipment shall include:

- As a general rule, any part of the drilling rig which extends over the borehole, shall be steam cleaned.
- All drilling rods, augers, and any other equipment which will be introduced to the hole shall be steam cleaned.
- The drilling rig, all rods and augers, and any other potentially contaminated equipment shall be decontaminated between each well location to prevent cross contamination of potential hazardous substances.

Prior to leaving at the end of each work day and/or at the completion of the drilling program, drilling rigs and transport vehicles used onsite for personnel or equipment transfer shall be steam cleaned, as practicable. A drilling rig left at the drilling location does not need to be steam cleaned until it is finished drilling at that location.

Error! Bookmark not defined.**5.2 Sampling Equipment**

5.2.1 Bailers and Bailing Line

The potential for cross-contamination between sampling points through the use of a common bailer or its attached line is high unless strict procedures for decontamination are followed. For this reason, it is preferable to dedicate an individual bailer and its line to each sample point, although this does not eliminate the need for decontamination of dedicated bailers. For non-dedicated sampling equipment, the following conditions and/or decontamination procedures must be followed.

Before the initial sampling and after each successive sampling point, the bailer must be decontaminated. The following steps are to be performed when sampling for organic contaminants. Note: contract-specific requirements may permit alternative procedures.

- Potable water rinse
- Alconox or Liquinox detergent wash
- Scrubbing of the line and bailer with a scrub brush (may be required if the sample point is heavily contaminated with heavy or extremely viscous compounds)
- Potable water rinse
- Rinse with 10 percent nitric acid solution*
- Deionized water rinse
- Pesticide-grade isopropanol (unless otherwise required)
- Pesticide-grade hexane rinse**
- Copious distilled/Deionized water rinse
- Air dry

If sampling for volatile organic compounds (VOCs) only, the nitric acid, isopropanol, and hexane rinses may be omitted. Only reagent grade or purer solvents are to be used for decontamination. When solvents are used, the bailer must be thoroughly dry before using to acquire the next sample.

In general, specially purchased pre-cleaned disposable sampling equipment is not decontaminated (nor is an equipment rinsate blank collected) so long as the supplier has provided certification of cleanliness. If decontamination is performed on several bailers at once (i.e., in batches), bailers not immediately used may be completely wrapped in aluminum foil (shiny-side toward equipment) and stored for future use. When batch decontamination is performed, one equipment rinsate is generally collected from one of the bailers belonging to the batch before it is used for sampling.

It is recommended that clean, dedicated braided nylon or polypropylene line be employed with each bailer use.

5.2.2 Sampling Pumps

Most sampling pumps are low volume (less than 2 gpm) pumps. These include peristaltic, diaphragm, air-lift, pitcher and bladder pumps, to name a few. If these pumps are used for sampling from more than one sampling point, they must be decontaminated prior to initial use and after each use.

The procedures to be used for decontamination of sampling pumps compare to those used for a bailer except that the 10 percent nitric acid solution is omitted. Each of the liquid factions is to be pumped through the system. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge hoses. Certain types of pumps are unacceptable for sampling purposes. For peristaltic pumps, the tubing is replaced rather than cleaned.

An additional problem is introduced when the pump relies on absorption of water via an inlet or outlet hose. For organic sampling, this hose should be Teflon. Other types of hoses leach organics (especially phthalate esters) into the water being sampled or adsorb organics from the sampled water. For all other sampling, the hose should be Viton, polyethylene, or polyvinyl chloride (listed in order of preference).

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* Due to the leaching ability of nitric acid on stainless steel, this step is to be omitted if a stainless steel sampling device is being used and metals analysis is required with detection limits less than approximately 50 ppb.

** If sampling for pesticides, PCBs, or fuels.

Whenever possible, dedicated hoses should be used. It is preferable that these types of pumps not be used for sampling, only for purging.

5.2.3 Filtering Equipment

On occasion, the sampling plan may require acquisition of filtered groundwater samples. Field-filtering is addressed in SOP SA-6.1 and should be conducted as soon after sample acquisition as possible. To this end, three basic filtration systems are most commonly used: the in-line disposable Teflon filter, the inert gas over-pressure filtration system, and the vacuum filtration system.

For the in-line filter, decontamination is not required since the filter cartridge is disposable, however, the cartridge must be disposed of in an approved receptacle and the intake and discharge lines must still be decontaminated or replaced before each use.

For the over-pressure and the vacuum filtration systems, the portions of the apparatus which come in contact with the sample must be decontaminated as outlined in the paragraphs describing the decontamination of bailers. (Note: Varieties of both of these systems come equipped from the manufacturer with Teflon-lined surfaces for those that would come into contact with the sample. These filtration systems are preferred when decontamination procedures must be employed.)

5.2.4 Other Sampling Equipment

Field tools such as trowels and mixing bowls are to be decontaminated in the same manner as described above.

5.3 Field Analytical Equipment

5.3.1 Water Level Indicators

Water level indicators that come into contact with groundwater must be decontaminated using the following steps:

- Rinse with potable water
- Rinse with deionized water

Water level indicators that do not come in contact with the groundwater but may encounter incidental contact during installation or retrieval need only undergo the first and last steps stated above.

5.3.2 Probes

Probes (e.g., pH or specific-ion electrodes, geophysical probes, or thermometers) which would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise (e.g., dissolved oxygen probes). Probes that contact a volume of groundwater not used for laboratory analyses can be rinsed with deionized water. For probes which make no direct contact, (e.g., OVA equipment) the probe is self-cleaning when exposure to uncontaminated air is allowed and the housing can be wiped clean with paper-towels or cloth wetted with alcohol.

5.4 Waste Handling

For the purposes of these procedures, contaminated materials are defined as any byproducts of field activities that are suspected or known to be contaminated with hazardous substances. These byproducts

include such materials as decontamination solutions, disposable equipment, drilling muds, well-development fluids, and spill-contaminated materials and Personal Protection Equipment (PPE).

The procedures for obtaining permits for investigations of sites containing hazardous substances are not clearly defined at present. In the absence of a clear directive to the contrary by the EPA and the states, it must be assumed that hazardous wastes generated during field activities will require compliance with Federal agency requirements for generation, storage, transportation, or disposal. In addition, there may be state regulations that govern the disposal action. This procedure exclusively describes the technical methods used to control contaminated materials.

The plan documents for site activities must include a description of control procedures for contaminated materials. This planning strategy must assess the type of contamination, estimate the amounts that would be produced, describe containment equipment and procedures, and delineate storage or disposal methods. As a general policy, it is wise to select investigation methods that minimize the generation of contaminated spoils. Handling and disposing of potentially hazardous materials can be dangerous and expensive. Until sample analysis is complete, it is assumed that all produced materials are suspected of contamination from hazardous chemicals and require containment.

5.5 Sources of Contaminated Materials and Containment Methods

5.5.1 Decontamination Solutions

All waste decontamination solutions and rinses must be assumed to contain the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. The waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility. Larger equipment such as backhoes and tractors must be decontaminated in an area provided with an impermeable liner and a liquid collection system. A decontamination area for large equipment could consist of a bermed concrete pad with a floor drain leading to a buried holding tank.

5.5.2 Disposable Equipment

Disposable equipment that could become contaminated during use typically includes PPE, rubber gloves, boots, broken sample containers, and cleaning-wipes. These items are small and can easily be contained in 55-gallon drums with lids. These containers should be closed at the end of each work day and upon project completion to provide secure containment until disposed.

5.5.3 Drilling Muds and Well-Development Fluids

Drilling muds and well-development fluids are materials that may be used in groundwater monitoring well installations. Their proper use could result in the surface accumulation of contaminated liquids and muds that require containment. The volumes of drilling muds and well-development fluids used depend on well diameter and depth, groundwater characteristics, and geologic formations. There are no simple mathematical formulas available for accurately predicting these volumes. It is best to rely on the experience of reputable well drillers familiar with local conditions and the well installation techniques selected. These individuals should be able to estimate the sizes (or number) of containment structures required. Since guesswork is involved, it is recommended that an slight excess of the estimated amount of containers required will be available.

Drilling muds are mixed and stored in what is commonly referred to as a mud pit. This mud pit consists of a suction section from which drilling mud is withdrawn and pumped through hoses, down the drill pipe to the bit, and back up the hole to the settling section of the mud pit. In the settling section, the mud's velocity is reduced by a screen and several flow-restriction devices, thereby allowing the well cuttings to settle out of the mud/fluid.

The mud pit may be either portable above-ground tanks commonly made of steel (which is preferred) or stationary in-ground pits as depicted in Attachment A. The above-ground tanks have a major advantage over the in-ground pits because the above-ground tanks isolate the natural soils from the contaminated fluids within the drilling system. These tanks are also portable and can usually be cleaned easily.

As the well is drilled, the cuttings that accumulate in the settling section must be removed. This is best done by shoveling them into drums or other similar containers. When the drilling is complete, the contents of the above-ground tank are likewise shoveled or pumped into drums, and the tank is cleaned and made available for its next use.

If in-ground pits are used, they should not extend into the natural water table. They should also be lined with a bentonite-cement mixture followed by a layer of flexible impermeable material such as plastic sheeting. Of course, to maintain its impermeable seal, the lining material used would have to be nonreactive with the wastes. An advantage of the in-ground pits is that well cuttings do not necessarily have to be removed periodically during drilling because the pit can be made deep enough to contain them. Depending on site conditions, the in-ground pit may have to be totally excavated and refilled with uncontaminated natural soils when the drilling operation is complete.

When the above-ground tank or the in-ground pit is used, a reserve tank or pit should be located at the site as a backup system for leaks, spills, and overflows. In either case, surface drainage should be such that any excess fluid could be controlled within the immediate area of the drill site.

The containment procedure for well-development fluids is similar to that for drilling muds. The volume and weight of contaminated fluid will be determined by the method used for development. When a new well is pumped or bailed to produce clear water, substantially less volume and weight of fluid result than when backwashing or high-velocity jetting is used.

5.5.4 Spill-Contaminated Materials

A spill is always possible when containers of liquids are opened or moved. Contaminated sorbents and soils resulting from spills must be contained. Small quantities of spill-contaminated materials are usually best contained in drums, while larger quantities can be placed in lined pits or in other impermeable structures. In some cases, onsite containment may not be feasible and immediate transport to an approved disposal site will be required.

5.6 Disposal of Contaminated Materials

Actual disposal techniques for contaminated materials are the same as those for any hazardous substance, that is, incineration, landfilling, treatment, and so on. The problem centers around the assignment of responsibility for disposal. The responsibility must be determined and agreed upon by all involved parties before the field work starts. If the site owner or manager was involved in activities that precipitated the investigation, it seems reasonable to encourage his acceptance of the disposal obligation. In instances where a responsible party cannot be identified, this responsibility may fall on the public agency or private organization investigating the site.

Another consideration in selecting disposal methods for contaminated materials is whether the disposal can be incorporated into subsequent site cleanup activities. For example, if construction of a suitable

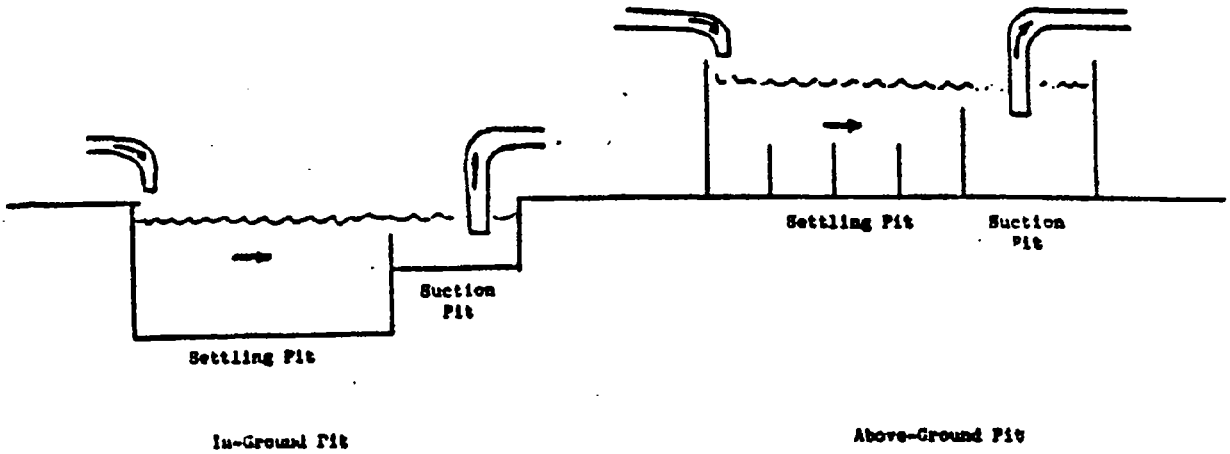
onsite disposal structure is expected, contaminated materials generated during the investigation should be stored at the site for disposal with other site materials. In this case, the initial containment structures should be evaluated for use as long-term storage structures. Also, other site conditions such as drainage control, security, and soil type must be considered so that proper storage is provided. If onsite storage is expected, then the containment structures should be specifically designed for that purpose.

6.0 REFERENCES

Brown & Root Environmental: Standard Operating Procedure No. 4.33, Control of Contaminated Material.

ATTACHMENT A

TWO TYPES OF MUD PITS USED IN WELL DRILLING



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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs and reports generally initiated and maintained for documenting Tetra Tech NUS field activities.

2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Tetra Tech NUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

3.0 GLOSSARY

None

4.0 RESPONSIBILITIES

Project Manager (PM) - The Project Manager is responsible for obtaining hardbound, controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports illustrated in this guideline (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time-frame.

5.0 PROCEDURES

5.1 Site Logbook

5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded or referenced (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start and/or completion of borehole, trench, monitoring well installation, etc.
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues (level of protection observed, etc.)
- Weather conditions

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that onsite activities take place which involve Tetra Tech NUS or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

The following information must be recorded on the cover of each site logbook:

- Project name
- Tetra Tech NUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2), but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the field notebook in which the measurements are recorded (see Attachment A).

All logbook, notebook, and log sheet entries shall be made in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, the data shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used must be signed and dated. The site logbook must also be signed by the Field Operations Leader at the end of each day.

5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook/notebook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided, since they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Once processed, the slides of photographic prints shall be consecutively numbered and labeled according to the logbook/notebook descriptions. The site photographs and associated negatives must be docketed into the project's central file.

5.2 Field Notebooks

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

5.3 Sample Forms

A summary of the forms illustrated in this procedure is shown as the listing of Attachments in the Table of Contents for this SOP. Forms may be altered or revised for project-specific needs contingent upon client

approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOP.

5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

5.3.1.1 Sample Log Sheet

Sample Log Sheets are used to record specified types of data while sampling. Attachments B-1 to B-4 are examples of Sample Log Sheets. The data recorded on these sheets are useful in describing the waste source and sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. A log sheet must be completed for each sample obtained, including field quality control (QC) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B-5. Adhesive labels must be completed and applied to every sample container. Sample labels can usually be obtained from the appropriate Program source electronically generated in-house, or are supplied from the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record Form

The Chain-of-Custody (COC) Record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site. One carbonless copy of the completed COC form is retained by the field crew, one copy is sent to the Project Manager, while the original is sent to the laboratory. The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the first cooler. The COC form should then state how many coolers are included with that shipment. An example of a Chain-of-Custody Record form is provided as Attachment B-6. Once the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed COC form (any discrepancies between the sample labels and COC form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the Tetra Tech NUS Project Manager). The COC form is signed and copied. The laboratory will retain the copy while the original becomes part of the samples' corresponding analytical data package.

5.3.1.4 Chain-of-Custody Seal

Attachment B-7 is an example of a custody seal. The Custody seal is an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. The COC seals are signed and dated by the samplers and affixed across the opening edges of each cooler containing environmental samples. COC seals may be available from the laboratory; these seals may also be purchased from a supplier.

5.3.1.5 Field Analytical Log Sheets for Geochemical Parameters

Field Analytical Log Sheets (Attachment B-8) are used to record geochemical and/or natural attenuation field test results. Attachments B-8 (3-page form) should be used when applicable.

5.3.2 Hydrogeological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

A groundwater level measurement sheet, shown in Attachment C-1 must be filled out for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The pumping test data sheet (Attachment C-2) facilitates this task by standardizing the data collection format, and allowing the time interval for collection to be laid out in advance.

5.3.2.3 Packer Test Report Form

A packer test report form shown in Attachment C-3 must be completed for each well upon which a packer test is conducted.

5.3.2.4 Summary Log of Boring

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring, or Boring Log, (Attachment C-4) is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a PID or FID), these results must be entered on the boring log at the appropriate depth. The "Remarks" column can be used to subsequently enter the laboratory sample number, the concentration of key analytical results, or other pertinent information. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock), different forms are used (see Attachments C-5 through C-9). Similar forms are used for flush-mount well completions.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log (Attachment C-10) must be filled out by the responsible field geologist or sampling technician.

5.3.2.7 Miscellaneous Monitoring Well Forms

Monitoring Well Materials Certificate of Conformance (Attachment C-11) should be used as the project directs to document all materials utilized during each monitoring well installation.

The Monitoring Well Development Record (Attachment C-12) should be used as the project directs to document all well development activities.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log (Attachment D) which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device used in the field; entries must be made for each day the equipment is used.

5.4 Field Reports

The primary means of recording onsite activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation, but are not easily useful for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain onsite for extended periods of time and are thus not accessible for timely review by project management.

5.4.1 Daily Activities Report

To provide timely oversight of onsite contractors, Daily Activities Reports are completed and submitted as described below.

5.4.1.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. This report must be filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors (Attachment E is an example of a Daily Activities Report).

5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DAR reports are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the Project Manager.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

It should be noted that in addition to the summaries described herein, other summary reports may also be contractually required. Attachment F is an example of a Field Trip Summary Report form.

6.0 ATTACHMENTS

Attachment A	TYPICAL SITE LOGBOOK ENTRY
Attachment B-1	EXAMPLE GROUNDWATER SAMPLE LOG SHEET
Attachment B-2	EXAMPLE SURFACE WATER SAMPLE LOG SHEET
Attachment B-3	EXAMPLE SOIL/SEDIMENT SAMPLE LOG SHEET
Attachment B-4	CONTAINER SAMPLE LOG SHEET FORM
Attachment B-5	SAMPLE LABEL
Attachment B-6	CHAIN-OF-CUSTODY RECORD FORM
Attachment B-7	CHAIN-OF-CUSTODY SEAL
Attachment B-8	FIELD ANALYTICAL LOG SHEET
Attachment C-1	EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET
Attachment C-2	EXAMPLE PUMPING TEST DATA SHEET
Attachment C-3	PACKER TEST REPORT FORM
Attachment C-4	EXAMPLE BORING LOG
Attachment C-5	EXAMPLE OVERBURDEN MONITORING WELL SHEET
Attachment C-5A	EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)
Attachment C-6	EXAMPLE CONFINING LAYER MONITORING WELL SHEET
Attachment C-7	EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL
Attachment C-8	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK
Attachment C-9	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK (FLUSHMOUNT)
Attachment C-10	EXAMPLE TEST PIT LOG
Attachment C-11	MONITORING WELL MATERIALS CERTIFICATE OF CONFORMANCE
Attachment C-12	MONITORING WELL DEVELOPMENT RECORD
Attachment D	EXAMPLE EQUIPMENT CALIBRATION LOG
Attachment E	EXAMPLE DAILY ACTIVITIES RECORD
Attachment F	FIELD TRIP SUMMARY REPORT

ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY

START TIME: _____ DATE: _____

SITE LEADER: _____

PERSONNEL:

TtNUS	DRILLER	SITE VISITORS
_____	_____	_____
_____	_____	_____
_____	_____	_____

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well ____ resumes. Rig geologist was _____. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well _____.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _____.
4. Well _____ drilled. Rig geologist was _____. See Geologist's Notebook, No. 2, page ____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _____.
8. Test pit _____ dug with cuttings placed in dump truck. Rig geologist was _____. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit ___ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

_____

Field Operations Leader

ATTACHMENT B-1

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date:	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other
Time:								
Method:								

PURGE DATA:

Date:	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	

ATTACHMENT B-2

Tetra Tech NUS, Inc.

SURFACE WATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other
Date:								
Time:								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT B-3

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT B-4

Tetra Tech NUS, Inc.

CONTAINER SAMPLE & INSPECTION SHEET

Page____ of ____

Project Site Name: _____
Project Number: _____
Site Identification: _____
Container Number(s): _____
Sample Type: 0 Grab
0 Composite

Sample ID No. _____
Sampled By: _____
C.O.C. No. _____
Concentration: 0 High
0 Medium
0 Low

CONTAINER SOURCE	CONTAINER DESCRIPTION
DRUM: 0 Bung Top 0 Lever Lock 0 Bolted Ring 0 Other _____	**COLOR:** _____ **CONDITION:** _____
TANK: 0 Plastic 0 Metal 0 Other _____	**MARKINGS:** _____ **VOL. OF CONTENTS:** _____
OTHER: _____	**OTHER:** _____

CONTAINER DISPOSITION	CONTENTS DESCRIPTION
SAMPLED: _____ **OPENED BUT NOT SAMPLED:** Reason _____ **NOT OPENED:** Reason _____	**SINGLE PHASED:** _____ **MULTIPHASE :** Layer 1 / Layer 2 / Layer 3 Phase (Sol. or Liq.) _____ _____ _____ Color _____ _____ _____ Viscosity L, M or H L, M or H L, M or H % of Total Volume _____ _____ _____
MONITOR READING:	**SAMPLE and /or INSPECTION DATE & TIME:** _____ HRS. **METHOD:** _____
SAMPLER(S) and / or INSPECTOR(S) SIGNATURE:	**ANALYSIS:**

ATTACHMENT B-5

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** **Site:** **Location:**	
Sample No:		**Matrix:**
Date:	**Time:**	**Preserve:**
Analysis:		
Sampled by:	**Laboratory:**	

ATTACHMENT B-6

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER | PAGE ____ OF _____

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER	CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)
PRESERVATIVE USED

DATE YEAR	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS								COMMENTS

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

ATTACHMENT B-7

CHAIN-OF-CUSTODY SEAL

CUSTODY SEAL	**CUSTODY SEAL**
Date	**Date**
Signature	**Signature**

ATTACHMENT B-8

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

Sampled By: _____ Duplicate: ☐

Field Analyst: _____ Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): _____

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	(Visual)	(S.U.)	(mS/cm)	(°C)	(NTU)	(mg/l)	(%)	
Method:								

SAMPLE COLLECTION/ANALYSIS INFORMATION:

ORP (Eh) (+/- mv):_____ Electrode Make & Model:_____

Reference Electrode (circle one): Silver-Silver Chloride / Calomel / Hydrogen

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT CHEMetrics (Range: _____mg/L) Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
_____	x 0.01	=	mg/L
_____	x 0.02	=	mg/L

CHEMetrics: _____mg/L

Notes:

Alkalinity: Analysis Time: _____

Equipment: HACH Digital Titrator AL-DT CHEMetrics (Range: _____mg/L) Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier		Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	x 0.1	=	mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4	=	mg/L
☐	100-400 mg/L	100 ml	1.600 N	1.0	_____ & _____	x 1.0	=	mg/L
☐	200-800 mg/L	50 ml	1.600 N	2.0	_____ & _____	x 2.0	=	mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0	=	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0	=	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:			

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Carbon Dioxide:

Equipment: HACH Digital Titrator CA-DT CHEMetrics (Range: _____mg/L) Analysis Time: _____

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☐	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count			Concentration
_____	x 0.1	=	mg/L
_____	x 0.2	=	mg/L
_____	x 1.0	=	mg/L
_____	x 2.0	=	mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

ATTACHMENT B-8 (Continued)

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page __ of __

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

Sampled By: _____ Duplicate: ☐

Field Analyst: _____ Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-8 __ HS-WR Color Wheel Other: _____ Analysis Time: _____

Program/Module: 610nm 93

Concentration: _____ mg/L Filtered: ☐

Notes: _____

Sulfate (SO_4^{2-}):

Equipment: DR-700 DR-8 __ Other: _____ Analysis Time: _____

Program/Module: 91

Concentration: _____ mg/L Filtered: ☐

Standard Solution: ☐ Results: _____

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes: _____

Nitrite (NO_2^--N): Analysis Time: _____

Equipment: DR-700 DR-8 __ Other: _____ Filtered: ☐

Program/Module: 60

Concentration: _____ mg/L Reagent Blank Correction: ☐

Standard Solution: ☐ Results: ☐

Notes: _____

Nitrate (NO_3^--N): Analysis Time: _____

Equipment: DR-700 DR-8 __ Other: _____ Filtered: ☐

Program/Module: 55

Concentration: _____ mg/L

Nitrite Interference Treatment: ☐

Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes: _____

ATTACHMENT B-8 (Continued)

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

Sampled By: _____ Duplicate: ☐

Field Analyst: _____ Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 DR-8 _ _ HACH MN-5 Other: _____ Analysis Time: _____

Program/Module: 525nm 41

Concentration: _____ mg/L Filtered: ☐

Digestion: ☐

Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes: _____

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 DR-8 _ _ IR-18C Color Wheel Other: _____ Analysis Time: _____

Program/Module: 500nm 33

Concentration: _____ mg/L Filtered: ☐

Notes: _____

Hydrogen Sulfide (H_2S):

Equipment: HS-C Other: _____ Analysis Time: _____

Concentration: _____ mg/L Exceeded 5.0 mg/L range on color chart: ☐

Notes: _____

QA/QC Checklist:

All data fields have been completed as necessary: ☐

Correct measurement units are cited in the SAMPLING DATA block: ☐

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☐

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Alkalinity *Relationship* is determined appropriatly as per manufacturer (HACH) instructions: ☐

QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☐

Nitrite Interference treatment was used for Nitrate test if Nitrite was detected: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

ATTACHMENT C-1
EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: _____ **Project No.:** _____
Location: _____ **Personnel:** _____
Weather Conditions: _____ **Measuring Device:** _____
Tidally Influenced: Yes ___ No ___ **Remarks:** _____

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments

* All measurements to the nearest 0.01 foot

Page ___ of ___

ATTACHMENT C-2
EXAMPLE PUMPING TEST DATA SHEET

Tetra Tech NUS, Inc.

PUMPING TEST DATA SHEET

PROJECT NAME: _____ PUMPING WELL NUMBER: _____
PROJECT NUMBER: _____ MEASURED WELL NUMBER: _____

[ ] PUMPING TEST [ ] STEP DRAW DOWN TEST

DATE(s): MONITORING POINT:
MEASUREMENT METHOD: DEPTH CORRECTION (ft):
TEST NUMBER: PUMP SETTING (Ft. below monitoring point):
STATIC WATER LEVEL (ft): DISTANCE FROM PUMPING WELL (ft):
PERSONNEL:
REMARKS:

MILITARY TIME	ELAPSED TIME SINCE PUMP START OR STOP (Min.)	WATER LEVEL (Ft.)	CORRECTION (Ft.)	DRAW DOWN OR RECOVERY (Ft.)	PUMPING RATE (GPM)	FLOW METER READING (Gals.)	REMARKS

NOTE: All measurements to nearest 0.01 foot measured from top of well riser pipe unless otherwise noted.

ATTACHMENT C-3

PACKER TEST REPORT FORM

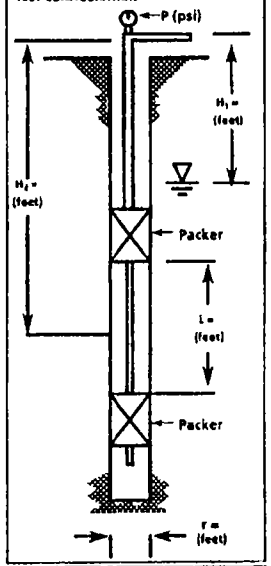
PROJECT: _____ PROJECT NO.: _____ TEST NO: _____ PAGE ____ OF ____

BORING NO.: _____ CASING DEPTH: _____ CONTRACTOR: _____ STATIC WATER LEVEL _____

TEST INTERVAL: _____ BY: _____ CHECKED: _____ PACKER PRESSURE _____

Flow Test					Calculated Results							
Pressure, P (psi)	Elapsed Time (min)	Flow Reading	Δ Flow, ΔQ (ft³)	Δ Flow, ΔQ (gal)	Flow Rate Q (gal/min)	H_1* (ft)	Hp(ft) = 2.31·(psi)	H_2* (ft)	H = Hp + (H1 or H2)	Cp	K (ft/yr) = Cp·Q/H	K (cm/sec) = 9.67 x 10⁻⁷ K (ft/yr)

TEST CONFIGURATION



Length of Test Section in feet, L	Cp			
	Drilling Bit Size			
	Ex (1.5")	Aw (1.875")	Bx (2.375")	Nx (3")
1	31,000	28,500	25,800	23,300
2	19,400	18,300	16,800	15,500
5	9,800	9,300	8,800	8,200
8	6,800	6,500	6,100	5,800
10	5,700	5,400	5,100	4,900
15	4,100	3,900	3,700	3,600
20	3,200	3,100	3,000	2,800

CP = (1/(2 x L)) ln(L/r) (70,315 5)
7.48 Gallons = 1 Ft³
1 psi = 2.31 ft head

* H_1 is used when the test length is below the water table.
H_2 is used when the test length is above the water table.

Remarks: _____

ATTACHMENT C-3

ATTACHMENT C-4

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING No.: _____
PROJECT NUMBER: _____ DATE: _____
DRILLING COMPANY: _____ GEOLOGIST: _____
DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area _____
Background (ppm): [ ]

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

ATTACHMENT C4 (Continued)

LEGEND
SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

COARSE-GRAINED SOILS
More Than Half of Material Is LARGER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights			GROUP SYMBOL	TYPICAL NAMES
GRAVELS (50%(+)>1/4"⌀	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
	GRAVELS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
SANDS 50%(+)<1/4"⌀	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see MCL)	SM	Silty sands, poorly graded sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.

FINE-GRAINED SOILS
More Than Half of Material is SMALLER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)	Identification Procedures on Fraction Smaller than No. 40 Sieve Size: DAY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)	GROUP SYMBOL	TYPICAL NAMES
SILTS AND CLAYS Liquid Limit <50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
	Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Slight to Medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.
SILTS AND CLAYS Liquid Limit >50	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
	Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other organic soils

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNC COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily pentrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENESS		
Descriptive Terms	Screwdriver or Knife Effects	Hammer Effects	Descriptive Terms	Abbreviation	Spacing
Soft	Easily Gouged	Crushes when pressed with hammer	Very Broken	(V. Br.)	0-2"
Medium Soft	Can be Gouged	Breaks (one blow); crumbly edges	Broken	(Br.)	2"-1'
Medium Hard	Can be scratched	Breaks (one blow); sharp edges	Blocky	(Bl.)	1'-3'
Hard	Cannot be scratched	Breaks conchoidally (several blows); sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES
5-2" Split-Barrel Sample
ST-3" O.D. Undisturbed Sample
O - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES
X-NX (Conventional) Core (~2-1/8" O.D.)
Q-NQ (Wireline) Core (~1-7/8" O.D.)
Z - Other Core Sizes, Specify in Remarks

WATER LEVELS
12/18
▽ 12.6'Initial Level w/Date & Depth

12/18

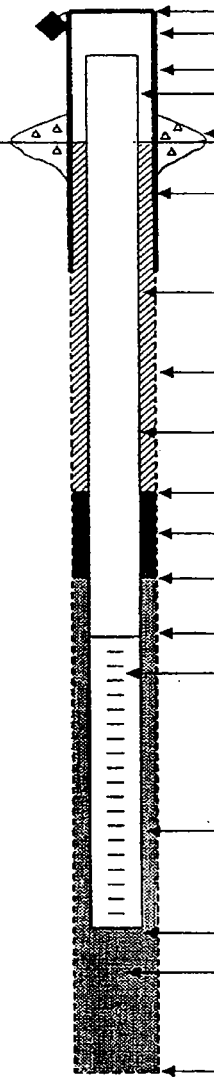
ATTACHMENT C-5
EXAMPLE OVERBURDEN MONITORING WELL SHEET

BORING NO.: _____

OVERBURDEN
MONITORING WELL SHEET

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF SURFACE CASING : _____
ELEVATION OF TOP OF RISER PIPE: _____

STICK - UP TOP OF SURFACE CASING: _____
STICK - UP RISER PIPE : _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____
TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: ____/____

TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION / DEPTH TOP OF SCREEN: ____/____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. OF SCREEN: _____

TYPE OF SAND PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: ____/____

ELEVATION / DEPTH BOTTOM OF SAND PACK: ____/____

TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

ELEVATION / DEPTH OF HOLE: ____/____

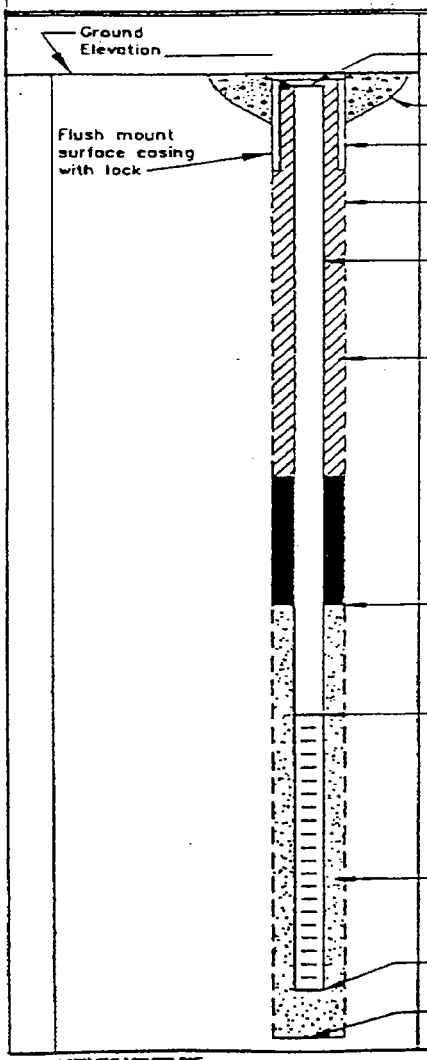
ATTACHMENT C-5A
EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)

BORING NO.: _____

MONITORING WELL SHEET

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____
I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____
RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____
_____

DEPTH/ELEVATION TOP OF SAND: _____ / _____

DEPTH/ELEVATION TOP OF SCREEN: _____ / _____
TYPE OF SCREEN: _____
SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

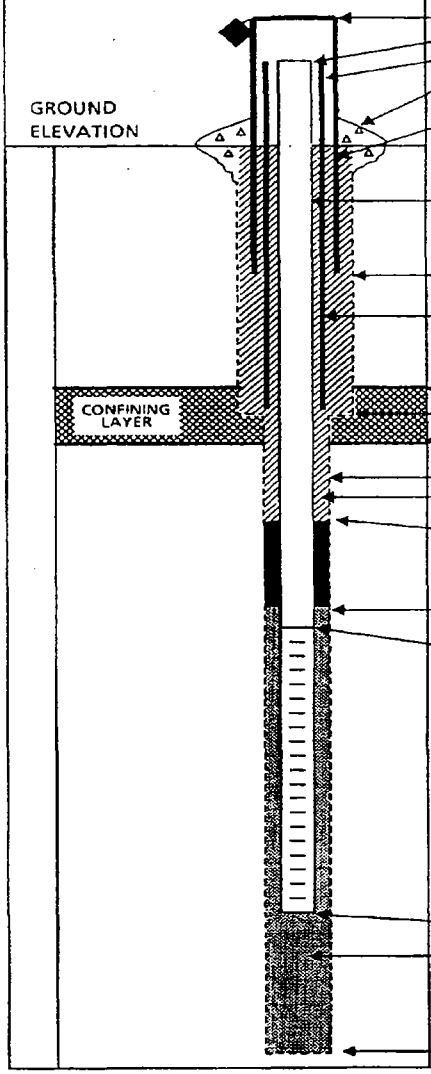
DEPTH/ELEVATION BOTTOM OF SCREEN: _____ / _____
DEPTH/ELEVATION BOTTOM OF SAND: _____ / _____
DEPTH/ELEVATION BOTTOM OF HOLE: _____ / _____
BACKFILL MATERIAL BELOW SAND: _____

ATTACHMENT C-6
EXAMPLE CONFINING LAYER MONITORING WELL SHEET

BORING NO.: _____

CONFINING LAYER
MONITORING WELL SHEET

PROJECT _____ LOCATION _____ DRILLER _____
PROJECT NO. _____ BORING _____ DRILLING METHOD _____
ELEVATION _____ DATE _____ DEVELOPMENT METHOD _____
FIELD GEOLOGIST _____



ELEVATION OF TOP OF SURFACE CASING : _____
ELEVATION OF TOP OF RISER PIPE: _____
ELEVATION TOP OF PERM. CASING: _____
TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____
TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

PERM. CASING I.D. _____
TYPE OF CASING & BACKFILL: _____

ELEVATION / DEPTH TOP CONFINING LAYER: _____
ELEVATION / DEPTH BOTTOM OF CASING: _____
ELEVATION / DEPTH BOT. CONFINING LAYER: _____

BOREHOLE DIA. BELOW CASING: _____
TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____
TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION/DEPTH TOP OF SCREEN: _____
TYPE OF SCREEN: _____

TYPE OF SAND PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____

ELEVATION / DEPTH BOTTOM OF SAND PACK: _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

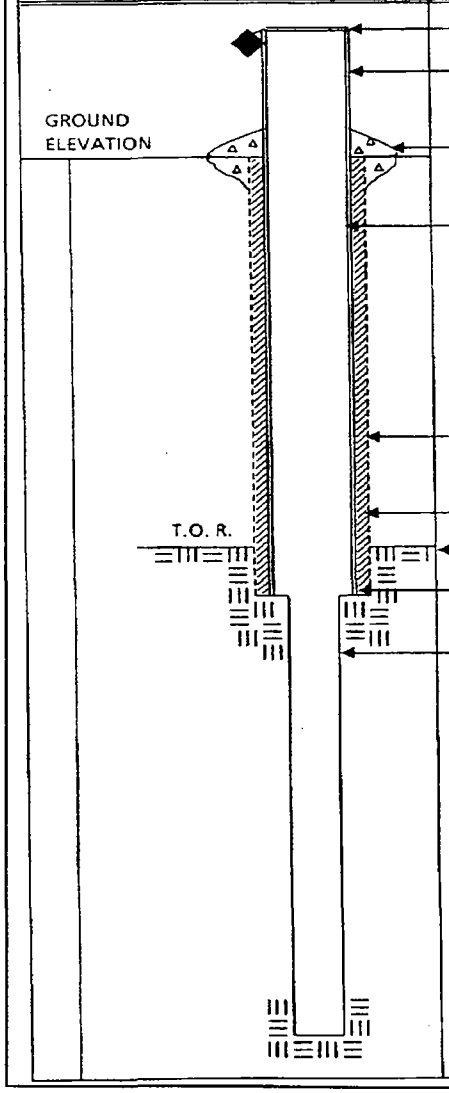
ELEVATION / DEPTH OF HOLE: _____

ATTACHMENT C-7
EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL

BORING NO.: _____

BEDROCK MONITORING WELL SHEET
OPEN HOLE WELL

PROJECT _____ LOCATION _____ DRILLER _____
PROJECT NO. _____ BORING _____ DRILLING METHOD _____
ELEVATION _____ DATE _____ DEVELOPMENT METHOD _____
FIELD GEOLOGIST _____



ELEVATION OF TOP OF CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

TYPE OF SURFACE SEAL: _____

I.D. OF CASING: _____
TYPE OF CASING: _____

TEMP. / PERM.: _____

DIAMETER OF HOLE: _____

TYPE OF CASING SEAL: _____

DEPTH TO TOP OF ROCK: _____

DEPTH TO BOTTOM CASING: _____

DIAMETER OF HOLE IN BEDROCK: _____

DESCRIBE IF CORE / REAMED WITH BIT:

_____

DESCRIBE JOINTS IN BEDROCK AND DEPTH:

_____

ELEVATION / DEPTH OF HOLE: _____ / _____

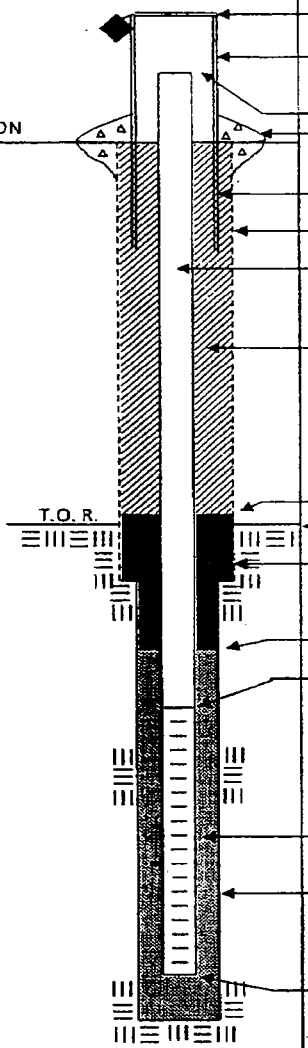
ATTACHMENT C-8
EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK

BORING NO.: _____

BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF SURFACE CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____

DIAMETER OF HOLE: _____

RISER PIPE I.D.: _____

TYPE OF RISER PIPE: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: ____/____

ELEVATION / DEPTH TOP OF BEDROCK: ____/____

TYPE OF SEAL: _____

ELEVATION / DEPTH TOP OF SAND: ____/____

ELEVATION / DEPTH TOP OF SCREEN: ____/____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. SCREEN: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK:

CORE / REAM: _____

ELEVATION / DEPTH BOTTOM SCREEN: ____/____

ELEVATION / DEPTH BOTTOM OF HOLE: ____/____

ATTACHMENT C-9
EXAMPLE BEDROCK MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK (FLUSHMOUNT)

BORING NO.: _____

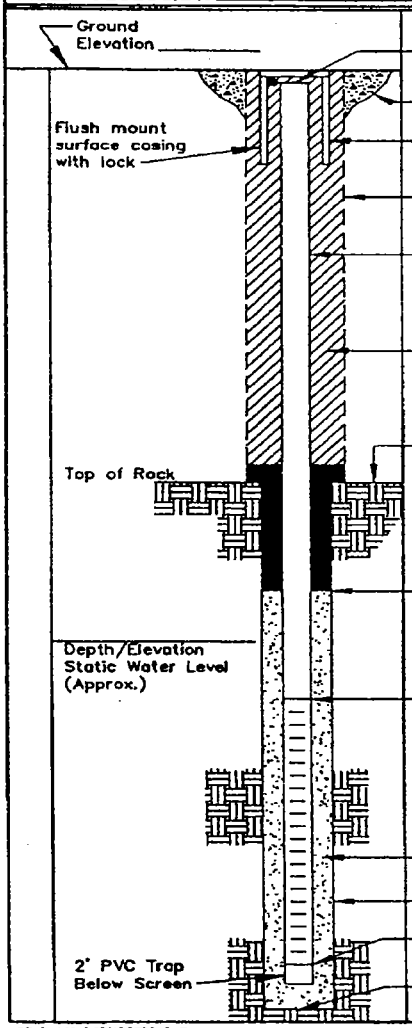
BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT: _____ LOCATION: _____ DRILLER: _____

PROJECT NO.: _____ BORING: _____ DRILLING METHOD: _____

ELEVATION: _____ DATE: _____ DEVELOPMENT METHOD: _____

FIELD GEOLOGIST: _____



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____

I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____

RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____

_____

DEPTH/ELEVATION TOP OF BEDROCK: _____/_____

DEPTH/ELEVATION TOP OF SAND: _____/_____

DEPTH/ELEVATION TOP OF SCREEN: _____/_____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

DEPTH/ELEVATION BOTTOM OF SCREEN: _____/_____

DEPTH/ELEVATION BOTTOM OF SAND: _____/_____

DEPTH/ELEVATION BOTTOM OF HOLE: _____/_____

BACKFILL MATERIAL BELOW SAND: _____

ACFILE: L870\GEOL\BEDR1.DWG

ATTACHMENT C-10
EXAMPLE TEST PIT LOG

Tetra Tech NUS, Inc.

TEST PIT LOG

PROJECT: _____ TEST PIT NO.:
PROJECT NO _____ DATE: _____
LOCATION: _____
FIELD GEOLOGIST: _____

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS

Test Pit Cross Section and / or Plan View

REMARKS _____

PHOTO LOG _____ TEST PIT _____

PAGE ____ OF ____

ATTACHMENT C-11
EXAMPLE CERTIFICATE OF CONFORMANCE

MONITORING WELL MATERIALS
CERTIFICATE OF CONFORMANCE

Well Designation: _____ Site Geologist: _____
Site Name: _____ Drilling Company: _____
Date Installed: _____ Driller: _____
Project Name: _____ Project Number: _____

Material	Brand/Description	Source/Supplier	Sample Collected ?
Well Casing			
Well Screen			
End Cap			
Drilling Fluid			
Drilling Fluid Additives			
Backfill Material			
Annular Filter Pack			
Bentonite Seal			
Annular Grout			
Surface Cement			
Protective Casing			
Paint			
Rod Lubricant			
Compressor Oil			

To the best of my knowledge, I certify that the above described materials were used during installation of this monitoring well.

Signature of Site Geologist: _____

ATTACHMENT C-12
EXAMPLE MONITORING WELL DEVELOPMENT RECORD

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of ___

Site: _____ Depth to Bottom (ft.): _____ Project Name: _____
Well: _____ Static Water Level Before (ft.): _____ Project Number: _____
Date Installed: _____ Static Water Level After (ft.): _____ Site Geologist: _____
Date Developed: _____ Screen Length (ft.): _____ Drilling Co.: _____
Dev. Method: _____ Specific Capacity: _____
Pump Type: _____ Casing ID (in.): _____

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)

ATTACHMENT D
EXAMPLE EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____ INSTRUMENT NAME/MODEL: _____

SITE NAME: _____ MANUFACTURER: _____

PROJECT No.: _____ SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

ATTACHMENT E

Tetra Tech NUS, Inc.

DAILY ACTIVITIES RECORD

PROJECT NAME: _____ **PROJECT NUMBER:** _____

CLIENT: _____ **LOCATION:** _____

DATE: _____ **ARRIVAL TIME:** _____

Tt NUS PERSONNEL: _____ **DEPARTURE TIME:** _____

CONTRACTOR: _____ **DRILLER:** _____

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS: _____

APPROVED BY:

_____ _____

Tt NUS REPRESENTATIVE DRILLER

DATE: _____

ATTACHMENT F
FIELD TRIP SUMMARY REPORT
PAGE 1 OF 2

SUNDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

_____

_____

_____

MONDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

_____

_____

_____

TUESDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

_____

_____

_____

WEDNESDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

_____

_____

_____

ATTACHMENT F
PAGE 2 OF 2
FIELD TRIP SUMMARY REPORT

THURSDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

_____

_____

_____

FRIDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

_____

_____

_____

SATURDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

_____

_____

_____

FIELD DOCUMENTATION FORMS

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING No.: _____
PROJECT NUMBER: _____ DATE: _____
DRILLING COMPANY: _____ GEOLOGIST: _____
DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ☐

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

Tetra Tech NUS, Inc.

DAILY ACTIVITIES RECORD

PROJECT NAME: _____ **PROJECT NUMBER:** _____

CLIENT: _____ **LOCATION:** _____

DATE: _____ **ARRIVAL TIME:** _____

Tt NUS PERSONNEL: _____ **DEPARTURE TIME:** _____

CONTRACTOR: _____ **DRILLER:** _____

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS: _____

_____

_____

_____

APPROVED BY:

_____ _____

Tt NUS REPRESENTATIVE DRILLER

DATE: _____

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____ INSTRUMENT NAME/MODEL: _____

SITE NAME: _____ MANUFACTURER: _____

PROJECT No.: _____ SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

TETRA TECH NUS
FIELD TASK MODIFICATION REQUEST FORM

Project/Installation Name _____ CTO & Project Number _____ Task Mod. Number _____

Modification To (e.g. Work Plan) _____ Site/Sample Location _____ Date _____

Activity Description: _____

Reason for Change: _____

Recommended Disposition: _____

Field Operations Leader (Signature) _____ Date _____

Approved Disposition:

Project/Task Order Manager (Signature) _____ Date _____

Distribution:

Program/Project File –
Project/Task Order Manager –
Field Operations Leader –

Other: _____

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: _____ **Project No.:** _____

Location: _____ **Personnel:** _____

Weather Conditions: _____ **Measuring Device:** _____

Tidally Influenced: Yes ____ No ____ **Remarks:** _____

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments

* All measurements to the nearest 0.01 foot

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	(Visual)	(S.U.)	(mS/cm)	(^{0}C)	(NTU)	(mg/l)	(%)	
Method:								

PURGE DATA:

Date:	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Site: _____ Depth to Bottom (ft.): _____ Project Name: _____
Well: _____ Static Water Level Before (ft.): _____ Project Number: _____
Date Installed: _____ Static Water Level After (ft.): _____ Site Geologist: _____
Date Developed: _____ Screen Length (ft.): _____ Drilling Co.: _____
Dev. Method: _____ Specific Capacity: _____
Pump Type: _____ Casing ID (in.): _____

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

S10 USEPA REGION 1 LOW-FLOW PURGING AND SAMPLING METHODS

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUND WATER SAMPLES FROM MONITORING WELLS

July 30, 1996
Revision 2

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUND WATER SAMPLES FROM MONITORING WELLS

I. SCOPE & APPLICATION

This standard operating procedure (SOP) provides a general framework for collecting ground water samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). The SOP emphasizes the need to minimize stress by low water-level drawdowns, and low pumping rates (usually less than 1 liter/min) in order to collect samples with minimal alterations to water chemistry. This SOP is aimed primarily at sampling monitoring wells that can accept a submersible pump and have a screen, or open interval length of 10 feet or less (this is the most common situation). However, this procedure is flexible and can be used in a variety of well construction and ground-water yield situations. Samples thus obtained are suitable for analyses of ground water contaminants (volatile and semi-volatile organic analytes, pesticides, PCBs, metals and other inorganics), or other naturally occurring analytes.

This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs). For this the reader may wish to check: Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation; C.K. Smoley (CRC Press), Boca Raton, Florida and U.S. Environmental Protection Agency, 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance; Washington, DC (EPA/530-R-93-001).

The screen, or open interval of the monitoring well should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flowpaths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval.

Use of trademark names does not imply endorsement by U.S.EPA but is intended only to assist in identification of a specific type of device.

Proper well construction and development cannot be overemphasized, since the use of installation techniques that are appropriate to the hydrogeologic setting often prevents "problem well" situations from occurring. It is also recommended that as part of development or redevelopment the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in shortest amount of time. With this information field crews can then conduct purging and sampling in a more expeditious manner.

The mid-point of the saturated screen length (which should not exceed 10 feet) is used by convention as the location of the pump intake. However, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permealability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help insure that the low stress procedure will not underestimate contaminant concentrations. The Sampling and Analysis Plan must provide clear instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the remaining criteria in this procedure are met. If after 4 hours of purging indicator field parameters have not stabilized, one of 3 optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization) c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may not meet the sampling objectives).

Changes to this SOP should be proposed and discussed when the site Sampling and Analysis Plan is submitted for approval. Subsequent requests for modifications of an approved plan must include adequate technical justification for proposed changes. All changes and modifications must be approved before implementation in field.

II. EQUIPMENT

A. Extraction device

Adjustable rate, submersible pumps are preferred (for example, centrifugal or bladder pump constructed of stainless steel or

Teflon).

Adjustable rate, peristaltic pumps (suction) may be used with caution. Note that EPA guidance states: "Suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" (EPA/540/P-87/001, 1987, page 8.5-11).

The use of inertial pumps is discouraged. These devices frequently cause greater disturbance during purging and sampling and are less easily controlled than the pumps listed above. This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

B. Tubing

Teflon or Teflon lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for inorganics analyses. However, these materials should be used with caution when sampling for organics. If these materials are used, the equipment blank (which includes the tubing) data must show that these materials do not add contaminants to the sample.

Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs. However, it should be used with caution when sampling for metals.

The use of 1/4 inch or 3/8 inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates.

Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump, to minimize gaseous diffusion.

C. Water level measuring device(s), capable of measuring to 0.01 foot accuracy (electronic "tape", pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level "tape" at the start and end of each record.

D. Flow measurement supplies (e.g., graduated cylinder and stop watch).

E. Interface probe, if needed.

F. Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.

G. Indicator field parameter monitoring instruments - pH, Eh, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards to perform field calibration of instruments. Analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For Eh measurements, follow manufacturer's instructions.

H. Decontamination supplies (for example, non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.).

I. Logbook(s), and other forms (for example, well purging forms).

J. Sample Bottles.

K. Sample preservation supplies (as required by the analytical methods).

L. Sample tags or labels.

M. Well construction data, location map, field data from last sampling event.

N. Well keys.

O. Site specific Sample and Analysis Plan/Quality Assurance Project Plan.

P. PID or FID instrument (if appropriate) to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

III. PRELIMINARY SITE ACTIVITIES

Check well for security damage or evidence of tampering, record pertinent observations.

Lay out sheet of clean polyethylene for monitoring and sampling equipment.

Remove well cap and immediately measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field logbook.

If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook.

A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended that water level depth (to 0.01 ft.) and

total well depth (to 0.1 ft.) be measured the day before, in order to allow for re-settlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe are usually not needed unless analytical data or field head space information signal a worsening situation. Note: procedures for collection of LNAPL and DNAPL samples are not addressed in this SOP.

IV. PURGING AND SAMPLING PROCEDURE

Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

1. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The Sampling and Analysis Plan should specify the sampling depth, or provide criteria for selection of intake depth for each well (see Section I). If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well. Collection of turbid free water samples may be especially difficult if there is two feet or less of standing water in the well.

2. Measure Water Level

Before starting pump, measure water level. If recording pressure transducer is used-initialize starting condition.

3. Purge Well

3a. Initial Low Stress Sampling Event

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize.

Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 - 0.4 l/min) to ensure stabilization of indicator

parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

3b. Subsequent Low Stress Sampling Events

After synoptic water level measurement round, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). Perform purging operations as above.

4. Monitor Indicator Field Parameters

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, Eh, DO) every three to five minutes (or less frequently, if appropriate). Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three (3) to five (5) minute intervals, are within the following limits:

turbidity (10% for values greater than 1 NTU),
DO (10%),
specific conductance (3%),
temperature (3%),
pH (± 0.1 unit),
ORP/Eh (± 10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values

measured within the cell and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through-cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system).

5. Collect Water Samples

Water samples for laboratory analyses must be collected before water has passed through the flow-through-cell (use a by-pass assembly or disconnect cell to obtain sample).

VOC samples should be collected first and directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing; (2) insert small diameter Teflon tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown, flow rate and new indicator field parameter values.

Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check analytical methods (e.g. EPA SW-846, water supply, etc.) for additional information on preservation. Check pH for all samples requiring pH adjustment to assure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter is required, and the filter

size (0.45 um is commonly used) should be based on the sampling objective. Pre-rinse the filter with approximately 25 - 50 ml of ground water prior to sample collection. Preserve filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in ground water for human health risk calculations.

Label each sample as collected. Samples requiring cooling (volatile organics, cyanide, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

6. Post Sampling Activities

If recording pressure transducer is used, remeasure water level with tape.

After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event. However, it is recommended if the well has a "silting" problem or if confirmation of well identity is needed.

Secure the well.

V. DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the well) will be decontaminated by one of the procedures listed below.

<u>Procedure 1</u>

The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Flush with isopropyl alcohol (pesticide grade). If equipment blank data from the previous sampling event show that the level of contaminants is insignificant, then this step may be skipped.

Flush with distilled/deionized water. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

VI. FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the ground water samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at a frequency of one set per VOC sample cooler.

Field duplicate.

Matrix spike.

Matrix spike duplicate.

Equipment blank.

Trip blank (VOCs).

Temperature blank (one per sample cooler).

Equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank will only include the pump in subsequent sampling rounds.

Collect samples in order from wells with lowest contaminant concentration to highest concentration. Collect equipment blanks after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

If split samples are to be collected, collect split for each analyte group in consecutive order (VOC original, VOC split, etc.). Split sample should be as identical as possible to original sample.

All monitoring instrumentation shall be operated in accordance with EPA analytical methods and manufacturer's operating instructions. EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846 with exception of Eh, for which the manufacturer's instructions are to be followed. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. At the end of each day, check calibration to verify that instruments remained in calibration. Temperature measuring equipment, thermometers and thermistors, need not be calibrated to the above frequency. They should be checked for accuracy prior to field use according to EPA Methods and the manufacturer's instructions.

VII. FIELD LOGBOOK

A field log shall be kept to document all ground water field monitoring activities (see attached example matrix), and record all of the following:

Well identification.

Well depth, and measurement technique.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and

detection method.

Pumping rate, drawdown, indicator parameters values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.

Well sampling sequence and time of each sample collection.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analysis.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling equipment used, including trade names, model number, diameters, material composition, etc.

VIII. DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, and whatever field logbook information is needed to allow for a full evaluation of data useability.

EXAMPLE (Minimum Requirements) Page____of____

Well PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name)_____ Depth to _____/_____ of screen
Well Number_____ Date_____ (below MP) top bottom
Field Personnel_____ Pump Intake at (ft. below MP)_____
Sampling Organization_____ Purging Device; (pump type)_____
Identify MP_____

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. °C	Spec. Cond.[2] µS/cm	pH	ORP/ Eh[3] mv	DO mg/L	Turb-idity NTU	Comments

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. µSiemens per cm(same as µmhos/cm)at 25°C.
3. Oxidation reduction potential (stand in for Eh).

S11 USEPA REGION 1 DRAFT CALIBRATION OF FIELD INSTRUMENTS

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

DRAFT CALIBRATION OF FIELD INSTRUMENTS
(temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity)

I. SCOPE & APPLICATION

The purpose of this standard operating procedure (SOP) is to provide a framework for calibrating field instruments used to measure water quality parameters for ground water and surface water. Water quality parameters include temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity. This SOP supplements, but does not replace, EPA analytical methods listed in 40 CFR Part 136 and 40 CFR 141 for temperature, dissolved oxygen, conductivity/specific conductance, pH and turbidity.

This SOP is written for instruments that utilize multiple probes (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP]) and the probe readings for pH, dissolved oxygen, and specific conductance are automatically corrected for temperature. Communication to the instrument (programming and displaying the measurements) are performed using a display/logger or a computer. Information sent to the instrument is entered through the keypad on the display/logger or computer. It is desirable that the display/logger or computer have data storage capabilities. If the instrument does not have a keypad, follow the manufacturer's instructions for entering information into the instrument.

For ground water monitoring, the instrument must be equipped with a flow-through-cell, and the display/logger or computer display screen needs to be large enough to simultaneously contain the readouts of each probe in the instrument. Turbidity is measured using a separate instrument because turbidity cannot be measured in a flow-through-cell. This procedure is applicable for use with the EPA Region 1 Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells.

II. GENERAL

All monitoring instruments must be calibrated before they are used to measure environmental samples. Part of the calibration is performed prior to the field event. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, conductivity/specific conductance, and

oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST) . Before any instrument is calibrated or used to perform environmental measurements, the instrument must stabilize (warm-up) according to manufacturer's instructions.

Most instruments will require at least two standards to bracket the expected measurement range, that is, one standard less than the expected value and one greater. Calibration must be performed at the beginning of each sampling day prior to sample collection. To determine if the instruments have remained in calibration during transport to each sampling location, use one of the previously used standards as a check standard at the sampling site. If the check measurement does not agree with the initial calibration or to within the specifications of the instrument, then the instrument must be re-calibrated. When an environmental sample measurement falls outside the calibration range, the instrument must be recalibrated to bracket the new range before continuing measurements.

This SOP requires that the manufacturer's instruction manual (including the instrument specifications) accompany the instrument into the field.

III. CALIBRATION PROCEDURES

Prior to calibration, all instrument surfaces must be cleaned according to the manufacturer's instructions. Failure to perform routine (proper maintenance) can lead to erratic measurements.

Program the multi-parameter instrument so that the following parameters to be measured will be displayed: temperature, percent dissolved oxygen, mg/l dissolved oxygen, conductivity, specific conductance, and pH.

The volume of the calibration solutions must be sufficient to cover both the probe and temperature sensor (see manufacturer's instructions for additional information).

When ready for measuring, make sure there are no air bubbles lodged between the probe and the protection guard.

TEMPERATURE

Most instrument manuals state there is no calibration of the temperature sensor, but the temperature sensor must be checked to determine its accuracy. This accuracy check is performed

at least once per year and the accuracy check date/information is kept with the instrument. If the accuracy check date/information is not included with the instrument or the accuracy check was over a year, the temperature sensor accuracy needs to be checked at the beginning of the sampling event. If the instrument contains multiple temperature sensors, each sensor must be checked.

Verification Procedure

1. Allow a container filled with water to come to room temperature.

2. Place a thermometer that is traceable to the National Institute of Standards and Technology (NIST), and the instrument's temperature sensor into the water and wait for both temperature readings to stabilize.

3. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (usually ±0.15°C). If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.

pH (electrometric)

The pH of water is determined electrometrically using a glass electrode.

Choose the appropriate buffered standards that will bracket the expected values at the sampling locations. For groundwater the pH will usually be close to seven. Three standards are needed for the calibration: one at pH seven, one at least two pH units below seven and the other at least two pH units above seven. For those instruments that will not accept three standards, the instrument will need to be re-calibrated if the water sample's pH is outside the initial calibration range described by the two standards.

Verification Procedure

1. Allow the buffered standards to equilibrate to the ambient temperature.

2. Fill calibration containers with the buffered standards so each standard will cover the pH probe and temperature sensor.

3. Remove probe from its storage container, rinse with distilled water, blot dry with soft tissue.

4. Select monitoring/run mode. Immerse probe in the initial standard (e.g., pH 7).

5. Stir the standard until the readings stabilize. If the reading does not change within 30 seconds, select calibration mode and then select [illegible] enter the buffered standard value into instrument. Select monitoring/run mode. The readings should remain within manufacturer's specifications; if they change, re-calibrate. If readings continue to change after re-calibration, consult manufacturer.

6. Remove probe from the initial standard, rinse with distilled water, and blot dry.

7. Immerse probe into the second standard (e.g., [illegible]) and repeat step 5.

8. Remove probe from the second standard, rinse with distilled water, and blot dry. If instrument only accepts two standards, the calibration is complete. Go to step 11. Otherwise continue.

9. Immerse probe in the buffered [illegible] (e.g., pH 9) and repeat step 5.

10. Remove probe from the third standard, rinse with distilled water, and blot dry.

11. Select monitoring/run mode, if not already selected. To ensure that the initial calibration standard (e.g., pH 7) has not changed, immerse the probe into the initial standard. Wait for readings to stabilize. The reading should read the initial standard value within the manufacturer's specifications. If not, re-calibrate the instrument. If re-calibration does not help, the calibration range may be too great. Reduce calibration range by using standards that are closer together.

12. The calibration is complete. Place pH probe in its storage container.

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DISSOLVED OXYGEN

Dissolved oxygen (DO) content in water is measured using a membrane electrode. The DO probe's membrane and electrolyte solution should be replaced prior to the sampling period. Failure to perform this step may lead to erratic measurements.

Calibration Procedure

1. Gently dry the temperature sensor according to manufacturer's instructions.

2. Place a wet sponge or a wet paper towel on the bottom of the DO [illegible] container.

3. Place the DO probe into the container without the probe coming in contact with the wet sponge or paper towel. The probe must fit tightly [illegible] container to prevent the escape of moisture evaporating from the sponge or towel.

4. Allow the confined air to become saturated with water vapor (saturation occurs in approximately 10 to 15 minutes). During [illegible] turn-on the instrument to allow the DO probe to warm-up. Select monitoring/run [illegible] Check temperature readings. Readings must stabilize before continuing to [illegible]

5. Select calibration mode; then select "DO %".

6. Enter the local barometric pressure (usually in mm of mercury) for the sampling location into the instrument. This measurement must be determined from an on-site barometer. Do not use barometric pressures obtained from the local weather services unless pressure is adjusted for the elevation of the sampling location. [Note: inches of mercury [illegible] 25.4 [illegible] equals mm of mercury or consult Oxygen Solubility at Indicated Pressure chart attached to the SOP for conversion at selected pressures].

7. The instrument should indicate that the calibration is in progress. The instrument will take approximately [illegible] minute to calibrate. After calibration, the instrument should display percent saturated DO.

8. Select monitoring/run mode. Compare the DO mg/l reading to the Oxygen Solubility at Indicated Pressure chart attached to the SOP. The numbers should agree. If they do not agree [illegible] the accuracy of the instrument (usually ± 0.2 mg/L), repeat calibration. If [illegible] not work, change the membrane and electrolyte solution.

9. Remove the probe from the container and place it into a 0.0 mg/L DO standard (see note). The standard must be filled to the top of its container and the DO probe must fit tightly into the standard's container (no head space). Check temperature readings. They must stabilize before continuing.

10. Wait until the "mg/l DO" readings have stabilized. The instrument should read 0.0 mg/L or to the accuracy of the instrument (usually ± 0.2 mg/L). If the instrument cannot reach these values, it will be necessary to clean the probe, and replace the membrane and electrolyte solution. If this does not work, prepare a new 0.0 mg/L standard. If these measures do not work, contact manufacturer.

Note: To prepare a zero mg/L DO standard follow the procedure stated in Standard Methods (Method 4500-O G). The method basically calls to add excess sodium sulfite (until no more dissolves) and a trace amount of cobalt chloride to water. The standard container must be completely filled (no head space). This solution is prepared prior to the sampling event. If some of the solution is lost during instrument calibration, add more water to the container so that the standard is filled with no head space.

SPECIFIC CONDUCTANCE

Conductivity is used to measure the ability of an aqueous solution to carry an electrical current. Specific conductance is the conductivity value corrected to 25°C.

Most instruments are calibrated against a standard which is near, but below the specific conductance of the environmental samples. A second standard which is above the environmental specific conductance is used to check the linearity of the instrument in the range of measurement.

Calibration Procedure

1. Allow the calibration standard to equilibrate to the ambient temperature.

2. Remove probe from its storage container, rinse the probe with a small amount of the conductivity/specific conductance standard (discard the rinsate), and place the probe into the conductivity/specific conductance standard.

3. Select monitoring/run mode. Wait until the probe temperature has stabilized.

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4. Look up the conductivity value at this temperature from the conductivity versus temperature correction table usually found on the standard bottle or the standard instruction sheet. You may need to interpolate the conductivity between temperatures. Select calibration mode, then conductivity. Enter the temperature corrected conductivity value into the instrument.

5. Select monitoring/run mode. The reading should be within manufacturer specifications. If it does not, re-calibrate. If reading continue to change after re-calibration, consult manufacturer.

6. Read the specific conductance on the instrument and compare value to the specific conductance value on the standard. The [illegible] value should agree with the standard within the manufacturer's specifications. If not, re-calibrate. If the re-calibration does not correct the problem, the probe may need to be replaced or serviced by the instrument manufacturer.

7. Remove probe from the standard, rinse the probe with a small amount of the second conductivity/specific conductance standard (discard the rinsate), and place the probe into the second conductivity/specific conductance standard. The second standard will serve to verify the linearity of the instrument. Read the specific conductance value from the instrument and compare value to the specific conductance on the standard. The two values should agree within the specifications of the instrument. If they do not agree, re-calibrate. If readings do not compare, then the second standard may be outside the linear range of the instrument. Use a standard that is closer, but above the first standard and repeat the verification. If values still do not compare, try cleaning the probe or consult the manufacturer.

8. When monitoring ground water or surface water, use the specific conductance readings.

OXIDATION/REDUCTION POTENTIAL (ORP)

The oxidation/reduction potential is the electrometric difference measured in a solution between an inert indicator electrode and a suitable reference electrode. The electrometric difference is measured in millivolts and is temperature dependent.

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Calibration or Verification Procedure

1. Allow the calibration standard (a Zobell solution) to equilibrate to ambient temperature.

2. Remove the probe from its storage container, and place it into the standard.

3. Select monitoring/run mode.

4. While stirring the standard, wait for the probe temperature to stabilize, then read the temperature.

5. Look up the millivolt (mv) value at this temperature from the millivolt versus temperature correction table usually found on the Zobell bottle or on the standard instruction sheet. You may need to interpolate millivolt value between temperatures. Select "calibration mode", then "ORP". Enter the temperature-corrected ORP value into the instrument.

6. Select monitoring/run mode. The reading should remain unchanged within manufacturer's specifications. If the reading, re-calibrate. If readings continue to change after calibration, contact manufacturer.

7. If the instrument instruction manual states that the instrument is factory calibrated, then verify the factory calibration against the standard. If they do not agree within the specifications of the instrument, the instrument will need to be re-calibrated by the manufacturer.

TURBIDITY

The turbidity method is based upon a comparison of intensity of light scattered by a sample under defined conditions with the intensity of light scattered by a standard reference suspension. A turbidimeter is a nephelometer with a visible light source for illuminating the sample and one or more photo-electric detectors placed ninety degrees to the path of the light source.

Some instruments will only accept one standard. For these instruments, the standards will serve as check points.

Calibration Procedures

1. Allow the calibration standards to equilibrate at the ambient temperature. The use of commercially available polymer primary standards (MCO-AEPA) is preferred, however, the standards can be prepared using Formazin according to the analytical Method 180.1.

2. If the standard cuvette is not sealed, rinse a cuvette with deionized water. Shake the cuvette to remove as much water as possible. Do not wipe the inside of the cuvette because lint from the wipe may remain in the cuvette. Add standard to the cuvette.

3. Before performing the calibration procedure, make sure the cuvettes are not scratched and the outside surfaces are dry, free from fingerprints and dust. If the cuvette is scratched or dirty, discard or clean the cuvette.

4. Zero the instrument by using either a zero or 0.0 NTU standard. A zero standard (approximately 0 NTU) can be prepared by passing distilled water through a 0.45 micron pore size membrane filter.

5. Using a standard in the range of [illegible] NTUs, calibrate according to manufacturer's instructions or verify calibration if instrument will not accept a second standard. If verifying, the instrument should read standard value to within the specifications of the instrument. If the instrument has range of scales, check each range that will be used during the event with a standard that falls within that range.

6. Using a standard between 20 and 100 NTUs, calibrate according to manufacturer's instructions or verify calibration if instrument does not accept a third standard. If verifying, the instrument should read standard value to within the specifications of the instrument. If the instrument has range of scales, check each range that will be used with the proper standard for that scale.

IV. DATA MANAGEMENT AND RECORDS MANAGEMENT

All calibration records must be documented in the project's log book. At a minimum, include the instrument manufacturer, model number, instrument identification number, standards used to calibrate the instruments (including source), calibration date, and the instrument readings.

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References

Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995.

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised March 1983.

Turbidity - Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R-93/100, August 1993.

Oxygen Solubility at Indicated Pressure

Temp.	Pressure (Hg)							
	760	755	750	745	740	735	730	mm
°C	29.92	29.72	29.53	29.33	29.13	28.94	28.74	in
0	14.57	14.47	14.38	14.28	14.18	14.09	13.99	mg/l
1	14.17	14.08	13.98	13.89	13.79	13.70	13.61	
2	13.79	13.70	13.61	13.52	13.42	13.33	13.24	
3	13.43	13.34	13.25	13.16	13.07	12-98	12.90	
4	13.08	12.99	12.91	12.82	12.73	12.65	12.56	
5	12.74	12.66	12.57	12.49	12.40	12.32	12.23	
6	12.42	12.34	12.26	12.17	12.09	12.01	[illegible]	
7	12.11	12.03	11.95	11.87	11.79	11.71	[illegible]	
8	11.81	11.73	11.65	11.57	11.50	11.4[illegible]	11.34	
9	11.53	11.45	11.38	11.30	11.22	11.[illegible]	11.07	
10	11.28	11.19	11.11	11.04	10.96	10.[illegible]	10.81	
11	10.99	10.92	10.84	10.77	10.70	10.[illegible]	[illegible]	
12	10.74	10.67	10.60	10.53	10.45	10.3[illegible]		
13	10.50	10.43	10.36	10.29	10.22	10.15		
14	10.27	10.20	10.13	10.06	10.00	9.9[illegible]	[illegible]	
15	10.05	9.98	9.92	9.85	9.78	9.7[illegible]	9.65	
16	9.83	9.76	9.70	9.63	9.57	[illegible]	9.43	
17	9.63	9.57	9.50	9.44	9.3[illegible]	[illegible]	9.24	
18	9.43	9.37	9.30	9.24	[illegible]	[illegible]	[illegible]05	
19	9.24	9.18	9.12	9.05	[illegible].99	[illegible]	[illegible]	
20	9.06	9.00	8.94	8.8[illegible]	8.82	[illegible].75	[illegible]	
21	8.88	8.82	8.76	8.[illegible]	8.64	8.58	[illegible]	
22	8.71	8.65	8.59	[illegible]	8.[illegible]	8.42	[illegible].36	
23	8.55	8.49	8.43	[illegible]	[illegible]	8.26	8.20	
24	8.39	8.33	8.2[illegible]	8.22	[illegible]6	8.1[illegible]	8.05	
25	8.24	8.18	8.[illegible]	8.07	[illegible]	[illegible]	7.90	
26	[illegible]8.09	8.03	[illegible]	7.92	[illegible]	[illegible].81	7.76	
27	[illegible]95	7.[illegible]	[illegible]	7.79	[illegible]	7.68	7.62	
28	[illegible]	7.76	[illegible]	7.65	7.60	7.54	7.49	
29	[illegible]	7.63	[illegible]	[illegible]2	7.47	7.42	7.36	
30	[illegible]	[illegible]0	7.4[illegible]	[illegible]	7.34	7.29	7.24	
31	7.[illegible]	[illegible]	7.32	[illegible]7	7.22	7.16	7.11	
32	7.30	[illegible]	7.20	7.15	7.10	7.05	7.00	
33	7.08	[illegible]	[illegible]	7.03	6.98	6.93	6.88	
34	7.07	7.[illegible]	[illegible]7	6.92	6.87	6.82	6.78	
35	6.95	6.[illegible]	6.85	6.80	6.76	6.71	6.66	
36	6.84	6.[illegible]	6.76	6.70	6.65	6.60	6.55	
37	6.73	[illegible]8	6.64	6.59	6.54	6.49	6.45	
38	6.63	[illegible].58	6.54	6.49	6.44	6.40	6.35	
39	6.5[illegible]	6.47	6.43	6.38	6.35	6.29	6.24	
[illegible]	[illegible]	6.37	6.33	6.28	6.24	6.19	6.15	
[illegible]	[illegible].32	6.27	6.23	6.18	6.14	6.09	6.05	
42	6.22	6.18	6.13	6.09	6.04	6.00	5.95	
43	6.13	6.09	6.04	6.00	5.95	5.91	5.87	
44	6.03	5.99	5.94	5.90	5.86	5.81	5.77	
45	5.94	5.90	5.85	5.81	5.77	5.72	5.68	

(Continued)

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

draft

S12 SA-1.2 SURFACE WATER AND SEDIMENT SAMPLING

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1.0 PURPOSE

This procedure describes methods and equipment commonly used for collecting environmental samples of surface water and aquatic sediment for either onsite examination and chemical testing, or for subsequent laboratory analysis.

2.0 SCOPE

The information presented in this guideline is generally applicable to all environmental sampling of surface waters (Section 5.3) and aquatic sediments (Section 5.5), except where the analyte(s) may interact with the sampling equipment. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions and equipment different from those described herein.

3.0 GLOSSARY

Environmental Sample - a sample containing (or suspected to contain) low-level concentrations of contaminants, which does not require special handling or transport considerations as detailed in SOP SA-6.1.

Hazardous Waste Sample - a sample containing (or suspected to contain) higher concentrations of contaminants thus requiring special handling and/or transport considerations per SOP SA-6.1.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager has the overall responsibility for seeing that all surface water and sediment sampling activities are properly conducted by appropriately trained personnel.

Field Operations Leader - The Field Operations Leader (FOL) is responsible for the in-field supervision of the conduct of onsite water quality analyses, ensuring the completion and accuracy of all field documentation, and making sure that custody of all samples obtained is maintained according to proper procedures.

5.0 PROCEDURES

5.1 Introduction

Collecting a representative sample from surface water or sediments is difficult because of water movement, stratification, or patchiness. To collect representative samples, one must standardize sampling bias related to site selection, sampling frequency, sample collection, sampling devices, and sample handling, preservation, and identification.

Representativeness is a qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been taken. Regardless of quality control applied during laboratory analyses and subsequent scrutiny of analytical data packages, reported data are no better than the confidence that can be placed in the representativeness of the samples.

5.2 Defining the Sampling Program

Many factors must be considered in developing a sampling program for surface water or sediments including study objectives, accessibility, site topography, physical characteristics of the water body (such as flow and mixing), point and diffuse sources of contamination, and personnel and equipment available to conduct the study. For waterborne constituents, dispersion depends on the vertical and lateral mixing within the body of water. For sediments, dispersion depends on bottom current or flow characteristics, sediment characteristics (density, size) and geochemical properties (which affect adsorption/desorption). The hydrogeologist developing the sampling plan must therefore know not only the mixing characteristics of streams and lakes, but also must understand the role of fluvial-sediment transport, deposition, and chemical sorption.

5.2.1 Sampling Program Objectives

The objective of surface water sampling is to determine the surface water quality entering, leaving or remaining within the site. The scope of the sampling program must consider the sources and potential pathways for transport of contamination to or within a surface water body. Sources may include point sources (leaky tanks, outfalls, etc.) or nonpoint sources (e.g., spills). The major pathways for surface water contamination (not including airborne deposition) are overland runoff, leachate influx to the waterbody, direct waste disposal (solid or liquid) into the water body; and groundwater flow influx from upgradient. The relative importance of these pathways, and therefore the design of the sampling program, is controlled by the physiographic and hydrologic features of the site, the drainage basin(s) which encompass the site, and the history of site activities.

Physiographic and hydrologic features to be considered include slopes and runoff direction, areas of temporary flooding or pooling, tidal effects, artificial surface runoff controls such as berms or drainage ditches (and when they were constructed relative to site operation), and locations of springs, seeps, marshes, etc. In addition, the obvious considerations such as the location of man-made discharge points to the nearest stream (intermittent or flowing), pond, lake, estuary, etc., shall be considered.

A more subtle consideration in designing the sampling program is the potential for dispersion of dissolved or sediment-associated contaminants away from the source. The dispersion could lead to a more homogeneous distribution of contamination at low or possibly non-detectable concentrations. Such dispersion does not, however, always readily occur. For example, obtaining a representative sample of contamination from a main stream immediately below an outfall or a tributary is difficult because the inflow frequently follows a stream bank with little lateral mixing for some distance. Sampling alternatives to overcome this situation are: (1) move the site far enough downstream to allow for adequate mixing, or (2) collect integrated samples in a cross section. Also, nonhomogeneous distribution is a particular problem with regard to sediment-associated contaminants, which may accumulate in low-energy environments (coves, river bends, deep spots, or even behind boulders) near or distant from the source while higher-energy areas (main stream channels) near the source may show no contaminant accumulation.

The distribution of particulates within a sample itself is an important consideration. Many organic compounds are only slightly water soluble and tend to adsorb onto particulate matter. Nitrogen, phosphorus, and the heavy metals may also be transported by particulates. Samples must be collected with a representative amount of suspended material; transfer from the sampling device shall include transferring a proportionate amount of the suspended material.

5.2.2 Location of Sampling Stations

Accessibility is the primary factor affecting sampling costs. The desirability and utility of a sample for analysis and consideration of site conditions must be balanced against the costs of collection as controlled by accessibility. Bridges or piers are the first choice for locating a sampling station on a stream, because bridges provide ready access and also permit the sampling technician to sample any point across the stream. A boat or pontoon (with an associated increase in cost) may be needed to sample locations on lakes and reservoirs, as well as those on larger rivers. Frequently, however, a boat will take longer to cross a water body and will hinder manipulation of the sampling equipment. Wading for samples is not recommended unless it is known that contaminant levels are low so that skin contact will not produce adverse health effects. This provides a built in margin of safety in the event that wading boots or other protective equipment should fail to function properly. If it is necessary to wade into the water body to obtain a sample, the sampler shall be careful to minimize disturbance of bottom sediments and must enter the water body downstream of the sampling location. If necessary, the sampling technician shall wait for the sediments to settle before taking a sample.

Sampling in marshes or tidal areas may require the use of an all-terrain vehicle (ATV). The same precautions mentioned above with regard to sediment disturbance apply.

Under ideal and uniform contaminant dispersion conditions in a flowing stream, the same concentrations of each would occur at all points along the cross section. This situation is most likely downstream of areas of high turbulence. Careful site selection is needed in order to ensure, as nearly as possible, that samples are taken where uniform flow or deposition and good mixing conditions exist.

The availability of streamflow and sediment discharge records can be an important consideration in choosing sampling sites in streams. Streamflow data in association with contaminant concentration data are essential for estimating the total contaminant loads carried by the stream. If a gaging station is not conveniently located on a selected stream, the project hydrogeologist shall explore the possibility of obtaining streamflow data by direct or indirect methods.

5.2.3 Frequency of Sampling

The sampling frequency and the objectives of the sampling event will be defined by the project plan documents. For single-event site or area characterization sampling, both bottom material and overlying water samples shall be collected at the specified sampling stations. If valid data are available on the distribution of the contaminant between the solid and aqueous phases, it may be appropriate to sample only one phase, although this is not often recommended. If samples are collected primarily for monitoring purposes (i.e., consisting of repetitive, continuing measurements to define variations and trends at a given location), water samples shall be collected at a pre-established and constant interval as specified in the project plans (often monthly or quarterly, and during droughts and floods). Samples of bottom material shall be collected from fresh deposits at least yearly, and preferably seasonally, during both spring and fall.

The variability in available water-quality data shall be evaluated before determining the number and collection frequency of samples required to maintain an effective monitoring program.

5.3 Surface Water Sample Collection

5.3.1 Streams, Rivers, Outfalls and Drainage Features (Ditches, Culverts)

Methods for sampling streams, rivers, outfalls, and drainage features at a single point vary from the simplest of hand-sampling procedures to the more sophisticated multi-point sampling techniques known as the equal-width-increment (EWI) method or the equal-discharge-increment (EDI) methods (see below).

Samples from different depths or cross-sectional locations in the watercourse taken during the same sampling episode, shall be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore shall not be composited. Generally, the number and type of samples to be taken depend on the river's width, depth, discharge and on the suspended sediment the stream or river transports. The greater the number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

In small streams less than about 20 feet wide, a sampling site can generally be found where the water is well mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross section.

For larger streams, at least one vertical composite shall be taken with one sample each from just below the surface, at mid-depth, and just above the bottom. The measurement of DO, pH, temperature, conductivity, etc., shall be made on each aliquot of the vertical composite and on the composite itself. For rivers, several vertical composites shall be collected, as directed in the project plan documents.

5.3.2 Lakes, Ponds and Reservoirs

Lakes, ponds, and reservoirs have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained.

The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small lakes, a single vertical composite at the deepest point may be sufficient. Similarly, the measurement of DO, pH, temperature, etc., is to be conducted on each aliquot of the vertical composite and on the composite itself. In naturally-formed ponds, the deepest point may have to be determined empirically; in impoundments, the deepest point is usually near the dam.

In lakes and larger reservoirs, several vertical composites shall be composited to form a single sample. These verticals are often taken along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones. In a stratified lake, the epilimnion is the thermocline which is exposed to the atmosphere. The hypolimnion is the lower, "confined" layer which is only mixed with the epilimnion and vented to the atmosphere during seasonal "overturn" (when density stratification disappears). These two zones may thus have very different concentrations of contaminants if input is only to one zone, if the contaminants are volatile (and therefore vented from the epilimnion but not the hypolimnion), or if the epilimnion only is involved in short-term flushing (i.e., inflow from or outflow to shallow streams). Normally, however, a composite consists of several verticals with samples collected at various depths.

In lakes with irregular shape and with bays and coves that are protected from the wind, separate composite samples may be needed to adequately represent water quality since it is likely that only poor mixing will occur. Similarly, additional samples are recommended where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

Many lake measurements are now made in-situ using sensors and automatic readout or recording devices. Single and multi-parameter instruments are available for measuring temperature, depth, pH, oxidation-reduction potential (ORP), specific conductance, dissolved oxygen, some cations and anions, and light penetration.

5.3.3 Estuaries

Estuarine areas are by definition, zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Estuaries are generally categorized into three types dependent upon freshwater inflow and mixing properties. Knowledge of the estuary type is necessary to determine sampling locations. Each type of estuarine area is described below:

- Mixed Estuary - characterized by the absence of a vertical halocline (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically this type of estuary is shallow and is found in major freshwater sheetflow areas. Being well mixed, the sampling locations are not critical in this type of estuary.

- Salt Wedge Estuary - characterized by a sharp vertical increase in salinity and stratified freshwater flow along the surface. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally, back and forth, with the tidal phase. If contamination is being introduced into the estuary from upstream, water sampling from the salt wedge may miss it entirely.

- Oceanic Estuary - characterized by salinities approaching full-strength oceanic waters. Seasonally, freshwater inflow is small with the preponderance of the fresh-saline water mixing occurring near, or at, the shore line.

Sampling in estuarine areas is normally based upon the tidal phases, with samples collected on successive slack tides (i.e., when the tide turns). Estuarine sampling programs shall include vertical salinity measurements at 1- to 5-foot increments, coupled with vertical dissolved oxygen and temperature profiles.

5.3.4 Surface Water Sampling Equipment

The selection of sampling equipment depends on the site conditions and sample type to be acquired. The most frequently used samplers are:

- Open tube.
- Dip sampler.
- Weighted bottle.
- Hand pump.
- Kemmerer.
- Depth-Integrating Sampler.

The dip sampler and the weighted bottle sampler are used most often, and detailed discussions for these devices only (and the Kemmerer sampler) are addressed subsequently in this section.

The criteria for selecting a sampler include:

1. Disposability and/or easy decontamination.
2. Inexpensive cost (if the item is to be disposed).
3. Ease of operation.
4. Nonreactive/noncontaminating properties - Teflon-coated, glass, stainless-steel or PVC sample chambers are preferred (in that order).

As specified in the project plan document plan documents, each sample (grab or each aliquot collected for compositing) shall be measured for:

- Specific conductance.
- Temperature.
- pH.
- Dissolved oxygen (optional).

Sample measurements shall be conducted as soon as the sample is acquired. Measurement techniques described in SOP SA-1.1 shall be followed. All pertinent data and results shall be recorded in a field notebook or on sample logsheets (see SOP SA-6.3). These analyses will provide information on water mixing/stratification and potential contamination.

Dip Sampling

Water is often sampled by filling a container either attached to a pole or held directly, from just beneath the surface of the water (a dip or grab sample). Constituents measured in grab samples are only indicative of conditions near the surface of the water and may not be a true representation of the total concentration that is distributed throughout the water column and in the cross section. Therefore, whenever possible, it is recommended to augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

Weighted Bottle Sampling

A grab sample can also be taken using a weighted holder that allows a bottle to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects sample throughout the total depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach what is known as a depth-integrated sample.

A closed weighted bottle sampler consists of a stopped glass or plastic bottle, a weight and/or holding device, and lines to open the stopper and lower or raise the bottle. The procedure for sampling with this device is:

- Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).
- Pull out the stopper with a sharp jerk of the stopper line.
- Allow the bottle to fill completely, as evidenced by the absence of air bubbles.
- Raise the sampler and cap the bottle.

- Decontaminate the outside of the bottle. This bottle can be used as the sample container as long as the bottle is an approved container type.

Kemmerer

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon coated sampler, a standard Kemmerer sampler may be used. The Kemmerer sampler is a brass, stainless-steel or acrylic cylinder, with rubber stoppers that leave the ends open while being lowered in a vertical position (thus allowing free passage of water through the cylinder). A "messenger" is sent down the line when the sampler is at the designated depth, to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill sample bottles.

5.3.5 Surface Water Sampling Techniques

Most samples taken during site investigations are grab samples. Typically, surface water sampling involves immersing the sample container in the body of water; however, the following suggestions are made to help ensure that the samples obtained are representative of site conditions:

- The most representative samples are obtained from mid-channel at a 0.6 foot stream depth in a well-mixed stream.
- Even though the containers used to obtain the samples are previously laboratory cleaned, it is suggested that the sample container be rinsed at least once with the water to be sampled before the sample is taken. This is not applicable when sample containers are provided "pre-preserved."
- For sampling running water, it is suggested that the farthest downstream sample be obtained first, and that subsequent samples be taken as one works upstream. In general, work from zones suspected of low contamination to zones of high contamination.
- To sample a pond or other standing body of water, the surface area may be divided into grids. A series of samples taken from each grid node is combined into one sample, or several grid nodes are selected at random.
- Care should be taken to avoid excessive agitation of the water, as loss of volatile constituents could result.
- When obtaining samples in 40 mL septum vials for volatile organics analysis, it is important to exclude any air space in the top of the bottle and to be sure that the Teflon liner of the septum faces in after the vial is filled and capped. The vial can be turned upside down to check for air bubbles.
- Do not sample at the surface, unless sampling specifically for a known constituent which is immiscible and on top of the water. Instead, the sample container should be inverted, lowered to the approximate depth, and held at about a 45-degree angle with the mouth of the bottle facing upstream. When sample containers are provided "pre-preserved," use a dedicated, clean, un-preserved bottle for sampling and transfer to an appropriately-preserved container.

5.4 Onsite Water Quality Testing

Onsite water quality testing shall be conducted as described in SOP SA-1.1.

5.5 Sediment Sampling

5.5.1 General

Sediment samples are usually collected at the same verticals at which water samples were collected. If only one sediment sample is to be collected, the sampling location shall be approximately at the center of the water body.

Generally, the coarser grained sediments are deposited near the headwaters of the reservoir. Bed sediments near the center of a water body will be composed of fine-grained materials which may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations of contaminants. The shape, flow pattern, bathometry (i.e., depth distribution), and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (e.g., bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) shall be sampled while areas likely to show net erosion (i.e., high-velocity, turbulent areas) and suspension of fine solid materials, shall be avoided.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments (especially fine-grained material) may act as a sink or reservoir for adsorbed heavy metals and organic contaminants (even if water column concentrations are below detection limits). Therefore, it is important to minimize the loss of low-density "fines" during any sampling process.

All relevant information pertaining to sediment sampling shall be documented as applicably described in SOP SA-6.3.

5.5.2 Sampling Equipment and Techniques

A bottom-material sample may consist of a single scoop or core, or may be a composite of several individual samples in the cross section. Sediment samples may be obtained using onshore or offshore techniques.

When boats are used for sampling, life preservers must be provided and two individuals must undertake the sampling. An additional person shall remain onshore in visual contact at all times.

The following samplers may be used to collect bottom materials:

- Scoop sampler.
- Dredge samplers.

Each type of sampler is discussed subsequently.

Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if it can be waded, the easiest and best way to collect a sediment sample is to use a scoop sampler. This reduces the potential for cross-contamination. This method is accomplished by reaching over or wading into the water body and, while facing upstream (into the current), scooping the sampler along the bottom in the upstream direction. It is very difficult not to disturb fine-grained materials of the sediment-water interface when using this method.

Dredges

Dredges are generally used to sample sediments which cannot easily be obtained using coring devices (i.e., coarse-grained or partially-cemented materials) or when large quantities of sample are required. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a "messenger". Most dredges are heavy (up to several hundred pounds) and require use of a winch and crane assembly for sample retrieval. There are three major types of dredges: Peterson, Eckman and Ponar dredges.

The Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The Peterson dredge shall be lowered very slowly as it approaches bottom, because it can force out and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high flow velocities.

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave" and permitting direct access to the secured sample without opening the closed jaws. The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

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APPENDIX D

RESPONSE TO COMMENTS

RESPONSE TO USEPA COMMENTS DATED APRIL 8, 2002 ON DRAFT (PRELIMINARY) DATA QUALITY OBJECTIVES FOR SITE 34 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

General

1. **Comment:** The introductory paragraph of the DQO materials indicates that the data quality objectives as presented in the package are put forth to support a non-time critical removal action. EPA notes that the document also puts forth a goal of determining if groundwater has been impacted from past activities at Site 34. It is not clear whether this DQO package is meant to support a Site Screening Investigation as well as support a non-time critical removal action. In several places, it appears that this may be a goal but this is not clear from the information provided. This issue needs to be clarified since it impacts design of the study.

   Response: The DQOs will be revised to clarify that the intent of the investigation is to collect data to support a non-time critical removal action for the ash pile and to support the site screening evaluation for the site. All steps of the DQOs will be revised appropriately.

Specific

2. **Comment:** Page 3, paragraph 1: EPA notes that since Site 34 is a new site, the contaminants of concern (COC) identified for the off-shore area adjacent to the site may need to be revisited. For example, EPA does not recall that pesticides are considered a potential COC in the existing off-shore documents. However, data collected to date from Site 34 may result in the inclusion of pesticides (or some pesticides) as COCs in the off-shore area adjacent to Site 34. While this does not impact the potential removal action, it does need to be considered for site screening or remedial investigation work.

   Response: The Navy recognizes the contaminants of concern (COC) identified for the off-shore area adjacent to Site 34 may need to be revisited based on the results of the site screening or remedial investigation work.

3. **Comment:** Page 4, paragraph 2: 4,4'-DDT should be carried forward as a potential COC. Updated Region 1 risk assessment guidance/policy does not consider it acceptable to drop COCs based on a comparison to background. In particular, this would not be appropriate for Site 34, since the building was historically used as a pesticide storage area.

   Response: The discussion provides a summary of the available soil data from 1998 in comparison to potential risk screening levels and facility background concentrations and is not intended as a COPC risk screening. The summary helps to focus on the appropriate analysis to support the removal action for the ash. Samples to support the site screening evaluation will be analyzed for the full suite of analytes (including pesticides) for site screening investigations.

4. **Comment:** Page 4, paragraph 6: EPA notes that the existing Preliminary Remediation Goals (PRGs) may not account for all COCs. The PRGs were developed based on the list of COCs at the time that the PRGs were developed. The text should clarify this fact.

Response: Although pesticides are not currently offshore COCs, in accordance with the Interim Record of Decision (ROD) for OU4, the Navy included pesticide data in the development of the offshore Preliminary Remediation Goals (PRGs) and PRGs are available for the more toxic, persistent, and bioaccumulative pesticides. Please see the Preliminary Remediation Goals for OU4 report (TtNUS, November 2001) for the PRG development process and the PRGs for OU4. After the site screening has been performed, the offshore COCs may need to be reevaluated.

5. **Comment:** Page 5, Problem Statement, bullet #2: It is not clear why data on groundwater and sediment are needed at this time to support a non-time critical removal action. The problem statement as outlined under this bullet seems to go beyond what is necessary to develop an EE/CA. However, it is not clear whether the assessing impacts of contaminants on the environment is intended to meet the requirements of a Site Screening Investigation. The intended purpose need to be further discussed and clarified.

   Response: The DQOs will be revised to clarify that the intent of the investigation is to collect data to support a non-time critical removal action for the ash pile and to support the site screening evaluation for the site. All steps of the DQOs will be revised appropriately.

6. **Comment:** Page 6, Decision Statement, Principal Decisions, (B): This decision statement seems to imply that the intent of this work is to support a Site Screening Investigation at Site 34. If this is the case, additional information should be discussed in this DQO package. Please clarify.

   Response: The DQOs will be revised to clarify that the intent of the investigation is to collect data to support a non-time critical removal action for the ash pile and to support the site screening evaluation for the site. All steps of the DQOs will be revised appropriately.

7. **Comment:** Page 7, Data Quality Objective Step 3, Data required for groundwater and sediment impact assessment: According to the information provided in this package, groundwater has not been sampled at Site 34 in the past. Therefore, it is not clear that the limited list of analytes is appropriate. This concern is related to the fact that it is not clear as to the objective of the groundwater assessment. This needs to be clarified before EPA is willing to consider a limited list of constituents for analysis.

   Response: The DQOs will be revised to clarify that the intent of the investigation is to collect data to support a non-time critical removal action for the ash pile and to support the site screening evaluation for the site. All steps of the DQOs will be revised appropriately. Samples to support the site screening evaluation will be analyzed for the full suite of analytes for site screening investigations.

8. **Comment:** Page 9, Principal Decision Rules: The note here should clarify that if residual contamination exists following the removal action, the Navy will need to show that the residual contamination does not present an unacceptable risk.

   Response: The information is provided in the first paragraph of DQO Step 5 (under EE/CA Principal Decision Rule).

9. **Comment:** Page 9, Principal Decision Rules, Screening level discussion: The proposed use of background levels as a screening tool may result in the Navy having insufficient evidence to address whether the residual risk after a removal action presents any unacceptable risks. In this case, the Navy will have to perform a Site Screening Investigation to determine whether the site should move into the RI/FS process. The future implications of the proposed use of background during a removal action should be evaluated to avoid the need to duplicate work in the future.

   Response: The types of contaminants associated with the ash pile (polycyclic aromatic hydrocarbons [PAHs] and metals) are typically found in industrial areas because of day-to-day activities such as combustion of diesel or fuel oil, asphalt road construction, etc. Therefore, it is important to consider facility background levels in determining the extent of contamination associated with the ash pile. At the conclusion of the Site Screening Process, the Navy will consider background in making a recommendation whether the site should enter the RI/FS process. The Navy's recommendation will be based on USEPA and Navy Guidance.

10. **Comment:** Page 10, Principal Decision Rules, (B): As stated above, it is not clear why the impact to groundwater is being considered if the sole intent of the effort is to support a removal action. If the proposed work is meant to address a Site Screening Investigation, EPA does not believe that the limited analysis proposed for groundwater is sufficient.

    Response: The DQOs will be revised to clarify that the intent of the investigation is to collect data to support a non-time critical removal action for the ash pile and to support the site screening evaluation for the site. All steps of the DQOs will be revised appropriately. Samples to support the site screening evaluation will be analyzed for the full suite of analytes for site screening investigations.

RESPONSES TO MEDEP COMMENTS DATED APRIL 10, 2002 ON DRAFT (PRELIMINARY) DATA QUALITY OBJECTIVES FOR SITE 34 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

General Comment

1. **Comment:** This document addresses DQOs for the Site Investigation of Site 34. It appears to be focused solely on addressing the ash pile outside the building. However, Building 62 used to be an oil gasification plant. Therefore, there may be other sources of contamination associated with this building, specifically the tar pit that is mentioned in the Industrial History of Building 62 document. While oil gasification produced much less tar than coal gasification the plant was in operation for approximately 30 years. Therefore, it is likely a substantial amount of tar was produced in that time. Presumably, this pit was covered over when the concrete floor was laid in the early 1900s. The historical report indicates the location of the tar pit. The construction of the pit is unknown but it is quite possible that groundwater may flow through this pit with the result of mobilizing PAHs to groundwater and surface water.

   The MEDEP is not suggesting that the Navy investigate the tar pit as part of the sampling discussed in the Draft DQO document. However, the language of the document should indicate that the ash pile investigation is not the only investigation needed for this building.

   Response: The DQOs will be revised to clarify that the intent of the investigation is to collect data to support a non-time critical removal action for the ash pile and to support the site screening evaluation for the site. All steps of the DQOs will be revised appropriately. The tar pit, which was located in the building, was relatively small in size (approximately 5 feet by 5 feet). Additional information on the size and location of the tar pit will be provided. The site screening evaluation samples (for groundwater) will also address potential contamination from the tar pit. Groundwater levels and samples will be collected as part of the investigation which will enable the Navy to determine whether PAHs are a potential concern in the groundwater.

   Also, the Navy will evaluate methods to investigate whether the pit is still present and submit the information at a later date as an addendum to the Site 34 work plan if an investigation method is identified. The Navy would appreciate any input in identifying potential investigation methods.

2. **Comment:** The Navy has proposed in this document not to analyze soil/ash samples for VOCs, PCBs, dioxins, cyanide, and DRO/GRO. The basis for this decision is given as non-detects in previous samples at the site. These prior samples are stated under "Historical Site Chemical Data" in this DQO as one sample of ash, one sample of soil between the ash pile and Back Channel, and two intertidal sediment samples. The ash pile along the back side of Building 62 is roughly 150 long by up to 30 feet wide. MEDEP believes that a single sample of the ash and a lack of any sample of the soil underneath the ash comprises insufficient evidence to justify eliminating the above-named analyses. We also think that adequate knowledge of site process detail is lacking, and therefore cannot support the narrow field of analytes now proposed. At a minimum, the Navy needs to add PCBs and dioxin analyses.

   Response: Samples to support the site screening evaluation will be analyzed for the full suite of analytes for site screening investigations (TCL organics and TAL metals). The TCL organics include PCBs. Samples of ash will be analyzed for a full suite of analytes. Dioxins and cyanide

will also be analyzed. If dioxins and cyanide are present in the ash at levels exceeding background and residential screening levels, then, the soil samples will also be analyzed for dioxins and cyanide in addition to the regular full suite.

The most toxic constituents found in DRO/GRO will be covered in the TCL organics, therefore, DRO/GRO analysis will not be performed.

Specific Comments

3. **Comment:** paragraph 3, p. 1

   "...'removal action' does not mean physical removal of materials."

   Please add "necessarily" after "does not."

   Response: The text will be revised as requested.

4. Site History, p. 2

   a) **Comment:** Please reference Figure 1 in the first paragraph of this section. Also, please add a figure to this document showing the location of Building 62 relative to the rest of the Shipyard.

      Response: The text will be revised to reference figures in the QAPP and the QAPP will include a figure showing the location of the site at PNS will be added.

   b) **Comment:** "Ash, assumed to be from the combustion of coal..."

      Typically, coal ash has much higher levels of mercury (5-10 ppm) than is indicated in the table attached to the DQOs. Therefore, the MEDEP suspects that the ash is not entirely from coal. It is likely that some portion of the ash is a result of the 1919 fire.

      Response: Text will be added to indicate that the ash outside the building could also contain remains of the old building from the fire.

   b) **Comment:** There is no information regarding use of the building from 1930 to the present other than that at some point it was used for pesticide storage. Please provide more details of use of this building after 1930.

      Response: Information on the use of the building after 1930 is limited; however, available detail (from the report by Dolph and Turpin on Building 62 and existing conditions maps from several years) will be added.

   c) In the fourth paragraph change "hermculite" to "herculite".

      Response: The text will be revised as requested.

5. **Comment:** Previous Investigations, p. 3, 2nd paragraph

Indicate that the data are provided in Table 1 (as is indicated on p. 4).

Response: The data are discussed under historical site chemical data and the reference to Table 1 is provided with that discussion.

6. **Comment:** Conceptual Site Model, p. 5

a) Please reference Fig. 1 here. However, note that are two problems with this figure. The most significant problem is that there is no north arrow. In addition, Storer Street is not drawn on the map. These omissions make it difficult to follow the text in this section. Please add these two elements.

Response: A reference to Figure 1-3 of the QAPP showing the site layout will be added. A standard GIS figure of the site will be provided (which includes the PNS base map, north arrow, and scale).

b) "A conceptual site model for exposure to potential receptors is not being considered at this time because the objective of this investigation is to obtain information to support a non-time critical removal action."

Can the need for a non-time critical removal action be determined without risk data?

Response: The concentrations of PAHs in the ash sample were well above the risk screening levels; therefore, the Navy believes that the entire ash pile may contain similarly high levels of PAHs, and therefore, there is a potential unacceptable risk . For example, the concentration of benzo(a)pyrene in the ash sample was 1000 times greater than the risk screening level.

7. **Comment:** Decision Statements, p. 6

Change "Site 32" to "Site 34".

Response: The text will be revised as requested.

8. DQO Step 3, p. 7

a) **Comment:** Other types of chemical analyses for soil should be run besides those listed. Please add PCBs and dioxins, at a minimum. See Comment 1.

Response: Please see the Navy's response to MEDEP General Comment No. 2 above.

b) **Comment:** "Pesticide use at the site occurred after the ash disposal occurred, therefore, pesticides, if present would be outside the ash pile area."

Considering this building was once used for pesticide storage it is quite possible that pesticides could have been disposed of in the ash pile. The Navy should analyze the ash for pesticides.

Response: A full suite of analysis (including pesticides) will be conducted on ash samples to characterize the composition of the ash as discussed in the DQOs.

c) **Comment:** "No...dioxins...based on process knowledge and previous data."

Typically, when ash has been found, such as at the JILF, it is targeted for dioxin analysis since dioxin can result from combustion of organic materials. Based on Table 1 it doesn't appear that the ash has been sampled for dioxin in the past. The Navy needs to add dioxin to the soil chemistry data requirements.

Response: Please see the Navy's response to MEDEP General Comment No. 2.

d) **Comment:** Under "Data required for groundwater and sediment impact assessment", MEDEP recommends adding another item, as follows:

"Geologic stratification and soil characterization to bedrock"

Information regarding the need for this information was provided via electronic mail dated June 05, 2002 from Iver LcLeod to Fred Evans, as follows:

"If an SI is to include a groundwater impact assessment (per language on page 7), at a minimum, some site-specific knowledge must be obtained to geologically characterize the shallowest aquifer. The geologic composition of subsurface layering is a large factor in contaminant transport (i.e., horizontal and vertical hydraulic conductivity). Also, if the shallowest geologic material is mostly fine-grained (silts/clay, versus sand and gravel) metals and PAHs are likely to be more concentrated in the vadose zone above the water table. In some cases, characterization of shallow bedrock is also necessary, but we do not propose that this is necessary for this SI."

Response: The Navy recognizes that geological characterization is important to understand the contaminant transport mechanisms that may exist at the site. However, the intent of the SSI is to find out whether contaminant impact has occurred or not. If an impact has occurred to the groundwater, then additional geological characterization would be necessary to study possible transport mechanisms of contaminants from the source area of the site.

Using the DPT technique proposed in the DQOs, the Navy can attempt at two locations (34-05 at the source and 34-01 upgradient of the site) to penetrate the saturated zone to the extent possible until refusal occurs. However, when refusal occurs, it might not be possible to confirm that it is due to bedrock because of the limitations of DPT. Nevertheless, the groundwater samples at 34-05 should indicate whether a deeper zone of contamination has occurred.

e) **Comment:** Please define BTU content (under Inputs to Secondary Decision).

Response: The text will be revised to indicate that the "heat of combustion " of any organic free product will be analyzed. The term "BTU" refers to the abbreviation for "British Thermal Unit", which is a typical unit of measurement of heat, will be eliminated.

9. **Comment:** DQO Step 4, Investigate vertical distribution, p. 8

"Sampling at low tide is expected to yield contaminant levels more representative of the impact to groundwater than high tide when dilution from surface water intrusion would occur."

This may not be the case if soil contamination lies above the low tide level. This potential situation should be discussed.

Response: The Navy believes sampling at low tide is appropriate (even if soil contamination lies above the low tide level) for the following reasons:

- If the concern is that the groundwater at low tide may not reflect the soil contamination that may be present above this level, then, the contamination is not very mobile and remains entrapped in the soil. Therefore, sampling at low tide is still reflective of the mobile fraction of contamination.
- If the concern is that the contaminants that may have been mobilized at high tide have migrated away from the well before sampling occurs at low tide, then, apparently the contamination is very mobile. This is an unlikely situation, considering that the source have been present for several decades and consequently, the predominant fraction of mobile contamination should have already been flushed away.

In any case, if the soil contamination lies above the low tide level, then the analytical results from the soil sample should reflect this contamination. If the groundwater does not reflect this contamination, it is likely that an indication of an impact does not exist.

The Navy requests additional input from MEDEP regarding why sampling at low tide would not be appropriate at this site.

10. **Comment:** Secondary Decision Study Boundaries, p. 8

"The study boundaries will be within the study boundaries for the principal study decision."

This statement does not make sense. Please correct or explain, as appropriate.

Response: The study boundaries have been clarified based on the clarification related to the objectives to support a removal action and a site screening investigation. Therefore, this sentence has been replaced.

11. **Comment:** DQO Step 5, Decision Rules, p. 9

1st bullet: " 'Dirty' samples are those where both the metal and PAH concentrations are greater than selected EE/CA screening levels."

Change "both" to "either".

Response: The text should have read "either;" however, the text will be replaced to provide additional clarification on the decision rules.

12. **Comment:** DQO Step 5, p. 9

"Continue sampling for one more round to determine extent of contamination"

Please explain what the Navy means by "one more round". MEDEP is accustomed to seeing this expression applied to groundwater sampling at monitoring wells.

Response: The use of "sampling round" is not exclusive to groundwater sampling and is synonymous with "phase." However, the text will be replaced to provide additional clarification on the decision rules.

13. **Comment:** DQO Step 5, Screening levels for soil, p. 9

a) "Screening levels for soil will be determined as follows..."

Does this include ash as well? "Ash/soil" is mentioned earlier in this section.

Response: The screening levels are for soil. Visual presence of ash will be used to determine the extent of ash. The text will be clarified.

14. **Comment:** DQO Step 5, Screening levels for soil, p. 10, 1st bullet

"For surface water dilution, a dilution factor of 100 is proposed, for screening purposes."

Please provide justification for this dilution factor.

Response: The dilution factor was calculated for OU3 groundwater discharge to the Back Channel and it was estimated to be 230, which was presented in Appendix E (Dilution Factor Development) of the seep/sediment Summary report (TtNUS, August 2000). Site 34 being a much smaller site (in area) is expected to actually have a higher dilution factor. However, a conservative order-of-magnitude dilution factor for screening purposes is proposed to be 100.

15. DQO Step 7, p. 11

a) **Comment:** 2nd full paragraph:

What is the rationale for stopping vertical soil sampling when the water table is encountered? Contaminants may have leached downward below the current water table elevation during periods of low groundwater levels (low tides, drought conditions). Perhaps

2 or 3 feet lower than the current water table would be sufficient. A confirmation of clean soil at depth will be important if a contaminant profile is found to extend to the current water table.

Response: The rationale is that the sampling depth corresponds to the exposure depth for a potential receptor. The need for sampling below the water table can be evaluated if the groundwater is shown to be impacted (i.e., as part of an RI investigation). The investigation is to support a removal action and a site screening investigation; therefore, sampling to support these two objectives are necessary.

b) **Comment:** The second full paragraph has several references to north and east on Figure 1. As noted above there is no north arrow on the figure making it difficult to follow the text. Please add this arrow.

Response: The north arrow will be added to the figure as requested.

c) **Comment:** "These four visual observations of the horizontal extent of the ash also need to be verified with samples at...34-TW-01."

According to Figure 1 34-TW-01 is on the opposite side of the building from the ash. How does this help to determine horizontal extent?

Response: The sample location will help confirm that ash was not deposited on the south side of the building. Note that based on the clarification of the objectives of the investigation (to support both EE/CA and SSI), sample locations will be revised. Please see the sample rationale table provided in the revised draft DQOs.

d) **Comment:** "Also, a monitoring well will be required in a location upgradient of the source to provide a perspective on the groundwater contamination beneath the source."

All known or potential upgradient sources of contamination must be noted and considered when evaluating the results of the upgradient well.

Response: The use of the data to be collected from the upgradient monitoring well is to compare the data from the site wells to determine if the groundwater has been impacted by the site sources. It is not within the scope of this investigation to investigate other potential upgradient sources, if any.

16. **Comment:** Sampling summary, 2nd bullet, p. 12

The 6-8 ft. interval appears to be missing.

Response: The required sampling intervals to support the removal action and to support the SSI differ slightly. The additional sampling intervals considered to support the removal action (2 to 4 feet bgs and 6 to 8 feet bgs) are included because they will assist in refining the volume of impacted soil for the removal action. These additional sampling intervals are not required for

the SSI (the samples from 0 to 2 feet bgs, 4 to 6 feet bgs, and 8 to 10 feet bgs are sufficient to determine potential impact for site screening).

17. **Comment:** DQO Step 7 p. 12 and Figure 1, Conceptual Site Layout and Proposed Sampling Plan for Site 34

Page 12 has a summary of the sampling and analytical rationale. Likewise, Figure 1 shows three proposed locations for surface and subsurface soil sampling. Two locations are within the ash pile relatively close to the building wall. The third location is upgradient to provide background levels. At least two additional locations should be added just downslope of the ash pile to test for the depth of contaminant leaching and to confirm that the ash does not have a greater northward extent in the subsurface than that visible on the surface.

*Note that there are **three** not two borings in the ash pile. Further clarification was provided by Iver McLeod via electronic mail dated June 05 2002, to Fred Evans, as follows:*

> "This third well (which MEDEP did overlook) has been located close to the back of the building, and as such will not answer our concern about what is in the soil just off the downgradient edge of the ash pile."

Upon further questioning the need for the additional boring (since the extent of the ash-impacted soil will be confirmed when a removal action is conducted and confirmatory samples will be available at that time), the MEDEP replied as follows:

> "The Navy won't know if they're going to perform a removal action until after the results of the investigation. Two additional sampling locations may help to make a decision as to whether or not a removal action is needed. Also, our concern should include not only where the ash now resides, but all surrounding soil that may have been (or was) contaminated by leaching from the ash. We need a minimum of two downslope soil sampling borings."

Response: The DQOs assume that the Navy will conduct a removal action before preparing a SSI report. The SSI report will present and evaluate the data from the SSI investigation, as well as any confirmatory sampling conducted as part of the ash pile removal action. The general sequence of events is expected to be: Site investigation (SI)→ EE/CA →Removal Action → Confirmatory Sampling → Site Screening Report.

However, the Navy recognizes the need for an additional downgradient boring. The Navy also notes that there are certain terrain-related features that can limit the scope of what can be designated "downgradient". The site's topography is such that beyond the northern side of the road that runs parallel to the northern side of Building 62, there is a rapid drop in terrain towards the shoreline. Therefore, there is a limited area of the site where a preliminary investigation of this nature can be conducted. On the other hand, the Navy does recognize the need for an additional boring for additional information on the downgradient impact of the ash pile. Therefore, the Navy proposes two soil borings (one of which will be converted to a temporary monitoring well) downgradient of the pile.

RESPONSES TO SAPL COMMENTS DATED APRIL 12, 2002 ON DRAFT DATA QUALITY OBJECTIVES FOR SITE 34 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1. **Comment: General Comment.** SAPL concurs with the majority of the comments presented in the Maine Department of Environmental Protection's (MEDEP's) letter dated April 10, 2002, and the U.S. Environmental Protection Agency's (USEPA's) letter dated April 8, 2002, and will not duplicate the agencies' comments except where SAPL feels additional emphasis is needed.

   Response: Comment noted. Please see the Navy's responses to USEPA and MEDEP comments provided above.

2. **Comment: Page 1, Opening Paragraph.** The first sentence in the document states that the DQOs are provided to support a non-time critical removal action for the site. However, the Potential Actions for Principal Questions and Decisions Statements: Principal Decisions sections on page 6 identify a second, more far-reaching goal. Principal Decision A on page 6 clearly focuses on the possible removal of the soil/ash pile adjacent to Building 62. The second Principal Decision (Decision B) is to determine if a Remedial Investigation/Feasibility Study (versus No Action) is needed at Site 34. While the DQOs outlined in the document are (with minor revisions) adequate to address possible removal of the ash pile, the DQOs are not sufficient to determine if no other action would be required at the site. As the MEDEP points out in comment 1, other potential sources (such as the tar pit mentioned on page 2) may exist at the site. Furthermore, the data gathering identified in the DQO document is insufficient for making a No Action decision. Other potential sources would have to be considered and additional site work performed before a determination of No Action could be made. The DQO document must be revised to clearly identify up front what the DQOS are being developed for, and if the DQOs are intended to describe the basis for a Site Screening Investigation, additional information and investigation will be required.

   Response: The DQOs will be revised to clarify that the intent of the investigation is to collect data to support a non-time critical removal action for the ash pile and to support the site screening evaluation for the site. All steps of the DQOs will be revised appropriately.

3. **Comment: Page 2, DQO Step 1: State the Problem, Site History.** Activities (and associated potential for contamination) taking place at the site since 1930 are not described adequately. SAPL is particularly concerned that pesticides are not being given adequate consideration in the DQO process, despite the fact the Building 62 was used for pesticide storage. This is especially troublesome given that Principal Decision B (see comment 2, above) could lead to No Action at the site. The DQOs must be revised to address the potential for pesticide contamination in both onshore and offshore areas associated with Site 34.

   Response: Information on the use of the building after 1930 is limited; however, available detail (from the report by Dolph and Turpin on Building 62 and existing conditions maps from several years) will be added. As indicated in the Navy's response to SAPL Comment No. 2, the intent of the investigation (to support both removal action and SSI) will be clarified. In addition, samples to support the site screening will be analyzed for the full suite of analytes for site screening investigations (Target Compound List [TCL] organics and Target Analyte List [TAL] metals). The TCL organics list includes pesticides.

4. **Comment: Pages 2 & 3, DQO Step 1: State the Problem, Previous Investigations at/offshore of Site 34.** SAPL concurs with the USEPA's comment 2, dated April 8, 2002, that because Site 34 is a new site, Contaminants of Concern (COCs) for the offshore area adjacent to the site may need to be revisited. SAPL also concurs with USEPA comment 3 that DDT should be carried forward as a potential COC.

   Response: Regarding additional COCs for the offshore area, please see the Navy's response to USEPA Comment 2 dated April 8, 2002. Regarding comparison to background concentrations, please see Navy's response to USEPA Comment No. 9 dated April 8, 2002.

5. **Comment: Page 4, DQO Step 1: State the Problem, Historical Site Chemical Data.** The fourth paragraph lists metals that significantly exceeded both background concentrations and screening levels. SAPL has expressed reservations in a number of earlier comment letters about how the Navy developed background data for the Shipyard and how the data is used to evaluate specific sites. SAPL supports the USEPA position (USEPA comment 3, dated April 8, 2002) that USEPA's risk assessment guidance and policy do not find it acceptable to drop COCs based on comparison with background. Therefore, the passage in the fourth paragraph on page 4 should identify metals that exceeded screening levels, regardless of background concentrations.

   Response: Please see the Navy's response to SAPL Comment No. 4 above related to the intent of the discussion provided on historical site chemical data. Also regarding background concentrations, please see Navy's response to USEPA Comment 9 dated April 8, 2002.

6. **Comment: Page 5, DQO Step 2: State the Decision(s).** The second of the Principal Study Questions at the bottom of page 5 focuses on the impact on groundwater and sediment by source(s) at Site 34. However, the DQO document does not address any potential source(s) other than the ash pile. If this second Principal Study Question is correct, the DQO document will require significant revisions to ensure that this Principal Study Question can be answered with confidence in the future.

   Response: It is not clear from the comment what significant revisions are necessary; however, the Navy believes the clarification on the intent of the investigation to provide data to support both a removal action for the ash pile and the site screening evaluation for the site and associated revisions to the DQO steps will provide sufficient data so that the study questions can be answered with confidence.

7. **Comment: Page 7, DQO Step 3: Specify Inputs to the Decision(s).** SAPL concurs with MEDEP and USEPA comments on the Inputs to Principal Decisions section, particularly that it is premature to limit parameters for testing at this stage. As currently written, the data inputs required for groundwater and sediment impact are not sufficient to make a decision regarding No Action. If the Navy intends to evaluate potential site impacts to groundwater and sediment, in addition to identifying other site-related sources, more analytical testing should be performed to characterize the ash. Additional information regarding site geology and hydrogeology is also needed.

Response: Please see the Navy's responses to USEPA and MEDEP comments related to inputs to principal decisions section (DQO step 3).

8. **Comment: Page 8, DQO Step 4: Establish the Study Boundaries.** The boundaries for Principal Decision B should encompass sediment in the offshore area adjacent to Site 34, as impacts to sediment offshore of the site are specifically included in the Decision Statement on page 6.

   Response: The study boundaries will be clarified as they relate to the clarification of the objectives for the removal action and site screening evaluation study questions.

9. **Comment: Page 11, DQO Step 7: Sampling Plan Design.** The second paragraph on page 11 includes the statement that a relatively minor variation in chemical constituents of the ash may be expected as the ash and residue from the [gasification] operation would be similar over time. However, the information presented in the Site History section on page 2 indicates a number of unknowns about past operations at the site. For example, if a gas purifier was used during the oil gasification, the waste generated would have contained chemicals (such as cyanides) that differ from those in ash generated from coal combustion. There is no information presented regarding potential contamination from activities (such as pesticide storage) after 1930. Therefore, it would be premature to state that the chemical composition of the ash should vary only minor amounts. Furthermore, there is data from only one ash sample so far, and no ash sampling is proposed in the DQOs. If the Navy intends to evaluate the potential impacts of the ash on groundwater and other media, additional characterization of the ash is needed.

   The third paragraph on page 7 touches upon erosion and redeposition as a means to spread contamination to the north. Will the Navy evaluate potential windblown transport and deposition as well? The fourth paragraph discusses evaluation of groundwater using monitoring wells. A single down-gradient groundwater sampling point will not be sufficient to determine if there have been site impacts to groundwater. More monitoring wells will be needed.

   Response: The Navy recognizes the need for additional ash characterization, which is included in the revised DQOs. The Navy does not believe that an ongoing concern of windblown erosion/deposition exists, because the ash has been around for decades, the lighter fraction that could be subjected to erosion would have already been blown away. Moreover, the pile is covered with vegetation.
   Regarding groundwater monitoring wells, please see the Navy's response to MEDEP Comment 17 dated April 10, 2002.

RESPONSES TO USEPA COMMENTS DATED OCTOBER 10, 2002
DRAFT SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Responses to USEPA Attachment 1 Comments

1. **Comment:** Tables 1-3, 2-1, and 5-1 to 5-9 should be updated to include the latest issue of EPA Region IX Residential PRGs (October 1, 2002). These can be found at http://www.epa.gov/region09/waste/sfund/prg/whatsnew.htm

   Response: The QAPP will be updated to use the latest version of the USEPA Region 9 PRGs. The tables impacted are Tables 1-3, 2-1, 2-2, 5-1, 5-2, 5-3, 5-4, 5-6, 5-7, and 5-8.

2. **Comment:** Appendix B, Page 16, second bullet: Request clarification; does this bullet address individual chemicals, or all those exceeding background levels? EPA policy is that PRGs for individual chemicals should be derived based on 1E-06 cancer risk and HI =1, if the cumulative cancer risk of all COCs is higher than the acceptable risk range (1E-04 to 1E-06, HI =1) so that the cumulative risk of multiple chemicals of concern is likely to be within the acceptable risk range if PRGs are achieved.

   Response: The referenced bullet states: "The preliminary cleanup levels for these chemicals will be targeted on achieving an exposure point concentration that will correspond to a cumulative incremental cancer risk of 10-5 or a hazard index (HI) of 1.0. For lead, the cleanup level will be targeted on achieving a mean concentration equal to the residential PRG of 400 mg/kg."

   This bullet addresses ***all chemicals*** selected as COCs for the removal action. Analytes detected at concentrations that do not exceed the facility-wide background levels will not be selected as COCs. The preliminary removal action cleanup goals for the COCs will be calculated such that ***cumulative*** risk for the receptors of concern will not exceed 10^{-5} or a hazard index (HI) of 1.0. Because the goal is not to exceed these cumulative risk benchmarks and because the number of COCs impacts the potential to exceed the ***cumulative*** risk benchmarks, the preliminary removal action cleanup goals for individual COCs will be set at the appropriate level to meet the cumulative risk benchmark. For example, if three non-carcinogenic COCs have the potential to adversely impact the same target organ, a removal action cleanup level for each COC should represent an HI set at 0.3. Similarly, if three carcinogenic COCs are identified as causing a risk exceeding 10^{-5}, then the removal action cleanup level for each COC should represent a cancer risk of 0.3×10^{-5}.

   The explanation of the derivation of the preliminary removal action goals will also needs to be included in Section 2. Accordingly, the three bullets on Appendix B, page 16, will be included after the table and footnotes under the Principal Decision Rule for the EE/CA (on page 2-9), as follows:"

   - ***EE/CA screening levels for selection of soil contaminants to include in the evaluation of removal action alternatives are the USEPA Region IX Residential PRGs (including a factor of 0.1 for noncarcinogenic chemicals).***
   - ***The preliminary cleanup levels for these chemicals will be targeted on achieving an exposure point concentration that will correspond to a cumulative incremental***

cancer risk of 10-5 or a hazard index (HI) of 1.0. For lead, the cleanup level will be targeted on achieving a mean concentration equal to the residential PRG of 400 mg/kg.

- ***The preliminary cleanup levels for all chemicals will be estimated such that the facility background levels are considered and consequently, cleanup can be demonstrated with an acceptable level of statistical confidence.***"

3. **Comment:** Appendix B, Page 19, Sediment Screening Level for Pesticides Bullet: For screening if an OU4 IRG is not available, ER-Ls or similar values from literature are more appropriate than ER-Ms, unless justified otherwise. Please revise to ER-Ls or provide a justification for the use of effects-based ER-Ms.

   In general ER-Ls or other no-effect screening levels are preferable as screening levels because they represent concentrations that are unlikely to have effects as opposed to ER-Ms which are effect-based screening levels that are likely to have effects. If concentrations exceed background and ER-Ls, then it may be appropriate to use effects-based screening levels such as ER-M in the RI or conduct toxicity tests to derive PRGs in a similar process as used to develop the OU4 IRGs.

   Use of ER-Ls would require a change in Tables 1-4 and 2-3 so that screening levels are either OU4 IRGs or ER-Ls or equivalent. This would require adjustment of desired detection limits for sediment analyses and associated QAPP analytical tables.

   Response: The Navy has proposed the use of ER-Ms in the absence of OU4 PRGs, for the following main reasons:

   - The offshore risks have been quantified in the EERA and therefore, we are past the screening level stage for pesticides for the offshore.
   - The PRGs that were developed for the offshore areas of PNS, based on site-specific studies were similar to ER-Ms values rather than ER-Ls.
   - The PRGs developed for the offshore areas of PNS also took into consideration reference station maximum concentrations of almost all of the pesticides in the reference station sediment samples. The ER-L values for pesticides are noted to be almost always less than the corresponding maximum detected reference station sediment values, and therefore very conservative.

   A more detailed discussion of the rationale for the Navy's decision to select ER-M values rather than ER-Ls is presented in Attachment A to these responses to comments.

Responses to USEPA Attachment 2 Comments

1. **Comment: Page 3-4, Planned Assessments.** Change the following sentence "an independent performance audit of field activities may be conducted at the discretion of and under the direction of the QA officer" to "an independent audit or review of field activities to be performed will be conducted under the direction of the QA officer".

A field audit or review is necessary to ensure that the samples are collected according to the Site's QAPP and SOPs. Since the SOPs are not site specific and they depend on the specifics in the QAPP, it's important that the samplers understand the exact procedures to be followed so that samples are collected and analyzed according to the site's specific QAPP. Normally, the audit/review is performed at the beginning of the project so that any problems, inconsistencies or discrepancies can be addressed early so that consistent sampling technique results. Please note that the use of the word "audit" here implies a review by the contractor QA officer and not a comprehensive QA audit by an independent agency such as NAVFAC QA staff or Navy HQ level contractor, etc.

Response: The choice to conduct audits is a programmatic consideration for the Navy. Under the Navy contract with its subcontractors (in this case, TtNUS), audits are conducted randomly across projects because the staff performing the fieldwork are largely drawn from the same pool of people experienced in meeting the protocols.

Unless the particular requirements of an investigation warrant a special audit, the audits are selected on a random basis. It is not viewed that the requirements for this project are so different from typical project requirements to warrant an audit. Of course, if Site 34 were selected for an audit, the resolution of any QAPP-SOP discrepancies would not preclude the audit. Also, USEPA or MEDEP may conduct audits at their discretion.

Also, it is a standard requirement for TtNUS that review of procedures occurs before field activities and it is the FOL's responsibility to conduct the review. Section 3.3 details the FOL's responsibility, which includes ensuring that the procedures in the QAPP are implemented. The FOL will supervise and check on a daily basis that the field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and fieldwork is accurately and neatly documented. The following sentence will be added to the paragraph describing the FOL's responsibilities: "***Before starting fieldwork the FOL will ensure that field SOPs are consistent with the QAPP and that any questions affecting the quality of planned field work are resolved.***"

2. **Comment: Page 4-3, Section 4.3.1 Direct-Push Methods for Surface and Subsurface Soil and Ash Sampling.**

Please add the compositing instructions to this Section for the composite samples that will be collected or add the appropriate reference to the SOP.

VOC samples should not be composited as stated in this Section; they must be collected as grab samples. Also, "Notes 6" in Table 4-3 (Summary of Soil, Ash, and Sediment Sampling) will need to indicate that the samples collected for VOC analysis are collected as a grab.

Response: SOP SA-1.3 will be referenced for instructions on compositing. A note will be added to Table 4-3 to indicate that VOC analysis will be conducted on grab samples.

3. **Comment: Page 4-3, Section 4.3.1 Direct-Push Methods for Surface and Subsurface Soil and Ash Samples.**

The first paragraph on page 4-3 states "composite samples that contain wood chips or limestone with a prussian blue coloration will be analyzed for cyanide". Prussian blue is an iron

complex cyanide (Ferric Ferrocyanide). There is maybe a problem analyzing this compound because the analytical method is based on the sample's cyanide content being convert to hydrogen cyanide. To ensure that prussian blue can be analyzed by the analytical method selected, the EPA recommends that the sample be spiked with prussian blue to determine its percent recovery.

Response: Prussian blue is a very tightly bound iron complex that is not going to dissociate under normal conditions during cyanide analysis. The solubility product constant for Prussian blue (in the 18°C to 25°C range for water) is 10^{-41} (source: Lange's Handbook of Chemistry, 13th ed., 1985), which is considered to indicate a very low tendency to dissociate, and therefore it should not have an effect for any human health evaluation. In other words, if the cyanide is bio-available, it should be readily measured by the laboratory, and consequently the presence of Prussian blue is not of concern for the intended use of the data, i.e., as input for evaluation of human health effects. Therefore spiking the sample with Prussian blue is not necessary.

4. **Comment .** *Not included in EPA letter.*

5. **Comment: Page 4-5, Section 4.3.3 Sediment Sampling.** Please explain how these samples will be collected or reference the appropriate SOP.

   Response: The appropriate SOP ("SA-1.2: Surface Water and Sediment Sampling") will be included and referenced in this section.

6. **Comment: Page 4-7, Section 4.6.1 Groundwater Purging and Page 4-8, Section 4.6.2 Temporary Monitoring Well Sampling.**

   Since a peristaltic pump will be used to collect samples for VOC analysis, the VOC data will need to be qualified as minimum concentration values because of the possible loss of VOCs from the ground water using a vacuum pump.

   Section 4.6.1 states "calibration and standards checks will be conducted on the water quality meter in accordance with the manufacturer's recommendations and SOP 11, as discussed in Section 11.0", yet there isn't a Section 11.0 in the QAPP.

   Response: The sentence in Section 4.6.2 will be clarified to indicate how the groundwater sample will be collected for VOC analysis. (The method is modified slightly when a peristaltic pump is used, as detailed in SOP SA-2.5). The reference to "Section 11.0" will be corrected to "Section 4.14.1.1".

7. **Comment: Table 4-2 Sample Containers, Preservation Methods, and Holding Times.** Please add the sediment information to the following Table columns: sample containers, preservation methods, and holding times. Also note that EnCore samplers are not appropriate for collecting sediment samples for VOC analysis.

   Response: Sediment samples are not intended to be analyzed for VOCs. Table 4-2 will be revised to include the information for the analyses of TCL pesticides in sediment. The following will be added:

Analytical Method	Parameter	Container Material	Container Volume	Preservation	Holding Time
Sediment Samples					
CLP OLM04.2	TCL Pesticides	Clear wide mouth jar	8 oz.	Cool to 4 C	7 days to extraction 40 days to analysis

8. **Comment: Table 4-5 Solid and Aqueous Volatiles, Semivolatiles, Pesticides/PCB Field Sampling QC and Table 4-6 Solid and Aqueous Dioxin Field Sampling QC.** Please add to the "Note" that the "Field Blanks/Rinsate Blanks" for soil borings that the blank needs to include the acetate liner.

   Response: The note will be added to page 4-9 under "Equipment Rinsate Blanks". Also, please note that the title of Table 4-6 will be revised to exclude dioxin analysis for aqueous samples.

   The information on ambient blanks in the second paragraph of Section 4.8 will be removed and the following information pertaining to temperature blanks will be added to the end of this section:

   "Temperature Blank – Temperature blanks are vials of water inserted into each sample cooler prior to shipment from the field. The temperature of the temperature blank is measured prior to shipment and upon receipt at the laboratory to assess whether samples were properly cooled during transit."

9. **Comment: Table 5-12 Laboratory Analytical Method/ SOP Reference Table and Table 5-13 Fixed Laboratory Instrument Maintenance and Calibration.** Please add the cyanide analysis to the tables.

   Response: The following information pertaining to cyanide will be added to Tables 5-12 and 5-13 as requested:

   Table 5-12

Reference Number	Fixed Lab Performing Analysis	Title, Revision, Date, and/or Number	Definitive or Screening Data	Region I NESTS Method Code	Analytical Parameter	Instrument	Modified for project work
L38	Katahdin Analytical Services	Preparation and Analysis of samples for cyanide using MIDI-Distillation followed by Flow injection analysis SW 846 9012A CA-751	Definitive	NA	Cyanide	Lachat Ion Analyzer	N

Table 5-13

Instrument	Activity	List Maintenance, Testing, and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible	Method SOP
Lachat Ion Analyzer	Cyanide	Refer to SOP L38	ICAL-prior to analysis ICV-one per analytical batch CCV-one per 10 samples	ICAL-linear Regression Correlation Coefficient >0.995 ICV 85-115%R CCV 85-115%R	Recalibrate	Analyst/ Supervisor	L38

10. **Comment: Page 6-7, Laboratory Data Verification.** Please add to the "solid samples" list percent solids.

    Response: The list under "solid samples" indicates the units for the analyses that are being performed. Separate samples for calculation of dry weight by the laboratory is not required because the laboratory's standard procedure is to conduct the percent solids analysis using the same sample as for chemical analysis. All results for soil are reported on a dry weight basis. Therefore, percent solids does not need to be added to the list.

11. **Comment: Page 6-11, Section 6.3.1.5, Completeness.** Please define "critical data points".

    Response: In order to define critical points, the last sentence in the first paragraph and the first sentence in the second paragraph of Section 6.3.1.5 will be changed as follows:

    "Whether any particular sample is critical ***(absolutely necessary for the attainment of project objectives)*** to the investigation will be evaluated in terms of the sample location, the parameter in question, the intended data use, and the risk associated with the error."

    "Critical data points may not be ~~evaluated~~ ***identified*** until all the analytical results are evaluated."

RESPONSES TO MEDEP COMMENTS DATED OCTOBER 16, 2002
DRAFT SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1. **Comment:** Executive Summary

   The executive summary seems to come to an abrupt stop, as if it is unfinished (The only subsection is titled "introduction"). One obvious main topic missing is that new monitoring wells will be installed into the shallow overburden. Some enhancement to the ES is needed.

   Response: The word "Introduction" was inadvertently included in the Executive Summary and will be deleted. The summary is intentionally succinct. No additional details are proposed.

2. **Comment:** 1.2.2 EPA Worksheet 2, p. 1-2

   "USEPA-NE QAPP Worksheet No. 2 for the Site 34 investigation and also include the cross walk to the elements of QAPP per the guidance, which is provided on the following pages."

   Some language appears to be missing from this sentence. Please correct.

   Response: The last sentence of Section 1.2.2 will be revised to read "...which is provided on ~~the following pages~~ Pages 1-3 through 1-8."

3. **Comment:** 1.3.2 Site History and Background, p. 1-11, 1st full paragraph

   If available please indicate the year when the Navy built the new pesticide control shop.

   Response: The date the new pesticide shop (Building 314) was built (1985) will be added as requested.

4. 1.4.1 Previous Investigations, p. 1-13

   a. **Comment:** Please identify the previous investigations by name, not just date. That is, under what study were the 1998 samples collected? Likewise, identify the source of the data in Table 1-3.

      Response: The 1998 soil samples and intertidal sediment samples at Site 34 were not collected as part of an investigation. The Navy provided the sampling results in a correspondence to the regulators dated January 6, 1999. The data were collected to support the Navy's relative risk ranking for the site (see Appendix B of the Site Management Plan). The first paragraph of Section 1.4.1 will be clarified and the source of the data (Navy, January 1999) will be added to the table. The first paragraph will also be updated to provide the reference for the data package for the fifth round of interim offshore monitoring. The following provides the proposed revisions.

      "Previous ***sampling at and*** investigation~~s at or~~ in the vicinity of Site 34 ~~consisted~~ ***included*** of soil and sediment sampling. ***In 1998, the Navy collected soil and sediment samples at Site 34 to support their relative risk ranking for the site.*** Two locations were

sampled for ash/soil material and soil respectively ~~at Site 34 in 1998. Two~~ ***and two*** intertidal sediment samples were also collected ~~in 1998~~***(Navy, January 1999)***. Sample collection field logs of these samples are presented in Appendix A. One intertidal location (MS-01 STA.2) and two subtidal locations (MS-01 STA. 1 and STA.3) within Monitoring Station ***1*** (M01) were sampled during the Interim Offshore Monitoring Program (Rounds 1 through 4***5***, 1999 to 2001) as reported in TtNUS, February 2000, October 2000, January 2001, ~~and~~ September 2001***, and February 2002***. A ~~fifth~~ ***sixth*** round of sampling was conducted in August ~~2001~~***2002***."

b. **Comment:** TtNUS Feb. 2000, Oct. 2000, Jan. 2001, and Sept. 2001 are not included in the references. Please add them.

Response: The references for the data packages for the five rounds of interim offshore monitoring (February 2000, October 2000, January 2001, September 2001, and February 2002) will be included. A reference to the Round 6 Data Package will be added after it is submitted.

5. **Comment:** 1.5.2 Potential Contaminant Migration Mechanisms, p. 1-16

As the Navy indicates elsewhere in the document another potential current pathway of contaminant migration is to the offshore via the drain pipe called Outfall 49.

Also, in the header sentence at the top of this page, the word "current" should be removed, as erosion is likely much more a historic mechanism than a current mechanism.

Response: The following bullet will be added:

- "Infiltration of contaminated soil particles from the wash pad area into the drain system leading to Outfall 49. "

Erosion from incident rainfall cannot be discounted as a current pathway of migration because the topography of the site is such that surface water flow rate should probably not be ignored. Therefore, sampling around the ash pile may still provide useful information on erosion from the ash pile.

6. **Comment:** 2.1 Project Planning Meetings, p. 2-1

Please change "Appendix B" to "Appendix D" at the end of the first paragraph.

Response: The DQOs are provided in Appendix B and the response to comments are provided in Appendix D. The first paragraph of Section 2.1 will be revised to read as follows: "The DQOs were revised based on comments from the regulators/RAB and the final DQOs are presented in Appendix B. Responses to regulator/RAB comments on the DQOs are included in Appendix D."

7. **Comment:** 2.2 Problem Definition, p. 2-1

"Therefore, one of the study questions, discussed in the following Section 2.3 addresses the needs for the EE/CA, which is the extent of the ash pile and associated soil contamination."

This sentence does not read clearly. We suggest the following reformatting:

"Therefore, one of the study questions, discussed in the following Section 2.3, addresses the need for an EE/CA, i.e., to delineate the extent of the ash pile and associated soil contamination."

Response: The second paragraph of Section 2.2 will be revised to read as follows:

"***In support of the removal action, an Engineering Evaluation/Cost Analysis (EE/CA) is required to evaluate potential removal action alternatives for the ash source area. Information on the extent of the ash pile and associated soil contamination is required to conduct the EE/CA. Therefore, one of the primary study questions (provided in Section 2.3) relates to this information requirement."***

8. **Comment:** 2.2 Problem Definition, p. 2-2

"The Navy will evaluate methods to evaluate whether the tar pit exists under the building. However, the scope of the current investigation does not include this additional evaluation."

We are confused whether the Navy will actually perform this 'additional evaluation." Please clarify.

Response: The Navy suggests the tar pit evaluation be performed following the investigation outside the building. The Navy would appreciate any suggestions from MEDEP, USEPA, or RAB members on how the tar pit could be evaluated while minimizing impacts to the historic structure. A schedule for investigation of the tar pit will be provided at a later time.

Also, the sentence needs some revision as follows: "The Navy will evaluate methods to ~~evaluate~~ ***investigate*** whether the tar pit exists under the building. However, the scope of the current investigation does not include this additional evaluation."

9. **Comment:** 2.4.1 Target Parameters Selection and Development of Removal Action Levels for EE/CA, p. 2-5 2nd para:

"Dioxins are not expected to be present, ..."

It cannot be assumed the dioxins are not present when Building 62 was gutted by a fire in 1919 (see second bullet on page 1-11).

Response: The Navy has agreed to analyze for dioxins in the ash, to prove or disprove the presence of significant levels of dioxin. However, it is noted that chlorinated compounds (such as PCBs and DDT) were reported in literature to be commercially available after the time period when the building fire occurred. For example, PCBs were in commercial production after 1927 and DDT was not mass produced until the 1940s. Therefore, it is also unlikely that they could have been converted to byproducts such as dioxins because of incomplete combustion or other oxidative reactions.

10. **Comment:** 2.4.1 Target Parameters Selection and Development of Removal Action Levels for EE/CA, p. 2-6, 1st bullet

The Navy lists three criteria that will be used for the selection of contaminants to be addressed in a removal action and in the development of preliminary cleanup levels for evaluation of removal action alternatives.

In addition to USEPA Region IX PRGs and achieving an exposure point concentration corresponding to a cumulative incremental cancer risk of 10E-5 or a hazard index of 1.0 the Navy indicates that, "The preliminary cleanup levels for all chemicals will be estimated such that the facility background levels are considered..."

As USEPA Region I has stated it is not acceptable to drop COCs based on a comparison to background. This implies that the selection of contaminants should not be based on whether or not the contaminant exceeds background.

The MEDEP will closely scrutinize any decisions based on facility background levels.

Response: Comments noted.

11. **Comment:** 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI, p. 2-7

"For SS purposes characterization of the ash will provide an understanding of the composition of the source of contamination to the environmental media."

Please change "...the source of contamination..." to "...the source of ash-related contamination..."

Response: The change will be made as requested.

12. **Comment:** 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI, p. 2-7

"Analyses of soil samples will consist of a full suite, and other analytes (dioxins and cyanide) will be included only if these additional analytes are present in the ash at levels exceeding facility background levels and residential screening levels."

Dioxins and cyanide should not be automatically ruled out if background levels are exceeded but residential screening levels are not. The degree of background exceedance must be analyzed first. A significant exceedance of background levels may require analysis.

Response: The investigation of Site 34 is under CERCLA, which addresses incremental risk from a site/source. If dioxin concentrations are less than risk-based screening levels in the source, the Navy will not analyze for it in media that could be potentially impacted by the source. However, the Navy will conduct cyanide analysis on all soil, groundwater, and sediment samples that are proposed for site screening purposes, if the ash samples are selected for cyanide analysis, i.e., when a prussian blue coloration is noted in the field.

The analysis for dioxins is more expensive and sample holding time until extraction for dioxins is much greater than for cyanide analysis, therefore a phased approach for dioxin analysis is warranted. Accordingly, the Navy proposes dioxin analysis be conducted based on the decision tree provided in Attachment A to these responses to comments. Per the decision tree, dioxin analysis will be deleted from groundwater analysis, so screening levels for dioxins in

groundwater will be removed from Table 2-2. Sediment analysis for dioxin is not proposed under the current investigation, therefore sediment screening levels for dioxin will be deleted from Table 2-3. However, the sediment screening levels for dioxins will be included in Table 2-1 for soil screening levels to support the decision tree to determine whether soil must be analyzed for dioxins.

The decision tree will be included in the QAPP and appropriate references to the decision tree will be included in the text. The following parts of the QAPP are expected to be revised:

- Sections: 2.4.2, 2.6, and 4.3.1
- Tables: 2-1, 2-2, the sampling rationale table in Section 2, 4-3, 4-4, and 4-8
- Appendix B: DQO Steps 2,3,7, and the sampling rationale table
- Executive Summary

Proposed changes to the DQOs and text reflecting the dioxins and cyanide analysis will follow under a separate cover.

13. **Comment:** 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI, p. 2-7, last sentence

"The soil data will also be compared to generic soil screening levels for protection of groundwater..."

Please rephrase this to indicate the soil data will be compared to USEPA's "Generic Soil Screening Levels for Migration to Groundwater" to avoid the uninformative word "generic".

Response: The text will be revised as follows:

"The soil data will also be compared to USEPA's G~~g~~eneric S~~s~~oil S~~s~~creening L~~l~~evels for Migration to ~~protection of~~ G~~g~~roundwater, although the site groundwater is expected to be brackish or saline (due to its proximity to the shoreline) and therefore, unfit for human consumption."

14. **Comment:** 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI, p. 2-8

"For assessing impacts to the sediment due to pesticide operations, the data will be compared to ecological screening levels. These screening levels are OU4 PRGs for chemicals that have been identified in the PRG development process and ER-Ms for other chemicals."

It is inappropriate to use the ER-Ms as a screening level. According to Long et. al. (1995)1 concentrations equal to and above the ER-L but below the ER-M, represent a possible-effect range within which effects would occasionally occur. To be conservative the Navy should use the ER-L as a screening level.

Also, it is not clear if the above statement refers to just pesticides or all the analytes in sediment since Table 2-3 has screening levels for all the analytes. Please clarify.

Response: Please see the Navy's response to USEPA Comment No. 3 dated October 10, 2002 regarding the use of ER-Ms. Table 2-3, (Sediment Screening Level Summary) will be revised to contain only pesticides. Sediment screening levels for dioxins will be included in Table 2-1 (Soil Screening Level Summary) so that the dioxin analysis decision tree (see Navy's response to MEDEP Comment No. 12) can be implemented.

15. **Comment:** 2.5 Principal Decision Rule for the EE/CA, EE/CA Decision Rule Table, p. 2-9

Footnote 1 states, "Site data set for each chemical must be shown to exceed facility background data set for that chemical to be considered for the removal action."

We disagree with this statement as well as the statements within the table that indicate extent of contamination is defined when concentrations do not exceed background. Please our Comments 10 and 12.

Response: Please see the Navy's response to MEDEP's Comment Nos. 10 and 12.

16. **Comment:** 2.5 Principal Decision Rule for SS, p. 2-10

Again, as stated in Comment 15, we cannot accept decisions that rule out contaminants based on not exceeding background alone.

Response: Please see Navy's response to MEDEP's Comment Nos. 10 and 12.

17. **Comment:** 2.5 Principal Decision Rule for SS, p. 2-12, 1st bullet

"Sediment screening levels for pesticides are as follows...ER-Ms or similar values from literature..."

For screening purposes the ER-L should be used. Also, please clarify "similar values". Do other studies similar to Long et. al. (1995) exist?

Response: Please see the Navy's response to USEPA Comment No. 3 dated October 10, 2002 regarding the use of ER-Ms and why ER-Ls are not appropriate for this site. Similar levels are available in literature for chemicals not addressed by Long, et. al., 1995, some of these sources are listed in Attachment A of these responses to comments. Other sources were presented in the Table 3-1 of the "Seep/Sediment Summary Report for Data Collected between December 1996 and November 1997 (TtNUS, August 2000)".

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1 1995. Long, E.R, MacDonald, D.D, Smith, S.L., and Calder, F.D. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in marine and Estuarine Sediments. Env. Management 19:1, pp. 81-97.

18. **Comment:** 2.6 Sampling Design and Rationale, p. 2-12

"The primary sampling objective for the SS is to investigate whether soil and groundwater contamination has occurred because of the sources at the site."

Please change this to "...to investigate whether soil, sediment and/or groundwater contamination has occurred..."

Response: The change will be made as requested.

19. **Comment:** 2.6, Soil Contamination Beneath Ash Pile, p. 2-13, last paragraph

"Sampling intervals to serve this purpose [the SS] can be broader than those required for the volume estimation, and therefore a 4-foot interval is adequate."

It is not clear why sampling intervals for the SS can be broader. Please provide justification for the 4-foot sampling interval.

Response: The sampling interval of 4 feet is being proposed only for subsurface soil to a depth of 10 feet bgs or to the water table depth, whichever is shallower. The data will be compared to residential risk-screening levels, which is a very conservative approach considering that the potential exposure would be to a construction worker. Therefore, any uncertainty in the difference in concentrations between the two 2-foot sections within a 4-foot section, compared to the composite of the 4-foot section should be minor. The Navy proposes to refine the sampling depths only under the ash pile because the additional cost of analysis and data handling would be minor compared to the difference in removal action costs for the two volumes of soil.

The Navy suggests a conference call if the MEDEP would like to further discuss sampling intervals.

20. **Comment:** Soil Contamination Outside Ash Pile, p. 2-14

In the next to last paragraph, the last two sentences do not seem logical to MEDEP. Please explain how vertical profiling data for the ash pile footprint will be used to predict the depth of soil contamination outside the ash pile. Also, describe what the Navy means by a "2-foot resolution in sampling depth" and "a 4-ft sampling interval" (also see following comment).

Response: For estimation of contaminated soil volumes to be addressed in the removal action, the Navy intends to extrapolate the data from the more refined resolution of depth from the soil beneath the ash pile to the data outside the ash pile. Note that this data will be used to supplement the soil data outside the ash pile which will be obtained with a 4-foot resolution in sampling depth. While this approach saves analytical costs, the relative lack of resolution in soil data outside the ash pile should not be of concern for the conceptual design and costing of removal action alternatives in an EE/CA. Also, please see the Navy's response to MEDEP Comment No. 19 above.

21. **Comment:** Soil Contamination Outside Ash Pile, p. 2-15

The Navy indicates a 4-ft soil sampling interval will be adequate for collecting soil samples from the pesticide rinse area. It is not clear if this means that a four foot section of soil will be composited or if a soil sample will be collected every 4 feet. Please clarify this. The MEDEP disagrees with compositing such a long section of soil, even for non-VOCs.

Response: Four-foot sections of soil will be composited. This method has been applied before at various sites, including Site 10 at PNS. When a source has impacted the environmental media, it is obvious irrespective of whether the sampling interval is 2 feet or 4 feet, as evident from the soil data collected at Site 10. Also see Navy's response to MEDEP Comments No. 19 and No. 20.

22. **Comment:** Groundwater Impact Investigation, p. 2-15

According to the first paragraph and Figure 4-1, only one monitoring well (34-TW-02) is proposed for installation downgradient of the ash pile as presently delineated. MEDEP believes that this will be inadequate, and recommends that a second well be installed. We do not see a compelling need to locate 34-TW-03 west of the ash pile in a side gradient orientation. This well should be moved to a downgradient location approximately off the northeast corner of Building 62.

Response: One well will go in the source area and one downgradient. Side gradient and upgradient wells are also included so that there are sufficient wells to determine groundwater flow direction. These wells are sufficient to determine impact to groundwater to support the SSI.

The Navy suggests a conference call if the MEDEP would like to further discuss number of wells and locations.

23. **Comment:** Sediment Impact Investigation, p. 2-16

"Samples should be collected in the offshore under Outfall 49."

Does this location correspond with Monitoring Station 1 of the OU4 Interim Offshore Monitoring Program? If not, are the MS-1 locations located directly downgradient of the outfall?

Response: The sediment sampling locations for the SSI are not the same locations as the interim offshore monitoring locations for MS-1. The SSI locations are within the sediment deposition area represented by the MS-01 samples however, additional samples close to and within the Outfall 49 are proposed to provide data to evaluate the link to the site.

24. **Comment:** Secondary Data to Support EE/CA, p. 2-16

Please add the following to the last sentence of the first paragraph:

"..., and a well shall be located directly downgradient of such a sample."

Response: An additional well is not necessary for secondary data to support the EE/CA. No change necessary.

25. **Comment:** Table 2-3, Sediment Screening Level Summary, p. 2-33

The title of the third column refers to footnotes 2 and 3. This should be changed to refer to footnotes 1 and 2 as there is no footnote 3.

Response: The footnotes will be corrected as requested.

26. **Comment:** Figure 3-1, p. 3-15

Please update this chart to indicate that Mike Barry is the USEPA RPM.

Response: The QAPP will be updated to include Mr. Michael Barry as the current USEPA RPM and Ms. Kelly Carper as the TtNUS Corporate QA Officer. Also, Tom Johnston will be changed to the Project QA Advisor. The impacted tables are Tables 1-1, 1-2, 3-1, 3-3, and 3-4. Figure 3-1 will also be revised to include these changes. The signature page will also be revised to reflect that Ms. Carper is the QA officer.

27. **Comment:** 4.3 Soil and Groundwater Investigation Equipment and Procedures, p. 4-1,

MEDEP believes that it is likely that the direct-push sampling equipment will not be able to penetrate to the desired depths at some of the locations due to rock fragments in soils overlying bedrock, common to PNSY. The Navy should be prepared to resort to heavier boring equipment should a hole not reach its target depth.

Response: Section 4.3.2 already discusses that a small diameter hollow-stem auger technique will be used if DPT is hindered by the subsurface materials.

28. 4.3.1 Direct-Push Methods for Surface and Subsurface Soil and Ash Sampling, p. 4-2

a. **Comment:** Throughout this section it is unclear if soil samples collected for chemical analysis will be discrete samples every 2 (or 4) feet, or if 2 foot (or 4 foot) sections will be composited. Please clarify.

   Response: Except for VOCs, the entire length of each section will be composited. These are not discrete samples at 2-foot or 4-foot depths. The purpose of the samples are to determine the residential or occupational risk for the first 0-2 foot interval, and construction worker risk for the 2 foot to groundwater or 10 foot interval whichever comes first.

b. **Comment:** "Borings will be attempted within 2-3 hours after low tide has occurred as predicted in the tide charts."

   Please explain why this timeframe has been selected. It appears that the depths of the borings would end up shallow because groundwater would be near its high when the boring reached the water table. Perhaps the Navy meant to say "before low tide".

   Response: Based on previous investigations, it is expected that up to 3 hours of lag can occur between the low tide in the river and the low level in the groundwater. Therefore, the text is correct.

29. **Comment:** 4.3.2, p. 4-4

The first sentence of this section is missing some words. Please correct.

Response: The following correction will be made: " Five borings (34-01, 34-03, 34-04, 34-05, and 34-15) will ***be*** converted into temporary groundwater monitoring wells (labeled 34-TW01, 34-TW02, 34-TW03, 34-TW04, and 34-TW05, respectively), ~~will be installed~~ and sampled for groundwater."

30. **Comment:** 4.3.2 Temporary Monitoring Point Installation, p. 4-5

Please justify why the Navy intends to limit well development to one-half hour. The common duration in proposals that we review is up to 2 hours per well if turbidity does not stabilize at a low level sooner.

Also, MEDEP strongly recommends that sampling groundwater be postponed for several days after well development. Twelve hours is very short, even under the most ideal conditions, and especially is augering were to be used – regardless of tidal flushing.

Response: One-inch monitoring wells installed with the direct-push technique cause very little disturbance to the subsurface soils and generally would not require the development time normally allotted for regular 2-inch diameter wells installed with conventional auger rigs. However, the text will be revised to indicate that development time will be based on stabilization of development parameters (temperature, pH, specific conductance, turbidity). Since a pre-manufactured sand pack is recommended as discussed in Section 4.3.2, it is anticipated that the reduced amount of fines (compared to the conventional method of manually pouring sand around the well screen) will result in reduced development time.

Regarding sampling time after development, the general time of 24 hours was reduced to 12 hours because the aquifer should stabilize faster using the minimal impact method (i.e., peristaltic pump) than more aggressive techniques that are typically used in larger diameter wells.

The Navy suggests a conference call if the MEDEP would like to discuss this issue further.

31. **Comment:** 4.6.2, p. 4-8

"The bottle should be filled completely with little or no head space remaining in the bottle."

For VOC samples there should be absolutely no head space. A "little" head space should not be allowed. Please correct this sentence.

Response: Comment noted. The correction will be made as requested.

32. **Comment:** Table 4-3, p. 4-25 footnote 4:

Please add a short description (or reference) as to how the sampling depths will be determined in the field.

Response: The appropriate text on page 4-3 will be referenced in the footnote.

33. **Comment:** Table 5-2, Quantitation Limits for Volatile Parameters for Groundwater, p. 5-10

The minimum screening level given for vinyl chloride is 0.041 μg/L, whereas the achievable laboratory MDL is 2.24 μg/L. Therefore, vinyl chloride could go undetected and yet exceed Region 9 tapwater Preliminary Remediation Goals. If any parent solvent of vinyl chloride is found in Site 34 groundwater the MEDEP and the Navy (and USEPA if they so choose) will need to discuss a more appropriate screening level. Alternatively, a re-sampling may occur using the appropriate lower MDL.

Response: If fresh groundwater is encountered at this site and it is shown to contain any parent solvent of vinyl chloride, the Navy will consider resampling of groundwater using an analytical method with lower detection limits for vinyl chloride.

34. **Comment:** 6.1.6.3 Geographical Information System (GIS), p. 6-4

The last sentence in this subsection states:

"The 2002 PNS vertical datum will be used for elevation."

Please explain what this is, so any differences with former vertical datums used at PNY are known, and any needed adjustments can be made.

Response: PNS had several surveying benchmarks throughout the facility which were not tied together in one survey. In 2002, PNS contracted to establish a consistent coordinate system throughout the facility. As future investigations are performed, the Navy will include resurveying of existing wells into the present basewide coordinate system. No major adjustments are anticipated.

35. **Comment:** 6.3.2 Data Quality Assessment, p. 6-13

"Statistical tests for outliers will be conducted using standard statistical techniques appropriate for this task. Potential outliers will be removed if a review of field and laboratory documents indicates that the results are true outliers. If no identifiable reason for the outlier can be identified, the datum will not be removed from the data set."

MEDEP would like clarity as to what is the implication of removing an apparent outlier from a data set. We suggest that an apparent outlier be flagged as such wherever it appears in data tables and reports, and only removed from statistical analyses if sufficient evidence suggests it should be removed, and/or the analysis be run with and without the data point and the results presented.

Response: Evaluation of data (for the site screening or other purposes) when one or more data points do not belong together (e.g., they don't represent the same physical quantity) can invalidate the results unless the ramifications are understood or can be reasonably estimated. The implication of removing an outlier from a data set is that those values that are judged not to belong to the data set are removed. Thereby, the validity of the calculations and data use are increased. It would be inappropriate and an oversimplification to permanently flag outliers because an outlier in one context may not be an outlier in another context. Therefore, no

change is proposed to the existing text. Additional detail on the outlier identification process and the implications of removing outliers from data sets is provided for your information in Attachment A to these responses to comments.

36. **Comment:** App. B, Conceptual Site Model, p. 8

"Human health exposure to sediments in the offshore at Site 34 is not of concern because the shoreline cannot be easily accessed."

This is a curious statement to make considering the Navy is currently developing surface water and sediment screening levels that are specifically to be used to select COPCs when evaluating human recreational receptor exposure to contaminants in surface water and sediments at the Shipyard.

Please clarify the intent of this statement.

Response: Screening levels for COPCs selection for a site are identified for complete exposure pathways based on the conceptual model for a potential receptor. At Site 34, the shoreline cannot be easily approached from the land side, and only with difficulty from the water side. Therefore, it is highly unlikely for the intertidal area of Site 34 to be suitable for a recreational user, and consequently the pathway of potential exposure is not of concern at this site.

The Navy suggests a site walk for the regulators/RAB to observe site conditions.

RESPONSES TO SAPL COMMENTS DATED OCTOBER 19, 2002
DRAFT SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1. **Comment: General Comment.** SAPL concurs with the majority of the comments presented in the Maine Department of Environmental Protection's (MEDEP's) letter dated October 16, 2002, and the U.S. Environmental Protection Agency's (USEPA's) letter dated October 10, 2002, and will not duplicate the agencies' comments except where SAPL feels additional emphasis is needed.

   Response: Comment noted. Please see the Navy's responses to MEDEP's comments dated October 16, 2002, and USEPA's comments dated October 10, 2002.

2. **Comment: Page ES-1, INTRODUCTION.** The second bullet states that following a removal action of the ash pile and associated contaminated soil, any impacts to the environmental media that may have occurred due to other sources at the site also need[s] to be evaluated for site screening (SS) purposes. The text should be revised to clarify that the impact of the ash pile, as well as other potential sources, will be evaluated for SS purposes. In addition, the second bullet states that the other sources present at Site 34 are the tar pit under Building 62 and the pesticide-rinse wash pad/drainage. While SAPL agrees that these two potential sources must be evaluated for site screening purposes, the information presented in the QAPP does not indicate that the possibility of other potential sources at Site 34 can be ruled out. Of particular concern is the storage and handling of pesticides. For example, where were the pesticides mixed? How and where were pesticide containers stored? Are/were there floor drains in Building 62 that would allow fluids containing pesticides or other contaminants to escape to the environment? The field drawings in Appendix A show at least two 8-inch outfalls that appear to originate in two different upgradient areas, and one of the sample log sheets notes a petro[leum] odor and a sheen on the water (see Comment Number 40, below). The outfalls and the indicators of possible petroleum contamination are not described or addressed elsewhere in the QAPP. Additional information regarding these and other potential sources must be added to the QAPP to ensure that the SS investigation is not too narrowly focused. This comment also applies to Data Quality Objectives (DQOs) the Appendix B (see pages 6 and 7, for example).

   Response: The Navy does not believe that the SS investigation is too narrowly focused – however, it is focused on sources based on available information. Detailed information of how and where the storage and mixing occurred or the presence of floor drains are not available. Please see the Navy's responses to SAPL Comment Nos. 4 and 41 regarding other potential sources.

3. **Comment: Page ES-2, INTRODUCTION.** If dioxins or cyanide are detected in any of the on-shore sample locations, the offshore sediment samples should also be analyzed for those parameters.

   Response: Please see the Navy's response to MEDEP Comment No. 12 dated October 16, 2002 regarding the inclusion of cyanide analysis and the decision-making process for evaluating the inclusion of dioxin analysis in sediment samples.

4. **Comment: Page 1-1, Section 1.1 OBJECTIVES AND SCOPE.** The scope of the investigation must include the potential sources (besides the ash pile), not just the environmental media potentially impacted by the historical operations at the site.

   Response: The purpose of the investigation is to determine if potential past CERCLA releases (releases prior to October, 1986) are causing a potential risk, which needs to be addressed based on the available historical information. Environmental media potentially impacted by other releases are not covered under the Installation Restoration Program.

   Please see the Navy's response to MEDEP comment no. 8 dated October 16, 2002 regarding investigation of the tar pit. The Navy requests information on any other CERCLA sources SAPL believes are being excluded from the investigation.

5. **Comment: Page 1-9, Section 1.3.1 Site Location and Description.** There appears to be a typo in the last full sentence on page 1-9. It should read, "The land on the northern side of the building...".

   Response: The street referenced is to the north of Bldg 62, not Smoot Street. No change is needed.

6. **Comment: Page 1-10, Section 1.3.1 Site Location and Description.** The wash pad is described as having no obvious signs of any release to the adjacent soil. What is the basis for that statement? What are the signs that would indicate a [pesticide] release? Where is that previous investigation/evaluation/screening documented? SAPL requests a copy. In addition, as noted in Comment Number 2 above, the pesticide storage and handling areas at Site 34 are also of concern and should be part of the SS evaluation.

   Response: There have been no previous investigations specifically at Site 34. As indicated in the text, the information on the wash pad is based on a preliminary site visit. The site visit was informally conducted as part of the development of the DQOs/QAPP; a separate site visit report has not been prepared. Obvious signs of release (such as staining or a breach in the concrete) in the area of building 62 were not observed during the site visit.

   The Navy suggests a site visit for the regulators and RAB to observe the site conditions.

7. **Comment: Page 1-11, Section 1.3.2 Site History and Background.** The paragraph following the bullets states that the pesticides stored in the building included Malthion, Bromacil, Biotrol, Carbaryl, and Avitrol. However, this same list of pesticides are described on page 4 in Appendix B as having been used during the 1980s, not as having been stored in Building 62. Please provide information regarding the nature and extent of record-keeping available for pesticide storage, handling, and disposal activities for Building 62 and/or for the 1960s through 1985, the period when these activities reportedly occurred at Site 34. Information regarding DDT and related compounds and Aldrin (all mentioned on page 1-13) should also be provided. The discussion of the outfall/drainage system should also address the presence of floor drains in Building 62, as well as the outfalls noted on the field observations in Appendix A (see Comment Number 41, below).

   Response: The specifics of which pesticides were stored in Building 62 are not available. However, based on the list of pesticides that were used at the shipyard at the time of Building 62's operation as a Pest Control Storage shop, it is the Navy's interpretation that the same type

of pesticides may have been stored/handled/mixed at the building. The information available indicates that only OF-49 is connected to the wash pad and parking lot adjacent to Building 62. There is no indication of other drains that might have been used at the time of the pesticide handling/mixing activity. Also, please see the Navy's response to SAPL Comment No. 41 below.

8. **Comment: Page 1-11, Section 1.3.2 Site History and Background.** Building 60 is briefly mentioned. Information regarding Building 63, which is located east of Building 62 should also be presented. For example, when was it built, what is it/was it used for, etc. Figure 1-3 shows the ash pile extending around the east end of Building 62 and up to the north side of Building 63. Does the ash extend under Building 63?

   Response: The following information will be added to section 1.3.2:

   "Building**s** 60 **and 63 are** located adjacent ~~to the northwest~~ of Building 62 **to the northwest and east, respectively. Building 60** has historically been used for the building of small ships. **Building 63 was constructed in 1874 as a Cart and Wheel Shed and is currently used for Public Works Storage."**

   The Navy is conducting a field investigation at Building 62 to determine the extent of ash contamination. Since Buildings 62 and 63 were built within a year of each other, it is unlikely the ash extends under Building 63.

9. **Comment: Page 1-11, Section 1.3.2 Site History and Background.** SAPL requests a copy of the April 1999 Foster Wheeler Environmental Corporation report mentioned at the bottom of page 1-11.

   Response: The April 1999 Foster Wheeler Environmental Corporation report mentioned at the bottom of page 1-11 is included as Attachment 1, and will be included in Appendix A of the Site 34 Site Investigation Quality Assurance Project Plan.

10. **Comment: Page 1-12, Section 1.3.2 Site History and Background.** The second bullet states that a concrete floor was installed between 1901 and 1912. What kind of floor was there in Building 62 prior to this? What are the contaminants that might have been produced by the blackmithy operation between 1915 and 1930? The fourth bullet mentions pesticide storage and possibly rinsing of pesticide equipment as occurring at Building 62 between the 1960s and 1985. Pesticide handling (such as mixing and disposal) during that period should also be addressed in the bullet.

    Response: No information is available on the type of floor prior to the current concrete floor. The blacksmithing operations would have generated ash from the burning of coal. Information from the IAS related to pesticides handling (triple rinse, reuse of rinse water, good management from late 1960s to present) will be added to the QAPP.

11. **Comment: Page 1-13, Section 1.4.1 Previous Investigations.** SAP requests a copy of the document containing the 1998 sampling information and results.

Response: Please see the Navy's response to MEDEP Comment 4 dated October 16, 2002. The RAB was copied on the Navy's January 1999 correspondence. The correspondence, with enclosure, will be added to Appendix A..

12. **Comment: Page 1-13, Section 1.4.1 Previous Investigations.** The information on the intertidal sample locations is confusing. If they are indeed intertidal samples, how could they not be collected between high and low tide levels? The text and Figure 1-4 require clarification. Also, please explain why the historical shoreline shown on Figure 1-4 differs from either the Mean High Water and Mean Low Water Levels.

    Response: The topography of the site is such that the ground surface drops very rapidly near the shoreline, and then flattens out in the mudflat area. Therefore, the Low-Low Water level can be several feet away (horizontally) from the Mean Low Water Level, and much further away (horizontally) compared to the Mean High Water Level. Also, note that the 1998 sample locations were not surveyed or located using GPS, therefore, their positions have been estimated using field notes. The historical shoreline was provided by PNS Public Works for general reference only and it is not known how it relates to Mean High Water, Mean Low Water Level. The date of the historical shoreline (circa 1880) is also approximate.

13. **Comment: Page 1-13, Section 1.4.1 Previous Investigations.** The discussion of analytical results should note that detection levels exceeded the human health screening levels for several parameters. Furthermore, all results that exceeded Region 9 criteria should be indicated by highlighting in Table 1-3, regardless of the magnitude of exceedance. The text should also note that the samples were not analyzed for dioxins.

    Response: The intent of Section 1.4.1 and Table 1-3 is to summarize the previously collected information and how it compares to screening levels. This data shows that the ash pile has very elevated levels of PAHs, and the adjacent soil has been impacted. Therefore, an order-of-magnitude or greater exceedance of screening levels was used as a threshold for this purpose. Section 1.0 is the introduction that includes previously collected data, whereas Section 2.0 evaluates the information to determine the Data Quality Objectives of the current investigation. Section 2.4.2 of the QAPP identifies the laboratory analysis necessary to support the primary decisions listed in Section 2.3. The Navy has recognized dioxin analysis in Section 2.4.2.

14. **Comment: Page 1-14, Section 1.4.1 Previous Investigations.** The paragraph at the top of page 1-14 ends with the statement that the concentrations of other pesticides marginally exceeded their respective PRGs (Preliminary Remediation Goals). A footnote is needed on Table 1-4 regarding NC. If NC means no criteria, then only 9 of the parameters out of approximately 125 in the table have PRGs. This needs to be clarified in the text. The text must also state that the PRGs were developed before Site 34 was investigated, and therefore, will have to be evaluated for possible revision or additions once the Site 34 investigation data is available.

    Response: A footnote will be added to Table 1-4 to explain "NC" means "No Criteria". The QAPP discusses further on in Section 2.0 the decision rules that will result in the evaluation of the need for PRGs for pesticides. This section is only discussing the historical information, therefore, it is premature to discuss whether revisions or additions to the PRGs will be necessary.

15. **Comment: Page 1-15, Section 1.5.1 Potential Sources of Contamination.** This section should be amended to include discussion of pesticide handling and storage. The first bullet should include Building 63. The second bullet or a new bullet should address pesticide storage and handling.

    Response: Pesticide handling and storage are not necessarily sources of contamination. In all likelihood, (because the information from the IAS related to pesticides handling notes that reuse of rinse water and good management from late 1960s to present was practiced), the handling and storage of pesticides in Building 62 may not be potential sources of contamination. No additional bullets regarding storage and handling will be added.

16. **Comment: Pages 1-15 & 1-16, Section 1.5.2 Potential Contaminant Migration Mechanisms.** The discussion of site drainage must also address floor drains or other drains in the building, as well as the outfalls noted in Comment Number 41, below. Migration from pesticide storage and handling locations must also be addressed, along with the migration of contaminated wash water and soil particles from the wash pad. Because the integrity of the drainage system connected to the wash pad is unknown, migration of contaminated fluids from a leaky drainage system must be added as a potential migration pathway. The final paragraph in the section opens with a sentence about PAHs in offshore sediments. Offshore monitoring data also shows a potential impact from pesticides. The text should be revised to address this omission.

    Response: Please see the Navy's response to SAPL Comment No. 7 above regarding drains and Navy's response to SAPL Comment 41 below, regarding outfalls. Regarding pesticide storage and handling, please see the Navy's response to SAPL Comment No. 15 above. Regarding the potential migration from the wash pad drainage system, see the Navy's response to MEDEP Comment No. 5 dated October 16, 2002. Offshore sediment is currently being monitored under the Interim Offshore Monitoring Program. At this time, pesticide detections in the sediment have not been linked to an on-shore CERCLA release.

17. **Comment: Pages 1-16 & 1-17, Section 1.5.3 Land Uses and Potential Exposure.** The second sentence in the section should be revised to state "The current land use for Building 62 ...". The paragraph at the top of page 1-17 ends with the statement that the industrialized nature of the site minimizes exposure to any onshore ecological receptors. SAPL notes that the ash pile is not paved and has been there for decades, so historical and current exposure exists. The statement regarding exposure should be revised.

    Response: The historical and current industrialized nature of the area, coupled with the relatively small size of any vegetated area, renders the potential onshore habitat of the site unlikely to be of any significant ecological value.

    The Navy suggests a site visit for the regulators and RAB.

18. **Comment: Table 1-3.** Any result that exceed the Region 9 criteria, regardless of magnitude, should be highlighted in the table.

    Response: Please see the Navy's response to SAPL Comment No. 13 above.

19. **Comment: Table 1-4.** Comment Number 14, above, applies to Table 1-4.

Response: Please see the Navy's response to SAPL Comment No. 14 above.

20. **Comment: Figure 1-2.** The label for Site 34 should be moved so that it doesn't cover the site location.

Response: The change will be made as requested.

21. **Comment: Page 2-2, Section 2.2 PROBLEM DEFINITION.** As noted in Comment Number 2, above, the SS must evaluate potential pesticide handling and storage impacts. Additional action will likely be required if screening criteria are exceeded, regardless of background concentrations - please revise. The general process for evaluating the tar pit (how, when, etc.) must be added (this comment also applies to page 2 in Appendix B).

Response: Please see the Navy's response to SAPL Comment No. 2 and Comment No. 15 above. It is Navy's policy to account for facility background levels in any site screening. No revision needed. Please see Navy's response to MEDEP Comment No. 8, dated October 16, 2002 regarding the evaluation of the tar pit.

22. **Comment: Page 2-2, Section 2.2 Problem Statement.** The statement in the second bullet must be revised to be consistent with the problem statement on page 8 in Appendix B. It should read "Data on soil and groundwater at the site and data on sediment offshore are also needed to determine the potential that site sources may have impacted environmental media for the site screening (SS) evaluation."

Response: The change will be made as requested.

23. **Comment: Page 2-3, Section 2.3 DECISION STATEMENTS.** Based on the Decision Statement on page 2-4, should there be a secondary question for the SS regarding is there sufficient information to support No Further Action or to proceed with an RI/FS or an interim action/removal action?

Response: The site screening investigation is designed using the decision rules that lead to one of the following decisions: No Further Action; Proceed with an RI/FS; or Perform an interim action/removal action. Therefore, no secondary questions for these decisions are necessary. The Site Screening report will make appropriate recommendations for one of the above courses of action. Any subsequent work plan for an RI/FS or interim action/removal action will address the collection of any additional information, if needed.

24. **Comment: Page 2-3, Section 2.3 Potential Actions for SS Principal Question.** The first sentence in the first bullet should be revised to read "Determine whether an impact of one or more contaminant sources has occurred on the soil, groundwater, or sediment."

Response: The revision will be made as follows: "Determine whether an impact from one or more contaminant sources has occurred on the soil, groundwater, ~~and~~ ***or*** sediment."

25. **Comment: Page 2-4, Section 2.3 Principal Decision for SS.** The bullet should contain a statement regarding the additional assumption that the proposed SS sampling locations and methods are sufficient to support a No Further Action decision. This comment also applies to page 10 in Appendix B.

Response: The data to be collected will be adequate to support either the No Further Action or an RI/FS decision. No change proposed.

26. **Comment: Page 2-7, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** The analysis of groundwater (third bullet) must include dioxins or cyanide if detected in soil or sediment. The fourth bullet mentions pesticides/insecticides/herbicides reported by PNS to have been mixed/stored in Building 62. As noted in several comments above, the information regarding storage and handling must be added to the QAPP and considered in the SS design. For example, where did mixing occur? In addition, the fourth bullet states that the toxicity and persistence of the TCL Pesticides and PCBs is greater than the compounds reportedly mixed and stored in Building 62. Please provide a comparison of the TCL analytes and the compounds reported by the Shipyard as having been stored in Building 62.

Response: Groundwater will not be analyzed for dioxins. Evidence of surface erosion and subsurface migration (i.e., into subsurface soil) will first be evaluated following the decision tree presented in the Navy's response to MEDEP Comment No. 12 dated October 16, 2002. Regarding mixing/storage of pesticides, see Navy's response to Comment 2 above. A comparison of toxicity and persistence of TCL Pesticides and PCBs to the compounds stored in Building 62 (the table provided in Attachment A to these responses to comments) will be provided in the DQOs.

27. **Comment: Page 2-7, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** Please explain the statement in the second paragraph under the bullets that following the removal action, some or all of the samples from beneath the ash pile and adjacent to the ash pile may be replaced by confirmatory samples. Does this mean that sampling under and adjacent to the ash pile won't occur until after the removal of the ash is complete?

Response: Confirmatory sampling will be performed following any completed removal action. These data may replace or supplement some of the data to be collected in the current investigation from beneath the ash pile and adjacent to it.

28. **Comment: Page 2-7, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** The second paragraph under the bullets concludes with the statement that dioxins and cyanide will only be included in the soil analytes if detected in the ash at levels exceeding background levels and residential screening criteria. This is not acceptable. If either or both of these compounds are detected in the ash, regardless of concentration, potentially affected media (soil, groundwater, and sediment) must also be analyzed to confirm contaminants have not migrated and there have been no adverse impacts. This comment applies to all other similar passages in the QAPP (see pages 2-13, 2-15, 2-19, and pages 7, 10, and 11 in Appendix B, for example).

Response: Cyanide analysis will be included for ash and other media depending on field observations, and dioxin analysis will follow the decision tree, both of which are discussed in Navy's response to MEDEP Comment No. 12 dated October 16, 2002.

29. **Comment: Page 2-8, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** Please provide the basis and rationale for using a dilution factor of 100.

    Response: A dilution factor of 100 is expected to be conservative for this site. Larger sites (such as OU3) were estimated to have a dilution factor of 230 for groundwater mixing in the Back Channel (see Appendix A.4 of the OU3 FS, TTNUS, November 2000).

30. **Comment: Page 2-8, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** The two surveying tasks listed as field parameters should not be classified as such. Please revise.

    Response: The word "parameters" will be changed to "information".

31. **Comment: Page 2-8, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** Basic geologic information on the overburden and shallow bedrock must be collected in order to understand the site's hydrogeologic setting. Otherwise, how can sample locations and results be deemed sufficient to support a No Further Action decision? This comment also applies to pages 10 and 11 in Appendix B, where DQO Step 3, Specify Inputs to the Decision(s), is described.

    Response: Geological information to be collected from the overburden will be adequate for making either a No Further Action or RI/FS decision, if indeed contaminant concentrations meet the appropriate decision rules. Information on bedrock is not necessary unless the results from the overburden indicate the possibility that contaminant migration has occurred to depths close to bedrock.

32. **Comment: Page 2-9, EE/CA DECISION RULE TABLE.** The criteria for considering soil for removal should be screening criteria rather than background level (also applies to page 15 in Appendix B).

    Response: No. The removal action will be based on preliminary cleanup goals that will be estimated following the risk-based goals that are presented on page 16 of Appendix B. Also please see the Navy's response to USEPA Comment No. 2 dated October 10, 2002.

33. **Comment: Pages 2-10 & 2-11, Principal Decision Rule for SS.** As noted in earlier comments, the criteria for considering the need for further action should be screening criteria rather than background levels. That said, it also appears that the Navy is not being consistent in the application of facility background data. For soil and groundwater conditions listed on page 2-10, if the chemical concentration exceeds background, but not residential screening level, the media will be considered not impacted by the chemical. The media will also be considered not impacted if the chemical concentration does NOT exceed background. If only the exceedance of residential screening criteria matters in determining if there's been an impact, why is the Navy bothering to consider background data at all? With regard to the

sediment conditions and actions on page 2-11, if a pesticide concentration in offshore sediment exceeds an ecological screening criteria, it is not acceptable to simply propose no further action and automatically kick it into the OU4 monitoring program. There should be an evaluation of potential actions (one of which should be monitor as part of the interim offshore monitoring program) within the context of the EE/CA, SS, and OU4 monitoring results. Furthermore, requiring that any pesticide concentration must exceed ecological criteria in both the offshore sediment and in the sediment collected in the onshore drainage system as the only way to designate that the sediment may have been contaminated by Site 34 is also not acceptable. There are other pathways by which pesticides could migrate from Site 34 to the offshore. The table must be revised. This comment also applies to pages 14, 17, and 18 in Appendix B.

Response: Exceedance of both risk-based screening criteria AND facility background is necessary to select a COPC. Potential actions based on sediment concentrations will depend on the data indicating that Site 34 is a CERCLA source to these concentrations. The Navy is collecting soil, groundwater, and sediment (in the drain and in the vicinity of Outfall 49) samples to determine if there is any correlation between Building 62 and the offshore sediments. The Navy requests SAPL to provide other potential pathways by which pesticides could migrate from Site 34 to the offshore.

34. **Comment: Page 2-12, Section 2.6 SAMPLING DESIGN AND RATIONALE.** The Navy has not yet proposed how to investigate one of the potential sources within Building 62, yet is proceeding with the rest of the study design. It is likely that a number of issues will have to be raised or revisited once evaluation of the tar pit is proposed.

    Response: Please see Navy's response to SAPL Comment No. 4 regarding other potential sources.

35. **Comment: Page 2-12, Section 2.6 SAMPLING DESIGN AND RATIONALE.** The primary objective of the SS is identified as investigating whether soil and groundwater contamination has occurred because of sources at the site. The next sentence identifies only ash as a source. This passage must be revised to state that soil, groundwater or sediment contamination is to be investigated. Furthermore, the potential sources include the ash pile, the tar pit, and pesticide storage and handling areas.

    Response: The sentence will be revised to include sediment. Regarding potential sources, please see Navy's response to SAPL Comment 4 above.

36. **Comment: Page 2-13, Section 2.6 Ash Pile Characterization.** Foundry operation is mentioned in the first paragraph. How does this differ from blacksmithy operations described earlier? What are the resulting wastes and potential contaminants?

    Response: "Foundry operations" will be corrected to "blacksmithing operations".

37. **Comment: Page 2-13, Section 2.6 Soil Contamination Beneath Ash Pile.** The Navy proposes collecting soil samples to a depth of 10 feet below the ground surface or until groundwater is encountered, whichever is shallower. What is the rationale for not collecting soil samples from a greater depth? Furthermore, soils should be logged continuously to characterize the overburden for both the EE/CA and the SS. This comment applies to similar passages in the QAPP (see page 4-2, for example).

Response: The rationale for not collecting soil samples from a depth greater the 10-foot depth is because 10-feet is the exposure depth expected for a construction worker. Please note that for the soil samples to be collected from beneath the ash pile, the surface soil will begin after the deepest presence of ash is noted. See the discussion in Section 4.3.1 detailing the collection of samples beneath the ash pile. Continuous soil logging is included in the investigation.

38. **Comment: Page 3-13, Table 3-5.** If the Final QAPP is issued at the end of March, the May-August timeframe does not seem long enough to generate the EE/CA and the Removal Action Work Plan, perform the removal action and confirmatory sampling, and then do the SS tasks. Please clarify.

    Response: The Site Screening Report will be prepared after the confirmatory sampling from the removal action is obtained. Only a data package will be prepared following the Site Investigation being planned in this QAPP.

39. **Comment: Page 4-4, Section 4.3.2 Temporary Monitoring Point Installation.** If the soil borings are proposed to go to 10 feet below the ground surface or the water table, whichever is shallower, installing a monitoring point with a 10-foot screen would mean that the screen would extend above the ground surface. Please clarify and revise as necessary.

    Response: Please see the first paragraph of Section 4.3.3. To install a temporary monitoring point, the boring will continue below the water table. No revision is necessary.

40. **Comment: Pages 5-7 - 5-17, Tables 5-1 - 5-7.** Please provide commentary in the text regarding why the minimum screening levels are less than the achievable laboratory MDLs for a number of parameters in the tables, and how this will affect interpretation of data with regard to frequency of detections and number of exceedances. This comment also applies to the IDLs in Table 5-8.

    Response: The MDLs and IDLs are the minimum levels that the laboratory can achieve with the available technology and the chosen analytical methods. An assessment of the detection limits with regard to screening levels will be included in the Site Screening report.

41. **Comment: Appendix A.** The observations recorded on the log sheet for sample BC-6202-SD-0897 include a petro[leum] odor and sheen [on] water. How will these signs of potential contamination be addressed in the SS? Also noted on some diagrams are at least two 8-inch outfalls that appear to originate in two different upgradient areas. How will these be investigated in the SS?

    Response: Please see the Navy's response to SAPL Comment No. 4 regarding the purpose of the investigation. Petroleum contamination is excluded from CERCLA except under specific conditions. Please note there are numerous current sources in the industrialized vicinity of PNS, including ships, barges, etc., that ply the river for commerce which may cause the presence of a petroleum sheen. Nevertheless, the interim offshore monitoring program already includes the analysis for PAHs from sediment samples collected from MS-01. The PAH data will address potential chemicals that may be connected to petroleum contamination, irrespective of the source. No other sampling is necessary for this site screening investigation.

Only the OF-49, which discharges storm water from the site needs to be investigated. The other two outfalls are not connected to the site and will not be investigated.

42. **Comment: Appendix B.** A number of the comments above also apply to similar passages in the Data Quality Objectives (DQOs) in Appendix B and will not be repeated. An example is the Navy's proposed application of facility background data. SAPL feels that if a parameter exceeds screening criteria, regardless of background data it should be evaluated for further action

    Response: Comment noted.

43. **Comment: Appendix D, Page 12, SAPL Comment 3.** The Navy's response states that samples to support the site screening will be analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) metals. The response should also state that samples will be analyzed for dioxins and cyanide.

    Response: Please see the Navy's response to SAPL Comment No. 28 above regarding analysis for dioxins and cyanide.

44. **Comment: Appendix D, Page 13, SAPL Comment 7.** The Navy's response states that soil samples will not be analyzed for dioxins and cyanide unless the compounds are present in the ash at levels exceeding background and residential screening levels. As stated in Comment Number 28, above, if either or both of these compounds are detected in the ash, regardless of concentration, potentially affected media (soil, groundwater, and sediment) must also be analyzed to confirm contaminants have not migrated and there have been no adverse impacts.

    Response: Please see the Navy's response to SAPL Comment No. 28 above.

ATTACHMENT A

-RATIONALE FOR USE OF ER-Ms IN THE ABSENCE OF OU4 PRGs

-DECISION TREE FOR DIOXINS ANALYSIS IN SOIL AND SEDIMENT

- EXPLANATION OF OUTLIER IDENTIFICATION PROCESS AND THE IMPLICATIONS OF REMOVING OUTLIERS FROM DATA SETS
- -COMPARISON OF TOXICITY AND PERSISTENCE OF TCL PESTICIDES TO CHEMICALS STORED/MIXED/HANDLED IN BUILDING 62

RATIONALE FOR THE USE OF ER-M VALUES IN THE ABSENCE OF OU4 PRGs

As part of the interim offshore monitoring program for OU4 at PNS, preliminary remediation goals (PRGs) for protecting ecological receptors were established for nine chemicals (TtNUS, November 2001). The PRGs were developed using site-specific bulk sediment and sediment pore water toxicity tests along with chemical data from the sediment and pore water. One of the steps in the PRG process included identifying a list of Limiting Chemicals of Concern (L-COCs) for the site. The chemicals determined to be the L-COCs are the risk drivers at the site so that when implemented as PRGs, they will focus remedial action in those areas where aquatic risk is higher than acceptable levels. Pesticides, PAHs, PCBs, and metals were included in the PRG process, but only the nine chemicals listed in the table below were identified as L-COCs. Therefore, the PRGs were only developed for the chemicals identified as L-COCs. The following table lists the chemicals, the recommended PRG, and the Effects Range-Low (ER-L) and Effects Range-Median (ER-M) values from Long et al. (1995).

Chemical	Preliminary Remediation Goal (mg/kg)(1)	Effects Range-Low (mg/kg)(2)	Effects Range-Median (mg/kg)(2)
Copper	486	34	270
Nickel	161	20.9	51.6
Acenaphthylene	210	44	640
Anthracene	1236	85.3	1100
Fluorene	500	19	540
High Molecular Weight Polyaromatic Hydrocarbons	13057	1700	9600
Endosulfan II	3.95	14(3)	
Trans-Nonachlor	3.99	0.5(4,5)	6(4,5)
p,p'-DDT	66.4	1(4)	7(4)

1 – Source of data is TtNUS, 2001
2 – Values are from Long at al., (1995) except where noted
3 – Value is sediment quality benchmark from USEPA (1996)
4 – Values are from Long and Morgan (1991). DDT value is for sum of p,p'-DDT and o,p'-DDT
5 – Value is for chlordane; trans-nonachlor is a primary component of chlordane

The ER-Ls are conservative values and are indicative of chemical concentrations where effects are unlikely to occur. The ER-Ms are less conservative values and are more indicative of chemical concentrations where adverse effects to aquatic organisms are more likely to occur. The ER-Ls and ER-Ms are literature values; they are not based on site-specific studies at PNS. The PRGs, on the other hand, are based on site-specific studies, so they are better indicators of potential effects levels than either the ER-L or ER-M values. Based on the above table, it is shown that most of the ecological PRGs that were developed for the offshore area at PNS are more similar to ER-M values than the ER-L values. Therefore, it is expected that effects levels for chemicals that do not have PRGs also would be similar in concentration to the ER-M versus the ER-L. Also, the offshore area of Site 34 is past the screening stage, where it would be more appropriate to use the very conservative ER-L values. Finally, as shown by the table below, the maximum concentrations of almost all of the pesticides in the reference sediment samples were greater than the ER-Ls

indicating that the ER-Ls are within background concentrations, and therefore, very conservative. For all of these reasons, the ER-Ms are more appropriate for comparison to site sediment concentrations.

Chemical Concentrations in Reference Sediment Samples Compared to Screening Levels

Parameters	Frequency of Detection	Maximum Concentration (µg/kg)	Mean Concentration (µg/kg)	Effects Range-Low (µg/kg)	Effects Range-Median (µg/kg)
1,2,3,4-Tetrachlorobenzene	30/64	1	0.14	Not Available	
2,4'-DDD	55/64	8.2	1.66	2[1]	20[1]
2,4'-DDE	40/64	0.80	0.14	2.2[1]	27[1]
2,4'-DDT	30/64	0.98	0.08	1[1]	7[1]
4,4'-DDD	61/64	4.2	0.84	2[1]	20[1]
4,4'-DDE	63/64	9.7	0.73	2.2[1]	27[1]
4,4'-DDT	49/64	12	0.64	1[1]	7[1]
TOTAL DDT	64/64	22.2	4.08	1.58[2]	46.1[2]
Aldrin	29/64	5.3	0.53	9.5[4]	
Alpha-BHC	50/64	0.29	0.08	0.32[3]	0.99[3]
Alpha-Chlordane	57/64	1.5	0.23	0.5[1]	6[1]
Beta-BHC	16/64	0.40	0.13	0.32[3]	0.99[3]
Chlorpyrifos	25/64	3.6	0.30	Not Available	
Cis-Nonachlor	56/64	3.2	0.24	0.5[1]	6[1]
Delta-BHC	32/64	0.36	0.06	0.32[3]	0.99[3]
Dieldrin	20/64	0.68	0.08	0.02[1]	8[1]
Endosulfan II	53/64	4.8	0.75	14[5,6]	
Endrin	4/64	0.45	0.07	0.02[1]	45[1]
Gamma-BHC (Lindane)	21/64	1.2	0.19	0.32[3]	0.99[3]
Gamma-Chlordane	40/64	0.43	0.08	0.5[1]	6[1]
Heptachlor	37/64	0.57	0.12	0.3[4]	
Heptachlor Epoxide	14/64	0.22	0.04	0.3[4]	
Hexachlorobenzene	22/64	71	1.40	6[4]	
Mirex	18/64	0.63	0.08	800[4,5]	
Oxychlordane	24/64	0.99	0.09	0.5[1]	6[1]
Pentachloroanisole	30/64	0.91	0.09	Not Available	
Pentachlorobenzene	29/64	1	0.13	0.69[5,6]	
Trans-Nonachlor	42/64	1	0.15	0.5[1]	6[1]

1 – Values are from Long and Morgan (1991).

- DDD value is for sum of p,p'-DDD and o,p'-DDD
- DDE value is for sum of p,p'-DDE and o,p'-DDE
- DDT value is for sum of p,p'-DDT and o,p'-DDT
- Values for oxychlordane, cis-nonachlor and trans-nonachlor are based on chlordane

2 – Values are from Long et al, 1995.

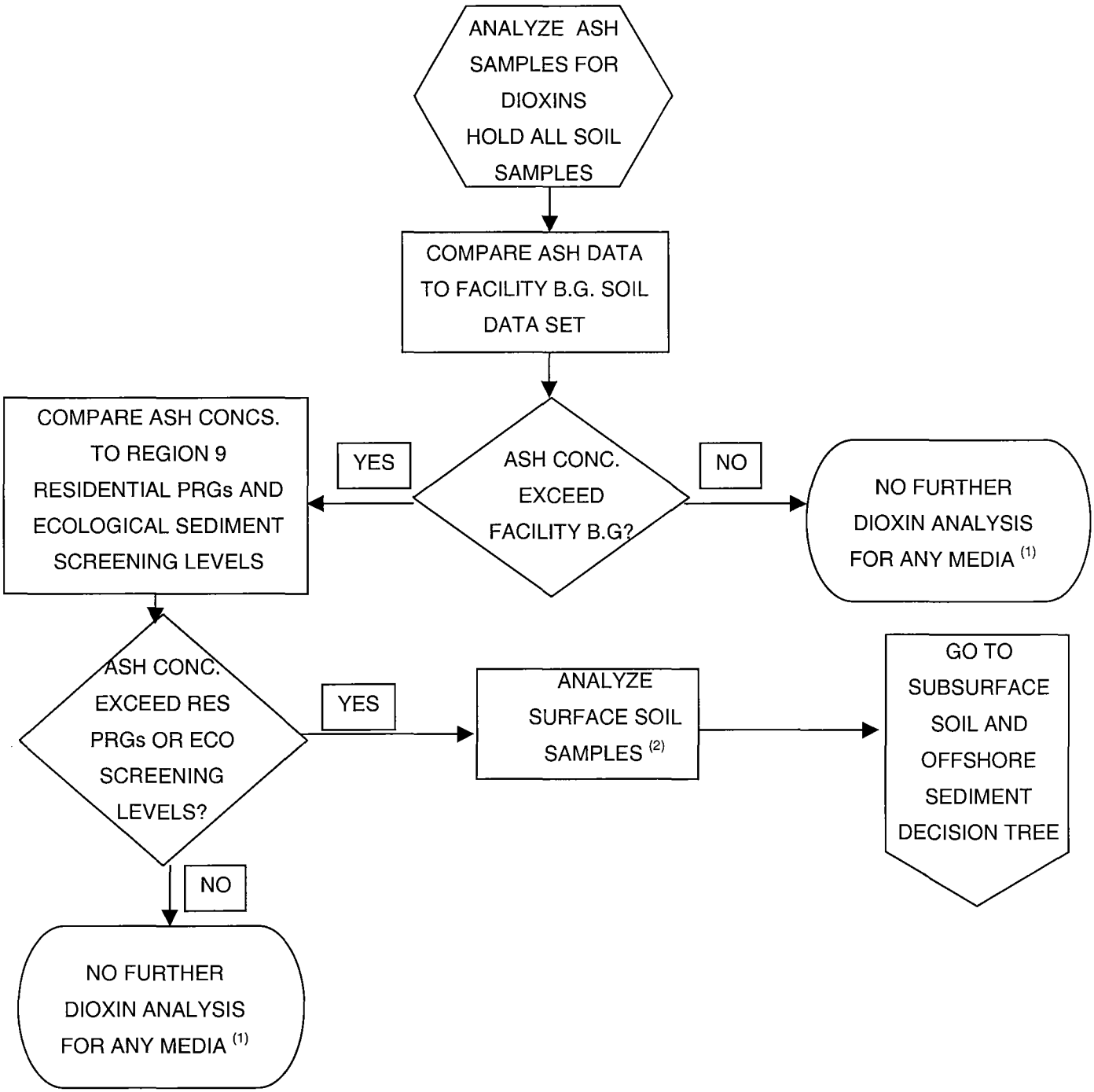
3 – Values are from McDonald, 1994; values are based on gamma-BHC

4 – Value is from Buchman (1999) (NOAA SQUIRT Table); only one marine value was available for each chemical. Values are Apparent Effects Threshold levels for all chemicals, except mirex, for which the value is the Upper Effects Threshold.
5 – Freshwater sediment value
6 – Values from USEPA, 1996 (Ecotox Thresholds)

DECISION TREE FOR ANALYSIS OF DIOXIN IN SOIL AND SEDIMENT SAMPLES AT SITE 34 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

The decision tree consists of a step-by-step evaluation of potential findings of dioxin levels in the ash to make decisions to analyze other media that could be impacted by the ash. The conceptual pathway of dioxin migration from the ash pile (if indeed the ash contains dioxins), is via erosion to the surface soil, followed by further erosion to the offshore sediment or vertical migration to subsurface soil. For example, unless the ash contains dioxins above human health risk-screening levels and facility soil background levels, it is unlikely for surface soil or subsurface soil to be impacted above the same levels, and therefore it is unnecessary to analyze the soil samples for dioxins. Similarly, unless the surface soil is impacted above ecological screening levels and facility soil background levels, it is should not be expected to have potentially impacted offshore sediment above the ecological screening levels. The screening levels that will be used for determining whether or not to analyze for dioxin, are the following: (1) USEPA Region 9 Residential PRGs for human health risk-screening and, (2) USEPA ecological screening levels obtained from literature (USEPA, 1993 "Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife") that were used in the Baseline Interim Offshore Monitoring Report for Operable Unit 4 (TtNUS, May 2002), and (3) PNS Facility Background concentrations to be collected as part of the Site 32 Remedial Investigation. While these screening levels will be used as conservative indicators in the dioxin analysis decisions, it must be noted that they do not necessarily apply to the human health risk screening and the ecological risk screening for all media. For example, although the ecological screening levels are used for the dioxin analysis decision making for ash, the dioxin data to be obtained from the ash will not be used to make site screening decisions for the offshore sediment. The dioxin data for the sediment (if obtained), will be used to make such decisions for the offshore sediment.

DECISION TREE FOR ANALYSIS OF DIOXIN IN SURFACE SOIL SAMPLES AT SITE 34
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

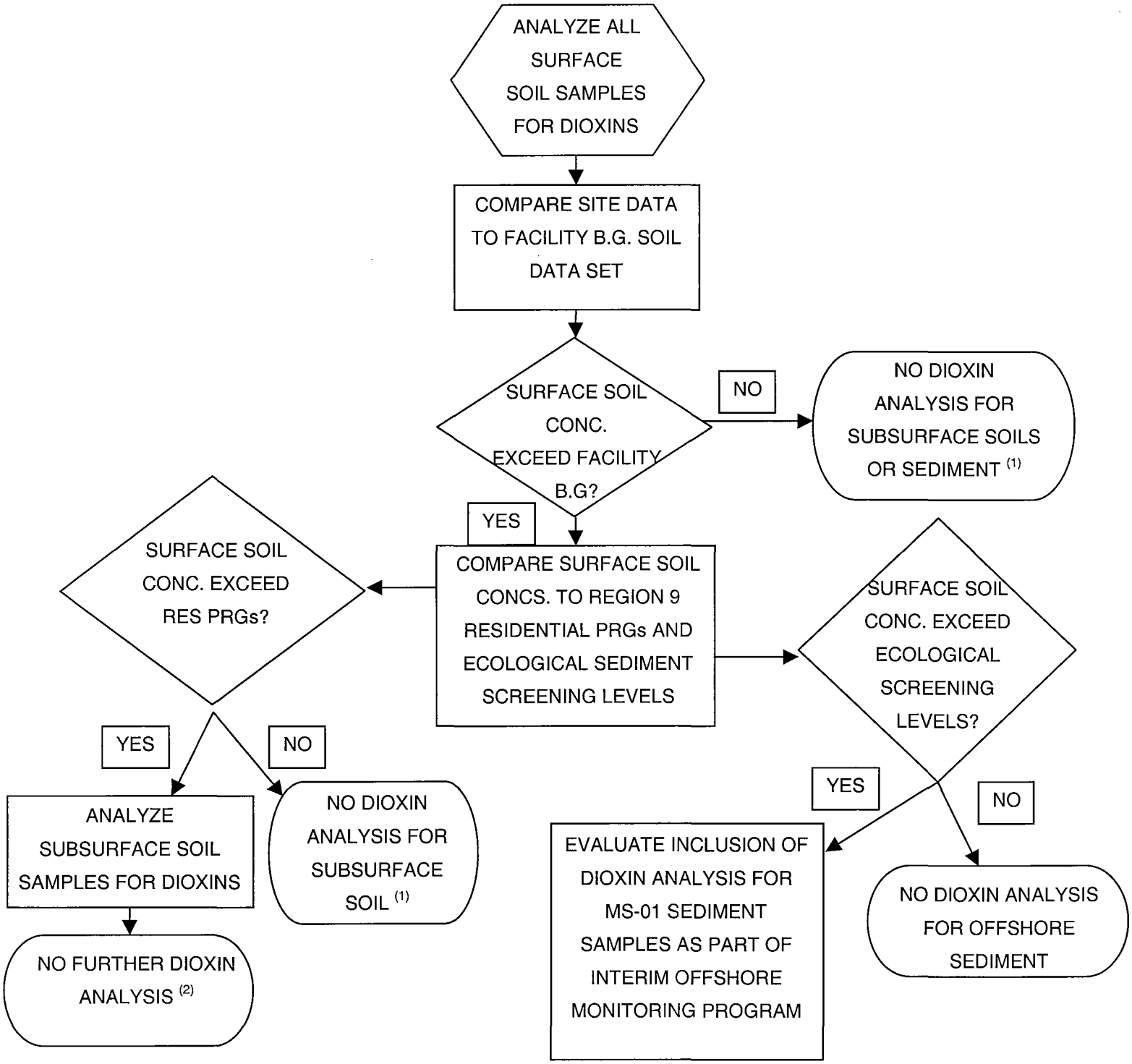


Footnotes:

(1) Analysis of dioxins in surface soils, subsurface soils and sediment will not be conducted. However, the site screening evaluation will continue using the remaining data following the decision rules discussed in the DQOs, and summarized in Section 2.0.

(2) Surface soil samples will be collected from the 0-2 ft bgs depth at locations outside the ash pile. Under the ash pile, the surface soil sample begins beneath the bottom of the ash pile as discussed in the QAPP.

DECISION TREE FOR ANALYSIS OF DIOXIN IN SUBSURFACE SOIL AND OFFSHORE SEDIMENT AT SITE 34, PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE



Footnotes:

(1) The site screening evaluation will continue using the remaining data and surface soil dioxin data following the decision rules discussed in the DQOs, and summarized in Section 2.0.

(2) The site screening evaluation will continue using the remaining data and the dioxin data for surface soil and subsurface soil, following the decision rules discussed in the DQOs, and summarized in Section 2.0.

EXPLANATION OF OUTLIER IDENTIFICATION PROCESS AND THE IMPLICATIONS OF REMOVING OUTLIERS FROM DATA SETS

Classification of a data value as an outlier is not an absolute in the sense that once a value is declared to be an outlier it is always an outlier. Rather, an outlier in one context may not be an outlier in another context, even though the value is unchanged. Hence, there is no reason to permanently label a numerical value as an outlier. However, outliers are identified as such during outlier testing and are understood to be outliers in the context in which they were tested.

In outlier testing, the value to be tested is compared to the rest of the data set to which it is believed to belong. There are several ways to do this comparison and more than one way is often used in an effort to elucidate with confidence whether the value is a true outlier. The underlying premise is that any value that is "much different" from the rest of the data may not represent the same physical quantity that is represented by the other data. Such a value is an outlier.

There are two kinds of outliers – "statistical outliers" and "outliers." The identification of statistical outliers hinges on the definition of "much different." The statistical outlier identification process first requires comparisons of a suspect data point to the rest of the data set. Often a suspect data point will be a value that does not seem to "belong" to the data set because it is very different from the rest of the data. If the observed difference between the suspect data point and the data set is improbable, the suspect data point is declared to be a statistical outlier. The level of probability (the statistical significance) is decided prior to running the outlier test and is usually selected to be 5 percent significance. Many people prefer to think in terms of the level of confidence, in which case the corresponding value is 95 percent confidence (95% = 100% - 5%). When a value is identified as a statistical outlier, the data point is evaluated further in an attempt to identify a physical cause for its being classified as a statistical oultier. This may include a review of any part of the process used to collect a sample and analyze it.

If a physical cause is found for the *statistical outlier*, the value is declared to be an *outlier*. If a simple error such as an incorrect transcription of the value from one document to another is the cause, an attempt may be made to correct the value. Whether a value can be corrected depends on whether the correct value can be ascertained from the available data. If the datum is found to truly represent a physical quantity that is different from the rest of the data set, it is removed from the data set because data summaries including this value (e.g., calculation of mean values) could be corrupted by the outlier. If no physical cause can be found for the datum being a statistical outlier, the value is retained in the data set. Its classification is then changed from " statistical outlier" to "normal data point." Such values may change the understanding of the physical quantity being investigated because they represent values that were not originally thought likely to be encountered.

COMPARISON OF TOXICITY AND ENVIRONMENTAL PERSISTENCE FOR TCL PESTICIDES AND CHEMICALS STORED/MIXED/HANDLED AT BUILDING 62

Compound	Footnote Reference	USEPA Region 9 Residential PRGs (1) (mg/kg)	Environmental Persistence in Soil - High (2)	Environmental Persistence in Soil - Low (2)
Aldrin	C	0.029	1.6 yrs	3 wks
alpha-BHC	C	0.09	135 days	13.8 days
alpha-Chlordane	C	4.6	3.8 yrs	283 days
beta-BHC	C	0.32	124 days	13.8 days
4,4'-DDE	C	1.7	15.6 yrs	2 yrs
4,4'-DDD	C	2.4	15.6 yrs	2 yrs
4,4'-DDT	C	1.7	15.6 yrs	2 yrs
delta-BHC	NA	NA	100 days	13.8 days
Dieldrin	C	0.03	3 yrs	175 days
Endosulfan I	N	370	9.1 days	4.5 hrs
Endosulfan II	N	370	9.1 days	4.5 hrs
Endosulfan sulfate	N	370	9.1 days	4.5 hrs
Endrin	N	18	NA	NA
Endrin aldehyde	N	18	NA	NA
Endrin ketone	N	18	NA	NA
gamma-BHC (Lindane)	C	0.44	NA	NA
gamma-Chlordane	C	1.6	3.8 yrs	283 days
Heptachlor	C	0.11	5.4 days	23.1 hrs
Heptachlor epoxide	C	0.053	552 days	33 days
Methoxychlor	N	310	1 yr	6 mths
Toxaphene	C	0.44	NA	NA
Chlorpyrifos (o-p)	N	180	1 yr	2 wks
Diazinon (o-p)	N	55	14 wks	3 wks
Malathion (o-p)	N	1200	7 days	3 days
Avitrol	N	1.2	2.5 yrs	3 mths
Baygon	N	240	3 mths	1 wk
Bromacil	NA	NA	8 mths	60 days
Carbaryl	N	6100	30 days	3.2 hrs

Notes:
C - Carcinogenic value.
N - Noncarcinogenic value.

1 - USEPA Region 9 Residential Preliminary Remediation Goals. (October 2002). Human health toxicity is assumed to be inversely proportional to PRG value for a preliminary comparison between compounds.
2 - Environmental persistence in soil values are the higher and lower end of biodegradation half lives available from various studies (source: Handbook of Environmental Degradation Rates, Howard, 1999). Half life indicates the duration for a chemical to reduce to half of its intial concentration due to biodegradation. A higher half life indicates greater persistence in the environment.

RESPONSES TO USEPA FOLLOW-UP COMMENTS DATED DECEMBER 24, 2002
DRAFT SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Responses to USEPA Attachment 1 Comments
(Comment numbers are the same as the USEPA original comments dated 10 October 2002.)

1. **Comment: Tables 1-3, 2-1, and 5-1 to 5-9.** Comment addressed pending confirmation review of modified draft final QAPP.

   Response: Comment noted. Also please note that in addition to the tables mentioned previously, Table 5-9 will also be revised.

2. **Comment: (Comment of Record) Appendix B, Page 16, second bullet** regarding basing the PRG upon individual chemical risk of 1E-05. EPA policy is that PRGs for individual chemicals should be derived based on 1E-06 cancer risk and HI =1, if the cumulative cancer risk of all COCs is higher than the acceptable risk range (1E-04 to 1E-06, HI =1) so that the cumulative risk of multiple chemicals of concern is likely to be within the acceptable risk range if PRGs are achieved. However, we can concur with the Navy's proposal to proceed for Site 34 and PNS pending resolution of this and other risk assessment issues with the Navy by higher level authorities.

   Response: Comment Noted. The following changes will be made to the DQOs and Section 2.0 of the QAPP to clarify that screening levels similar to $1x10^{-6}$ or HI=0.1, with consideration of background will be used to determine whether our extent is bounded and which chemicals will require preliminary clean up levels in the EE/CA. (The development of the preliminary clean up levels for the EE/CA will be discussed as part of the EE/CA.):

   - DQO Step 5, EE/CA Decision Rule Table, Footnote 2: Replace by the following: "Screening levels as discussed in the text will be used only to determine whether adequate data are available to meet the requirements of the Principal Study Question for the EE/CA. Preliminary removal action cleanup levels will be developed as necessary to meet remedial action objectives to be defined in the EE/CA. The removal action extent will then be determined based on the preliminary cleanup levels such that the soil will meet acceptable risk levels following a removal action."

   - DQO Step 5, EE/CA Decision Rule Table, Text Following Footnotes: The first bullet will be replaced with the following text and the second two bullets (discussing general method for calculating the preliminary removal action cleanup levels) will be deleted: "The EE/CA screening levels for selection of soil contaminants to include in the evaluation of removal action alternatives and for determining whether adequate data are available for estimating the extent of contamination in an EE/CA are the USEPA Region 9 Residential PRGs (including a factor of 0.1 for noncarcinogenic chemicals), with consideration of PNS Facility Background (as indicated in the table above)."

   - Similar changes will be made to the footnote of the EE/CA Decision Rule Table provided in Section 2.5 (under the discussion of the Principal Decision Rule for the EE/CA).

The following revision will be made to the third paragraph in Section 2.4.1 and bullets following the paragraph: "The visual presence of ash indicates the extent of contaminated media that must be included in the removal action. The presence of ash-related contaminants in the soil outside and beneath the ash pile at levels exceeding ~~removal action~~ screening levels will also be used for ***determining whether adequate data have been gathered to estimate the extent of contamination in an EE/CA*** ~~developing the extent of contamination for evaluation of removal action alternatives~~. ~~The development of the extent of contamination is addressed in the Decision Rules discussed in Section 2.5.~~ The selection of contaminants to be addressed in a removal action and ***screening criteria for determining whether adequate data are available for estimating the extent of contamination in an EE/CA,*** ~~development of preliminary cleanup levels for evaluation of removal action alternatives~~ will ***be based on USEPA Region 9 Residential PRGs (including a factor of 0.1 for noncarcinogenic chemicals).*** ~~based on the following:~~

- ~~USEPA Region 9 Residential PRGs (including a factor of 0.1 for noncarcinogenic chemicals) for selection of contaminants for which preliminary cleanup levels will be developed.~~

- ~~The preliminary cleanup levels for these chemicals will be targeted on achieving an exposure point concentration that will correspond to a cumulative incremental cancer risk of 10-5 or a hazard index (HI) of 1.0. For lead, the cleanup level will be targeted on achieving a mean concentration equal to the residential PRG of 400 mg/kg.~~

- ~~The preliminary cleanup levels for all chemicals will be estimated such that the facility background levels are considered and consequently, cleanup can be demonstrated with an acceptable level of statistical confidence."~~

3. **Comment: (Comment of Record) Appendix B, Page 19, Sediment Screening Level for Pesticides Bullet** regarding the use of ER-Ms in event there is no OU4 IRG for a contaminant. EPA believes ER-L's are most often appropriate if there is no IRG/PRG. However, we have reviewed the Navy's rationale for using ER-M's and concur with using them for the reasons cited at Site 34 for this Site Screening Investigation.

   Response: Comment noted that USEPA is in agreement with the use of ER-M values for the Site 34 investigation.

Responses to USEPA Attachment 2 Comments
(Comment numbers are the same as the USEPA original comments dated 10 October 2002.)

1. **Comment: Page 3-4, Planned Assessments.** As in EPA comment to the Site 32 QAPP, it appears there is a semantic misunderstanding of "audit" vs "field review". The Navy's response that the FOL will ensure that the field SOPs are consistent with the QAPP is acceptable. In EPA's experience, field personnel often disregard the specific QAPP in favor of the general SOPs unless they are fully and frequently briefed beforehand on what is expected of them to obtain the required data quality. Thus we urge the Navy to ensure field personnel are briefed in addition to the FOL verifying the SOPs against the QAPP. As noted in the Navy's response, the EPA may also request permission for Quality Assurance or oversight contractor personnel to be

present and observe during field work. It is likely that we will make a request for such a visit at a mutually agreed time.

Response: It is standard practice for the TtNUS FOL to ensure that the field personnel follow the QAPP and any discrepancies between the QAPP and the SOPs are resolved before the start of the field work. USEPA is authorized to enter the Site in accordance with Section XVI of the Federal Facility Agreement for Portsmouth Naval Shipyard.

6. **Comment: (Comment for Record) Page 4-7, Section 4.6.1 Groundwater Purging and Page 4-8, Section 4.6.2 Temporary Monitoring Well Sampling.** EPA believes that using peristaltic pumps for VOC samples on investigative phases is not usually appropriate because of the possible loss of VOCs from the ground water using a vacuum pump (as opposed to during long term monitoring where it is often acceptable to track overall contaminant conditions over time). However, EPA can concur to using a peristaltic pump in wells at Site 34 in the belief that an environmentally significant concentration of VOCs will be detected in any case. Our concurrence is based upon several site specific reasons:

   - VOCs are not expected to be encountered due to the building use and history.
   - Low level VOCs even if encountered are not expected to be a risk nor trigger regulatory action due to expected brackish groundwater and short pathway to river discharge.

   Response: The sentence in Section 4.6.2 will be corrected as follows: " Sample containers for VOCs will be filled ***(following the method detailed in SOP S2)*** by allowing the ~~pump discharge~~ ***groundwater trapped within the intake end of the tubing leading to the pump,*** to flow gently down the inside of the container with minimal turbulence."

RESPONSES TO MEDEP FOLLOW-UP COMMENTS DATED DECEMBER 23, 2002
DRAFT SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

General Comment

1. **Comment:** Some of the Navy's responses add clarifications that should be incorporated into the Final QAPP (e.g., parts of Responses to Comments 19 and 20).

   Response: Based on the discussions between Mr. Fred Evans, EFANE, and Mr. Iver McLeod and Mr. Larry Dearborn, MEDEP on January 21, 2003, the text will be clarified. The following revisions will be made:

   The second paragraph of the discussion of Soil Contamination Beneath Ash Pile in Section 2.6 will be revised to read as follows: "For the SS, additional analyses of a full suite ... will be conducted. Sampling intervals to serve this purpose can be broader than those required for the volume estimation. The sampling interval of 4 feet is being proposed for subsurface soils to a depth of 10 feet bgs or to the water table depth, whichever is shallower. The data will be compared to residential risk screening levels (as discussed in Section 2.5), which is a very conservative approach considering that the potential exposure to subsurface soil would be to a construction worker. Therefore, any uncertainty in the difference in concentrations between the two 2-foot sections within a 4-foot section, compared to the composite of the 4-foot section should be minor."

   The second paragraph of the discussion of Soil Contamination Outside Ash Pile in Section 2.6 will be revised to read as follows: "...The area of contamination outside the ash pile is expected to be limited, therefore a 2-foot resolution in sampling depth is not required for a more precise estimation of volume. A 4-foot sampling interval for subsurface soil will suffice especially because the vertical profiling beneath the ash pile can be used to extrapolate the depth of soil contamination outside the ash pile. The relative lack of vertical resolution in soil data outside the ash pile (compared to beneath the ash pile) should not be of concern for the conceptual design and costing of removal action alternatives in an EE/CA...."

Specific Comments

2. **Comment:** Navy response to MEDEP Comment 4

   The revised text should state that Rounds 1 through 5 occurred from 1999 to 2002, not 2001 as is stated in the response (second to last sentence).

   Response: Sampling for Round 5 of the interim offshore monitoring program was conducted in August 2001. The data package for Round 5 was submitted in February 2002. Therefore, the sentence as provided is correct (Rounds 1 through 5 occurred from 1999 to 2001).

3. **Comment:** Navy response to MEDEP Comment 8

   "The Navy would appreciate any suggestions...on how the tar pit could be evaluated while minimizing impacts to the historic structure."

Is the floor of this building considered historic? As long as no supporting structures are impacted it should not be that difficult be to cut a narrow opening through the concrete floor across the area where the pit is thought to have existed (using methods similar to those used at Building 184). Drive-core samples could be collected every several feet in the opening to identify if the tar yet exists.

Response: The Navy recognizes MEDEP's suggestion, however, we are trying to determine whether there are any non-invasive methods to evaluate whether the pit has been removed prior to implementing a technique which has the potential to damage plumbing under the building.

4. **Comment:** Navy response to MEDEP Comment 9

We appreciate that the Navy will analyze dioxins in the ash. However, the Navy implies that dioxin is not expected to be present in significant levels in the ash because chlorinated compounds such as DDT and PCBs were produced after 1927. But these are not the only potential sources of dioxin. Dioxins can be created from the combustion of many different materials including wood, coal and fuel.

Response: The Navy agrees that dioxins can be created from combustion of non-hazardous materials, such as wood, coal, and fuel, which are not regulated as hazardous materials under CERCLA. These combustion sources can aerially disperse PAHs and possibly low levels of dioxins over thousands of miles, thereby causing background levels of these chemicals to be present in soils across the nation. As noted in Navy's response to SAPL Comment No. 12 on the Site 32 Draft Final QAPP (see TtNUS correspondence dated January 3, 2003):

"Windblown dispersion of dioxins (from industrial as well as natural combustion sources) can occur across political boundaries over thousands of miles. For example, see the Q&A under the press release at http://www.des.state.nh.us/ard/dioxin/press_dioxinstrategy.htm. That is one of the main reasons why background levels of dioxins can be expected to be present anywhere. PAHs and heavy metals also behave is a similar fashion. Please review any number of studies on dispersion of contaminants over thousands of miles from forest fires, for example at http://www.econ.upm.edu.my/~peta/nassir_h/nassir_h.html."

5. **Comment:** Navy response to MEDEP Comment 12

"Accordingly, the Navy proposes dioxin analysis to be conducted based on the decision tree provided in Attachment A to these responses to comments. Per the decision tree, dioxin analysis will be deleted from groundwater analysis."

The decision tree and its accompanying text have no discussion as to why groundwater will not be included for dioxin analysis. Please clarify.

Response: The Navy does not propose to consider analyzing for dioxins in groundwater until evidence is obtained indicating the migration of dioxins from the source and surface soils at the site (if indeed they contain significant levels of dioxins) to subsurface soils at the site.

The text with the decision tree will be revised to add the following: "Groundwater sampling and analysis for dioxin will not be conducted until there is evidence indicating the migration of

dioxins from the source and surface soils at the site to subsurface soils at the site. The need for dioxin data for site groundwater will be determined based on the results of the subsurface soil dioxin data (if subsurface soil need to be analyzed for dioxin) and the Navy will propose the additional sampling requirements for groundwater at that time."

The second footnote on the subsurface soil decision tree will be revised as follows: "2. The site screening evaluation will continue using the remaining data and the dioxin data for surface soil and subsurface soil, following the decision rules discussed in Section 2.0. ***The need for groundwater sampling and analysis for dioxin will be determined based on the results of the subsurface sampling."***

The following text will be added to the bullet for groundwater in Section 2.4.2, which discusses target parameter selection:

"Dioxin analysis will not be included for groundwater under the current investigation. If the ash and soil sample results meet the conditions discussed in the dioxin sampling decision tree noted earlier, then the need for collection of groundwater samples for dioxin analysis will be evaluated and if recommended, sampling and analysis will be conducted under a separate program."

6. **Comment:** Navy response to MEDEP Comment 17

As the table in the attachment "Rationale for the Use of ER-M Values in the Absence of OU4 PRGs" indicates the ER-L for p,p'-DDT (1 mg/kg) is fairly close to the ER-M for p,p'-DDT (7 mg/kg). The difference for trans-nonachlor is similarly not significantly large (0.5 mg/kg vs. 6 mg/kg). Therefore, we are willing to accept the ER-M values in this specific case.

However, we note the following. As the Navy indicates in the table on p. 2-11 the primary action to be taken for the sediments offshore of Site 34 is to continue monitoring of other COCs in the offshore as part of the ongoing offshore monitoring program, regardless of the concentration of pesticides found in the offshore sediment. If concentrations in both the offshore sediments and the pesticide rinse area drain are above screening levels then there is an additional action of "Evaluate the need for IRGs for the selected pesticides."

However, the scenario where only the sediments in the drain are above screening levels has not been addressed. Regardless of whether or not sediments in the drain are a source of pesticides to the offshore area, and regardless of whether or not offshore sediments are above screening levels, if there are elevated levels of pesticides, i.e. above the ER-M, in the drain sediments then some sort of action needs to be taken. Since drain sediments really aren't an environmental issue we believe they would need to be evaluated for potential human health risks, e.g. construction workers. The recently derived sediment screening levels for human health may or may not be applicable depending on differences in exposure assumptions.

As ecological screening levels are generally more conservative than human health screening levels the ER-M may be acceptable as a screening level for human health in this situation. However, the MEDEP will determine if we need to be concerned about potential risk to construction workers from pesticide concentrations below the ER-M.

Response: It is unlikely that the volume of sediment that may be present in the drain would be sufficient for any exposure of significance for a construction worker.

7. **Comment:** Navy response to MEDEP Comment 21

"Four-foot sections of soil will be composited...When a source has impacted the environmental media, it is obvious irrespective of whether the sampling interval is 2 feet or 4 feet..."

This is may not be true if the contaminant is only in the shallow subsurface (as is likely in a pesticide rinse area). Depending on the levels of contamination compositing a 4-foot core of soil can result in contaminant concentrations being non-detect due to dilution of contaminated soil with deeper clean soil. The MEDEP still objects to a 4-foot resolution in the pesticide rinse area. We suggest further discussions to resolve this issue.

Response: As discussed in the telephone conversation between Mr. Fred Evans, EFANE, and Mr. Iver McLeod and Mr. Larry Dearborn, MEDEP, soil samples outside the ash pile are being collected from 0 to 2 feet bgs, 2 to 6 feet bgs, and 6 to 10 feet bgs for chemical analysis as indicated in Table 4-3.

8. **Comment:** Navy response to MEDEP Comment 22

The MEDEP visited Site 34 on December 13 of this year. Having observed the physical limitations of the site we no longer recommend that a second well be installed as part of this Site Investigation.

Response: Comment noted.

9. **Comment:** Navy response to MEDEP Comment 26

Due to recent staff changes at USEPA the QAPP should be updated to indicate that Mr. Matt Audet is the current USEPA RPM if the QAPP is finalized after he takes over the position from Mike Barry.

Response: Comment noted. The final QAPP will be updated to include the most current project personnel (including Navy, TtNUS, USEPA, and MEDEP) as appropriate at the time the QAPP is finalized.

10. **Comment:** Navy response to MEDEP Comment 28a

"Except for VOCs, the entire length of each section will be composited...The purpose of the samples are to determine the...construction worker risk for the 2 foot to groundwater or 10 foot interval whichever comes first."

The MEDEP cannot accept analytical results from a composited soil core that is potentially as long as eight feet. We suggest further discussion to resolve this issue.

Response: As discussed in the telephone conversation between Mr. Fred Evans, EFANE, and Mr. Iver McLeod and Mr. Larry Dearborn, MEDEP, the section to be composited will be 4-foot in length, not 8 feet. As discussed in the QAPP (on pages 4-2 and 4-3), subsurface soils outside the ash pile will be collected from a 4-foot interval.

11. **Comment:** Navy response to MEDEP Comment 28b

Although Site 34 does not have the peninsula-type of tide exposure as Site 10, the tidal lag time within 50 feet of the high-tide shoreline could be in the order of one hour, versus the Navy's estimate of 3 hours.

Response: The actual lag-time will not be known unless a tidal study is performed, however, given the physical constraints and the number of borings, it is impossible for all borings to be conducted within an hour of the low tide time in the river. Therefore, a window of three hours was provided to maximize productivity for any given day of field work at this site.

12. **Comment:** Navy response to MEDEP Comment 30

If the direct-push installation method is successfully used, the Navy's response is acceptable. However, if augering must be used to penetrate to the desired depths, the local impact to the aquifer may be substantial, and a longer development time and several days of inactivity prior to sampling will be expected by MEDEP.

Response: A longer duration between development and sampling for hollow stem auger-drilled wells is standard practice and will be employed.

13. **Comment:** Navy response to MEDEP Comment 32

"If fresh groundwater is encountered at this site and it is shown to contain any parent solvent of vinyl chloride, the Navy will consider resampling of groundwater..."

Why is the Navy limiting itself to fresh groundwater? Brackish and/or saline groundwater should also be included.

Additionally, it is noted that footnote numbers 4, 5, and 6 do not appear in the body of the table. Please add these as appropriate.

Response: The minimum screening level for vinyl chloride is based on the USEPA Region 9 tap-water PRGs. If the groundwater at the site is saline/brackish water, the tap-water PRGs would not apply and the groundwater data would be screened using a construction worker RBC that is calculated using the same method as previously used, see for example the Site 10 Additional Investigation Report, TtNUS, January 2003. Typically construction worker RBCs are much higher than tap-water PRGs, therefore, detection limits should not be an issue for saline/brackish water. Also, note that there are no surface water criteria for VOCs as shown in Table 2-2 of the QAPP. However, the Navy will evaluate the impact of quantitation limits on the decision making and will propose the appropriate actions. This is part of the activities for data usability and reconciliation with project quality objectives (see Section 6.3 of the QAPP).

As an added note, footnote 1 for Table 2-2 will be revised as follows: " Calculated screening levels based on dermal exposure of construction workers to water. ***RBCs have been estimated only for previously detected groundwater contaminants at other sites at PNS.***"

As discussed in the telephone conversation between Mr. Fred Evans, EFANE, and Mr. Iver McLeod and Mr. Larry Dearborn, footnotes 4, 5, and 6 are located in the left hand column of Table 4-3, Page 1 of 3.

14. **Comment:** Navy response to MEDEP Comment 36

"Therefore, it is highly unlikely for the intertidal area of Site 34 to be suitable for a recreational user, and consequently the pathway of potential exposure is not of concern at this site."

Again, the MEDEP objects to dismissing a component of potential risk based on the physical aspects of the Portsmouth Naval Shipyard shoreline. All of the people present at the Dec. 13, 2002 site walk were able to access the sediments/shoreline of Site 34 without much difficulty, despite the steep slope, a good deal of brush and wet, slick leaves covering the ground. There is no reason to suppose that potential future users of the site, e.g. residents and trespassers, would have any less access to the site than is currently available.

Actual risk may be insignificant but the Navy must consider this potential exposure pathway when calculating potential risk for Site 34.

Response: The Navy acknowledges that access to the offshore sediment is possible from adjacent areas of the site. The following text revisions will be made to the DQOs and Sections 1.0 and 2.0 of the QAPP:

- DQO Step 1, Conceptual Site Model (discussing sediment exposure): "Human health exposure to sediments under a recreational scenario to in the offshore at Site 34 is not of concern because the steep shoreline directly adjoining the site minimizes the likelihood of access from the site. However, because access to the sediments from adjacent areas to the site may be possible, exposure to a recreational user will be considered during evaluation of potential site risks. [Note for SS, ecological screening levels, which are more stringent than human health screening levels, will be used to evaluate the sediment data as discussed further in DQOs.]"

- Section 1.5.3, add the following: "Offshore exposure to a recreational user is an unlikely scenario because the steep shoreline directly adjoining the site reduces the likelihood of access from the site. However, access to the intertidal area is possible from areas adjacent to the site (although the terrain is still rugged)."

- Section 2.4.2, second to last paragraph (discussing sediment screening levels), add the following: "As discussed in Section 1.5.3, recreational exposure to the intertidal area offshore of Site 34 is unlikely; however, because access to the intertidal sediments from adjacent areas to the site may be possible, exposure to a recreational user will be considered during evaluation of potential site risks. For the SS, ecological screening levels, which are more stringent than human health screening levels, will be used to evaluate the sediment data."

No changes are required for the SS screening levels tables for sediment provided in Sections 1.0, 2.0, and 5.0 based on this comment.

15. **Comment:** Decision Tree for Analysis of Dioxin in Surface Soil Samples at Site 34

This decision tree rules out dioxin analysis for any media when the concentrations of analytes in the ash do not exceed facility background. The MEDEP has repeatedly stated its objection to using background to rule out analytes from analyses, consideration as potential COCs, etc.

We will not accept any decisions ruling out analysis of dioxin (or any other analyte for that matter) that are based on concentrations not exceeding facility background.

Response: The Navy's use of facility background to eliminate potential COCs is consistent with current Navy policy.

RESPONSES TO SAPL FOLLOW-UP COMMENTS DATED DECEMBER 29, 2002
DRAFT SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1. **Comment: Navy Response to SAPL Comment 2, Page ES-1, INTRODUCTION.** "The Navy does not believe that the SS investigation is too narrowly focused however, it is focused on sources based on available information. Detailed information of how and where the storage and mixing occurred or the presence of floor drains are not available."

   SAPL disagrees that there is sufficient focus on potential sources in the investigation if the Navy's ultimate goal is to be able to walk away from Site 34. The Navy has information that pesticide handling and storage occurred at the site. Experience at Brunswick Naval Air Station has shown that significant environmental contamination can result from historic pesticide storage and handling activities, particularly when drains or other conduits to the subsurface exist. Without investigating logical potential sources at some point, it shouldn't be possible for the Navy to reach a No Further Action decision for Site 34.

   Response: The Navy recognizes SAPL's concerns that they believe the Navy should put more effort into site reconnaissance to determine the locations pesticide mixing and storage may have occurred within Building 62. However, the Navy has reviewed the information available on pesticide use at PNS and on Building 62 in particular and developed a site screening investigation to try to capture potential sources from the building. If new information is identified which was not available for this investigation, the Navy will evaluate it and determine whether additional investigations are necessary based on that information.

   The Navy is trying to determine whether there are elevated levels of pesticides, which need to be addressed under CERCLA. As to floor drains in Building 62, the Navy believes that there is a sanitary sewer connection in the lavatory and that there maybe two storm sewer drains in the storage areas. The Navy will confirm this information.

   The purpose of this SS investigation is to determine whether there has been a release to the environment and if a release has occurred could it potentially be transported to other media that would warrant further investigation. The Navy is already proposing to sample sediment in the storm sewer system (in the storm sewers outside the building), and surface and subsurface soil around the building. Therefore, the Navy believes the proposed sampling and analysis will identify whether there has been a potential release to the environment from past pesticide storage and handling activities at Building 62. If SAPL has suggestions on additional areas to investigate that are not currently proposed please provide them. If evidence of a CERCLA release is identified during our investigation, the Navy will address the release in accordance with CERCLA.

2. **Comment: Navy Response to SAPL Comment 3, Page ES-2, INTRODUCTION.** The Navy proposes dioxin analysis be conducted based on the decision tree provided in Attachment A. SAPL notes that the decision tree allows further dioxin analysis to be dropped if concentrations do not exceed facility background concentrations, regardless of comparison with risk screening criteria. SAPL reiterates its position that potential contaminants of concern should not be eliminated based solely on comparison with background values, and concurs with the Maine Department of Environmental Protection's (MEDEP's) Comment Number 15 to that effect dated December 23, 2002. Furthermore, the OU4 offshore monitoring should be updated in the

future, if necessary, to address new information about potential onshore sources of contamination.

Response: Regarding use of background, as the Navy has indicated previously to SAPL, Navy's use of facility background to eliminate potential COCs is consistent with current Navy policy. The Navy recognizes that SAPL is in disagreement with current Navy policy for use of background. The Navy's Policy on the Use Of Background Chemical Levels is available at http://enviro.nfesc.navy.mil/erb/erb_a/regs_and_policy/don-background-pol.pdf.

Regarding the offshore monitoring program, the Navy agrees the OU4 offshore monitoring should be updated in the future, if necessary, to address new onshore CERCLA sources.

3. **Comment: Navy Response to SAPL Comment 4, Page 1-1, Section 1.1 OBJECTIVES AND SCOPE.** "... The Navy requests information on any other CERCLA sources SAPL believes are being excluded from the investigation."

   As noted in SAPL's October 19th comments (see Original Comments 2, 7, and 16, for example), potential contamination resulting from pesticide storage and handling activities, as well as the potential migration pathways involving floor drains and/or outfalls, should be evaluated as part of the Site Screening Investigation.

   Response: Please see the Navy's response to SAPL Comment No. 1.

4. **Comment: Navy Response to SAPL Comment 7, Page 1-11, Section 1.3.2 Site History and Background.** "...There is no indication of other drains that might have been used at the time of the pesticide handling/mixing activity...." The Navy should provide the basis for this statement. Has the Navy actually looked for floordrains in the Site 34 buildings and not found any? If not, it is reasonable for the Navy to conduct such a search, given that pesticide handling and storage, a potential source (or sources), was located within the Site 34 buildings and floordrains would provide a potential migration pathway.

   Response: Regarding the need to investigate the drains inside the building, please see Navy's response to SAPL Comment No. 1.

5. **Comment: Navy Response to SAPL Comment 12, Page 1-13, Section 1.4.1 Previous Investigations.** SAPL appreciates the explanation for why the intertidal samples could in fact be collected below the mean low water line, and suggests that a note be added to Figure 1-4 stating that the 1998 sample locations are estimated from field notes and were not surveyed.

   Response: The figure already notes that these locations are approximate. The text on page 1-13 discussing the figure indicates that these locations were not surveyed.

   Note that Figure 1-4 was updated to show the topographic contours for the site including the mean high water level. The contour intervals were developed from aerial photography (from July 2001) and topography (produced in November 2002). The elevations in the figure are based on 2002 PNS vertical datum and control network and horizontal locations are based on NAD83. The explanation is provided in the text (see page 1-13).

6. **Comment: Navy Response to SAPL Comment 15, Page 1-15, Section 1.5.1 Potential Sources of Contamination.** "Pesticide handling and storage are not necessarily sources of contamination. In all likelihood, (because the information from the IAS related to pesticides handling notes that reuse of rinse water and good management from late 1960s to present was practiced), the handling and storage of pesticides in Building 62 may not be potential sources of contamination. No additional bullets regarding storage and handling will be added."

   There is nothing in this response, in any of the Navy's other responses, or in the QAPP that demonstrates that pesticide storage and handling locations should NOT be investigated as potential sources of contamination. The Navy's ambiguous wording -" ...are not necessarily sources", " ...may not be potential sources" - could easily be reversed (...are not necessarily not sources, ...may be potential sources) to support SAPL's position. The Navy has not presented any data to support the concept that pesticide handling at Site 34 was known to be completely protective of human health and the environment. Furthermore, the standard of practice for pesticide use and handling during the 1960s would not be considered protective today. As noted above, experience at Brunswick Naval Air Station has shown that significant environmental contamination can result from historic pesticide storage and handling activities, particularly when drains or other conduits to the subsurface exist. The Navy has acknowledged elevated pesticide concentrations in sediment at monitoring locations immediately offshore of Site 34. If the Navy's ultimate goal is to close out Site 34, it is not appropriate for the Navy to ignore the potential impacts (to both onshore and offshore media) from historic pesticide storage and handling activities at Site 34.

   Response: The Navy is aware of the pesticide handling facility at Brunswick. The site was identified when soil samples were taken by the Navy, which indicated there were very elevated levels of pesticides in the surface soil. Based on the results of that sampling, the Navy did additional soil sampling, prepared an Engineering Evaluation/Cost Analysis and Action Memorandum, and performed a Non-Time Critical Removal Action under CERCLA. The Navy is following the same process at PNS. First, we need to identify a CERCLA release. Then, if a CERCLA release is identified, we will address it.

7. **Comment: Navy Response to SAPL Comment 16, Pages 1-15 & 1-16, Section 1.5.2 Potential Contaminant Migration Mechanisms.** "...At this time, pesticide detections in the sediment have not been linked to an on-shore CERCLA release."

   SAPL understands that a link has not yet been established between onshore source and offshore impact. However, the QAPP only states that offshore monitoring data for certain PAHs shows a potential impact, while the OU4 offshore monitoring data also shows a potential impact from pesticides. SAPL believes that the QAPP text should be amended to include the information about pesticides in offshore sediments, particularly because of the pesticide-related activities immediately adjacent onshore at Site 34. SAPL was not asking that the text be revised to state that a link between on-shore sources and offshore impacts had been established. Also, please see Comments 4 and 6, above, regarding evaluation of potential impacts from pesticide handling and storage areas and of floordrains as potential conduits for contamination.

   Response: Please see text on page 1-14 of the QAPP regarding the pesticides in the offshore of Site 34. Regarding the floor drains as a potential conduit for offshore migration of contaminants, it is not expected to be a current source of contamination because (unlike the wash pad outside the building), rainfall infiltration does not occur inside the building. Therefore,

the only foreseeable connection to the offshore is being investigated via sample collection from the outfall sediments and nearby offshore sediments, and the subsurface soil samples under the wash pad. This potential pathway of contaminant migration will be addressed in the proposed text to be added to page 1-15 of the QAPP, as provided in the Navy's response to MEDEP Comment No. 5 dated October 16, 2002 on the draft QAPP.

8. **Comment: Navy Response to SAPL Comment 21, Page 2-2, Section 2.2 PROBLEM DEFINITION.** Please see Comments 1 and 6, above, regarding the necessity for the Navy to evaluate potential pesticide handling and storage impacts. SAPL also believes that the QAPP text should be revised to state that it is appropriate and necessary for additional action(s) to be taken if screening criteria are exceeded, regardless of background concentrations. Regarding the Navy's request for input on the process for evaluating the tar pit, SAPL concurs with the MEDEP's Comment Number 3, dated December 23, 2002.

   Response: Please see Navy's responses to SAPL Comment No. 1 regarding pesticide handling and storage. Please see the Navy's response to SAPL Comment No. 2 regarding background. Please see the Navy's response to MEDEP Comment No. 3 dated December 23, 2002 related to the tar pit.

9. **Comment: Navy Response to SAPL Comment 26, Page 2-7, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** SAPL concurs with MEDEP's Comment Number 5, dated December 23, 2002, that the Navy must supply an explanation regarding why groundwater will not be included for dioxin analysis. How will the Navy confirm that groundwater has not be affected by contamination known to exist in the ash at the site? SAPL also concurs with MEDEP's Comment Number 15 that it is not acceptable to eliminate contaminants from consideration for sampling or risk evaluation (dioxin in this instance) based on facility background concentrations alone.

   Response: Please see Navy's responses to MEDEP Comment No. 5 dated December 23, 2002 related to groundwater analysis of dioxin. Please see the Navy's response to SAPL Comment No. 2 related to background. Regarding SAPL's question on how the Navy will confirm that groundwater has not be affected by contamination known to exist in the ash at the site, groundwater sampling will be conducted as part of the Site 34 investigation, with one groundwater sampling location within the ash pile. As discussed in Section 2.6 of the QAPP temporary well 34-TW04 is planned to investigate the impact of the sources (i.e., directly under the ash or downgradient of the tar pit within the building) at the site. (Note that sampling of groundwater under the source area is the most likely location to see an impact to groundwater from the ash, if groundwater has been impacted.)

10. **Comment Navy Response to SAPL Comment 28, Page 2-7, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** See Comment 9 above for SAPL's position regarding the decision tree and elimination of contaminants from consideration based on background concentrations.

    Response: Please see Navy's response to SAPL Comment No. 9 above regarding the decision tree and use of background.

11. **Comment: Navy Response to SAPL Comment 31, Page 2-8, Section 2.4.2 Target Parameters Selection and Development of Screening Levels for SSI.** "Geological information to be collected from the overburden will be adequate for making either a No Further Action or RI/FS decision, if indeed contaminant concentrations meet the appropriate decision rules. Information on bedrock is not necessary unless the results from the overburden indicate that possibility that contaminant migration has occurred to depths close to bedrock."

    SAPL would be willing to accept the concept of a phased approach to the evaluation of potential bedrock contamination, assuming that the text of the QAPP was revised to clearly spell out the process. However, as noted in several comments above and in previous comments on the Site 34 QAPP, SAPL believes that the Navy's use of facility background concentrations, rather than comparison with screening criteria, as the primary driver in making decisions is inappropriate. The Navy's decision criteria must be revised.

    Response: The approach to groundwater investigation is phased, wherein further action will be proposed if an impact is noted. Further action could include a removal action or an RI, wherein the scope of the RI will be defined using the DQO process. The scope of the RI could include deeper investigation. Please see the Navy's response to SAPL Comment No. 2 regarding background.

12. **Comment: Navy Response to SAPL Comment 32, Page 2-9, EE/CA DECISION RULE TABLE.** "... "The preliminary cleanup levels for these chemicals will be targeted on achieving an exposure point concentration that will correspond to a cumulative incremental cancer risk of 10-5 or a hazard index (HI) of 1.0. For lead, the cleanup level will be targeted on achieving a mean concentration equal to the residential PRG of 400 mg/kg." This bullet addresses **all chemicals** selected as COCs for the removal action. Analytes detected at concentrations that do not exceed facility-wide background levels will not be selected as COCs. The preliminary removal action cleanup goals for the COCs will be calculated such that the **cumulative** risk for receptors of concern ..."

    SAPL agrees that cumulative risks for potential receptors should be the focus of removal action cleanup goals. However, as stated in comments above and in numerous previous comment letters, SAPL believes it is inappropriate to eliminate potential COCs based on facility background concentrations alone.

    Response: Please see the Navy's response to SAPL Comment No. 2 regarding background.

13. **Comment: Navy Response to SAPL Comment 33, Pages 2-10 & 2-11, Principal Decision Rule for SS.** SAPL disagrees with the Navy's position that exceedance of both risk-based screening criteria AND facility background is necessary to select a COPC. If concentrations of constituents exceed screening criteria, the compounds should factor into decision-making, particularly when cumulative risks are considered (see Comment 12, above). With regard to the Navy's request that SAPL provide other potential pathways by which pesticides could migrate to the offshore, please see SAPL's original October 19,2002, Comments 2, 7, and 16, which address pesticide handling and storage areas as potential sources and the site drainage system (including floordrains and migration from a leaky drainage system attached to the wash pad) for potential pathways for contaminant migration to groundwater and/or the offshore media.

Response: Please see the Navy's response to SAPL Comment No. 2 regarding background. Please see Navy's response to SAPL Comment Nos. 1, 4, and 7 regarding pesticide handling and storage areas.

14. **Comment: Navy Response to SAPL Comment 34, Page 2-12, Section 2.6 SAMPLING DESIGN AND RATIONALE.** Please see SAPL's Comment Number 3 above, for example, regarding other potential sources.

    Response: Please see Navy's response to SAPL Comment No. 1 regarding other potential sources.

15. **Comment: Navy Response to SAPL Comment 35, Page 2-12, Section 2.6 SAMPLING DESIGN AND RATIONALE.** Please see SAPL's Comment Number 3 above, for example, regarding other potential sources.

    Response: Please see Navy's response to SAPL Comment No. 1 regarding other potential sources.

16. **Comment: Navy Response to SAPL Comment 38, Page 3-13, Table 3-5.** SAPL suggests that the information in the Navy's response (regarding the different reports to be submitted) be added to the QAPP text.
    Response: The text is provided in Section 3.8.

17. **Comment: Navy Response to SAPL Comment 43, Appendix D, Page 12, SAPL Comment 3.** Please see Comment 9, above.

    Response: It is unclear how SAPL Comment No. 9 above relates to the indicated text; however, please see the Navy's response to SAPL Comment No. 9 above regarding target parameters and use of background.

18. **Comment: Navy Response to SAPL Comment 44, Appendix D, Page 13, SAPL Comment 7.** Please see Comment 9 above.

    Response: It is unclear how SAPL Comment No. 9 above relates to the indicated text; however, please see the Navy's response to SAPL Comment No. 9 above regarding target parameters and use of background.

RESPONSES TO USEPA COMMENTS DATED FEBRUARY 26, 2003
DRAFT FINAL SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

General Comment in body of letter: Upon review of the responses, EPA considers Attachment 1, comments 1 and 3 as well as Attachment 2, comments 1 and 6 resolved for this site.

Response: Comment noted. Please note that revisions to the QAPP were made as indicated in the Navy's correspondences dated February 25, 2003 and March 20, 2003 and email dated February 27, 2003 (included at the end of these responses to comments).

2. **Comment** ***Appendix B, Page 16, second bullet.*** The Navy maintains the QAPP will clarify that screening levels "similar to" 1×10^{-6} or HI = 0.1, with consideration of background will be used to determine whether the Navy's extent is bounded and which chemicals will require preliminary cleanup levels in the EE/CA. EPA Region I policy is that the screening levels should be "equal to", not "similar to", these risk levels. The term "similar" is too vague. EPA agrees that background may be used to determine the boundaries of the extent of Navy's contamination. However, EPA disagrees that background may be used to determine which chemicals will require preliminary clean up levels in the EE/CA for this site at PNS. The use of background to screen out chemicals for PRG derivation at OU4 was negotiated prior to EPA's guidance was issued and does not apply to other sites at PNS. EPA policy is that site-related and background chemicals should be screened out from quantitative risk assessment only if they are equal to or lower than appropriate risk-based screening levels. Therefore, EPA requests that preliminary cleanup levels be derived for all chemicals, including background chemicals, that exceed Region 9 PRGs (including a factor of 0.1 for noncarcinogenic chemicals). For background chemicals, the selected preliminary cleanup level would be the higher of the background concentration or the risk-based preliminary cleanup level.

Response: The screening levels that will be used will be based on 1×10^{-6} or HI = 0.1 as indicated in Section 2.5 (e.g., see the first bullet on page 2-12) of the QAPP.

As required by Navy policy, the selection of chemicals for development of preliminary clean up levels to support a removal action will include consideration of background. As discussed in Section 2.5 (pages 2-9 and 2-10) of the Site 34 QAPP, chemicals that do not exceed facility background will not be considered for the removal action.

RESPONSES TO MEDEP COMMENTS DATED FEBRUARY 10, 2003
DRAFT FINAL SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1. **Comment :** Figure 1-3, p. 1-31

   This figure was extensively revised by the Navy for the draft final as a result of observations made by the regulators and SAPL during the December 13, 2002 walkover. It is much improved, but several tasks appear to remain.

   - Both outfalls 49 and 50 terminate at relatively high elevations above the mean high water elevation, whereas the group observed them to extend into the tidal zone sediments, considerably beyond the river bank. Outfall 49 has a note that says that termination point to be determined, but outfall 50 does not have a note. Even though their river ends have not been surveyed, these outfalls should be extended to at least the 100 ft contour. Outfall 50 should be labeled on the figure.

   - What is the heavy alternating green and brown line that runs from Building 60 to the east edge of the figure? Also, what is the alternating heavy black and gray line that protrudes north from Building 63? The legend apparently does not address these features.

   - The above features also need to be identified on Figures 1-4 and 4-1.

   Response: No revisions were made to the figure based on observations noted during the December 13, 2002 site walkover. Only the utility locations (based on PNS utility drawings) and the topographic information based on the July 2001 aerial survey were added to the drawing.

   The outfall termination points will be surveyed as part of the site investigation; therefore, the Navy will correct the outfall termination points post investigation based on actual survey data. The only outfall that is related to Site 34 is Outfall 49. Outfall 50 is not associated with Site 34 and therefore, does not need to be labeled.

   The alternating color and black lines are the dashed utilities mentioned in footnote 1 of Figure 1-3. These lines are the utility lines that are abandoned. For clarity, footnote 1 on Figures 1-3, 1-4, and 4-1 will be revised to read "Alternating color and black dashed lines indicate an abandoned utility line."

Responses to MEDEP Follow-up comments dated December 23, 2000

2. **Comment:** 3. Navy response to MEDEP Comment 8

   Due to potential plumbing under the slab the Navy is trying to determine if non-invasive methods are available to investigate the presence or absence of the tar pit. We suggest ground-penetrating radar or perhaps some other geophysical technique.

   The coal tar would act as an electrical reflector and so would show up as a bright spot on the print out. The GPR depth of penetration depends on the soil type and density. If the

subgrade beneath the floor has settled and resulted in an air space larger than a couple of inches, it is unlikely the GPR will be of much use in those areas because the signal is lost in the air space (the air would show up as a bright spot). Similarly, if the underlying soil contained a large amount of clay, the signal would be lost (i.e., attenuated). Barring these two conditions and the presence of extraneous electrical fields, the GPR survey would provide an effective non-intrusive method for identifying reflectors beneath the floor. However, without sampling, there is no way to confirm the reflector is in deed a coal tar pit.

Another idea is to conduct air sampling (using Summa canisters) around the outside perimeter using geoprobes and standard soil gas technology. High levels of BTEX/SVOCs in the soil gas may be indicative of the presence of the tar pit. But again, confirmation will require sampling.

Lastly, samples could be taken via angled borings around the perimeter of the building. This method minimizes the disturbance to the site, and provides a means of sample collecting from below the floor without penetrating the floor. If used in conjunction with one or both of the options presented previously, the borings would be limited in number by focusing on previously identified target areas.

Response: The Navy is still evaluating how to investigate the former tar pit. The MEDEP's suggestions are noted for consideration.

3. **Comment:** 4. Navy response to MEDEP Comment 9

The Navy will be analyzing the ash for dioxins so the following is for clarification only.

The Navy's response discusses wind-blown dispersion of dioxins from industrial and natural combustion sources. We agree that background levels of dioxins are generally caused by wind-blown dispersion of combustion sources. However, our point was specifically regarding the ash pile and whether or not there could be a source for dioxins in the ash pile. As stated in our original comment the Navy implied that dioxin is not expected to be present in significant levels in the ash because chlorinated compounds such as DDT and PCBs were produced after 1927. In addition to any background levels of dioxin it is possible that there are non-chlorinated compound sources. In this case, we are referring to any ash in the pile that might be a result of the building burning or any other combustion process that took place in the building (recognizing that the oil gasification process probably produced little to no ash).

Response: The Navy will not be determining the specific source of the ash. Regardless of the source, the Navy will sample and analyze the ash for dioxins and compare the results to background levels and risk screening levels. As provided in the QAPP, if the dioxin levels exceed background and screening levels in the ash, then other samples will be analyzed for dioxin as discussed in the decision tree (see Section 2.4.1 and Appendix B) and these samples will be evaluated as per the decision rules in Section 2.5.

RESPONSES TO SAPL COMMENTS DATED FEBRUARY 28, 2003
DRAFT FINAL SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1 **Comment: Ash Removal Action.** SAPL supports the Navy's proposal to remove the ash pile and associated contaminated soil at Site 34.

Response: As discussed in the QAPP (e.g., the first bullet on page ES-1), the Navy is planning to conduct a non-time-critical removal action for the ash and associated contaminated soil. However, a specific removal action alternative has not been selected yet. The data that will be collected as part of the Site 34 Site Investigation will be used to prepare an engineering evaluation/cost analysis (EE/CA), in which possible removal action alternatives (including an excavation alternative) will be evaluated. The Navy's goal in selecting a removal action alternative would be have no further action under CERCLA, if possible.

2 **Comment: Use of Background Data in Decision-Making.** SAPL concurs with the U.S. Environmental Protection Agency's position, as stated in the agency's letter dated February 26, 2003, regarding the use of background data to screen out chemicals from further consideration at Site 34. As SAPL has stated in numerous previous comment letters, including Comments Number 2, 8, 11, 12, and 13 in its December 29, 2002 letter on Responses to Comments on the August 2002 Draft Site 34 QAPP, concentrations of potential chemicals of concern should be compared with appropriate screening levels. Chemicals should not be eliminated from consideration based on comparison with background concentrations alone.

Response: Please see Navy's response to USEPA Comment 2 dated February 26, 2003 related to background.

3. **Comment: Floordrains/Outfalls.** In its response to SAPL Comment Number 1 (dated December 29, 2003) regarding the need to investigate the site's drainage system as a possible migration pathway, the Navy states it thinks there is a sanitary sewer connection in the lavatory and there may be two storm sewer drains in the storage areas, and that the Navy will confirm this information. SAPL is encouraged that the Navy has found additional information on floordrains and outfalls at Site 34 and will investigate further. The drainage system may provide a pathway for contaminants (such as pesticides from storage/handling/mixing activities) to be migrate to the offshore environment. Elevated concentrations of PAHs and pesticides are known to occur in the monitoring locations immediately offshore of Site 34. However, since specific information regarding how the Navy would investigate the drain system was not provided, SAPL cannot be more specific in its comments on the Navy's approach or methods. In general, SAPL is concerned with not only the current configuration of the drainage system, but also with the historic layout. For instance, has the system been altered since the 1960s-1980s period when pesticides were stored and handled at Site 34. Another consideration is that breaks, cracks, loose fittings, etc., in the drainage system might have allowed contaminants to leak into the subsurface environment at the site.

Response: The Navy is not aware of any change to the configuration of the drainage system. The current investigation focuses on the most likely locations where the discharge may have entered the drainage system (i.e., the pesticide rinse/wash pad) and where the outfall from the drain discharges to the environment. As shown in the QAPP, sampling locations for this are the locations at the pesticide rinse/wash pad (34-16 and 34-18) and at the termination point of Outfall 49 (34-19 and 34-20). The Navy also will conduct a full suite of analysis, including pesticide analysis, at the other sample locations that are part of the SSI. These other soil samples included as part of the SSI are located downgradient of Building 62 (34-05, 34-12) and upgradient/side gradient of Building 62 (34-01, 34-03, 34-04, 34-13, and 34-15). In addition, all groundwater samples will be analyzed for pesticides. Therefore, the Navy believes the proposed sampling and analysis will identify whether there has been a potential release to the environment from past pesticide storage and handling activities at Building 62.

4. **Comment: Pesticide Handling/Mixing/Storage Activities.** SAPL had commented on the need to investigate potential adverse environmental impacts caused by the historic pesticide handling and storage in Comments Number 1, 3, 6, 14, and 15 in the December 29, 2002 letter. In its response to Comment Number 1, the Navy asked SAPL for suggestions on additional areas to investigate beyond those already proposed. As noted in Comment Number 3, above, SAPL believes the Navy's investigation of floordrains and outfalls would help address the question of potential migration pathways for pesticides, although SAPL cannot comment on the specifics of the Navy's approach and methods. However, with an appropriate level of effort to determine where the drain system is located, and with appropriate sampling of areas possibly impacted, the impact of the potential migration pathways can be evaluated.

   With regard to other areas to cover, the Navy knows that pesticide storage and handling occurred within the buildings, but doesn't know exactly where within the buildings. There has been an adverse impact to offshore sediments, although the link to an on-shore source at Site 34 has not yet been established. SAPL also notes that concentrations of several pesticides were detected in the ash adjacent to the building, suggesting the possibility of pesticide disposal or handling at locations other than just inside of the buildings or at the wash pad. Additional surface and subsurface soil sampling locations to supplement those already proposed would help determine the nature and extent of adverse impact to soil. The Navy proposes compositing subsurface soil samples over a four-foot interval. SAPL suggests that analyzing samples over a two-foot interval would provide additional detail. There are also no monitoring wells proposed for down-gradient of the Building 62 Annex (see Figure 4-1). An additional well at that end of the site would help determine if there has been an adverse impact to groundwater.

   Response: Please see Navy's response to SAPL Comment No. 3 above regarding investigation of the drains and outfalls.

   As discussed on page 1-13 of the QAPP and shown on Table 1-3, three pesticides were detected at low concentrations in the ash (below screening levels and facility background). Therefore, there is no evidence to suggest that pesticide operations were conducted in the vicinity of the ash pile. However, all samples to support the site screening investigation are being analyzed for pesticides. Please see the Navy's response to SAPL Comment No. 3 regarding the sampling at the site, which include pesticide analysis. The Navy believes that the sampling locations proposed in the QAPP are sufficient at this time to determine the

nature and extent of the ash and associated contaminated soils to support the evaluation and selection of a removal action as well as to determine whether site sources may have impacted site media. Please see the discussion of the data quality objectives in Section 2.0 of the QAPP which provides the decision statements, decision rules, and sampling rationale.

Compositing of 4-foot intervals is proposed where a 2-foot interval is not necessary. A 2-foot sampling interval is proposed for estimating the extent of contamination for removal action purposes. The Navy believes that 2-foot sampling intervals have already been proposed at adequate locations to support the removal action.

Given the small area of the site and the fact that two monitoring wells (34-TW04, which is directly within the ash pile/immediately downgradient of the building and 34-TW-02, which is downgradient of the ash pile) have already been proposed, the Navy believes that adequate number of monitoring wells have been proposed to identify whether an adverse impact has occurred to the groundwater. Therefore, no additional monitoring wells are necessary as part of this site screening investigation.

5. **Comment: Dioxin Sampling.** SAPL suggests that if dioxin is detected in ash, that the underlying soil as well as also be tested to confirm contaminant migration has not occurred. Dioxins should also be included (assuming they were detected in the overlying ash or soil) in the confirmatory sampling that should be conducted once the removal action is complete. Comparison with background concentrations should not be the basis for eliminating dioxin from consideration. It is also not clear to SAPL how the decision to test groundwater samples for dioxin will be made. The decision information SAPL received only addressed soil and sediment.

   Response: As discussed in the decision tree, underlying soil will be analyzed only if dioxins are detected above facility background levels and screening levels. As discussed in the Navy's response to SAPL Comment No. 1, a removal action alternative has not been selected. The need for and specifics of confirmatory sampling will be determined as part of the removal action.

   The decision tree also states that groundwater analysis for dioxins will not be conducted unless evidence of migration into subsurface soils is evident. The Navy needs the results of the Site 34 site investigation to determine whether dioxin data may be necessary for groundwater.

CORRESPONDENCES FROM THE NAVY RELATED TO REVISIONS TO THE SITE 34 SAMPLING AND ANALYTICAL PROGRAM

DEPARTMENT OF THE NAVY
ENGINEERING FIELD ACTIVITY, NORTHEAST
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
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LESTER, PA 19113-2090

IN REPLY REFER TO
5090
Code EV23/FE
February 25, 2003

Mr. Matthew Audet
U.S. Environmental Protection Agency, Region I
1 Congress Street
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Boston, MA 02114-2023

Mr. Iver McLeod
Maine Department of Environmental Protection
State House Station 17
Augusta, ME 04333-0017

SUBJECT: PROPOSED REVISIONS TO THE DRAFT FINAL SITE 34 QAPP; INSTALLATION RESTORATION PROGRAM, PORTSMOUTH NAVAL SHIPYARD

Dear Mr. Audet/Mr. McLeod:

The Navy is proposing the following revisions to the subject QAPP:

- Analyze ash for alkylated polycyclic aromatic hydrocarbons;
- Analyze groundwater for total suspended solids (TSS); and
- Revise surface soil sampling depth for select samples.

A brief rationale for the above-mentioned revisions is attached for your information.

Please provide any comments on the proposed changes on or before March 13, 2003.

If additional information is required, please contact Ms. Marty Raymond at 207-438-2536 or myself at 610-595-0567, x159.

Sincerely,

Frederick J. Evans

FREDERICK J. EVANS
Remedial Project Manager
By Direction of the
Commanding Officer

5090
Code EV23/FE
February 25, 2003

Copy to:
NOAA (K. Finkelstein)
USFWS (K. Munney)
MEDMR (D. Card)
NHFG (Dr. C. McBane)
Mr. Doug Bogen
Mr. Peter Britz
Mr. Jeff Clifford
Mr. Alan Davis
Ms. Michele Dionne
Mr. James Horrigan
Ms. Mary Marshall
Mr. Phil McCarthy
Mr. Jack McKenna
Ms. Diana McNabb
Mr. Onil Roy
Dr. Roger Wells
Ms. Carolyn Lepage
PNS Code 100PAO
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PNS (Code 106.3R)
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PROPOSED REVISIONS TO THE DRAFT FINAL SITE 34 QAPP
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

The Navy is proposing the following revisions to the subject QAPP:

- Analyze ash for alkylated polycyclic aromatic hydrocarbons (PAH) for characterization;
- Analyze groundwater for total suspended solids (TSS);
- Revise surface soil sampling depth for select samples.

A brief rationale for the above-mentioned revisions is as follows:

- Based on a recent review of PAH and alkylated PAH data for interim offshore monitoring station MS-01 (located offshore Site 34) has indicated a similarity in the PAH "fingerprint" for the samples (i.e., the PAH concentration patterns appear to be similar). Comparison of the offshore sediment PAH fingerprint and the onshore source area PAH fingerprint (i.e., the ash), including alkylated PAHs, may be useful in providing more information to determine if a link exists between the offshore sediment and the ash at Site 34. Therefore, the Navy is recommending that the samples for ash characterization also be analyzed for alkylated PAHs.

- Total suspended solids may be useful to indicate whether the concentrations of organic compounds in the groundwater are indeed dissolved (and hence more mobile) or they are attached to soil particulates. Therefore, the Navy is recommends TSS be included for groundwater samples analysis.

- The draft final Site 34 QAPP indicates all surface soil samples will be collected from 0 to 2 feet bgs. The surface soil sampling depth used for previous site screening investigations at PNS and planned for the Site 32 remedial investigation is 0 to 1 feet bgs. Therefore, the Navy is recommends the surface soil samples used to support the site screening investigation (SSI) be collected from 0 to 1 feet bgs. Surface soil samples collected for support of a removal action horizontal extent only will still be collected from 0 to 2 feet bgs. Samples collected under the ash pile to support removal action vertical extent will also be collected from 0 to 2 feet bgs. Therefore, the soil sampling locations affected by this change are: _34-01, 34-03, 34-04, 34-15, and 34-16.

The revisions will be reflected in the final QAPP.

DEPARTMENT OF THE NAVY
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IN REPLY REFER TO

5090
Code EV23/FE
March 20, 2003

Mr. Matthew Audet
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Mr. Iver McLeod
Maine Department of Environmental Protection
State House Station 17
Augusta, ME 04333-0017

SUBJECT: SITE 34 SITE INVESTIGATION QUALITY ASSURANCE PROJECT PLAN; INSTALLATION RESTORATION PROGRAM, PORTSMOUTH NAVAL SHIPYARD

As discussed in separate telephone conversations on 19 March 2003, the Navy recommends the wells (temporary monitoring well points) in Section 4.3.2 of the QAPP be abandoned by grouting in place instead of the procedure recommended in the 2nd full paragraph on page 4-5 of the QAPP. While both methods are considered acceptable practices, there may be a greater chance of cross-contamination from the surface into the subsurface because withdrawal of the risers may cause collapse of the bore hole.

The second full paragraph on page 4-5 of the QAPP will be revised to reflect this change.

Please provide any comments on the proposed changes on or before April 2, 2003.

If additional information is required, please contact me at 610-595-0567, extension 159.

Sincerely,

Frederick J. Evans

FREDERICK J. EVANS
Remedial Project Manager
By Direction of the
Commanding Officer

5090
Code EV23/FE
March 20, 2003

Copy to:
Mr. Jeff Clifford
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Ms. Mary Marshall(via email)
Ms. Diana McNabb(via email)

Evans, Fred J (EFANE)

From: Evans, Fred J (EFANE)
Sent: Thursday, February 27, 2003 1:27 PM
To: 'Audet, Matthew'; 'McLeod, Iver J'
Cc: 'Raymond, Marty'; 'Lepage, Carolyn'
Subject: Proposed Revision to Analytical Methods for Site 32 Remedial Investigation and Site 34 Site Investigation

Matt/Iver,

As discussed earlier this morning, the proposes the following changes for the Site 32 Remedial Investigation and Site 34 Site Investigation:

- The Navy proposes to switch from the CLP methodology to SW 846 methodology for the semivolatile, pesticide, PCB, and metal fractions. The reason for this is that with the SW 846 methods the laboratory is able to report lower reporting limits than the Contract Required Quantitation Limits (CRQLs) what is specified in the CLP Statement of Work (SOW). The change in methodology will not impact the detection limits (MDL/IDL) and the laboratory will continue to report any positive detections that are detected above the detection limit but below the reporting limits (although qualified as an estimated result). The lower reporting limit will provide the Navy with a better understanding of potential chemical concentrations when the chemical is not detected between the detection limit and the reporting limit (and therefore reported as the reporting limit with a "U" qualifier).

- The Navy proposes to use the SW846 8270C SIM method for PAHs for the aqueous samples. This method has lower MDLs that will be much closer to the screening level. The MDLs may not be less than the screening level in every case but are within the same order of magnitude which was not achievable with either of the other methods. The SW846 8270C SIM method for PAHs is not proposed for the solid samples because the MDLs for PAHs using SW846 8270C method are already less than the screening levels and therefore, lower detection limits achievable by the SIM method are not necessary for solid samples to meet project objectives.

These changes in analytical methodology will be reflected in the Final Site 32 RI QAPP and the Final Site 34 SI QAPP unless where herre from you before close of business Monday, March 3, 2003.

Thank you,
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