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Work Plan

for

Remedial Investigation
Site 17
Building 32, Gould Island

Naval Station Newport
Newport, Rhode Island

Environmental Field Activity Northeast
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888
Contract Task Order 0842

July 2003

TETRA TECH NUS, INC.

W5203279DF

WORK PLAN

FOR

REMEDIAL INVESTIGATION
SITE 17
BUILDING 32, GOULD ISLAND

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Environmental 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 N62467-94-D-0888
CONTRACT TASK ORDER 0842

July 2003

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July 11, 2003

Project Number N5152

Mr. Franco LaGreca
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10 Industrial Highway, Mail Stop 82
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Reference: CLEAN Contract No. N62467-94-D-0888
Contract Task Order No. 0842

Subject: Draft Final Work Plan
Site 17, Gould Island Remedial Investigation
Naval Station Newport, Newport Rhode Island

Dear Mr. LaGreca:

Enclosed you will find four copies of the Draft Final Work Plan for Remedial Investigation at Site 17, Gould Island in Jamestown Rhode Island. This report has been prepared from the draft delivered in January 2003, amended by responses to comments from the National Oceanic and Atmospheric Administration (NOAA), the Rhode Island Department of Environmental Management (RIDEM) and the U.S. Environmental Protection Agency (EPA).

If you have any questions regarding this material, please do not hesitate to contact me.

Very truly yours,

Stephen S. Parker, LSP
Project Manager

SSP/rp

Attachment

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WORK PLAN
Remedial Investigation, Site 17
Building 32, Gould Island
Naval Station Newport
Newport, Rhode Island

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A Background Summary Report, Site 17
B Health and Safety Plan for Site Inspections
C Selected Standard Operating Procedures
D Field Documentation Forms

LIST OF ACRONYMS

AAL	Rhode Island Ambient Air Limit
ACOE	U.S. Army Corps of Engineers
ARAR	Applicable or Relevant and Appropriate Requirement
AVS	Acid Volatile Sulfides
AWQC	Ambient Water Quality Criteria
B&RE	Brown & Root Environmental
CAD	Contained Aquatic Disposal
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
CT	Central Tendency
DAF	Dissolved Air Flotation
EPA	U.S. Environmental Protection Agency
ERA	Marine Ecological Risk Assessment
ER-L	Effects Range-Low: NOAA Adverse Effects Benchmark Value For Sediment
ER-M	Effects Range-Median: NOAA Adverse Effects Benchmark Value For Sediment
FFA	Federal Facilities Interagency Agreement
FS	Feasibility Study
FWENC	Foster Wheeler Environmental Corporation
GRA	General Response Action
HHRA	Human Health Risk Assessment
HI	Hazard Index Ratio
IAS	Initial Assessment Study
IEUBK	Integrated Exposure and Uptake Biokinetic Model
IRP	Installation Restoration Program
IU/BK	Integrated Uptake/Biokinetic Model
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
mg/l	milligram per liter
MLW	Mean Low Water Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NETC	Naval Education and Training Center
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic and Atmospheric Administration
NORTHDIV	Northern Division
NPL	National Priorities List

LIST OF ACRONYMS (Continued)

NS	Nearshore
O&M	Operation and Maintenance
OS	Offshore
OSHA	Occupational Safety and Health Administration
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PDI	Pre-Design Investigation
POTW	Publicly-Owned Treatment Works
PPE	Personnel Protective Equipment
PRG	Preliminary Remedial Goal
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RfD	Risk Reference Dose
RI	Remedial Investigation
RIDEM	Rhode Island Department of Environmental Management
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SAIC	Science Applications International Corporation
SARA	Superfund Amendment and Reauthorization Act
SEM	Simultaneously Extracted Metals
SER	Shore Establishment Realignment Program
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TBC	To Be Considered Guidance
TCL	Target Compound List
TCLP	Toxic Characteristic Leaching Procedure
TCR	Tissue Concentration Ratio
TEV-HQ	Threshold Effects Value - Hazard Quotient
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRC	TRC Environmental Corporation
TSDF	Treatment, Storage, and Disposal Facility
TSS	Total Suspended Solids
TWA	Time-Weighted Average Concentration

LIST OF ACRONYMS (Continued)

µg/dl	microgram per deciliter
µg/kg	microgram per kilogram
µg/l	microgram per liter
URI	University of Rhode Island
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This Work Plan has been prepared under the Comprehensive Long -Term Environmental Action Navy (CLEAN) Contract No. N62472-94-D-0888, Contract Task Order (CTO) 842. The statement of work requires Tetra Tech NUS, Inc. (TtNUS) to provide a Remedial Investigation (RI) Work Plan for the Building 32 area on Gould Island, which is part of Jamestown, Rhode Island. The Building 32 area has been designated as Site 17 through Navy correspondence following the Phase 1 Study Area Screening Evaluation conducted in April 2000. This Work Plan describes the procedures for performing the RI at Site 17.

1.1 BACKGROUND

The purpose of the RI is to determine the nature and extent of contamination associated with the past use and disposal of chemicals and chemical wastes at Site 17. The investigation will focus on environmental contamination at and near the former Building 32 area located on the northern portion of Gould Island in Narragansett Bay. The RI report will be prepared in accordance with general U.S. Environmental Protection Agency (EPA) guidance and the Federal Facilities Agreement between the EPA, Rhode Island Department of Environmental Management (RIDEM) and the U.S. Navy.

Site 17 is centered on the former Building 32, which was a Torpedo Overhaul Shop. Building 32 contained an electroplating shop, machine shops, degreasing shops, grinding and buffing shops, and other workshops used for torpedo service and maintenance during the Second World War. Site 17 is currently described as the "Building 32 Area" and its exact boundaries are not yet defined. This RI will further determine the extent of contamination and the site boundaries will be adjusted to encompass the area where site-related contaminants have come to reside. It is likely that the extent of the site will cover several other known and potential release sites at Gould Island, which include underground storage tanks (USTs), former PCB transformer buildings, and former material storage areas. All above-ground structures in the vicinity were demolished in 2001 and 2002.

Some investigations and removal actions have been conducted at this and other release sites in the area, and a detailed description of these activities is presented in the Background Summary Report for Site 17, which is presented as Appendix A to this Work Plan. The Background Summary Report describes past industrial activities that apparently resulted in the presence of chlorinated solvents, fuel-related contaminants, and metals in the soil, groundwater, soil gas, and marine sediment at the site, and PCBs in the soil and marine sediments at the site. To determine the nature and extent of these contaminants, as well as the nature and extent of other contaminants that may not yet be identified, the

RI will be conducted through a focused program of investigation that is based on previous investigation findings, known and suspected contaminant migration pathways, and site background information.

The other sites on Gould Island are on property owned by the State of Rhode Island, and managed under the Formerly Used Defense Sites (FUDS) Program operated by the Army Corps of Engineers (Corps of Engineers). The New England District of the Corps of Engineers reported in both 2002 and 2003 that a Phase II Engineering Evaluation for Contamination was initiated for FUDS sites on Gould Island, but has been put on hold pending discussion with RIDEM on the scope of further investigations.

1.2 WORK PLAN FORMAT

The basic format of this Work Plan reflects that of similar documents provided for regulatory approval under the CLEAN contract for the Newport Installation Restoration Program sites. However, this Work Plan also includes some of the supporting information described in current Navy and regulatory policy and guidance, including (but not limited to) the following:

- Region I EPA- New England Quality Assurance Project Plan (QAPP) Compendium of QAPP Program Requirements and Guidance, October 1999

- U. S. Navy – Policy On Sediment Site Investigation and Response Actions, February 2002

Additionally, the investigation program has been designed to comply with federal and state environmental regulations (Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, and RIDEM Site Remediation Regulations) as well as Navy policy. To the extent possible, this investigation will utilize the principals of rapid assessment described in the document: "Integrating Dynamic Field Activities into the Superfund Response Process" OEER, (5201G). Applicability and use of other technical policy and guidance documents for use of background data, low flow sample collection, human health and ecological risk assessment are described in the pertinent sections of this Work Plan.

Section 1.0 of this Work Plan describes the project organization and communication pathways, personnel responsibilities, and a process for revision to the Work Plan during field activities, if necessary.

Section 2.0 of this Work Plan presents the project planning and project definitions, site history, site location and description, watershed contaminant source information, data use evaluation and the outline of a conceptual site model.

Section 3.0 presents a description of the data collection activities planned for this RI. This includes a rationale for field investigation design, description of field investigation efforts, and sampling and data acquisition procedures and analysis requirements.

Section 4.0 presents the Quality Assurance/Quality Control (QA/QC) Plan for the RI. This section includes the project quality objectives, project action limits, and measurement performance criteria. Also included in Section 4.0 are discussions of: sample collection documentation requirements; the sample identification system; sample handling and custody; analytical method requirements; sampling and analytical quality control; analytical documentation and data management; data validation and verification requirements and procedures; and QA assessment and management efforts.

Section 5.0 presents a general outline of the RI report, the human health risk assessment and the first tier of the ecological risk assessment that will be prepared following completion of the field work described in Section 3.0.

Section 6.0 presents references cited and used in preparing this Work Plan.

As stated previously, the Background Summary Report for Site 17 is provided as Appendix A. A site-specific Health and Safety Plan is attached as Appendix B. Appendix C presents Standard Operating Procedures (SOPs) for the field investigation work. Appendix D contains samples of forms to be used for documentation during this investigation.

1.3 PROJECT ORGANIZATION AND RESPONSIBILITIES

TtNUS will be responsible for the overall management of the project, including the performance of field activities presented in this Work Plan.

Navy personnel from the Environmental Field Activity Northeast (EFANE) will be responsible for administrative and technical oversight of the program, and project management and coordination between state and federal regulatory agencies, while the Navy personnel from the Naval Underwater Warfare Center (NUWC) and Naval Station Newport (NSN) will be responsible for on-site coordination with TtNUS.

Key Navy personnel supporting this project are as follows:

James Shafer, Remedial Project Manager (RPM)
EFANE, Philadelphia, PA · Phone: 610-595-0567 FAX: 610-595-0555

Melissa Griffin, Facility Contact, NSN PWD – Environment
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Philip DeNolfo, NBSWTF Manager, NUWC

Joann Spangenberg, NUWC DIVNPT Environmental, Safety and Security

Key TtNUS personnel supporting this project are as follows:

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TtNUS, Pittsburgh, PA Phone: (412) 921-8912 FAX: (412) 921-4040

The TtNUS Project Manager (PM) will have the primary responsibility for implementing and managing the investigation, and will also be responsible for notifying regulatory agencies of field activities or schedule modifications.

The Field Operations Leader (FOL) will be responsible for directing on-site field activities and will report directly to the PM. The FOL will coordinate efforts of the field sampling staff, the subcontractors, and the lead technical staff and will be responsible for identifying problem areas and bringing them to the attention of the PM for resolution.

The Lead Biologist and Lead Risk Assessment personnel will be responsible for reviewing the sampling program to ensure it is adequate to meet the objectives of the study, for assimilating the data into a format amenable to manipulations required for risk assessment modeling and calculations, and for performing the risk assessment steps.

The Lead Chemist will advise the PM on technical requirements of the chemical data, prepare laboratory specifications for analysis of samples collected, oversee the subcontracted analytical laboratories, and review or oversee the validation of the analytical reports prepared.

The Lead Geologist/Hydrogeologist will advise the PM and FOL regarding the interpretation of the subsurface materials encountered, location of borings and wells to be installed, and behavior of contaminants based on those subsurface materials and anticipated groundwater movement.

The CLEAN Health and Safety Manager is responsible for reviewing health and safety plans for all CLEAN operations, and performs site audits to ensure compliance with program and site health and safety requirements.

The Quality Assurance Manager is responsible for QA/QC requirements for the TtNUS CLEAN program. This individual reviews data and deliverable documents, and performs system audits to ensure contract QA/QC goals are met.

A Site Safety Officer (SSO) will be designated prior to field activities and will be responsible for ensuring adherence to the site-specific Health and Safety Plan. The SSO reports directly to the CLEAN Health and Safety Manager and the PM.

In addition to the above personnel, TtNUS program personnel will provide overall support in subcontracting, cost tracking, progress reporting, and supervising the PM. The program personnel include:

John Trepanowski, P.E., Program Manager
TtNUS, King of Prussia, PA Phone: (610) 491-9688 Fax: (610) 491-9647

Garth Glenn, P.E., Deputy Program Manager
TtNUS, King of Prussia, PA Phone: (610) 491-9688 Fax: (610) 491-9647

1.4 CHANGES TO THE WORK PLAN

Work Plan development is performed in steps, with the Navy providing draft, draft final, and final versions to oversight parties to allow for comments and other input. However, during the project execution, it may become necessary to modify the Work Plan after it is finalized. If the plan for collecting data needs to be altered, the Work Plan may be amended through the use of a Request for Field Modification (RFM) form. This form will be prepared by the TtNUS FOL and forwarded to the TtNUS PM. The PM will make a recommendation to the Navy RPM, who will forward the RFM to NSN and NUWC representatives, and to the regulatory oversight RPMs. Time limits on acceptance of, or comment to, the field modification requests will be stated.

When changes require immediate action, the proposed change will be implemented at the discretion of the TtNUS project manager in order to avoid schedule delays, cost impacts, and/or subcontractor standby times. The Navy and regulatory agencies will be notified through delivery of the RFM as described above.

An example of the RFM form is presented in Appendix D.

1.5 SCHEDULE AND REGULATORY OVERSIGHT

A schedule for field investigations will be prepared and submitted to the oversight parties upon development of a cost/schedule proposal to perform the field work. This schedule will be updated as necessary to inform oversight personnel when different tasks and activities are scheduled to occur. Weekly Progress Reports will be provided for planning purposes. A 24-hour advance notification of changes in scheduled field activities will be given to the regulatory agencies.

2.0 BACKGROUND INFORMATION

This section presents the project planning effort and project definitions. Within this section, the site location and description, site history, watershed contaminant source information, data use evaluation, problem definition, and the outline of a conceptual site model are presented.

2.1 SITE LOCATION AND DESCRIPTION

Gould Island is located in the East Passage of Narragansett Bay in Rhode Island, approximately 1.5 miles west of Newport, Rhode Island. Gould Island is located between Aquidneck and Conanicut Islands, and occupies approximately 52 acres (Figure 2-1). Building 32 (Site 17), located on the northeast end of Gould Island, served as a torpedo overhaul shop that has been inactive since the 1950's (Figure 2-2).

Appendix A of this Work Plan, the Background Summary Report for Site 17, presents a detailed summary of the Building 32 area (the Site). This summary includes a physical description of the area, the buildings that were present there, a history, and a summary of environmental investigations and removal actions conducted at the Site.

To summarize from Appendix A, the Site is located on the north portion of Gould Island, and occupies approximately 6 acres of land. In 2001 and 2002, the buildings on the Navy-held portion of Gould Island were demolished to the existing grade, with the at-grade slab foundations left in place. Some of this demolition material was used to backfill an excavation area at the former Building 44 area, and the remainder was moved offsite for land disposal elsewhere.

The north end of Gould Island where the Site lies is a weathered point of land, subject to prevailing wind exposure and currents almost year round. Sedimentation is not evident in the intertidal areas, but some may have occurred in the boat basin adjacent to the firing pier. The intertidal shoreline is subject to wave action and consists of a mixture of rotted steel sheetpile wall and a stony beachface.

The subject of this RI is the Building 32 area, and lacking further definition, the investigation area is generally discussed as the area on the north end of the island. This area was developed from coastal agricultural land in the early 1940s. At the east shoreline of the island (south of the Site), the overburden is very thin or nonexistent, and bedrock is exposed in places and eroding under the normal wave action, forming a shingle style beach face (Figure 2-3). Bedrock is undulating, brittle, and highly fractured, allowing available water to seep through the fractures. There is no pervasive dip or strike to the exposed bedrock on the east shore, due to the extreme undulations.

BASE MAP IS A PORTION OF THE FOLLOWING 7.5 X 15 MINUTE U.S.G.S. QUADRANGLE:
PRUDENCE ISLAND, RHODE ISLAND, 1955, PHOTOREVISED 1970 AND 1975

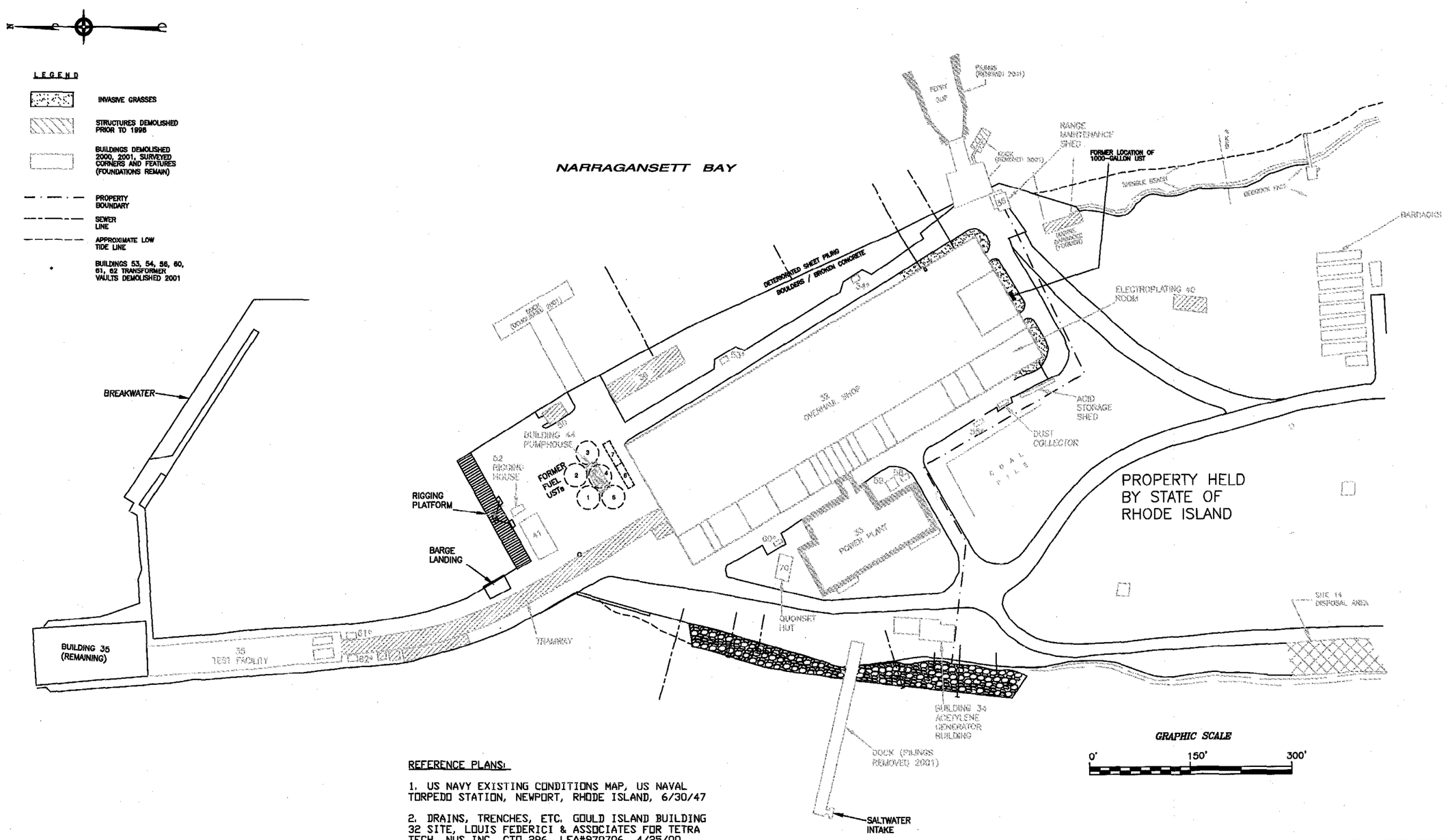
GRAPHIC SCALE
0 0.5 MILE 1 MILE

QUADRANGLE LOCATION

SITE LOCUS	FIGURE 2-1
SITE 17, GOULD ISLAND	TETRA TECH NUS, INC.
NAVSTA NEWPORT, RHODE ISLAND	

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	S. PARKER	DATE:	DECEMBER 27, 2002
SCALE:	AS NOTED	ACAD NAME:	DWG\5152\0430\FIG_2-1A.DWG

55 Jonspin Road Wilmington, MA 01887
(978)658-7899



REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47

2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00

3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03

4. LOCATION OF MONITORING WELLS AT BUILDING 32 - GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/9/00

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.

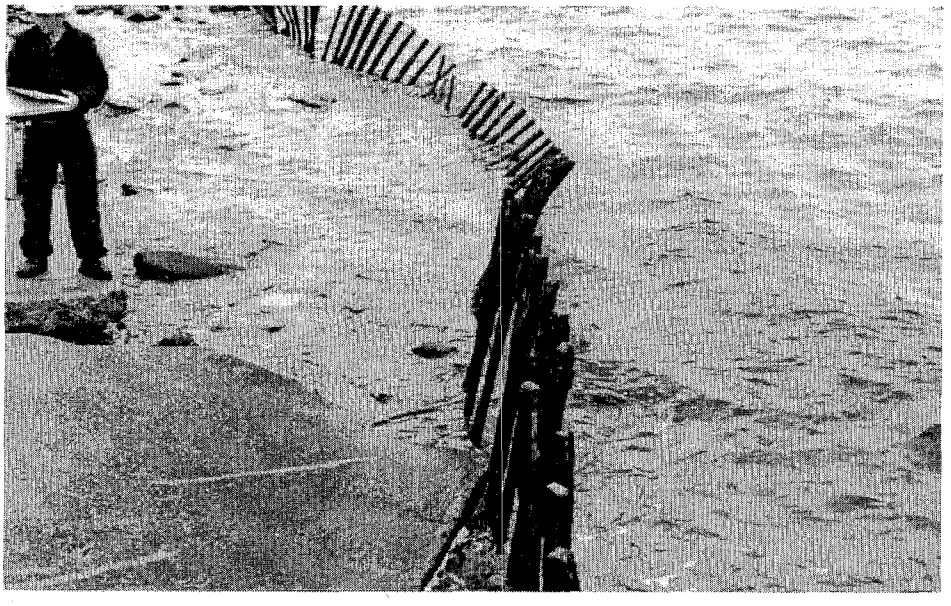
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.

3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

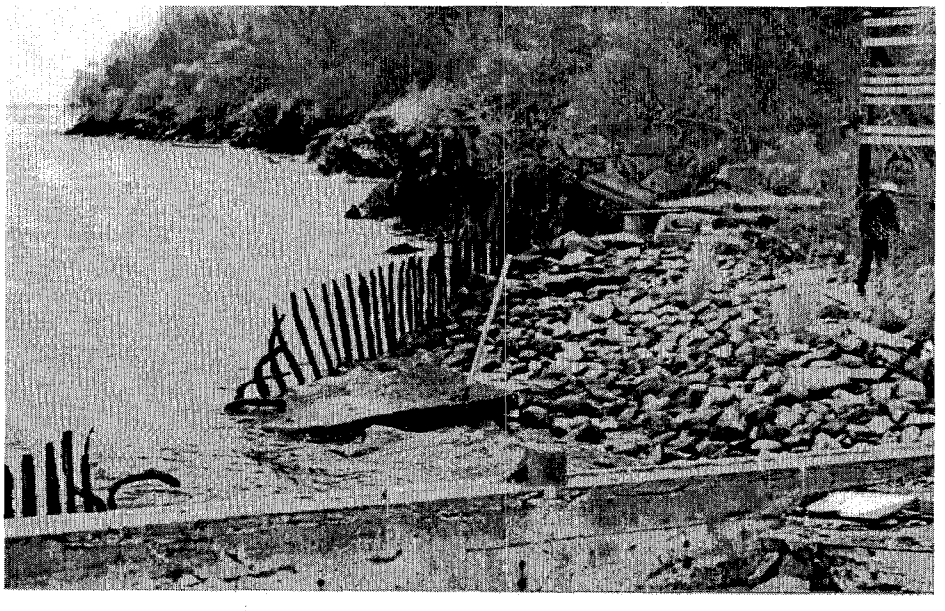
BASE MAP			FIGURE 2-2
SITE 17, GOULD ISLAND			TETRA TECH NUS, INC.
NAVSTA NEWPORT, RHODE ISLAND			55 Jonspin Road Wilmington, MA 01887 (978)658-7899
DRAWN BY:	D.W. MACDOUGALL	REV.: 0	
CHECKED BY:	S. PARKER	DATE: JANUARY 23, 2003	
SCALE:	AS SHOWN	FILE NO.: DWG\5152\0430\FIG_2-2.DWG	

0365A022

FIGURE 2-3
PHOTOS OF EAST SHORE, GOULD ISLAND
MARCH 1997



SHORELINE EAST OF BUILDING 32
AT LOCATION OF FORMER ELECTROPLATING ROOM DRAIN OUTFALL
(VIEW IS TO THE NORTH)



EAST SHORELINE SOUTH EAST OF BUILDING 32
SHOWING BEDROCK OUTCROPS AND STONY BEACH IN PREVIOUS FILL AREA
(VIEW IS TO THE SOUTH)

2.2 SITE HISTORY

Gould Island was purchased in 1918 (Presidential Proclamation, 1918). The northern end of the island, where the site resides was developed in the 1940s as a weapons support center for naval vessels. Ownership of the southern three-fourths of the island was recently transferred to the State of Rhode Island. Naval Station Newport (NAVSTA) retains ownership of the northern section. A fence separates the two properties, as shown on Figure 2-2.

To summarize from Appendix A, the Site housed electroplating, machining, parts washing, buffing, grinding, and other machinery operations during the 1940s until 1951 (EEI, 1983). Other structures on the NAVSTA property included transformer buildings, an acetylene generator building, administration building, and various structures used for loading and unloading personnel, torpedoes, and other material from small vessels.

A number of targeted environmental investigations and removal actions have been performed to date, as described in Appendix A. Based on the documentation from these efforts, the following environmental conditions are likely to exist:

Groundwater Contamination – Groundwater appears to contain low concentrations of petroleum, chlorinated solvents, polycyclic aromatic hydrocarbons (PAHs), and metals. Low concentrations of these contaminants are currently known to exist in the former Building 44 area. Groundwater movement at the Site is likely to reflect surface topography, discharging to the bay, which surrounds the Site on three sides.

Vadose Zone Contamination – Chlorinated solvents, toluene, and PAHs were found in soil gas samples from the vadose zone in the area north of Building 32 in 1997, and under the Building 32 foundation in 2000.

Soil Contamination – Soils containing PCBs at concentrations below 10 milligrams per kilogram (mg/kg), are likely to be present at the former locations of support structures within Site 17, including Buildings 52, 53, 54, 56, 59, 60, and 61. Additionally, some oil (probable #2 Fuel) was encountered in the excavation for the Building 56 foundation (Foster Wheeler, 2003).

Sediment Contamination – Based on historical records, wastes from solvent cleaners and electroplating operations were likely discharged to Narragansett Bay from the east side of Building 32 through a floor drain system.

2.3 WATERSHED CONTAMINANT SOURCE INFORMATION

This section has been prepared in accordance with the Navy/Marine Corps Installation Restoration Policy on Sediment Investigation and Response Actions, dated February 8, 2002. The Department of the Navy has installations along water bodies that are impacted by multiple activities, including municipal and private industrial entities. The aforementioned guidance document states the policy on sediment investigations and response actions to be implemented in the restoration of the Navy's Installation Restoration (IR) sites. Site 17, the subject of this Work Plan, has been designated as an IR site by the Navy. This section provides a baseline of information for the watershed area, and contaminants that might be expected even without the presence of the Site.

2.3.1 Description

This section details the physical features of Narragansett Bay, including the extent of the watershed, the geology and hydrogeology of the Bay and the hydrodynamics within the Bay. A description of the biological receptors is discussed as well.

Narragansett Bay is a large estuary, that is, a region where fresh water and ocean water interact, resulting in a brackish environment with a salinity range of 0.5 to 30 parts per thousand (ppt). The estuarine environment is highly productive for a variety of species since the deep water tidal habitats and adjacent tidal wetlands provide a complex and interrelated web of habitats defined by geology, river-flows and tides. These factors affect the composition, distribution and productivity of the biological communities that comprise the estuary. In addition, factors such as climatological forces and more recently, anthropogenic influences, have impacted the physical, chemical and biological composition and contribute to the present day estuary, Narragansett Bay.

2.3.1.1 Watershed

The Narragansett Bay watershed covers a land area of 1,853 square miles, which is more than 10 times the area of the Bay. Approximately 60 percent of the watershed is located in Massachusetts and 40 percent in Rhode Island. The three most significant tributaries to the Bay are the Blackstone, Taunton and Pawtuxet Rivers, which contribute an estimated 2.1 billion gallons of freshwater daily to the Bay. Currently, there are 100 cities and towns located within the watershed and the population density averages 1,100 persons per square mile.

2.3.1.2 Geology and Hydrogeology

Regional geologic information pertinent to the Work Plan for Remedial Investigation at Site 17 is presented below. Much of the regional geologic information was presented in the Draft Final RI report for the Old Firefighting Training Area prepared by Tetra Tech NUS, Inc. (2000).

Regional and Local Overburden Geology

The geology of the region, in general, consists of glacially-derived unconsolidated deposits overlying Pennsylvanian age sedimentary bedrock (USDA 1981; Hermes et al 1994). Wisconsin-age glaciers covered the region with ice several thousand feet thick. During ice advances, sediment and bedrock were eroded and carried beneath the ice sheet. As the glaciers melted and receded, unconsolidated glacial materials of variable thickness were deposited throughout the Narragansett Basin area. These glacial materials included till and sorted sand, silt, and gravel (USDA, 1981; EEI, 1983).

Till is the most extensive of the glacial deposits in Rhode Island. This deposit is unstratified and widely heterogeneous in grain size distribution, typically comprised of fine (clay/silt/sand) and coarse (pebbles/cobbles/boulders) fractions (USDA 1981). In southern New England, the late Wisconsinan surface till is predominant. Published reports indicate that the surface till forms a discontinuous mantle over bedrock uplands and beneath stratified drift deposits. In general, the surface till comprises a loose sandy unit containing boulders and cobbles, and lenses of stratified sediments. However, surface tills vary in composition. The physical characteristics of surface till generally reflect local bedrock and older surficial materials from which the deposit was derived (Melvin et al, 1992).

Regionally, the Upland till plains, the Narragansett till plains, and the Charlestown and Block Island end moraines are till deposits in Rhode Island. NAVSTA Newport is located on the Narragansett till plain. This glacial till deposit may have been derived from a sedimentary and meta-sedimentary rock provenance (USDA, 1981).

Stratified drift or outwash, composed of sorted sand, silt, and gravel deposits, were laid down by glacial meltwaters as the ice sheet receded. The eroded materials carried by the glacial meltwater were deposited in irregular layers of various thicknesses. Regionally, large deposits of outwash are located in Providence and East Greenwich (USDA, 1981).

Soils found on Gould Island are classified as Newport Series by the Soil Survey of Rhode Island. These soils are formed in compact glacial till derived from dark sandstone, conglomerate, argillite, and

phyllites. Permeability is generally moderate at the surface and low in the substratum (B&RE, November 1997).

Regional and Local Bedrock Geology

Narragansett Basin is an ancient structural basin originating near Hanover, Massachusetts. This basin is a complex synclinal mass of Pennsylvanian aged, non-marine sedimentary rock, and is the most prominent geologic feature in eastern Rhode Island and adjacent Massachusetts. The basin's approximate length is 55 miles; its width varies from 15 to 25 miles. The western margin of the basin is in the western portion of Providence, Rhode Island, and the eastern margin extends through Fall River, Massachusetts. Exposures of older rocks on Conanicut Island and in the vicinity of Newport suggest that the southern extent of the basin may be near the mouth of Narragansett Bay. Gould Island is situated at the southeastern end of the Narragansett Basin (EEI, 1983).

The rocks within Narragansett Basin chiefly consist of conglomerates, sandstones, shales, and anthracite. Total thickness of the strata in the basin has been estimated at 12,000 feet. Many folds and some faults occur throughout the basin, but the character and amount of the folding and faulting was not evaluated as part of this report. Refer to Hermes et al (1994) for a depiction of the faults mapped in the surrounding area.

The bedrock of the Narragansett Basin has been divided into six units, including the Purgatory Conglomerate and the Rhode Island Formation, which underlie Gould Island (Hermes et al, 1994). The contact between the two units has been mapped as crossing the eastern portion of the Site in a north-south direction. Refer to Hermes et al (1994) for a detailed depiction of the bedrock geology of Rhode Island.

The Purgatory Conglomerate is a buff to pale-gray conglomerate consisting of pebbles, cobbles, and boulders comprised of quartzite, with a matrix of primarily quartz. Some of the cobbles and boulders have been elongated as a result of tectonic forces in the southern portion of the basin (Hermes et al, 1994).

The Rhode Island Formation is the most extensive and thickest of the Pennsylvanian formations in Rhode Island. The majority of the Narragansett Basin is underlain by this formation. In northern Rhode Island, the Rhode Island Formation is not metamorphosed and primarily consists of gray to black, fine- to coarse-grained quartz arenite, litharenite, shale, and conglomerate. However, in the southern portion of the basin, such as in the vicinity of NAVSTA Newport, this unit has been metamorphosed.

Metasedimentary rocks, including metaconglomerates and metasandstones, as well as schist, carbonaceous schist, phyllites, and graphite are present within the formation (Hermes et al 1994).

No bedrock exposures have been observed at the northern end of Gould Island. However, bedrock is exposed south of the former Building 32 on the east side of the island, along the shoreline. Bedrock in the vicinity of Gould Island is mainly metamorphic rock, predominately phyllites and schists, which are exposed at outcrops at the main-base area of NETC, approximately two miles to the east of Gould Island.

Regional and Local Surface Water Hydrology

All surface water drainage from the Narragansett Bay watershed empties into Narragansett Bay. Gould Island, located in Narragansett Bay, is a part of the Bay's watershed. At Site 17, precipitation either evaporates, infiltrates the soil or flows overland towards the Bay. Surface water runoff enters the Bay as a result of direct overland flow or as discharge from the existing stormdrain network located on the Site.

Regional and Area Surface Water Classifications

All surface waters of Rhode Island have been categorized according to water use classifications considering public health, recreation, propagation and protection of fish and wildlife, as well as economic and social benefit. According to RIDEM's Water Quality Regulations and Water Quality Classification Descriptions, each class is defined by the most sensitive water uses to be protected (RIDEM, 1997). Generally, all waters shall be suitable for aquacultural uses, navigation, and industrial cooling, and have good aesthetic value.

Most of Narragansett Bay, including the area surrounding Gould Island, is described as Class "SA". This water quality classification denotes the water quality goal for the waterbody. Class "SA" seawaters are designated for shellfish harvesting for direct human consumption, primary and secondary contact recreational activities, and fish and wildlife habitat (RIDEM, 1997).

Site Surface Water Hydrology

No surface water bodies are present on Site 17, though it is bounded on 3 sides by Narragansett Bay. The general site topography slopes slightly from the southwest to the northeast. Narragansett Bay surrounds Gould Island and borders Site 17 to the north, east and west. The shoreline consists of mainly manmade materials, including concrete slabs, degrading steel and wooden pilings, and building rubble.

There is a sandy beach at the far southern point of Gould Island. Surface water runoff (precipitation) from the Site either evaporates, infiltrates into the Site soils, ponds on-site, or flows directly into the Narragansett Bay. Surface water runoff generally flows from southwest to northeast across the Site. Remaining building foundations, asphalt-paved roads, and an existing storm drain network beneath the Site redirect the surface water flow before it is discharged into Narragansett Bay.

Wetlands

Gould Island is designated an upland area. Published maps do not indicate the presence of wetlands on the island (USDOI, 1975).

Groundwater Hydrogeology and Groundwater Classifications

The groundwater hydrogeology and groundwater classifications for Site 17 are presented in the Background Summary Report (Appendix A, Section 2.5.2).

2.3.1.3 Hydrodynamics

Narragansett Bay is composed of three distinct north-south oriented, interconnected branches: West Passage, East Passage and the Sakonnet River. The Bay is 25 miles long and 10 miles wide, with a surface area of approximately 132 square miles at mean low water. The average depth of the Bay is 29 feet and the maximum depth, located within the lower East Passage, is 188 feet.

Narragansett Bay is a temperate, partially to well mixed estuary with an average salinity of 29 to 31 ppt. This is less than the salinity of seawater at 35 ppt. A salinity gradient extends from the head (Upper Bay) to the mouth of the Bay, with the lowest salinity levels present in areas of fresh water tributary discharge. Narragansett Bay is bound by fresh water inputs from the north and the salty inner shelf water of Rhode Island Sound to the south.

Circulation patterns within the Bay are generally north to south and are driven by competing tidal, wind and density forcing (URI and SAIC, 1995). Tidal forces interact with a highly variable bottom topography and result in a well mixed estuary. The mean flushing time for the Bay is 26 days (Ely, 2002) and the fresh water discharge from watershed tributaries varies between a minimum of 20 m^3/s in late summer-fall to >300 m^3/s in winter-spring months (URI and SAIC, 1995). Primarily, circulation in the Bay is driven by tides, and secondary circulation patterns result from wind forces (Weisberg 1976; Weisberg

and Sturges 1976; Gordon and Spaulding 1987). The prevailing wind direction changes seasonally and is generally from the southwest in the summer and the northwest in the winter.

The General NOAA Oil Modeling Environment (GNOME) model, a hypothetical spill model used by the US Coast Guard to predict contaminant spill distribution, was applied to determine the hydrodynamic response and the possible trajectory of sediment deposition within the Bay. The model integrates information for local oceanographic conditions including current patterns, relevant climatological and tidal information to simulate a response to selected parameters. The input parameters include wind (the velocity, direction, and consistency), contaminant selection and time scale.

GNOME is primarily utilized to generally predict the distribution of petroleum contaminants within a certain area for a specified amount of time. The precision of the modeled outcome is unknown, though "uncertainty estimates" of the modeled trajectory is provided for additional analysis. Modeled parameters include an assumed density of the selected contaminant particles and the contaminants to be biodegradable. Contaminant-specific physical and chemical properties are not generally accounted for in the model. There are limitations to selected parameters that affect how true-to-life the modeled trajectory will be.

According to the GNOME model, Narragansett Bay is a high-energy system. Contaminants move quickly throughout the system and are diluted in a short amount of time, depending on the physical and chemical properties of the contaminant. Depositional patterns coincide with the general north-south flow gradient and are highly affected by storm events and significant changes in wind patterns. Modeled scenarios had considerable dispersion of contaminants throughout a wide area of the Bay within a short amount of time.

Sediment Deposition

Sediment deposition is a continual process that occurs in areas of less kinetic energy, including coves, inlets and protected areas. Depositional areas are located at the inlets of tributaries into the Bay and in areas where topographic surface features form a barrier to sediment flow. Sediment movement is to the south as a result of circulation patterns within the Bay. Generally, the surface sediments of Narragansett Bay are silty sand, as determined by a study of samples collected from 942 stations by McMaster (1990). Some contaminants such as metals and PCBs adhere to sediment particles. It is therefore possible to use observed sedimentation to determine the origination of an attached contaminant. Layered sediment particles in stable depositional areas can be analyzed for contaminants to identify the age of deposition and then correlated with known historical records to determine the source. However, the disturbance of

deposited, contaminated sediments during severe storms or dredging projects, re-suspends the contaminants and sediments in the water and renders this type of evaluation more difficult (RIDEM, 2000).

2.3.1.4 Receptors

Narragansett Bay and the life that it supports are both economically and ecologically important. There are sixteen listings for threatened and endangered species in the State of Rhode Island (U.S. Fish & Wildlife Service, 2002). According to the Rhode Island Natural Heritage Program (Enger, 2002) there is low potential for habitation of federal or state endangered or threatened species in Narragansett Bay. The species that have been identified as target receptors of concern within the Bay include: the snowy egret (Egretta thula), the great blue heron (Ardea herodias), the herring gull (Larus argentatus), the American Oyster Catcher (Haematopus palliatus), and in general, colonial nesting birds. These birds are not identified on the federal or state endangered or threatened species list for Rhode Island (RIDEM, 1999).

The commercial and recreational fisheries associated with the Narragansett Bay drainage basin are valued at several million dollars (NOAA, 2002). Specifically, the Bay's commercially important species include: demersal and pelagic fish, shellfish, lobster and squid. Of the demersal fish in the Bay, the winter and summer flounder, tautog and black sea bass are of interest, in addition to the pelagic fish species, bluefish, striped bass, scup, squeteague, menhaden, Atlantic herring and alewife. Quahogs and oysters are also commercially significant (Ely, 2002).

Areas in the Lower East Passage are intensely fished, especially for lobster. Approximately 20 percent of the Bay's area is permanently closed to shellfishing and an additional 11 percent of the Bay has "conditionally approved" areas that are closed after heavy rains (Ely, 2002). A permanent closure area due to pollution is located in the East Passage and downstream of Gould Island. Bivalve species (clams, mussels, oysters, etc.) are the only species included in the shellfish management area bans, allowing collection of crab, lobster, and finfish.

Keystone organism populations include eelgrass, algae and plankton. The status of these species is an indication of the overall health of the Bay. There are no significant eelgrass beds north of Jamestown (RIDEM, April 2000). Eelgrass is a critical refuge habitat for benthic organisms. Plankton are the basis for the Bay's food web while algae is used more as an indicator of the level of available nutrients. Algael blooms generally result from an increased level of available nutrients in the system. The effect of such a

bloom can have a significant impact on the chemistry of the water and in turn, affect the rest of the nutritional ladder.

The relationship between benthic organisms and sediment type is separated into two dominant habitats in the lower Narragansett Bay and adjacent Rhode Island Sound. The first habitat, Lower Bay Complex, consists of a mixture of sediments containing sand and has an abundance of Mytilus (mussel) and Crepidula (slipper shells) shells. The mid-estuarine and estuarine-offshore species found in this habitat are Pherusa affinus (deposit feeding polychaetes), Aricidea (polychaetes), and Ampelisca vaderum (amphipod crustacean) (French et al, 1992). The second habitat, Marine Silty Sand, is typical of Rhode Island Sound and extends into the East Passage. The benthic fauna are characterized by such marine species as Astarte (bivalve), Cyclocardium (bivalve), Byblis serrata (amphipod), and Arctica islandica (bivalve) (Quinn et al, 1995).

The amphipod populations of Leptocheirus pinguis and Casco bigelowii are abundant in sand to silty sand sediments of the Lower East Passage. The burrowing activities of these organisms create a soft, high-water content and well-oxygenated sedimentary environment, which results in the mixing of the sediment surface and the overlying water column. (Quinn et al, 1995)

2.3.2 Contaminants Present

In considering the large size and location of the watershed, contaminants are likely introduced to the system from point and nonpoint sources. This section provides a general overview of the regional contaminants and their sources. Possible site-specific contaminant contributions are described in Sections 2.2 and 2.4 of this work plan.

2.3.2.1 Regional Sources

The Narragansett Bay watershed is one of the most populated watersheds in the country, with an average of more than 1,100 persons per square mile. The Blackstone River, a tributary to the Bay, was the location of the start of the Industrial Revolution in the United States in the 1700's. During the Industrial Revolution, textile mills were situated along the tributaries to the Bay which caused a corresponding population shift to the cities to support the developing textile industry. The machine tools industry then expanded in support of the rapid industrialization that occurred during the 1800s. At the time of the Civil War, production of armaments in factories located on the tributaries increased and was followed by the expansion of the jewelry and silver industries after World War II. The net result of the

industrialization and the untreated sewer and industrial discharges of the watershed drainage basin area was an increase in the input of metals and other toxic substances to the Bay (RIDEM, 2000).

Regional sources of contamination to Narragansett Bay include 7,624 Resource Conservation and Recovery Act (RCRA) sites located within the drainage basin. According to the Environmental Protection Agency's National Priorities List (NPL), eleven sites in Rhode Island and six in Massachusetts are within the limits of the watershed and are of specific concern. These sites are identified as having inorganics, metals, PAHs, PCBs, petroleum hydrocarbons, petroleum naphtha and VOCs as the contaminants of concern in sediment and/or surface water (USEPA, 2002). While VOCs and lighter fractions of SVOCs will dilute and volatilize, PCBs, heavier molecular weight PAHs, and some metals are persistent and will be transported down-bay with fine grain sediments.

Narragansett Bay receives effluent from wastewater treatment facilities and discharge from combined sewer overflows (CSOs) and industries. There are 33 wastewater treatment plants in the Narragansett Bay watershed (Ely, 2002). CSOs are the discharges resulting from the combined sanitary sewers and storm drains that were constructed to manage both stormwater and sewage in urban areas. During heavy rains, the stormwater flow exceeds the capacity of the wastewater treatment facility and all of the flow, including untreated human waste, is discharged directly to the Bay via the CSOs. CSOs are a significant source of nutrient loading, including nitrogen, for the Bay (RIDEM, 2000).

The pretreatment of industrial wastes has decreased the amount of metals and other toxic substances entering the wastewater treatment facilities. Correspondingly, there has been a decrease in the discharge of metals concentrations into the Bay over the past 15 to 20 years, due to government regulations (RIDEM, 2000).

There are PCBs known to be present in the sediments of the Bay and of the rivers feeding the Bay. Sampling conducted by the USEPA on the Woonasquatucket River found concentrations of PCBs in the associated sediments and fish tissues, in the reaches from Johnston to Providence. The Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) performs periodic monitoring of sediments in the upper reaches of the Narragansett Bay estuary, upstream of Gould Island, and their monitoring work has repeatedly identified PCBs in sediment samples exceeding the NOAA effects-range median (ERM) benchmark of 180 µg/kg.

Arsenic has been found to be present in soils and sediment in the region at concentrations exceeding the RIDEM direct exposure criteria. Arsenic is a naturally occurring toxic element, typically found in natural soils between 1 and 20 mg/kg, depending on the parent materials. Some coal-like rock types found in

Rhode Island can contain significant concentrations of arsenic-bearing materials. The soil overlying the bedrock in Rhode Island is anticipated to contain varying concentrations of arsenic, depending on the parent materials and other factors. Manmade sources of arsenic include coal and coal ash, agricultural chemicals, and chemicals used in tannery operations (Kowalski et. al., 1999).

Lead contamination in the Bay is one specific example of the effect of human activities. During the Industrial Revolution, lead was used to help fix the dyes as part of textile manufacturing. The manufacturing of machinery contributed even more lead to the rivers flowing into the Bay. Another significant source of lead was from gasoline before it was required to be unleaded. Government regulations combined with an increase in technology and environmental awareness have limited the amount of metals, including lead and other contaminants, that enter the Bay (Ely, 2002).

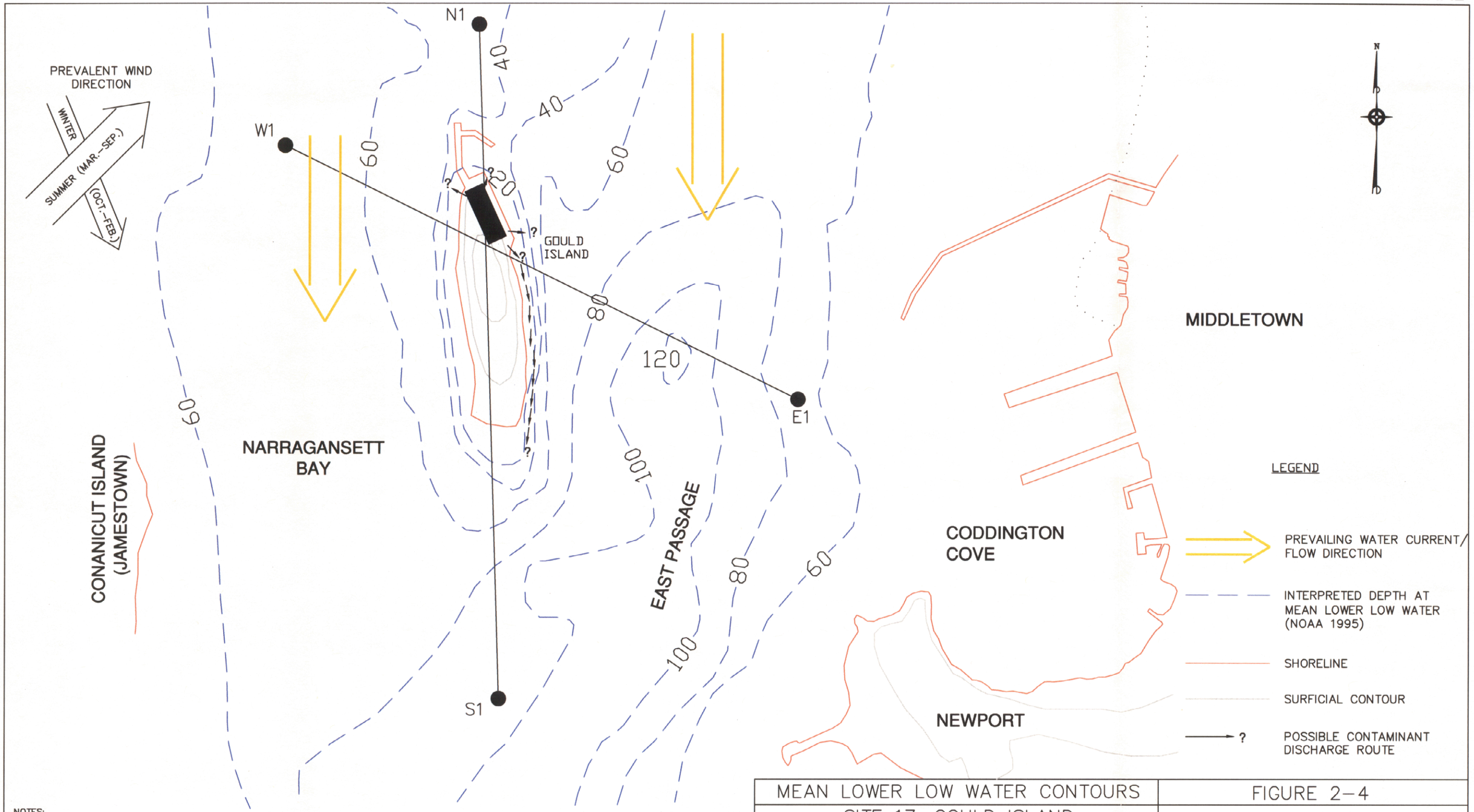
2.3.3 Summary

Contaminants originating from historical site activities and/or regional sources may be present near the Site. However, as described elsewhere in this section, some classes of contaminants are more persistent in the environment than others, and may behave differently. PCBs, high molecular weight PAHs, and metals tend to be more stable, adhere to soil or sediment particles, and therefore are more readily found in depositional sediment areas. VOCs and the lighter SVOCs are more soluble in water and are likely to dilute out or be metabolized by microorganisms. Since the site is in a relatively remote portion of the estuary, the non-site-related contaminants that come to be located near it are likely those that are more persistent in the environment, that is, PCBs and metals. Arsenic is likely to be present in ubiquitously elevated concentrations, and VOCs and lighter SVOCs that are found near the Site are more likely to be site-related, and not from regional conditions.

2.4 CONCEPTUAL SITE MODEL

Using the information provided in Appendix A and Sections 2.1 through 2.3, a conceptual site model has been developed to better understand how contaminants discharged at and near the Site would likely behave and interact with the surrounding soil, water and bedrock. This understanding will direct the development of the investigation, and the plan for that investigation.

A conceptual model for this Site has been developed around three two-dimensional views of the Site and its surrounding landforms. Some of the information required for a conceptual site model is not yet known, and is therefore estimated. Figure 2-4 provides the first view, which is an overhead view of the Site and its surroundings, including water depths near the island.



NOTES:

1. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BOTTOM CONTOUR DATA INTERPRETED FROM NOAA CHART 13221, APRIL 15, 1995.
4. WIND ROSE INFORMATION FROM NORTHEAST REGIONAL CLIMATE CENTER, CORNELL UNIVERSITY, AUGUST 2000.

MEAN LOWER LOW WATER CONTOURS			FIGURE 2–4
SITE 17, GOULD ISLAND			
NAVSTA NEWPORT, RHODE ISLAND			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	APRIL 4, 2003
SCALE:	AS SHOWN	FILE NO.:	DWG\5152\0430\FIG_2–4.DWG

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658–7899

Figure 2-5 presents two cross-sections bisecting the Site. The first cross-sectional view is west to east (view to the north) and the other cross-sectional view is north to south (view to the east).

The second-tier conceptual site model diagram is presented on Figure 2-6. The diagram illustrates the general movement of contaminants based on chemical behavior and natural processes. Specific sources, flow paths and depositional areas are identified within the model for reference.

These figures show possible contaminant flow paths based on the information available on the Site to date. Pertinent information is presented below, according to chemical groups. Contaminants discussed in the sections that follow are known or suspected to exist at the Site, as described in Appendix A of this Work Plan.

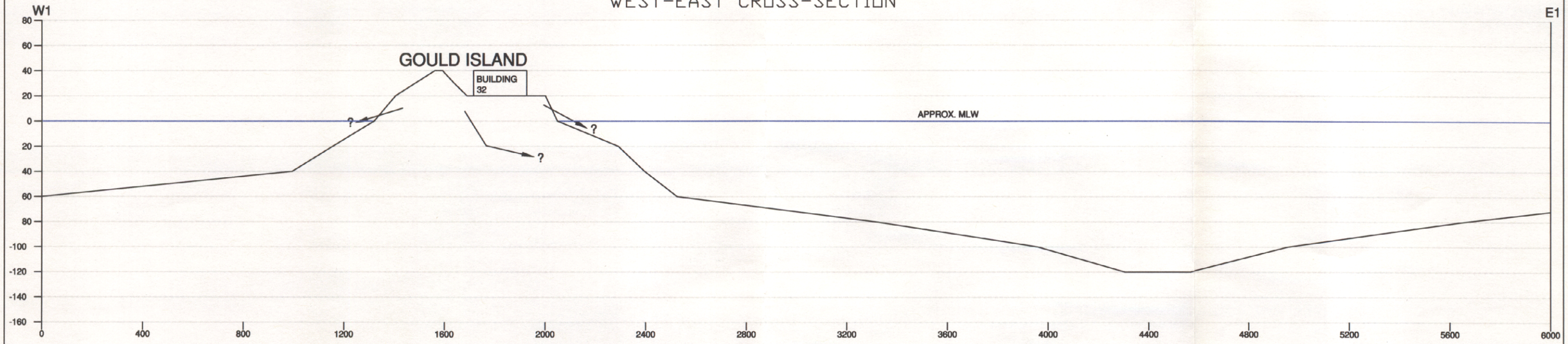
The third tier conceptual site model is presented on Tables 2-1 through 2-4. These tables summarize possible contaminant behavior at this Site for each primary release mechanism (underground release to soils and groundwater; overland release to soil, groundwater and surface water; release through intertidal and subtidal groundwater seeps; and direct waste discharge to surface water).

PCBs remaining in soils or sediments at discharge locations:

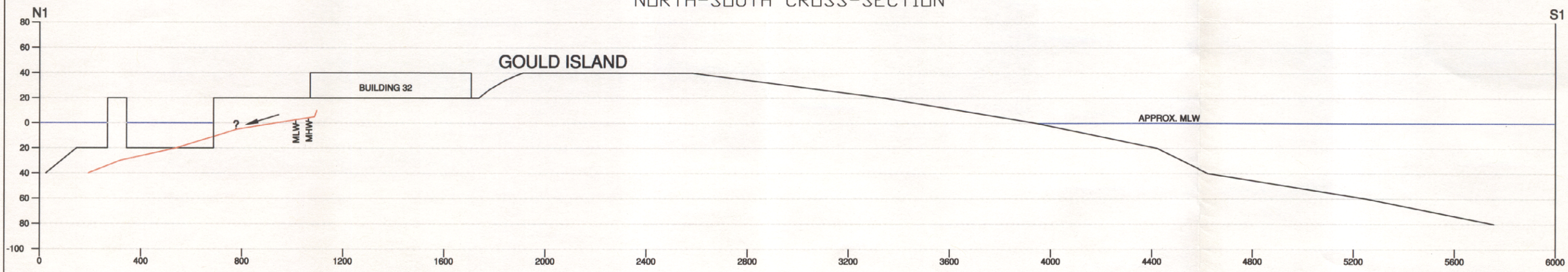
PCBs are hydrophobic, tending not to dissolve in water or bind with water molecules, and they are lipophilic, meaning they are attracted to fats and oils. PCBs are also chemically stable, resisting decomposition. Therefore, the PCB molecules tend to adhere to soil or sediment particles, and if given liberty to travel in this form, they will become stored in the sediments of waterways. If they are ingested, they will tend to gather in the fat tissue of animals.

PCBs released to the ground at the former transformer buildings will likely have traveled as far as the free oil from those transformers has traveled, but once that extent was reached, the PCB molecules will likely have remained in the soils, or traveled overland or through storm drains to discharge areas along the shorelines. If they were taken up by organisms grazing or filterfeeding in the discharge areas, those PCBs might have entered the food chain. Some may also have been washed out with soil by wave action and these would persist with the soil particles, becoming bedded with any sediment depositional areas nearby.

WEST-EAST CROSS-SECTION



NORTH-SOUTH CROSS-SECTION



L E G E N D

? ← POSSIBLE CONTAMINANT DISCHARGE ROUTE

PRE-CONSTRUCTION ELEVATION TAKEN FROM "GOULD ISLAND FACILITIES GENERAL PLAN", DATED DECEMBER 29, 1941

MHW - MEAN HIGH WATER
MLW - MEAN LOW WATER

NOTES:

1. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BOTTOM CONTOUR DATA INTERPRETED FROM NOAA CHART 13221, APRIL 15, 1995.

VERTICAL GRAPHIC SCALE

0′ 80′ 160′

HORIZONTAL GRAPHIC SCALE

0′ 400′ 800′

CROSS-SECTIONS			FIGURE 2-5
SITE 17, GOULD ISLAND			
NAVSTA NEWPORT, RHODE ISLAND			
DRAWN BY:	R.G. DEWSNAP	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	JUNE 18, 2003
SCALE:	AS SHOWN	FILE NO.:	DWG\5152\0430\FIG_2-5.DWG

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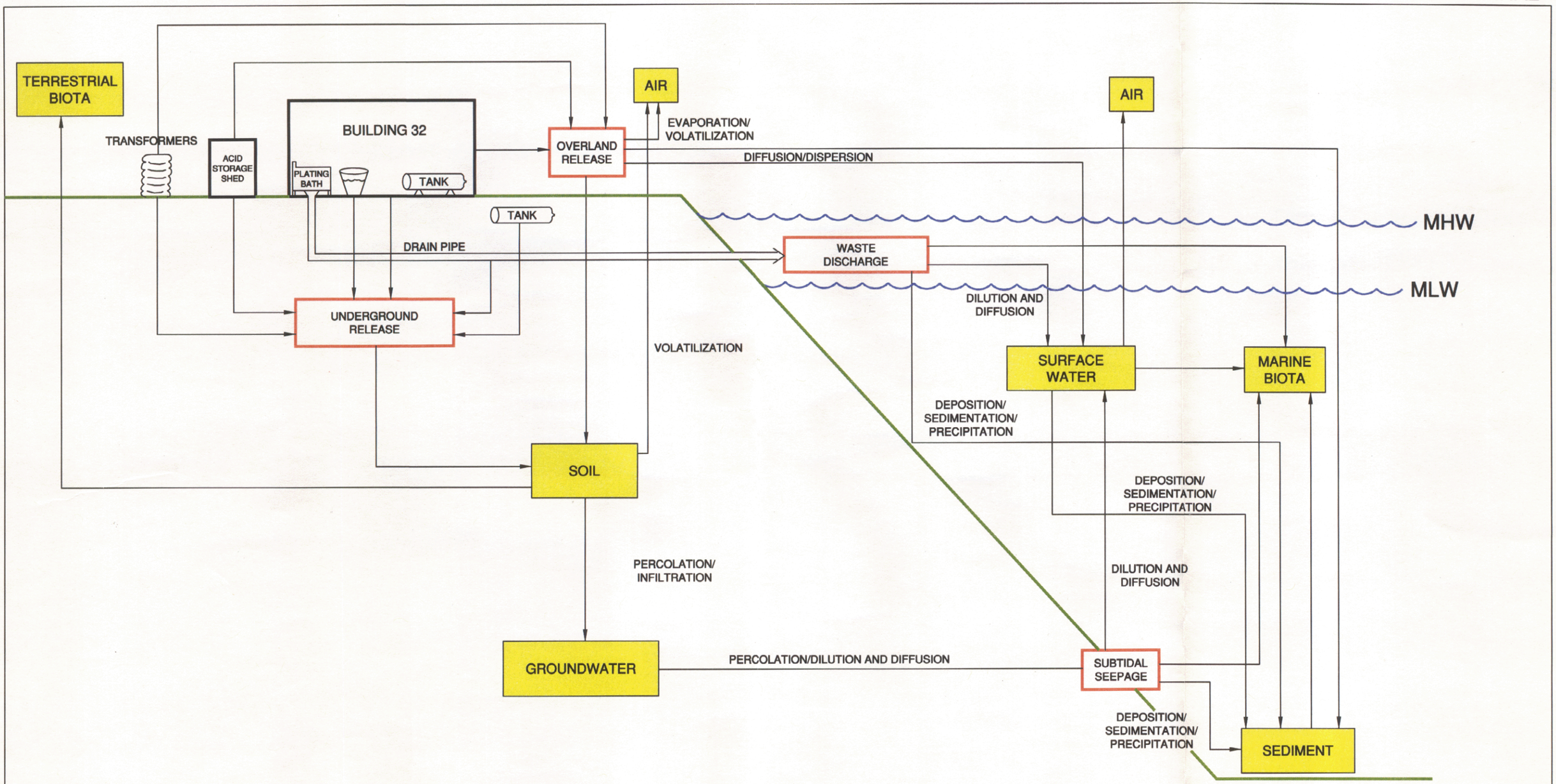

MHW - MEAN HIGH WATER
MLW - MEAN LOW WATER

SECOND TIER CONCEPTUAL SITE MODEL			FIGURE 2-6
SITE 17, GOULD ISLAND			TETRA TECH NUS, INC.
NAVSTA NEWPORT, RHODE ISLAND			55 Jonspin Road Wilmington, MA 01887 (978)658-7899
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	APRIL 4, 2003
SCALE:	NOT TO SCALE	FILE NO.:	DWG\5152\0430\FIG_2-6.DWG

TABLE 2-1
THIRD TIER CONCEPTUAL SITE MODEL – UNDERGROUND RELEASE
REMEDIAL INVESTIGATION WORK PLAN
SITE 17 GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

UNDERGROUND RELEASE

Contaminant	Fate and Transport	Receptors	Measurement Endpoint
Polychlorinated Biphenyls (PCBs)	Adhere to soil particles Hydrophobic, lipophilic Do not decompose, bioaccumulate in animal tissues Do not move with groundwater	Soil	Sample soil
		Terrestrial biota	Model bioaccumulation and uptake
Cleaning Solvents Plating Solvents	Degrade to breakdown products Chlorinated solvents sink, potentially to bedrock Lighter solvents dissolve, move with groundwater	Soil	Sample soil
		Bedrock groundwater Overburden groundwater	Sample groundwater
	Volatilize from ground slowly	Air	Model indoor air concentrations
Fuels	Dispersion, dilution Hydrophobic Degrade or decompose over time Volatilize (lighter fractions) May move with groundwater	Overburden groundwater	Sample groundwater
		Soil	Sample soil
		Air	Model indoor air concentrations
Acids	Reactive – disperse, dissolve, dilute to neutral condition Not persistent Do not bioaccumulate	Groundwater	Monitor pH during well development and purging.
	May accumulate in unsaturated soil under building	Soil	Sample soil
Cyanide	Dissolve/Disperse Dissipate Remnants may remain	Soil Groundwater Sediment through subtidal seepage	Sample groundwater Sample soil Sample sediment
Metals	Percolation to groundwater Adsorption to soil Precipitation under certain conditions Transport to subtidal seep via groundwater	Soil	Sample soil
		Groundwater	Sample groundwater
		Marine biota	Sample marine biota
		Terrestrial biota	Model uptake and bioaccumulation

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TABLE 2-2
THIRD TIER CONCEPTUAL SITE MODEL – OVERLAND RELEASE
REMEDIAL INVESTIGATION WORK PLAN
SITE 17 GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

OVERLAND RELEASE

Contaminants	Fate and Transport	Receptors	Measurement Endpoint
Plating Solvents Ketones Chlorinated Alkenes Aromatic Hydrocarbons	Volatilization Advection into soil Breakdown Dispersion and flow with groundwater	Air (at time of release)	None
		Subsurface soil Overburden groundwater Bedrock groundwater	Sample subsurface soil Sample overburden groundwater Sample bedrock groundwater
	Do not bioaccumulate	None	None
	Overland flow to water, dispersion, volatilization	Soil	Sample soil
		Surface water (at time of release)	None
Cyanide	Overland flow to water, dispersion, dissolution, advection into soil	Soil Sediment (limited)	Sample soil Sample sediment
Heavy metals (cadmium, chromium, zinc)	Overland flow to water, dispersion, precipitation, settling	Surface water (at time of releases	None
		Sediment	Sample sediment
		Biota	Sample biota Model bioaccumulation
	Percolation to deep soils and groundwater, adsorption to soil particles, precipitation under some conditions	Soil	Sample deep soils
		Overburden and bedrock groundwater	Sample groundwater
Polychlorinated biphenyls (PCBs)	Bioaccumulate in animal tissues Hydrophobic, Lipophilic Do not decompose Adhere to soil and sediment	Soil Sediment Biota	Sample sediment Sample soil Sample marine biota Model bioaccumulation (Terrestrial biota)
Acids	Dissolve, disperse, dissipate Dilute to neutral condition Not persistent Do not bioaccumulate	Surface water, at time of release	None
		Groundwater	Direct readings of pH during well development and purging
	May accumulate in unsaturated soil under buildings	Soil	Soil conditions

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TABLE 2-3
THIRD TIER CONCEPTUAL SITE MODEL – WASTE DISCHARGE TO BAY
REMEDIAL INVESTIGATION WORK PLAN
SITE 17 GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

WASTE DISCHARGE TO BAY

Contaminants	Fate and Transport	Receptors	Measurement Endpoint
Plating Solvents	Dissolve/disperse May decompose Volatilize Will not bioaccumulate	Surface water, at time of release	None
		Air at time of release	None
Metals	Dissolve/disperse	Surface water, at time of release	None
	Do not decompose Adhere to sediment/soil particles Precipitate under certain conditions	Sediment Marine biota	Sample sediment Sample shellfish
	Some metals bioaccumulate	Higher-level predators	Model bioaccumulation
Cyanide	Dissolve, disperse	Surface water, at time of release	None
Fuels	Disperse	Surface water, at time of release	None
	Biodegrade	Acute effects to local bacteria and benthic populations	None
Acids	Disperse, dissolve, neutralize Do not bioaccumulate Are not persistent	Surface water, at time of release Acute effects to biota at time of release	None

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TABLE 2-4
THIRD TIER CONCEPTUAL SITE MODEL – INTERTIDAL AND SUBTIDAL SEEPS
REMEDIAL INVESTIGATION WORK PLAN
SITE 17 GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

INTERTIDAL AND SUBTIDAL SEEPS

Contaminants	Fate and Transport	Receptors	Measurement Endpoint
Solvents: Subtidal (chlorinated solvents) Intertidal (Alkenes, aromatics)	Dissolve, Disperse Volatilize	Surface water (nominal) Air (nominal)	None None
Dissolved Metals Subtidal or intertidal	Disperse Some bioaccumulate	Surface water at seep Sediment Marine biota	None Sample sediment Sample shellfish, Model bioaccumulation
Cyanide Subtidal or Intertidal	Dissolve, disperse or precipitate Some adsorption to sediments	Surface water at seep(nominal)	None
		Sediment	Sample sediment
Fuels (Intertidal)	Dissolve, disperse, volatilize	Surface water (intertidal) Air (nominal)	Visual evidence (sheen) Sample sediment

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Chlorinated VOCs seeping through soils into shallow bedrock fracture zones:

Chlorinated solvents such as trichloroethene (TCE) and tetrachloroethene are more dense than water and therefore tend to sink through the saturated soils and bedrock, seeking a path of least resistance until they reach a confining layer, and pool together. Or, if they meet a less permeable barrier in the soil or bedrock, they will travel downslope along that barrier, and continue to seek a downward gradient until they reach a groundwater discharge area (at this Site, one which is likely to be underwater). They are then released to the surface water body and dissipate through dilution. Natural degradation of TCE provides breakdown products such as dichloroethene (DCE) and vinyl chloride through the loss of the chlorine atoms. Based on the presumption that TCE was likely to have been released at this Site during or after the active operations period, these degradation products should be sought at the Site as well. VOCs are generally not bioaccumulated.

Oil and fuel-related contaminants remaining in the shallow groundwater and soils, possibly discharging to the adjacent surface water:

Oil discharged to the surface water via overland runoff or through channeled outfalls will behave not unlike any other fuel oil spill in the ocean. During ocean spills, oils are dispersed and degraded through a number of processes that include evaporation from floating slicks or sheens, dissolution and dilution, photochemical oxidation, and then sedimentation of the heavier fractions or emulsions. Once oil compounds have undergone the initial decomposition processes, and sedimentation occurs, microbial activity may begin degradation of the remaining components. However, due to low temperatures, lack of light, and the nature of the heavier molecules of PAH compounds, remnants of the oils in the form of PAH compounds are likely to remain in the sediments for a considerable amount of time. Most of these heavier hydrocarbons are hydrophobic and will move and behave in a manner similar to PCBs and silts in the marine environment, becoming more concentrated in depositional areas, or bound within bedded sediments that are not subject to wave action.

Direct (historic) discharge of solvents and plating solutions to the Bay, east of the Site:

Releases of plating wastes to the ocean is presumed to have occurred via drain pipes from Building 32. In addition, some discharge to the subsurface may have also occurred through disruptions in the drain pipes. Such discharges may have provided a contaminant load to the ground, and as groundwater passed through the contaminants, they could have been dissolved and transported with groundwater, providing a continuing source for low-level releases discharging to the marine environment, hydraulically downgradient of the electroplating discharge line.

Some metals leaching out of soils and possibly discharging to the adjacent surface water:

Electroplating operations usually involve use of acids and cyanide compounds, including sodium cyanide. These cyanide compounds released to the environment are highly soluble and are broken down by oxidation. However, if they are not exposed to air or water, they could remain in place in soils. This is a common problem in mine tailings, which leach cyanide with groundwater flow. Cyanide solutions discharged directly to the marine environment should mostly dissolve, leaving a residue of the other metals with which they were combined, including copper, chrome, silver and gold. Signs in the electroplating shop prior to demolition indicated use of chromic acid, sulfuric acid, nitric acid, muriatic acid, nickel sulfate, sodium cyanide, copper cyanide, and caustic soda.

Appendix A also notes the findings of cyanide and copper in sediment, and copper in mussels at the electroplating shop outfall at concentrations greater than reference stations in Portsmouth. It is important to note that these samples were taken in 1983, and that residual electroplating materials remained in the vats and containers at Building 32 until 1992, when waste removal actions took place. The presence of the residual waste in Building 32 in 1983 may have provided a contaminant load to the sediment and mussels that were sampled in 1983. Although there was no recorded evidence of these containers leaking, elimination of the source of the contaminant load since the 1992 removal may currently result in lower or undetectable levels of cyanide contamination.

Discharges of the plating wastes to the ocean may have resulted in the presence of cyanide, copper, chromium and other heavy metals in the sediments, and possibly in biota living within the sediments. Since the discharges were likely discontinued a number of years ago, some of the direct evidence of these discharges may have dissipated through dilution, sediment movement, and wave action.

2.5 PROBLEM DEFINITION AND DATA USE EVALUATION

The data quality objectives (DQOs) for this project were developed in accordance with the EPA Guidance for Data Quality Objectives (EPA G4 document). The G4 document suggests seven steps be followed to develop project DQOs. This action has been done in a cursory manner for this project, since the objectives for this investigation are in part also dictated by CERCLA guidance, the Federal Facilities Agreement, and other standard guidances to perform investigations. The intended use of the data resulting from a field investigation is a determining factor in defining the DQO for that data. To be certain that the data is consistent with the goals of the investigation, the seven steps of defining DQOs are presented in the following subsections.

2.5.1 Statement of the Problem

Building 32 was constructed in the 1940s to service and store torpedoes used during World War II. All the facilities in the area were constructed to allow wastewater to discharge to Narragansett Bay, near the Gould Island shore.

Site history and design drawings for Building 32 show floor drains in the electroplating shop connecting to an acid resistant drain line that was designed to discharge into Narragansett Bay at the east shore of Gould Island. Floor drains and trench drains in the main portion of Building 32 also discharged to the bay through a series of sewerage/soil pipelines. It is assumed that most of the waste liquids were disposed of in this manner. Sludges are also typically generated during the electroplating process, and the disposal method for these materials is unknown. Site history indicates that this material may have been disposed of at a landfill identified in the IAS as Site 14 (Envirodyne, 1983). Site 14 is well to the south of the Building 32 area. It is not believed to be hydraulically connected to the Site. Additionally, it is not located on Navy property and is therefore, not a part of this investigation.

The problem this investigation will address is whether use, storage or disposal of chemicals and chemical waste material from Building 32 activities have resulted in residual contamination to the soil, sediment, and groundwater, and whether that contamination poses a viable risk to potential receptors at the Site. This investigation will focus on waste materials that were typically used in electroplating operations, on waste materials that have been found at other electroplating and degreasing operations sites, and on contaminants that have been detected during previous investigations at the Site. These will include metals, volatile organic compounds, semivolatile organic compounds and PCBs.

2.5.2 Identification of the Decision

Under this study, two decision points will be met. For human receptors, are exposure pathways complete, and if so, what is the risk to human receptors? For ecological receptors, are exposure pathways complete, and if so, what are the risks to ecological receptors? If a reasonable potential for risks to receptors is present, the feasibility study (FS) will evaluate remedial actions to address those risks.

2.5.3 Inputs to the Decision

Inputs to the decision are the elements used in the decision process. Inputs to the decision as stated in Section 2.5.2 are as follows:

- Concentrations of the contaminants present - information to be derived from data already collected, and additional data to be collected as a part of this RI,

- Presence of receptors – based on records review conducted as described in this document, Site observations, and additional reviews to be conducted as part of the preparation of the RI,

- Presence of one or more completed exposure pathways to the receptors – based on contaminants found in the media at the Site, and fate and transport information developed through data collection and available documentation,

- EPA and RIDEM standards for determining adverse risk – based on published guidance documents, discussed in Section 5 of this Work Plan,

- Potential for contaminants to complete one or more exposure pathways in the future – based on possible contaminant transport through various media found at the Site, and

- Future use of the Site – based on current use of adjacent properties (recreational to the south, military/industrial to the north).

2.5.4 Definition of the Study Boundaries

Study boundaries can be physical and temporal. This section defines the boundaries and the rationale for their selection.

Two separate areas require evaluation. The first is the onshore area, defined as the terrestrial environment outward to mean low water. The second is the marine environment, which includes the offshore area, extending inward to the mean high water. The intertidal area does overlap as necessary to fully evaluate both areas and both sets of receptors.

The statement of the problem and decision points stated in Sections 2.5.1 and 2.5.2 focus on the waste generated from the electroplating shop and degreasing operations at Building 32. Because other source areas may exist on the island, this RI will have to remain focused on the area proximal to Building 32 and the discharge pipes exiting the building to avoid interference from other potential source areas. Therefore, the study will evaluate the soil and groundwater under the building, the discharge pipes, the fenced area to the west and south of the building, and the island landmass to the north and east of the building.

Contaminant discharges to ocean water under different tide and wind conditions could have resulted in contaminant deposition anywhere near the discharge pipes outfalls. The most recent analysis of sediment samples from the area indicates the presence of moderate concentrations of metals in the sediment at and near the electroplating shop discharge pipe. At the time of that sample collection (1986), large quantities of what were believed to be plating residues remained in the vats and trenches connected to the discharge pipe, which may have constituted a continuing source (ENSR, 1992). Since that sample collection effort, the waste residues have been removed, eliminating that source. It is expected that the material in the onshore portions of the Site (in the soil and possibly under the building) are likely to have degraded very little. However, migration and degradation of contaminants over time in the marine systems may have resulted in the dispersion of contaminants in these offshore areas.

Because the RI is intended to determine the nature and extent of contamination, this study will address the onshore area in detail, and provide for a first view of sediment investigations based on where contaminants were discharged, and where they might have been deposited, based on prevailing winds, currents, and other influences.

Temporal boundaries are more difficult to isolate. While the site history reveals that activity was limited to a period 40 to 50 years in the past, residual discharges may have occurred as recently as 1990, prior to removal activities. Regardless, the current exposure and current and future risk must be evaluated. Current risk will be based on current use of the Site (an industrial property subject to occasional trespass) and on concentrations of contaminants detected. Future risk will be determined based on future use of the Site and reasonable maximum concentrations of contaminants that may be present in the future. Because the contaminant sources have been removed, it is reasonable to believe that the current concentrations detected at the Site will be the same or higher than the reasonable maximum concentrations that will be present in the future, owing to continued degradation, dispersion, and/or retention and perseverance. Since the Navy has no definite plans for the Site, assumptions of future use of its onshore locations will be made.

2.5.5 Decision Rule

The decision rule is a clear statement defining the requirements of the investigation based on the possible outcomes of the study. For this RI, the nature and extent of contamination shall be delineated, for the following purposes:

1. To determine if the human health risk assessment provides an estimated, quantified non-cancer risk providing a hazard quotient (HQ) of 1.0 or greater, and/or an increased incremental cancer risk in or above the range of 1E-6 to 1E-4. If so, that risk will be used to consider actionable contaminant concentrations in the risk management process associated with the FS and decision documents.

2. To determine if the ecological risk assessment provides a high potential for adverse effects (measured dose and associated response from site-related contaminants) to ecological receptors. If so, that risk will be considered actionable for consideration in the risk management process associated with the FS and decision documents. Dose is defined as the concentration of the contaminant to which the receptors are exposed, and response is defined as a toxic effect such as impaired reproduction or inhibited growth.

Additional details on the risk assessment efforts, as well as target risk levels imposed by state and federal regulations, are provided in Section 5 of this Work Plan.

2.5.6 Limits on Decision Errors

The limits of decision errors are set to quantify the potential for false negative and false positive decisions. A RI study is inherently designed to result in a low potential for a false negative decision, i.e., a decision that the estimated risk is low, when it is in actuality higher. Conversely, a somewhat higher tolerance for a false positive decision (estimating risk higher than it actually is) is acceptable for the RI, since the resulting effect is a conservative evaluation of risk reviewed during the risk management process. A new decision rule would be set for a cleanup action as a part of the Record of Decision (ROD).

Therefore, a number of sample stations are required, all targeted toward likely release points. A conservative assessment of risks will decrease the potential for a false negative decision but not overly increase potential for a false positive decision. A larger data set will reduce both the false positive decisions and the false negative decisions. Additional conservatism is applied by screening with maximum concentrations detected and calculating risk for reasonable maximum exposure (RME) scenario using the maximum concentrations detected, and the 95% Upper Confidence Level (UCL) of the mean.

2.5.7 Design for Obtaining Data

The DQO process described in the G4 DQO document describes the use of various statistical approaches for developing a database. These approaches are based on the representativeness of the data that is required. For instance, if the Decision Rule was to "remove soils with concentrations of lead above 10 mg/kg", the sampling plan would be based on identifying hot spots of a specific size, which is determined by the precision of the removal action to be taken.

However, since this investigation is being performed to measure reasonable maximum risk to receptors, the design of the sampling plan can be more qualitative, or "targeted". The sampling plan is provided in Section 3 of this Work Plan, and calls for the collection of samples in two distinct areas, the onshore area and the offshore area. Samples from both areas will be collected to measure concentrations of contaminants present to which human and ecological receptors may be exposed.

Specifics on the precision, accuracy, etc. of the data collected are described in the Quality Assurance/Quality Control discussion presented in Section 4 of this Work Plan.

3.0 SAMPLING AND ANALYSIS PLAN

This section presents a description of the data collection activities planned for this investigation. This includes a rationale for field investigation design, description of field investigation efforts, sampling and data acquisition procedures and requirements, and the analytical plan for the samples to be collected.

3.1 INTRODUCTION

The Sampling and Analysis Plan has been prepared to direct the collection of data that will provide a foundation for the RI report and risk assessments. The data will be used to describe the nature and extent of contamination at the Site, provide exposure point concentrations for the human health risk assessment, and provide exposure data for the first tier of an ecological risk assessment. The data must be of adequate quality and quantity to support the risk assessments scoped.

In order to effectively design a sampling program for the Site, the conceptual model provided in Section 2.4 has to be considered. The conceptual site model outlines the environmental factors at the Site that are documented to date, but speculates somewhat on the factors that are likely to exist, but are as yet unconfirmed. The sampling program presented in this section has been designed to build on the information documented to date by collection of complimentary data that will be used to complete the conceptual model with reasonable certainty.

The field sampling program is also designed so that, to the extent possible, data collected can be used to direct or refine planned samples and well installations, and to direct any necessary future sampling and investigative efforts not described in this Work Plan. This flexible approach uses field screening techniques wherever possible, and includes critical decision points, rather than a rigid task listing that must be carried out regardless of the information developed in the process.

To use the flexible approach, and to involve the stakeholders at the critical decision points in the most efficient way possible, the investigation is planned in two major phases, each with several short investigative efforts, or tasks, with time for data analysis and evaluation between them.

Phase 1 Goals

Phase 1 activities will be conducted to clarify the understanding of the conditions at the Site which are currently unknown, and to assure that the nature of the contaminants present is known. Phase 1 goals are summarized below:

- Determine depth to bedrock and condition of subsurface materials at the Site that may affect contaminant leaching and transport.
- Determine if there are likely to be continued contaminant discharges from the subsurface materials to the surface waters adjacent to the Site.
- Determine groundwater flow directions at the Site and estimate horizontal and vertical gradients to estimate discharge from the overburden and bedrock aquifers to the Bay.
- Determine if there is residual sediment contaminant presence in nearby depositional areas that can be associated with historic or continuing contaminant discharges from the Site.
- Determine purpose and role of underground structures that are not provided on historic drawings and records, and identify any possible underground injection points.
- Determine presence of receptors that may interact with Site contaminants.

Phase 2 Goals

Phase 2 activities will be conducted to refine the understanding of the extent of contamination present at the Site, and to determine effects of contaminants on ecological receptors present. The Phase 1 determinations will be used to direct additional data collection to meet the Phase 2 goals, summarized below:

- Determine extent of groundwater contaminant plume(s) and distribution of contaminants through additional sampling to be directed by likely groundwater flow and sediment transport directions.
- Determine possible toxic effects of contaminants on ecological receptors present, based on contaminants found at locations where receptors can be exposed.
- Determine the human health and first tier ecological risks of site contaminants.

3.2 PHASE 1 ACTIVITIES

Four efforts will be conducted to achieve the Phase 1 goals, including:

- a geologic and hydrogeologic investigation
- a sediment survey and depositional area sampling,
- a review and investigation of unknown structures and UICs, and
- an ecological evaluation (terrestrial, intertidal, and subtidal) to identify receptors in the area.

3.2.1 Geologic and Hydrogeologic Investigation

A geologic and hydrogeologic investigation will be conducted to determine the behavior of contaminants in the subsurface materials, and to determine the nature and extent of the contaminants in the subsurface soils and groundwater. The goals for the geologic and hydrogeologic investigations will be met through the application of standard field investigations and evaluations modified for use at this Site. TtNUS standard operating procedures (SOPs) for geologic and hydrogeologic investigations have been evaluated for use at this Site, and those that are anticipated for use are identified below, and provided in Appendix C of this Work Plan.

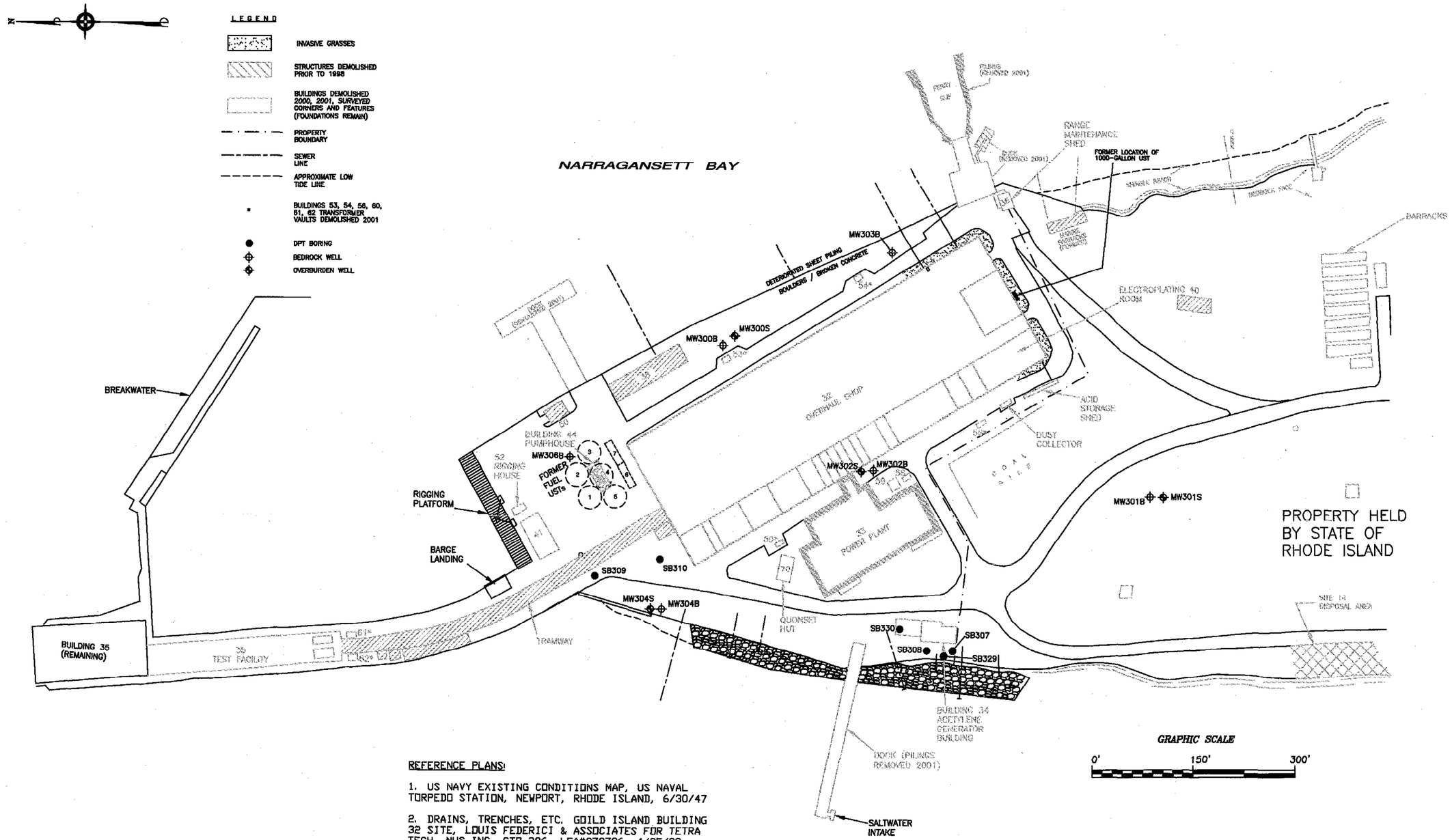
GH-1.3	Soil Sampling
GH-1.3	Soil and Rock Drilling
GH-1.5	Borehole and Sample Logging
GH-2.8	Groundwater Monitoring Well Point Installation
SA-1.1	Groundwater Sample Acquisition and Onsite Water Quality Testing

These SOPs have been reviewed for work at the Site, and included in the discussions of field activities below. These summaries are provided for the field crew and oversight parties for reference on procedural applications. Any modifications to the SOPs that are appropriate for the site-specific tasks are described in the sections that follow.

3.2.1.1 General Approach for Boring and Well Installations

This section and the subsections that follow discuss the geological and hydrogeological investigation activities that will be conducted during Phase I field activities, including the advancement of borings for soil sample collection and/or monitoring well construction. A drilling subcontractor, supervised by a TtNUS field geologist, will use drive and wash drilling methods to advance 12 borings, seven of which will include soil sample collection. Using direct push technique (DPT), the subcontractor will also advance 25 DPT borings for soil sample collection. Some of these DPT borings may be finished as small diameter water table monitoring points, pending evaluation of associated soils. Soil samples from all borings will be collected for evaluation of soil conditions, VOC headspace screening, and possible laboratory analysis. The collection and analysis of these soil samples will provide data to evaluate the potential presence of contaminants related to Building 32.

Figure 3-1 presents the approximate locations of borings and monitoring wells that are proposed to be installed outside the Building 32 foundation. Figure 3-2 presents the anticipated locations of DPT borings



NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOILD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 - GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/9/00

HISTORICAL FEATURES AND PROPOSED BORINGS/MONITORING WELLS			FIGURE 3-1
SITE 17, GOULD ISLAND			
NAVSTA NEWPORT, RHODE ISLAND			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	APRIL 28, 2003
SCALE:	AS SHOWN	FILE NO.:	DWG\5152\0450\FIG_3-1.DWG

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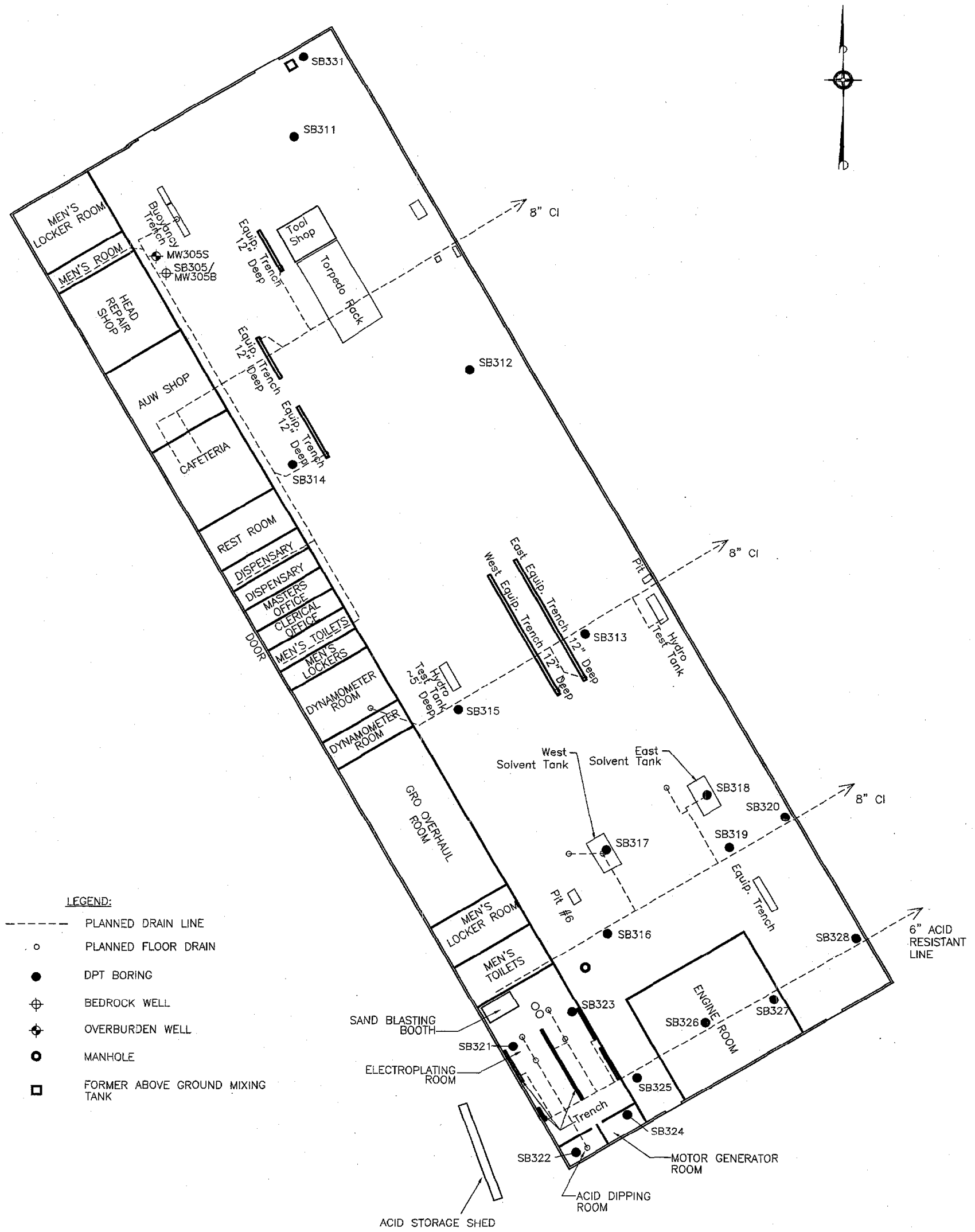

NOTES:

1. NOT FOR DESIGN
2. ALL LOCATIONS ARE APPROXIMATE
3. VERTICAL DATUM IS BASED ON THE NAVY BM H-2, LOCATED AT THE NORTHEAST NUT ON VALVE HYDRANT OPPOSITE SOUTHWEST CORNER OF BUILDING #32, ESTABLISHED BY P.W. SURVEY PARTY, DATED 1/3/45, BOOK NUMBER 20-B PAGE 10, MLW ELEVATION (LOCAL) 14.12.
4. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1983.
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

BUILDING 32 LAYOUT, DRAINAGE, AND PROPOSED BORINGS AND MONITORING WELLS	FIGURE 3-2
SITE 17, GOULD ISLAND	
NAVSTA NEWPORT, RHODE ISLAND	TETRA TECH NUS, INC.
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CHECKED BY: L. SEYDEWITZ / DATE: JUNE 18, 2003	
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that would be installed through the existing Building 32 foundation. Table 3-1A presents the rationale for these installations.

Detailed descriptions of the materials encountered and sampled in these borings will be recorded on the boring logs. An example of a boring log is provided in Appendix D. The soils will be described using the Unified Soil Classification System (USCS) as detailed in TtNUS SOP GH-1.5 Section 5.2 (S2).

Seven soil and bedrock borings (B300 through B306, Table 3-1A) will be advanced using drive-and-wash methods to determine the nature of the underlying natural soils, to determine the depth of the water table, and to determine if non-aqueous phase liquids (NAPL) are present. These seven borings will be advanced to the top of bedrock and then continued into rock using NX coring techniques. Soil samples will be collected throughout the overburden at 2-foot intervals for visual evaluation of soil conditions, for contaminant screening, and for possible laboratory analysis of VOCs, SVOCs, pesticides/PCBs and inorganics (including cyanide). All seven drive-and-wash borings will likely be completed as bedrock monitoring wells, as described in Tables 3-1A and 3-1B.

Drilling fluids will consist of potable water or sea water taken directly from Narragansett Bay. The use of drilling mud consisting of pure bentonite and water requires prior Project Manager approval and should only be used if technical problems arise from the use of water free of additives. No synthetic additives may be used in the mud, if approved for use. Rock cores will similarly be advanced with potable or sea water only. The drilling water source will be pre-approved by TtNUS, and sampled as "field blank" (Section 4). Random tanks of water transported to the drill sites will be screened for VOCs according to TtNUS procedures described in SOP SF-1.5. Drilling fluids and wash-tub contents will be removed and replaced with clean water prior to bedrock coring.

Five additional borings will be advanced for the sole purpose of installing shallow overburden water table wells, co-located with bedrock monitoring wells (installed as described above). No soil samples will be collected from these co-located borings unless samples could not be collected from the initial borings at these locations and depths.

Twenty-five shallow borings (SB307 – SB331, Table 3-1A) will be advanced using DPT on the Site to determine the nature of the underlying natural soils, to determine the depth of the water table, and to determine the presence of NAPL. For borings SB321, SB322, SB323 and SB324, the concrete core will be recovered and visually inspected for evidence of phases formed as a result of reactions between concrete and the plating solutions. Evidence of staining of the concrete such as yellow staining may be an indication of chromium-containing phases. The core will be recovered and inspected before collecting the subsequent soil boring samples. Soil samples will be collected at 2-foot intervals for evaluation of

TABLE 3-1A
PROPOSED SOIL BORING LOCATIONS AND PURPOSE
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

LOCATION	NUMBER/TYPE OF BORINGS	BORING LOCATION IDENTIFICATION	PURPOSE OF BORINGS
East of Former Building 32	1 Soil Boring and 1 Bedrock Boring	B300	Identification of contaminants and characterization of soils for geologic conditions downgradient of site. Complete as 1 overburden and 1 bedrock well.
On hill/berm southwest of electroplating shop	1 Soil Boring AND 1 Bedrock Boring	B301	Identification of contaminants and characterization of soils for geologic conditions at an upgradient area. Complete as 1 overburden and 1 bedrock well.
Between Former Building 32 and 33	1 Soil Boring and 1 Bedrock Boring	B302	Identification of contaminants and characterization of soils for geologic conditions. Complete as 1 overburden and 1 bedrock well.
West of Former Building 34	4 DPT Borings	SB307/SB308/SB329/SB330	Identification of contaminants in soil associated with local activities.
West of Former Building 44 and tramway	2 DPT Borings	SB309/SB310	Characterization of soils and identification of contaminants associated with local activities - former location of TCE detected in soil gas and possible former storage area. Complete B304 as 1 overburden and 1 bedrock well.
	1 Soil Boring and 1 Bedrock Boring	B304	
Area around Former Building 44	1 Soil/Bedrock Boring	B306	Identification of contaminants downgradient of Site and characterization of soils for geologic conditions. Complete as 1 bedrock well.
Beneath Former Building 32	5 DPT Borings	SB311/SB312/SB313/SB314/SB315	Identification of contaminants and characterization of soils under Building 32, former location of maximum TCE and PAHs detected in soil gas. Complete B305 as 1 overburden and 1 bedrock well.
	1 Soil Boring and 1 Bedrock Boring	B305	
Near former solvent tank and discharge pipe	5 DPT Borings	SB316/SB317/SB318/SB319/SB320	
	1 Soil/Bedrock Boring	B303	
Near electroplating shop and discharge drain	8 DPT Borings	SB321, 322, 323, 324, 325, 326, 326, 327, 328	Identification of contaminants - former location of TCE and PAHs detected in soil gas, and possible leakage from floor drains and from discharge pipe of electroplating wastes. A concrete core will be recovered from borings SB321, SB322, SB323, and SB324 to visually identify any phases formed as a result of a reaction between concrete and plating solutions.
Northeast corner of former Building 32, near former mixing tank	1 DPT Boring	SB331	Identification of contaminants and characterization of soils under Building 32, former location of mixing tank.

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TABLE 3-1B
PROPOSED WELL INSTALLATIONS AND PURPOSE
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

BORING/WELL NUMBER	LOCATION	WELL SCREEN INTERVAL*	PURPOSE OF INSTALLATIONS
MW300S/MW300B	Located on East Side of Building 32.	To be determined by headspace screening results of soil samples collected: MW300S to be screened in overburden at zone of highest contamination. MW300B to be left open and sampled as described in Section 3.2.1.7 (approximately 10-30 feet below top of rock)	Assess impacts of shop to groundwater quality in overburden and bedrock, and to assist determination of groundwater flow dynamics
MW301S/MW301B	Upgradient Location - Located on hill/berm southwest of electroplating shop in densely vegetated area (Refer to Figure 3-1)	To be determined - MW301S to be screened in overburden at top of water table. MW301B to be left open and sampled as described in Section 3.2.1.7 (approximately 10-30 feet below top of rock)	Establish reference groundwater quality in overburden and shallow bedrock, and assist determination of groundwater flow dynamics
MW302S/MW302B	Between Building 32 and 33, in area of potential impacts from former coal pile and leaks or releases from floor drains, cracked floor slab, etc.	To be determined by headspace screening results of soil samples collected: MW302S to be screened in overburden at any zone of contamination. MW302B to be left open and sampled as described in Section 3.2.1.7 (approximately 10-30 feet below top of rock)	Assess impacts of former coal pile and surrounding building's activities to downgradient groundwater quality in overburden and bedrock, and assist determination of groundwater flow dynamics

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TABLE 3-1B (cont.)
PROPOSED WELL INSTALLATIONS AND PURPOSE
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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BORING/WELL NUMBER	LOCATION	WELL SCREEN INTERVAL*	PURPOSE OF INSTALLATIONS
MW303B	East of Building 32, in area of potential impacts from leaks or releases from former solvent tank discharge pipe, floor drains, etc. and coupled with existing shallow well, MW03S	Anticipated to be left open and sampled as described in Section 3.2.1.7 (approximately 10-30 feet below top of rock)	Assess impacts of shop and discharge pipe to downgradient groundwater quality in overburden and bedrock and to assist determination of groundwater flow dynamics.
MW304S/MW304B	West of Building 44 and former tramway, in area where TCE was previously found in soil gas samples (refer to Appendix A)	To be determined by headspace screening results of soil samples collected: MW304S to be screened in overburden at any zone of contamination. MW304B to be left open and sampled as described in Section 3.2.1.7(approximately 10-30 feet below top of rock)	Assess impacts of shop and former storage area groundwater quality in overburden and bedrock, and to assist determination of groundwater flow dynamics
MW305S/MW305B	Located on the northwest corner of Building 32	To be determined - MW305S to be screened in overburden at top of water table. MW305B to be left open and sampled as described in Section 3.2.1.7 (approximately 10-30 feet below top of rock)	Assess impacts of shop to groundwater quality in overburden and bedrock, and to assist determination of groundwater flow dynamics
MW306B	Located in the area of Building 44, in area of potential impacts from leaks or releases from former USTs and will be coupled with existing shallow well MW-001R.	Anticipated to be left open and sampled as described in Section 3.2.1.7 (approximately 10-30 feet below top of rock)	Assess impacts of shop and former fuel USTs to downgradient groundwater quality in overburden and bedrock and to assist determination of groundwater flow dynamics

* Well screen intervals in overburden will be determined based on conditions encountered during drilling. Additional wells may be installed at any location where multiple zones of contaminants and /or confining layers are detected in the overburden.

TABLE 3-1C
PROPOSED SEDIMENT AND BIOTA SAMPLE LOCATIONS AND PURPOSE
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

SAMPLE NUMBER	LOCATION	PURPOSE OF SAMPLES
SD301/ET301	At south end of Gould Island, in area of softer sand, presumably a depositional area for sediment transported down-bay	Assess the downgradient depositional marine sediment. Assess contaminant load in biota at downgradient location.
SD302/ET302	South of Site 17 on east shoreline of Gould Island, this area is believed to be down-stream of the presumed release points	Assess the downgradient depositional marine sediment. Assess contaminant load in biota at downgradient location.
SD303/ET303	At storm drain discharge, immediately south of other drain discharge points	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD304/ET304	At electroplating room drain discharge	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD305/ET305	At sewer discharge shared by solvent tanks and degreasers	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD306/ET306 and SD307/ET307	At sewer and storm drain discharge points	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD308/ET308	At north end of Gould Island, under or near the rigging platform and within the boat basin, presumed to be a depositional area, but also affected by erosion of soil from the soils near former Buildings 41, 44, and the rigging house	Assess the local sediment conditions and contaminant load in biota at the erosion area.
SD309/ET309 and SD310/ET310	At sewer and storm drain discharge points on west shoreline	Assess the local sediment conditions and contaminant load in biota at the discharge point.
SD311/ET311	Southwest of Site 17 in an area presumed to be less affected by depositional sediment originating from the Site	A reference sample not within the depositional marine sediment area and not potentially impacted from the Site, but within a similar position in the watershed.

soil conditions, for jar headspace screening analysis and for possible laboratory analysis of VOCs, SVOCs, pesticides/PCBs and inorganics (including cyanide).

Soil samples at each boring location will be collected using the procedures described in the following sections. These procedures have been prepared for this project in accordance with the following applicable sections of TtNUS SOP SA-1.3 provided in Appendix C; Sections 5.6 (Subsurface Soil Sampling with a Split-Barrel Sampler) (S4); Section 5.2.1 (Procedure for Collecting Soil Samples for Volatile Organic Compounds) modified as described below; and Section 5.2.2 (Procedure for Collecting Non-Volatile Soil Samples).

3.2.1.2 Subsurface Soil Sample Acquisition

At each of the 32 boring locations where soil sampling will be conducted, split-barrel samples will be used to collect soil samples continuously at 2-foot intervals through natural soils, to the top of the bedrock, as defined by the field geologist. These samples will be collected beginning from the ground surface, or from the top of the soils under pavement or concrete surfaces, if present. Sample depths will be measured from the ground surface at 2-foot increments. Soil samples collected may also be selected for laboratory analysis, as described in this section. Each soil sample selected for laboratory analysis will be analyzed for VOCs, SVOCs, TPH-extractable petroleum hydrocarbons (TPH/EPH), pesticides/PCBs, and metals, including cyanide. A summary of samples to be collected is provided on Table 3-2.

A drilling subcontractor under the supervision of a senior TtNUS geologist will collect all of the subsurface soil samples, as described in Section 5.1 of TtNUS SOP SA-1.3. A modified Standard Penetration Test (SPT) based on ASTM D-1586-84 will be used to collect the split-barrel samples. The modification to the standard procedure is the use of nominal 3-inch inside diameter (ID) split-barrels in place of 2-inch ID split-barrels to collect additional volume for analytical samples. In order for the SPT blow counts to be comparable to standard 2-inch SPT blow counts, the use of a 300 lb. hammer with an 18-inch fall shall be used in place of a 140 lb. hammer with a 30-inch fall. This modification is based on an Army Corps of Engineers New England District geotechnical drilling standard of practice.

<u>Samples Collected for Laboratory Analysis:</u>

Two sample aliquots will be collected from each 2-foot long split-barrel interval, if sufficient soils are recovered. Required sample containers are described on Table 3-3. One aliquot will be used for jar headspace screening analysis, and the second aliquot will be stored for possible laboratory analysis. If

TABLE 3-2
FIELD QUALITY CONTROL SAMPLE SUMMARY
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Media	Analysis	Field Samples	Field Duplicates	Rinsate Blanks	Field Blanks	Source Blanks	Total Quantity
Sediment	TCL VOCs	22	3	1	1	1	28
	TCL SVOCs	22	3	1	1	0	27
	TCL Pesticides/PCBs	22	3	1	1	0	27
	TPH (EPH-GC/FID)	22	3	1	1	0	27
	TAL Metals	22	3	1	1	0	27
	Cyanide	22	3	1	1	0	27
	AVS/SEM	22	3	0	0	0	25
	TOC	22	3	0	0	0	25
	Grain Size	22	3	0	0	0	25
Soil	TCL VOCs	62	7	1	1	7	78
	TCL SVOCs	62	7	1	1	0	71
	TPH (EPH-GC/FID)	62	7	1	1	0	71
	TCL Pesticides/PCBs	62	7	1	1	0	71
	TAL Metals	62	7	1	1	0	71
	Cyanide	62	7	1	1	0	71
Residue	TCL VOCs	10	1	1	1	2	15
	TCL SVOCs	10	1	1	1	0	13
	TPH (EPH-GC/FID)	10	1	1	1	0	13
	TCL Pesticides/PCBs	10	1	1	1	0	13
	TAL Metals	10	1	1	1	0	13
	Cyanide	10	1	1	1	0	13
Groundwater	TCL VOCs	20*	2	1	1	3	27
	TCL SVOCs	20*	2	1	1	0	24
	TCL Pesticides/PCBs	20*	2	1	1	0	24
	TPH (EPH-GC/FID)	20*	2	1	1	0	24
	TAL Metals	20*	2	1	1	0	24
	Cyanide	20*	2	1	1	0	24
	TOC	20*	2	0	0	0	22
	Alkalinity	20*	2	0	0	0	22
	Sulfides	20*	2	0	0	0	22
Marine Biota	TCL SVOCs	11	2	0	0	0	13
	TCL Pesticides/PCBs	11	2	0	0	0	13
	TAL Metals	11	2	0	0	0	13
	Cyanide	11	2	0	0	0	13

* Assumes one sample from each overburden well, three samples from 3 bedrock wells undergoing discrete zone sampling and one sample from each of the remaining bedrock wells.

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TABLE 3-3
SAMPLE CONTAINER, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

SAMPLE MEDIUM	ANALYSIS (Method Reference)	SAMPLE CONTAINER	PRESERVATIVE	HOLDING TIME
	TCL VOCs (SW-846 8260B)	40-ml VOA vial	Methanol, Cool to 4°C	14 Days (Analysis)
	Percent Moisture (ASTM D422)	2-oz jar	Cool to 4°C	Not Specified
	TCL SVOCs (SW-846 8270C)	8-oz amber jar	Cool to 4°C	14 Days (Extraction)/40 Days (Analysis)
	TCL PCBs/Pesticides (SW-846 8082/SW-846 8081A)	8-oz jar	Cool to 4°C	14 Days (Extraction)/40 Days (Analysis)
	TPH (MADEP EPH by GC/FID)	8-oz amber jar	Cool to 4°C	14 Days (Extraction)/40 Days (Analysis)
	TAL Metals (SW-846 6020/6010B/7000A)	4-oz amber jar	Cool to 4°C	Hg 28 Days, Others 6 months
	Cyanide (SW-846-9012A)	8-oz jar	Cool to 4°C	14 Days (Analysis)
	AVS/SEM (Allen & Fu)	4-oz jar	Cool to 4°C	14 Days (Analysis - AVS) 28 days (Analysis - SEM)
	TOC (Lloyd Kahn)	40-ml VOA vial	Cool to 4°C	14 Days (Analysis)
	Grain Size Distribution (ASTM 422-63)	16-oz jar	None	None
Soils, Residue	TCL VOCs (SW-846 8260B)	40-ml VOA vial	Methanol, Cool to 4°C	14 Days (Analysis)
	Percent Moisture (ASTM D422)	2-oz jar	Cool to 4°C	Not Specified
	TCL SVOCs (SW-846 8270C)	8-oz amber jar	Cool to 4°C	14 Days (Extraction)/40 Days (Analysis)
	TPH (MADEP EPH by GC/FID)	8-oz amber jar	Cool to 4°C	14 Days (Extraction)/40 Days (Analysis)
	TAL Metals (SW-846 6020/6010B/7000A)	4-oz amber jar	Cool to 4°C	Hg 28 Days, Others 6 months
	Cyanide (SW-846 9012A)	8-oz jar	Cool to 4°C	14 Days (Analysis)
	AVS/SEM (Allen & Fu)	4-oz jar	Cool to 4°C	14 Days (Analysis – AVS) 28 days (Analysis – SEM)
	TOC (Lloyd Kahn)	40-ml VOA vial	Cool to 4°C	14 Days (Analysis)
	Grain Size Distribution (ASTM D422-63)	16-oz jar	None	None

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TABLE 3-3 (cont.)
SAMPLE CONTAINER, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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SAMPLE MEDIUM	ANALYSIS (Method Reference)	SAMPLE CONTAINER	PRESERVATIVE	HOLDING TIME
Groundwater	TCL VOCs (SW-846 8260B)	2 - 40 ml VOA vials	HCl to pH <2/Cool to 4°C	14 Days (Analysis)
	TCL SVOCs (SW-846 8270C)	1 liter amber bottle	Cool to 4°C	7 Days (Extraction)/40 Days (Analysis)
	TPH (MADEP EPH by GC/FID)	1 liter amber bottle	Cool to 4°C	7 Days (Extraction)/40 Days (Analysis)
	TCL PCBs/Pesticides (SW-846 8082/SW-846 8081A)	1 liter amber bottle	Cool to 4°C	7 Days (Extraction)/40 Days (Analysis)
	TAL Metals (SW-846 6020/6010B/7000A)	1 liter PE bottle	$HN0_3$ to pH <2	Hg 28 Days, Others, 6 months
	Cyanide (SW-846 9010B)	500 ml PE bottle	Cool to 4 °C, NaOH to pH>12	14 Days (Analysis)
	TOC (415.1 – carbon analyzer)	40 ml vial	Cool to 4 °C, H_2SO_4 to pH<2	28 Days (Analysis)
	Alkalinity (310.1 - titration)	1 liter PE bottle	Cool to 4°C	14 Days (Analysis)
	Sulfides (376.1 - titration)	1 liter PE bottle	Cool to 4°C, Zinc Acetate and NaOH to pH>9	7 Days (Analysis)
	Specific Conductance*	Field Measurement	Not Applicable	Not Applicable
	pH*	Field Measurement	Not Applicable	Not Applicable
	Temperature*	Field Measurement	Not Applicable	Not Applicable
	Dissolved Oxygen*	Field Measurement	Not Applicable	Not Applicable
	Turbidity*	Field Measurement	Not Applicable	Not Applicable
	Salinity*	Field Measurement	Not Applicable	Not Applicable
	Oxidation/Reduction Potential (ORP)*	Field Measurement	Not Applicable	Not Applicable
Marine Biota (Shellfish Tissue)	TCL SVOCs (SW-846 8270C)	Lab-specific	Cool to 4°C	7 Days (Extraction)/40 Days (Analysis
	TCL Pesticides/PCBs (SW-846 808A/8082)	Lab-specific	Cool to 4°C	7 Days (Extraction)/40 Days Analysis)
	TAL metals (SW-846 6020/6010B/7000A)	Lab-specific	Cool to 4°C	Hg 8 Days, Others, 6 months
	Cyanide (SW-846 9013	Lab-specific	Cool to 4°C	14 Days (Analysis
	Percent Lipids (SW-846, 8290, Sec. 6.7)	Lab-specific	Not Applicable	Not Applicable

*Measurement of field screening parameters by the YSI 6020 Multiple Parameter Meter per manufacture's operations manual.

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there is insufficient sample volume to collect all of the analytical parameters due to poor sample recovery, the following priority will be used when filling the appropriate bottleware:

1. VOCs & percent moisture (minimum volume for percent moisture is 1/2 of the 2 oz. container).
2. Inorganics, including cyanide (minimum volume required is 3/4 of the 4 oz. container).
3. SVOCs/Pesticide/PCBs (minimum volume required is 3/4 of the 8 oz. container).
4. Total Petroleum Hydrocarbons through extractable petroleum hydrocarbons (EPH) by GC/FID (minimum volume required is 3/4 of the 8 oz. container).

At least two samples will be collected from each boring for laboratory analysis. The first sample will be the 0-2' interval, and the second will be selected from the remaining boring samples taken, based on screening results, position of the water table, and visual, olfactory, or soil conditions noted. Additional soil samples may be collected for laboratory analysis, based on soil conditions encountered.

With the exception of the VOC samples, the soil samples for all analyses will be collected as a composite of each target depth interval. The entire 2-foot interval will be uniformly mixed before the remaining samples are collected. Following collection of the jar headspace screening aliquot, the VOC sample for laboratory analysis will be first collected as a grab sample from the most heavily contaminated portion of the split-barrel sampler, based on the initial screening results and/or visual observations. If no initial VOC screening readings are noted and no visual evidence of contamination is found, the grab VOC samples will be collected from the center of the target sample interval. Observed geologic conditions possibly affecting contaminant distribution, such as potential confining layers, coarse-grained (relatively high porosity/permeability) soils, or the vadose zone above the water table, will be taken into account when selecting the VOC sample location from the split-barrel sampler. The position of the collected VOC sample within the 2-foot split barrel sample will be recorded.

If free product or NAPL is identified within the split-barrel soil samples, the sample will be collected in a similar fashion as the soil described above. This NAPL sample will replace the soil sample from this depth interval and will be sent to the analytical laboratory with a note for a separate run, due to likely higher concentrations of contaminants.

Soil Sampling Procedures for VOC Laboratory Samples (Grab)

Soil samples for VOC analysis will be collected in accordance with the following SOP references, amended as described in this section:

- TtNUS SOP GH 1.3 - Soil Sampling

- EPA-Draft 1.4 Draft Standard Operation Procedure for Soil Sample Collection and Handling for the Analysis of Volatile Organic Compounds (March 1997)

Each soil VOC sample is to be preserved with methanol immediately after collection, and partnered with an aliquot to be analyzed for percent moisture. The following procedure for VOC soil samples shall be followed:

1. Label a pre-tare weighted 40-ml amber VOC vial (containing 5 ml of purge and trap grade methanol) with the sample location number and depth.

2. Collect a grab core soil (about 5g) with a 10-ml pre-cut syringe. **If NAPL is noted within the soils then a reduced volume of approximately 1 - 2 g should be collected as a separate "medium concentration" (NAPL) sample.** Extrude the sample into the 40-ml VOC vial containing the methanol. The soil must be immersed in the methanol; recollect the sample using a smaller volume if necessary. Avoid touching the thread of the vial neck or spilling methanol. Cap the vial and invert it several times to mix the preservative with the sample.

3. Weigh the sample vial to the nearest 0.01 g and record the weight in the field log sheet. Pack and ship to the laboratory. Include the field log sheet containing the sample weight information with the samples.

Soil sample for percent moisture. Fill one 2-oz. container with sample representing the same locations where the 40-ml VOC vial sample was collected. Every effort should be made to obtain the percent moisture soil aliquot as close as possible to the location where the VOC sample was collected.

Duplicate samples will also be collected from the subsurface soils. Following the collection of the first set of VOC containers, collect the field duplicate from the same sampling interval.

Soil Sampling Procedures for SVOCs, Pesticide/PCBs, TPH, and Metals Including Cyanide (Composite)

1. Record all required data on the boring log which will also serve as the soil sample logsheet (Appendix D), including sampling equipment, sampling personnel, date, time, depth of sample, and sample analyses. The boring log will also contain soil descriptions, depth of strata changes, and sample depth intervals. The soil will be visually classified using the Unified Soil Classification System (USCS), as defined by the American Society for Testing and Materials (ASTM) D-2488-98, Standard Method for Classification of Soils.

2. Label appropriate sample jars with the sample location number, sampler's name, date, and analytical fractions.

3. Transfer the soil from the split-barrel sampler into a decontaminated stainless-steel bowl using only decontaminated stainless steel trowels, and homogenize the sample.

4. Remove any large particles such as gravel or artificial fill too large to be sent for analysis. Note the removal of material on the boring log.

5. Fill the appropriate sample containers.

6. For field duplicate samples, after homogenization fill one set of sample containers for the original sample and fill another set of sample containers for the field duplicate sample.

7. Ensure that the samples are properly labeled, maintained in coolers with ice, and that chain-of-custody procedures (described in Section 4) are followed. Package and ship the sample coolers to the appropriate laboratory for overnight delivery.

8. Decontaminate the sampling equipment before reuse (see Section 3.4.3).

Due to the potential for contamination to be encountered, care should be taken in handling all soil samples to ensure that the exterior of the sample containers are clean and free of soils before shipping. All laboratory analytical samples will be kept on ice in coolers and will be shipped with appropriate QA/QC samples, as described in Section 4.

Jar headspace VOC screening:

All soil samples collected will have an aliquot separated for analysis of total VOCs using jar headspace screening with a PID and FID. The procedure for the headspace screening is provided below:

1. Collect sufficient soil representative of the sample interval to half-fill one clean 8-oz. glass jar. Quickly cover the jar with clean aluminum foil and apply screw cap to tightly seal the jar. All appropriate analytical sampling procedures should be followed to maintain this sample matrix as representative and to avoid cross-contamination.

2. Vigorously shake jar for 15 seconds. Allow headspace development for at least 10 minutes. Where ambient temperatures are below 32°F (0°C), headspace development should be performed within a heated vehicle or building, though not at conditions above 80°F.

3. Remove screw lid/expose foil seal. Quickly puncture the foil seal with the Photovac Micro FID probe, to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particulates.

4. Record highest FID reading as the jar headspace VOC concentration. The maximum response should occur between 2 to 5 seconds. Erratic meter response may occur with high organic vapor concentrations or high moisture content. If erratic responses are obtained, stop the headspace screening.

5. The Photovac Micro FID shall be used as the primary air-monitoring instrument. The Photovac 2020 PID will be used as a backup air monitoring device. Operation, maintenance, and calibration shall be performed in accordance with the manufacturer's specification which are provided in TtNUS SOP ME-12 (Photovac 2020 PID) (S5) and ME-15 (Photovac Micro FID) (S6). For jar headspace screening, the instrument calibration shall be checked/adjusted daily unless problems are encountered requiring more frequent calibration.

6. The Photovac MicroFID instrument has a digital (LED/LCD) display, which will not discern maximum headspace response unless the "maximum hold" feature has been cleared and reset between each reading. The instrument operator will clear and reset the maximum hold feature prior to each reading.

3.2.1.3 Bedrock Coring

At locations requiring a boring advanced into bedrock, the drill casing (minimum 4- inch ID) will be seated by driving or spinning the casing up to 2 feet into the bedrock surface. Bedrock coring will continue an estimated 30 feet into bedrock at each well cluster, using a double-walled NX or NQ core barrel, or equivalent. The length of bedrock coring is estimated to be 30 feet, unless observations of the recovered rock core and the borehole response to water level changes or the results of the packer testing indicate that the bedrock hole may be dry. If the rock hole is dry, the TtNUS field geologist will continue coring until groundwater enters the boring or observations of the recovered rock core indicate the potential for water-bearing fractures. The packer test results will be evaluated by the Project Manager and the technical staff to determine if a monitoring well should be installed, or another action taken, such as drilling deeper or abandoning the borehole.

Rock Core Documentation

Each rock core will be documented in accordance with TtNUS SOP No. GH-1.3. At a minimum, the following information will be documented:

- Date of activity
- Name of person(s) overseeing work activity
- Project name
- Project number
- Boring number
- Core Run numbers
- Footage (depths)
- Recovery
- RQD (%)
- Box number and total number of boxes for that boring (Example: Box 1 of 2)
- Rock type
- Fracturing
- Weathering

3.2.1.4 Monitoring Well Installations

Procedures and rationale for bedrock and overburden monitoring well installations and related activities are described in this section. As part of Phase I drilling activities, an estimated twelve borings will be completed as monitoring wells in shallow and deep overburden and in bedrock. Proposed locations of monitoring wells are presented on Figures 3-1 and 3-2. A rationale for these installations is provided on Table 3-1B.

The planned well installations will provide data on overburden and bedrock conditions in the Site vicinity and the groundwater gradient and flow regime around the Site, when used in conjunction with the existing wells on-site. Well clusters, each consisting of an overburden and bedrock well, will be located in areas of suspected contamination, as determined by the headspace screening results. It is anticipated that these well clusters will be located downgradient of potential "hot spots" within the Site, in order to identify concentrations of contaminants which may be discharging to Narragansett Bay or to the underlying groundwater.

TtNUS will subcontract a drilling company to advance the borings, collect soil and rock samples, conduct bedrock packer tests, and install monitoring wells on the Site. The subcontractor will also be responsible for developing the new monitoring wells with assistance from TtNUS.

Bedrock monitoring wells will remain open unless circumstances requiring immediate closure to prevent cross-contamination of fractured zones are present. Closure of wells will consist of sealing the entire borehole with grout. TtNUS will subcontract a drilling company to perform the well closures.

Overburden Monitoring Well Construction

The overburden wells in each well cluster will be installed using standard drive and wash drilling methods. It is anticipated that five overburden wells will be installed using this method. The remaining two bedrock wells described in Table 3-1B will be nested with existing overburden wells on the site. The deepest boring at each cluster (bedrock or deep overburden borehole) will be advanced using split-barrel soil sampling. The evaluation of these soil samples including results of jar headspace soil VOC screening and visual observations made by the site geologist will be used to determine the location/well screens/depths for the shallower borings within that cluster. The location of each shallower well in a cluster will be determined by the TtNUS Project Manager and site geologist based on a review of data gathered from the initial deepest boring.

Guidelines for monitoring well construction follow:

- All monitoring wells will be constructed of 2-inch ID, non-glued, flush joint, threaded, Schedule 40 PVC casing with either Teflon tape or O-rings at each joint. Well screens will be equipped with a screw-in PVC end plug.

- Well screen lengths will be determined based on the jar headspace VOC screening results, and visual observations such as soil classification, staining, and structure.

- Well screen slot sizes will be 10 (0.010-inch slot opening) or 20 (0.020-inch slot opening) based on visual soil classification in accordance with the Unified Soil Classification System.

- Due to the remote location of the Site, all wells will be completed with a steel protective casing that extends a minimum of 2 feet above ground surface.

- The drilling program will be designed to protect against cross-contamination of aquifers. This effort will be accomplished by telescoping casing and changing to new drilling fluids when it is

necessary to penetrate a potential confining layer when drilling in known or suspected source areas of contamination.

The well screen lengths will be determined using the approach presented below.

Water table monitoring wells will be completed with 10 feet of well screen. If possible, the well screens will be set across the water table so that potential floating product can enter the well and the well screen will not become submerged during periods of high groundwater elevations.

Intermediate or deep overburden wells will be screened to monitor potential contaminant pathways, as determined from field screening and field observations. If field screening does not detect VOCs in the deeper soils, the well screen will be set in that portion of the overburden aquifer which is expected to have the highest hydraulic conductivity. The relative hydraulic conductivity will be estimated based on the type of material encountered. Portions of the aquifer that contain clean sand and gravel will be judged to have a higher hydraulic conductivity than areas that contain silt and clay.

The screen slot size will be determined based on the texture of the soil samples collected from the depths of the proposed well screen location. Medium to fine sand is expected to have a 10 slot well screen, and coarse sand and gravel is expected to have a 20 slot well screen. Sand pack materials will be selected to stabilize the aquifer formation during well development and provide a good hydraulic connection to the aquifer.

Additional details for completing overburden monitoring wells will be presented in the drilling technical specification. The field geologist or engineer will document the well construction details on a well construction log (Appendix D). Any deviations from standard procedures will be documented using a Field Modification Record (FMR, Appendix D).

Bedrock Monitoring Well Installation

The bedrock monitoring well in each of the seven clusters will be installed first. The boring will be advanced using standard drive and wash drilling methods and rotary rock coring methods. The bedrock portion of the boring will be evaluated using data gathered from the recovered rock core, observations made during coring, and packer tests. These data will be evaluated to select the pump intake interval for groundwater sampling and provide bulk hydraulic conductivity data on the bedrock aquifer. No well screens will be placed in the bedrock boreholes and the bedrock wells will be left open until sampling is complete.

The bedrock monitoring wells will be constructed of 2-inch ID, non-glued, flush joint, threaded, Schedule 40 PVC riser casing with either an O-ring or Teflon-tape at each threaded joint. A tight fitting Teflon or PVC ring will be attached to the base of the PVC riser to form a base for the bedrock/overburden seal. This ring must fit snugly into the 2-foot deep 4-inch diameter bedrock socket and rest on the lip created at the transition point where the NX or NQ coring began. The entire PVC riser will rest on this ring which will also act as a trap for the bentonite seal & backfill materials. A stainless steel or PVC centralizer will be installed on the riser approximately 5 feet above the top of bedrock to ensure proper alignment and to secure the bentonite seal to the riser. The bedrock/overburden seal will consist of bentonite chips to a minimum of one foot above the bedrock surface. The placement of this seal will be monitored using a weighted tape to ensure a lack of bridging and proper placement. A bentonite and potable water slurry may be used as backfill above the seal following a minimum of one hour to allow the seal to set. Bentonite chips may be used as backfill in place of a slurry at the driller's discretion. The well installation will be completed with a protective casing. Additional well construction details will be provided in the drilling technical specification.

3.2.1.5 Well Development

Monitoring wells will be developed after installation to remove fines and sediments from around the well screens and to remove drill cuttings and residual drilling fluids from the area around the monitored interval. Development methods may include bailing, pumping, and surging, as determined by the field geologist. Well development will continue until turbidity is less than 5 nephelometric turbidity units (NTUs), determined by measuring the turbidity every 15 minutes, and until the pH and specific conductivity have stabilized, or until approved by the field geologist/engineer. A Horiba U-22 water quality meter and a LaMotte 2020 Turbidity meter will be used to collect the periodic readings during well development. If a well is not completely developed after 4 hours, the FOL will notify the TtNUS Project Manager who will consult with technical advisors and the Navy to determine the course of action for continued development. In accordance with RIDEM policy, development water will be collected in 55-gallon drums (DOT Specification 17) or equivalent storage tanks until disposal can be arranged.

3.2.1.6 Hydraulic Conductivity Tests

Hydraulic conductivity tests will be performed on all bedrock and overburden monitoring wells installed. The objective of this testing is to provide estimates of the hydraulic conductivity of the aquifer materials within the study area. These data will be used, along with other data, to refine the site conceptual model and divide the study area into hydrostratigraphic units, if appropriate. Additional information on this process is provided in TtNUS SOP GH-2.5: Groundwater Contour Maps and Flow Rates, provided in Appendix C.

The bulk hydraulic conductivity of the bedrock will be calculated from packer testing conducted at each of the bedrock boreholes prior to completion as a monitoring well (Section 3.2.1.3). The bedrock packer tests should provide sufficient data to calculate the bulk hydraulic conductivity of the bedrock. Other hydraulic conductivity tests, such as slug tests and constant rate discharge tests will not be performed at these locations unless it is determined during the field activities that one of these other methods would be more efficient at providing similar information.

For overburden monitoring wells, hydraulic conductivity tests will be conducted using either a constant discharge or slug test method, as described in TtNUS SOP GH-2.4. To determine which method will be used, observations such as pumping rate and drawdown, made during the well development and groundwater sampling of the wells, will be evaluated to determine the appropriate test method. Monitoring wells that are determined to be capable of producing water at a reasonable rate will undergo constant rate discharge tests. Other wells that are not expected to support a constant rate discharge test will undergo slug tests.

Constant Rate Discharge Test Method

The majority of wells will be tested using a constant rate discharge test method. Following completion of the Phase 1 low-flow groundwater sampling, as described in Section 3.2.1.7, the pump used to purge and sample will remain in the well and the pumping rate will be increased to approximately 3 to 5 gallons per minute in an attempt to achieve a stabilized drawdown. Water level readings, pump discharge rates, and the time will be recorded approximately every 1-minute for approximately 15 minutes, when stabilization should have occurred. If drawdown reaches 10 feet in the bedrock wells or de-waters the well screen in the overburden wells and stabilization has not occurred, the pumping rate will be decreased and testing continued. The test will be completed after a minimum of 15 minutes has lapsed and stabilization has been achieved.

Slug Tests

To aid in determining the bulk hydraulic conductivity of the aquifer(s) beneath the Site, rising head slug tests will be performed on overburden and bedrock wells that cannot support a constant rate discharge test. Falling head slug tests will only be conducted in wells with fully saturated well screens.

Prior to initiating slug testing at each selected well, the water level will be recorded to the nearest 0.01 foot using an electronic water level indicator. After the static water level has been established, a decontaminated PVC slug will be lowered into the well to a point just above the water table. The slug will be quickly inserted into the well so that its entire length will be below the water table. Water level

measurements will be taken at regular intervals as the water "falls" back to its static level (falling head test).

Once the water level has returned to static conditions, a rising head test will be performed by withdrawing the slug from the well and measuring the water level at regular intervals, a procedure identical to that of the falling head test. The slug will be decontaminated between wells by rinsing with a non-phosphate soap solution, tap water rinse, distilled water rinse, and isopropanol rinse, followed by a final deionized water rinse.

In-situ hydraulic conductivity testing procedures and recording requirements are described in SOP GH-2.4.

The hydraulic conductivity data will be evaluated in the field and, if necessary, a decision will be made to determine if a second test is required to collect additional data in order to calculate accurate hydraulic conductivities from each location. In some cases, a different method or frequency of measurements may be required to collect sufficient data to calculate the hydraulic conductivity.

Bedrock Packer Testing

Three bedrock holes will be packer tested to determine water-bearing zones. A "double packer" set up is expected at this time, which will allow for discrete zones of the bedrock to be isolated and tested. The interval between the packers is expected to be approximately 5 feet, however, actual packer test set-up and length between packers will be determined in the field based on spacing and frequency of fractures identified in the rock core. The entire length of the bedrock hole, to the extent practicable, will be packer tested. The test intervals will be selected so that areas where groundwater movement is expected will be isolated and tested as a separate interval.

Once the packer testing set-up is assembled and installed to the initial interval to be tested, the packers will be inflated/expanded to isolate the testing interval. After packer inflation, water will be pumped through the packer testing set-up at the desired pressure(s), as directed by the TtNUS Site Representative. After water pressure has stabilized at the desired testing pressure, the test will begin. The flow meter reading at the beginning of the testing period will be recorded, then flow meter readings will be taken at 15 to 30 second intervals, for the duration of the test. A minimum of 5 minutes of readings will be taken for each test. If no measurable flow occurs within the 5 to 10 minutes of testing, a holding test will be performed for several minutes as a check. The flow or bypass valve will be shut to completely isolate the system, then the water pressure gauge checked for a drop in pressure over time. Each interval may be tested at three pressure intervals. Once one interval testing is complete, the

downhole packer assembly will be moved to the next interval to be tested, and the testing procedures repeated.

The TtNUS field representative will record gauge pressures, water flow meter readings, and test times to calculate pumping rates on field forms. The TtNUS Project Manager and the Lead Geologist will review the results of the packer tests to determine whether a discrete zone sample can be collected. If a zone is identified for sampling, a low-flow groundwater sample will be collected. The well will be closed (sealed) if observations of contamination, including LNAPL and/or DNAPL indicate that contamination may be allowed to be transmitted to other intervals within the well. Packer test procedures are detailed in SOP GH-2.2, and the packer test assembly will be detailed in the Drilling Services Technical Specification.

3.2.1.7 Groundwater Sampling

All newly installed wells will undergo low-flow groundwater sample collection. In addition, three bedrock wells will be selected for additional discrete zone sample collection in conjunction with packer testing (Section 3.2.1.6).

Low-flow (low-stress) groundwater sampling will be conducted using the "EPA Region I Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells Revision 2", dated July 30, 1996, as amended 2002. The Phase 1 event involves sampling the groundwater monitoring wells installed on the Site during the Phase 1 drilling effort. Table 3-2 lists the number of samples to be collected and the analyses to be performed during the groundwater monitoring event for Phase 1; groundwater samples will be analyzed for VOCs, SVOCs, pesticides/PCBs, TPH/EPH, inorganics (total) including cyanide, alkalinity, sulfides, and total organic carbon (TOC). Table 3-3 presents the analytical methods proposed, and associated volume requirements, preservatives, and holding times. The three wells in which packer tests are performed will have discrete zone low-flow groundwater sampling performed in selected 5-foot intervals. Newly installed wells will be sampled no less than 3 days following development.

Work elements for the low-flow groundwater sampling task include the following:

- Measure presence/absence of NAPL using ORS probe 1 day before sampling.
- Measure water levels in wells to be sampled the day of sampling.
- Purge wells using low-stress low-flow methodology.
- Measure pH, temperature, specific conductivity, redox potential, dissolved oxygen, turbidity, water level, and pumping rate periodically while water is being extracted from the well.
- Collect samples using the low-flow methodology.

- Document, package, and ship all samples for chemical analysis.

For bedrock wells, where packer testing and discrete zone sampling is not performed, specific pump intake depths will be determined based on observations made during the advancement of the borings, locations of fractures in recovered cores, and on observations of well performance during well development activities. It is anticipated that either a bladder pump or submersible impeller pump will be required for the bedrock wells. For overburden wells, the pump intake will be set at the mid-point of the screened interval, or based on observations from soil profiles evaluated during drilling.

Groundwater Level Measurements

One day prior to groundwater sampling, water levels for all monitoring wells to be sampled will be measured on the same day, in as short a time span as possible. This information is used by the groundwater sampling crew to determine appropriate tubing/pump intake depths prior to groundwater sampling.

Groundwater levels will be measured with an electronic water-level indicator relative to a marked point on the top of the well casing, which will be the surveyed top of casing elevation. Water level measurements will be recorded to the nearest 0.01 foot. The measuring device will be calibrated and decontaminated prior to use and will be decontaminated between use in each well. Rinsing the device with deionized water will constitute the decontamination process unless significant contamination such as free product is encountered. If free product is encountered, liquinox soap and isopropyl alcohol will be used to remove the product, followed by rinsing with deionized water.

Well Purging Procedure

The procedures for purging and sampling of each well follow:

1. Using a water level indicator (M-scope), the depth to water in the well will be measured from a surveyed mark on each well and recorded to the nearest 0.01 foot, minimizing immersion of the M-scope probe within the standing water column to avoid disturbance of colloidal particles.

2. The required length of tubing will be calculated, measured, and marked with tape for attachment to the pump such that the intake end of tubing is placed at the midpoint of the saturated screened interval, (for overburden wells). Note that the tubing will be measured in order to allow a minimum distance between the well head and the discharge point (field testing equipment), to minimize temperature changes in the groundwater discharged from the well. Tubing will be disposed of after sampling is complete.

3. The tubing and pump will be slowly and smoothly lowered to the required depth to minimize the amount of mixing in the well. The tubing will be secured to the well casing (or PVC stick-up) to minimize movement.

4. The field testing equipment will be placed as close as possible to the well head/discharge tubing and adjusted to minimize air bubble entrapment within the tubing or flow-through cell.

5. The pump (submersible impeller type, or bladder pump) will be connected to the power supply (battery or other power source), and the power supply turned on (without starting the pump).

6. The depth to water with the tubing in the well will be re-measured and compared with the initial reading; if the readings vary by more than 0.05 foot, field personnel will wait for 5 minutes, remeasure the water, and begin pumping.

7. The pump will be started at the lowest flow setting (attempt 100 to 200 milliliters per minute). The pump start time will be recorded and the flow rate will be measured and recorded using a graduated cylinder and stopwatch. (Note that during the initial period of pumping, about 5 to 10 minutes, the depth to water in the well should be measured approximately once per minute to enable timely pump flow adjustments to minimize significant drawdown in the well).

8. The initial groundwater discharged from the tubing will be collected and field parameters (pH, temperature, conductivity, redox potential, turbidity, and dissolved oxygen) and time will be measured and recorded.

9. These field parameters (see above) and the depth to water in the well (using the M-scope) will be measured at approximately 5-minute intervals (initially the water level will be measured more frequently, as discussed in step 7). The data and the associated time will be recorded on the low-flow sampling data sheet. Attempts will be made to maintain the drawdown in the well during pumping to 0.3 foot or less, by adjusting the pump flow rate. Drawdown for each well will vary depending on the recharge capacity of the well. Drawdown may exceed 0.3 foot in some wells.

10. Groundwater samples will be collected following the stabilization of measured field parameters. "Stabilization" is considered to be achieved when three consecutive readings, taken at 3- to 5- minute intervals, are within the following limits:

- Turbidity (<5 NTU)
- Dissolved oxygen (10 percent)
- Temperature (3 percent)
- pH (within 0.1 unit)

All measurements, except turbidity, must be obtained using a flow-through cell. A ball-valve diverter will be placed in-line in the discharge tubing prior to the inlet for the flow-through cell to allow the collection of the turbidity measurement sample aliquot prior to entering the flow-through cell. The minimum purge volume is the stabilized drawdown volume plus the extraction tubing volume. Detailed information on stabilization is found in the "EPA Region I Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells Revision 2", dated July 30, 1996, as amended 2002.

3.2.1.8 Long-Term Water Level Measurements

Following completion of the Phase 1 groundwater sampling event, the long-term water level measurement round will be initiated. This effort will include all groundwater sampling locations and two surface water gauging stations, which will each be equipped with pressure-transducer/data loggers to measure and record groundwater elevations in both shallow and deep overburden, bedrock, and in the adjacent bay.

The transducers will be secured within the protective steel casing of the wells and will be installed at a depth sufficient to ensure that the transducer will not become dewatered. The transducers will be installed and initialized to provide water level elevation data in order to reduce the amount of data conversion from depth to elevation, and thereby reduce opportunity for mathematical errors. The transducer cable will be marked with duct-tape at the appropriate location so that, if it becomes necessary to remove the transducer for maintenance, it can be replaced accurately. The transducer cable will be secured within the PVC so that no vertical movement can occur which could create error in the measurements during data retrieval activities and manual measurements.

Each transducer will be left in place for approximately five days during the summer/fall (low water table) season. All of the transducers will be initialized to collect readings every 15 minutes. The transducer data will be downloaded as needed onto a laptop computer and will be field-verified using manual measurements to identify potential problems such as instrument drift or failure.

3.2.2 Sediment Evaluation

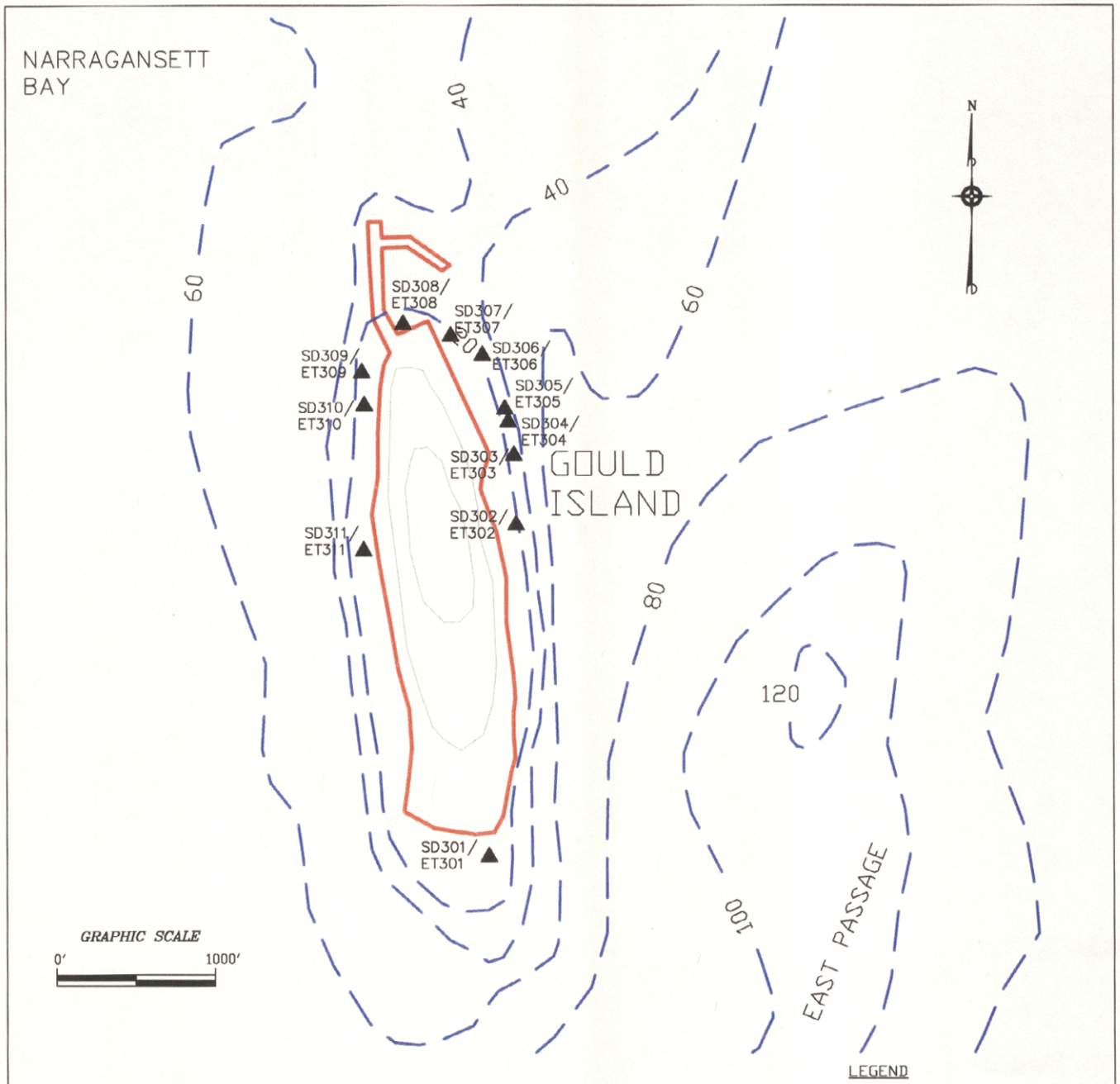
A sediment evaluation will be performed to determine the presence of contaminants in the marine sediments adjacent to the Site. Navy guidance for sediment investigations is directed at identifying the source of the contamination through records search, preparing a Watershed Contaminated Source Document (WCSD) and controlling the source of the sediment contamination, prior to conducting a risk-based cleanup. The WCSD has been prepared and is presented in Section 2.3 of this Work Plan. The next step is to identify any contaminants at the Site that are specifically attributable to the Site and are not the watershed contaminants. This will be accomplished in order to determine if there is residual sediment contaminant presence in any depositional areas that can be associated with historic or continuing contaminant discharges from the Site.

3.2.2.1 Sediment Sampling

Previous sampling of Narragansett Bay sediments adjacent to the Site showed slightly elevated levels of heavy metals in sediments (Appendix A). It is anticipated that eleven sediment stations will be sampled under this task to characterize present levels of Site-related contaminants in the sediments near the electroplating discharge outfall, Building 32 sewerage outfalls, and stormwater outfalls. Surficial sediment samples will be collected from depositional areas in the Bay in the vicinity of the outfalls. If available, additional sediment samples will be collected from depositional areas proximal to the existing terminus of each outfall pipeline. Samples will be collected from stations depicted in Figure 3-3, though these station locations may be adjusted pending sediment depositional area evaluation, discussed later in this section. A rationale for selection of these stations is provided on Table 3-1C.

It is anticipated that sediment samples will be collected from a boat using a stainless steel grab sampling device (eckman dredge or ponar sampler) or by divers using sediment core tube samplers. If possible, in shallow, near-shore areas, stainless steel coring tubes should be used for sample collection. If these surface sampling techniques are unsuccessful because of poor sampling conditions (dense or excessively rocky substrate), other methods (vibracoring, etc.) may be evaluated. Sediment samples will be collected from the 0 to 6 inch interval at all stations, measured from the sediment surface. In addition, if depositional sediments are located during the investigation, a 6 to 12 inch sample will also be collected from all such locations using a core sampling (or equivalent) device.

Samples will be collected for the full Target Compound List (TCL) organic analyses (VOCs, BNAs, pesticides, and PCBs), TAL metals, cyanide, TPH (EPH), grain size distribution analysis, total organic carbon (TOC), and Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM) analyses. The AVS/SEM sediment samples will be collected from the surface only (the oxic zone if it can be visually



NOTES:

1. ALL LOCATIONS ARE TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BOTTOM CONTOUR DATA INTERPRETED FROM NOAA CHART 13221, APRIL 15, 1995.

PROPOSED SEDIMENT AND SHELLFISH SAMPLE STATIONS	FIGURE 3-3
SITE 17, GOULD ISLAND	TETRA TECH NUS, INC.
NAVSTA NEWPORT, RHODE ISLAND	
DRAWN BY: L. SEYDEWITZ / REV.: 0	55 Jonspin Road Wilmington, MA 01887
CHECKED BY: S. PARKER / DATE: APRIL 25, 2003	(978)658-7899
SCALE: AS SHOWN / ACAD NAME: \DWG\5152\0450\FIG_3-3.DWG	

identified). In addition, the temperature, pH, specific conductivity, dissolved oxygen, and salinity of the surface water will be measured at each sediment sample location. Table 3-2 lists the number of samples to be collected, and the analyses to be performed during the sediment sampling for Phase 1. Table 3-3 presents the analytical methods proposed, and associated volume requirements, preservatives, and holding times.

A relatively undisturbed VOC and AVS/SEM sediment sample will be collected as soon as possible after the sediment sampler is retrieved. The aliquots for these analyses will be collected from the sediment core or grab and not homogenized. The VOC sample will be collected in accordance with the March 1997 (or most up-to-date) version of the Region I EPA-New England Draft Standard Operation Procedure for Soil Sample Collection and Handling for the Analysis of Volatile Organic Compounds. After collecting the VOC and AVS/SEM samples, the remaining sediment will be deposited into a stainless steel bowl. Attempts will be made to drain any excess standing water from the bowl without loss of fine materials from the sample. The remaining portion of the sample will be thoroughly mixed and transferred to the appropriate sample containers.

Appropriate chain-of-custody procedures will be followed (see Section 4.5) and samples will be labeled, packaged, and shipped according to TtNUS SOPs described in Section 4.

Each sediment sample location will also be surveyed using standard transit survey technique or GPS survey equipment (GPS to sub-meter accuracy). Off-shore locations will be buoyed and buoy locations will be maintained until survey activities are complete. If GPS surveying is selected, three onshore reference points will be established (staked, nailed, or use of monitoring wells) as control points for integration of GPS data into land survey data. These three control points will also be surveyed during the onshore survey.

3.2.2.2 Offshore Outfall Tracking/Underwater Imaging

As described in Appendix A, the Building 32 interior drainage systems leading to outfalls on the east side of the island were identified, however, the current and original discharge points are only approximated. The objective of this task is to track and, if possible, locate the existing outfall locations for discharges from the Building 32 interior drainage system. In addition, this survey will be used to aid in identifying sediment types, locating sediment sampling locations, and evaluating habitat.

Methodologies used to track the outfalls beyond the seawall and to locate potential sediment sample stations will include: visual observations (near shore) at low tide; video recording devices, e.g. submersible drop video camera, for deep water areas; a boat for operational work near and seaward of

the outfall positions; and if needed, a professional diver(s) with video or still camera capabilities. The outfall discharge points and potential sediment sampling locations will be recorded on video tape or still photographs, surveyed using GPS equipment to sub-meter accuracy, and temporarily marked using a weighted buoy marker. If feasible, a more permanent marker that is visible at low tide will be staked or anchored at the outfall discharge points. The underwater video operations will be performed by subcontractors to TtNUS operating under their own health and safety plans, and supervised by TtNUS technical staff.

As part of the underwater imaging activities discussed above, in addition to tracking the discharge line outfalls from the seawall, the bottom imaging scan will generally follow the island shoreline at a distance of up to 300 feet from the shoreline east and northwest of Building 32 and to a maximum water depth of 60 feet. Images from this scan will be used for the selection of depositional areas for sediment sampling. The entire survey tape will also be reviewed by an ecologist as part of the ecological assessment of the offshore environment.

3.2.2.3 Shellfish Sample Collection

Blue Mussel (*Mytilus edulis*) samples will be collected at stations where sediment samples are proposed (Figure 3-3). Mussels will be located by wading or by diving. Mussels will then be collected by hand, scrubbed in seawater, patted dry, and shucked. All collected mussels will be characterized according to species, length, width, breadth, total weight, and shucked tissue weight. Shell length, width, and breadth will be measured using dial calipers in millimeters. Total weight and tissue weight will be measured to the nearest gram. Field observations shall also be recorded. A sample collection logsheet shall be completed for each sampling location. Chain-of-custody procedures will be initiated for specimens selected for laboratory analyses. Approximately 25 specimens of the same size will be composited for each collection location. The actual number of samples collected at each location will be based on the required tissue mass for all chemical analyses. Tissue composites will be placed in pre-cleaned glass jars with Teflon-lined lids, labeled, and immediately frozen for shipment to the analytical laboratory. For shipment, samples will be packed in coolers with adequate dry ice of at least 50 percent of the weight of the biomass to maintain the sample in a frozen condition during transit.

3.2.3 UIC Evaluation

A UIC evaluation will be performed to identify and address any UICs that have not yet been identified, or have been identified though with no known function or purpose. This effort is planned to determine the purpose and role of underground structures that are not provided on historic drawings and records, and to map out any possible underground injection points.

Some floor drains and drainage systems from the demolished buildings have been identified, and residue and concrete chip samples have been collected from those drains to determine contaminant discharge possibilities. This information is provided in Appendix A and is accounted for in the applicable sections of this Work Plan.

The location of one possible UIC is immediately north of the former electroplating room, identified by a manhole present in the floor of the former building. This manhole was found to contain liquids that were removed and disposed of, as described in Appendix A. Although this material has been removed, the purpose of the structure is not evident, as it is not shown on construction drawings or as-built plans reviewed for the building. It is therefore likely to have been added at some later date, after building construction, and the function of the space underneath is unknown.

Other floor and sump drains identified in previous inspections were evaluated and found to likely discharge to the ocean through the floor drain system as described in Appendix A. UICs not previously identified (i.e. drains from other buildings not previously evaluated) that are found during RI field activities will be cleared for inspection by removing any soils or sludges so as to allow identification of inlet and outlet piping or openings. Additional sludge, sediment, or soil sampling (residue) will be conducted as described below to identify any contaminant presence in and around these structures.

Residue Sampling

Residue samples will be collected (if found) from within each new UIC identified. One sample will be collected from any depression or clean-out near the origin of the UIC, and one will be collected from the soil or sediment where that UIC is expected to discharge. Additional samples will be collected if standing fluids, water or obvious chemical contaminants are found to be present in the cleanouts or drainlines encountered. These residue samples will be collected to characterize contaminants in the UIC flow path and determine if a continuing source of contamination is present. If such material is not available, samples will not be collected. If possible, undisturbed VOC residue samples will be collected in accordance with the March 1997 (or most up-to-date) version of the Region I, EPA-New England Draft Standard Operation Procedure for Soil Sample Collection and Handling for the Analysis of Volatile Organic Compounds.

Due to the unknown number of potential UICs and accessible manholes/catch basins and cleanouts, a preliminary estimate of 10 residue samples is allotted in this Work Plan. These samples will be analyzed for the full TCL organic analyses (VOCs, BNAs, pesticides, and PCBs), TAL metals, cyanide, and TPH (EPH) analyses. Table 3-2 lists the number of samples anticipated to be collected, and the analyses to

be performed. Table 3-3 presents the analytical methods proposed and associated volume requirements, preservatives, and holding times.

3.2.4 Evaluation of Ecological Setting

Navy and EPA guidance for ecological risk assessment calls for a tiered, or stepped approach, as follows: 1) screening risk assessment, 2) baseline ecological risk assessment 3) develop site-specific risk-based cleanup values through reverse calculation of acceptable levels, modified through risk management appropriate for the site, and 4) monitor, if necessary, after cleanup. This Work Plan addresses only the performance of the first step, that of a screening level ecological risk assessment. Details on the performance of the risk assessment are provided in Section 5 of this Work Plan.

As a part of the determination of risk, the receptors must first be identified. This section describes an evaluation of the terrestrial and marine ecological settings for the purpose of identifying potential ecological receptors.

3.2.4.1 Ecological Setting

The ecology of the marine environment will be evaluated by a qualified ecologist during sediment evaluation and sampling activities, and through low tide observations. A literature review will also be conducted, including a review of other offshore ecological risk assessments that have been performed in Narragansett Bay. Due to the proximity of the McAllister Point Landfill site to Gould Island (Figure 2-1) and the similarity of the settings between the two sites, the Marine Ecological Risk Assessment Report and any monitoring data available for the McAllister Point Landfill will be utilized to provide baseline information for the Gould Island marine ecology evaluation, in addition to the bottom imaging scan performed as described in Section 3.2.2.2. In addition, a biologist's survey of the marine and upland areas will be performed to establish an ecological characterization of the Site. The ecological evaluation of the subtidal environment will include an evaluation of the imaging information collected.

Due to the remaining conditions of the Site following building demolition, and the expected limited nature of terrestrial contamination as a result of the on-shore removal actions, the ecological walkover will include the island as a whole, but will focus on the intertidal and shoreline areas of the site indicated in Figure 3-1. Evaluation of the terrestrial portions will be performed to the extent possible, limited by heavy brush and other vegetation. The habitat quality of the Site itself will be evaluated, though it is extremely limited, as it is in transition from demolition, and excavation is still ongoing. The ecological walkover will involve the following evaluations:

- identify the types and spatial extent of habitats that are present on and around the Site and on the island,

- identify the species and biological communities on and adjacent to the Site that may use these habitats and that may be potential receptors with regard to contaminants present in soils, sediments, and surface water at the Site,

- determine the presence of contaminated environmental media with regard to potential exposure of receptor species, and

- identify on-site and adjacent wetlands, if appropriate, and their approximate boundaries; provide sketch maps of the wetland boundaries relative to the Site.

3.2.4.2 Characterization of Habitats

The objective of the habitat characterization is to identify the nature and composition of non-marine animal and plant communities in the vicinity of the Site, to provide a basis for identifying potential receptors.

To characterize the habitats at the Site and on the island, biologists will provide: descriptions of the nature and composition of plant and animal communities; descriptions emphasizing wildlife species, their habitat, and key feeding behaviors; a description of significant habitat; and, if applicable, information on federal-or state-threatened or endangered species.

These tasks will be accomplished by conducting a literature search, a review of threatened and endangered species lists, queries with local birding groups and Audubon Society, and a field assessment (a qualitative survey of the flora and fauna).

3.2.4.3 Literature Review

The purpose of the literature review is to provide background information on the habitats and species of plants and animals expected to occur on the Site and in nearby areas, and the use of the general area by migrating or overwintering species. The review will include data or documents from RIDEM, the US Fish and Wildlife Service (USFWS), and other data sources.

3.2.4.4 Review of Threatened And Endangered Species

RIDEM, National Oceanic and Atmospheric Association (NOAA), and USFWS Office of Endangered Species lists will be reviewed by TtNUS to identify endangered, protected, or threatened species that may inhabit or use the Newport area and the island. This information will be checked with RIDEM, NOAA, and the USFWS, and maps will be provided at appropriate scales to show important habitats or nesting sites for these species. The determination of potential effects on any endangered or threatened species identified as being present in the Site area will receive special consideration.

3.2.4.5 Field Assessments

The purpose of this task is to provide qualitative field verification of the types of habitat and wildlife on and near the Site.

The goal of the wildlife assessment is to provide site-specific observations concerning the diversity (type) of species rather than data for assessing population structure or community analyses. Since the objective is to provide a general inventory of terrestrial fauna on the island, the survey will be qualitative rather than quantitative. These data will be used to provide an informed site-specific basis for selecting potential ecological components (receptors). Under this effort, the island as a whole will be evaluated since it is likely that the wildlife, particularly avian species, at the island will use the entire island as a forage area.

The survey requires a site walkover. Positioning will be by "line of site" and will therefore be approximate. A field map will be used to guide the survey and to record observations. The walkover path will be planned and modified as appropriate in the field. The path will be dictated by the types of environments encountered and their extent, based on visual observations. Obvious habitat features that may be of particular value to wildlife will be examined closely. The course of the walkover will be based on such observations as nesting sites, physical signs of wildlife, audible signs of birds, changes in vegetation patterns, obvious changes in hydrologic conditions, changes in slope, and physical accessibility.

During the survey, observations will be made on major flora in habitat areas, and bird, amphibian, reptile, and mammal sightings or their physical evidence, e.g., nesting sites, tracks. Observations will be recorded on a base map to mark the locations of major habitat types and observations and notes will be recorded in a field log book by the biologist.

Lists of flora and fauna will be produced for inclusion in the report. These lists will be species-specific where possible. The method for species identification, i.e., visual sighting, identification by tracks or other physical evidence, and audible identification, will be included on the fauna list.

3.2.4.6 Data Products

The data products from the habitat survey will include tables and maps to facilitate a qualitative biological characterization of the Site and the island. These will be provided in a report that will include:

- narrative descriptions of the nature and composition of plant and animal communities in the immediate vicinity of the Site, referencing a combination of maps (for major vegetation and habitat types) and tables (for species composition of the communities),

- descriptions emphasizing wildlife species observed, and their habitat requirements described in available literature, and key feeding habits; important features of the biology of these species, such as migrations into and out of the area through pertinent literature sources,

- a description of significant habitat, wetlands, waterbodies, and other resources in the immediate vicinity of the Site. As suggested by EPA guidance (1989), habitats that "are unique or unusual or necessary for continued propagation of key species" will be described. The USFWS, NOAA, and RIDEM are primary sources of this information, and

- information on federal or state threatened or endangered species.

These data products will be used to develop an ecological assessment for the Site, as described in Section 5.3.

3.3 PHASE 2 INVESTIGATIONS

The Phase 2 investigations are not scoped at this time. As stated in Section 3.1, the goals of the Phase 2 investigations are to collect, if necessary, additional data to determine extent of contaminant plumes (sediment and groundwater), and determine toxic effects on ecological receptors present. These investigations will be conducted, if necessary, to provide the following additional data endpoints:

- extent of groundwater or soil contamination,
- quantification of continued contaminant releases to Narragansett Bay through leaching, erosion, and/or groundwater flow,

- extent of site-related sediment contamination, and
- toxicity of site-related contaminants to the receptors present.

These Phase 2 efforts will be designed as appropriate to the data needs that are identified at the completion of Phase 1 investigations. This is a primary decision point that will require input from the Navy, EPA and RIDEM following completion, release and review of the Phase 1 data. Any necessary Phase 2 data collection efforts will be designed in an addendum to this Work Plan, to be developed after the data needs are identified.

3.4 SUPPORT EFFORTS

This section of the Work Plan describes some of the necessary efforts that will be conducted to support the data collection activities described in the preceding sections. These efforts include decontamination, surveying, management of investigation-derived wastes (IDW), and other tasks common to the individual sampling programs.

3.4.1 Land Survey

Following the investigative work, a survey will be performed by a State of Rhode Island registered surveyor to identify locations of sample points and other significant features identified during the RI. Surveys will be performed by a subcontractor supervised by TtNUS, working under the TtNUS Health and Safety Plan.

The base map presented in this Work Plan (Figure 2-2) will be used; however, locations of existing buildings and study area boundaries may be confirmed by survey.

The survey will be conducted to establish relative locations of sample points. Survey control will be maintained by tying into either the State of Rhode Island or United States Geological Survey (USGS) grid systems. Elevations will be referenced to a USGS benchmark and the mean low water level. Horizontal and vertical measurements will be made relative to on-site control points.

All surveyed features will be horizontally located to within plus or minus 0.1 foot. Tops of PVC well risers will be located to plus or minus 0.01 foot vertically.

At a minimum, it is expected that the following features will be surveyed:

- expected discharge outfall points at the seawall related to Building 32,
- manholes and catch basins near and inside Building 32,
- boring locations and monitoring well elevations,
- other onshore sample locations, and
- three GPS control points from sediment sampling

In addition, any sample collection points that are established during the investigation will be surveyed. Sediment sample locations will be buoyed and located using GPS with submeter accuracy, as described in Section 3.2.2 of this Work Plan.

Surveyed points will be mapped with AutoCAD V14.0 or a compatible system. The survey subcontractor will provide hard-copy prints and disk versions of the survey information for each survey operation. Survey points for each task will be set on a different "layer" of the AutoCAD data such that printouts of sample collection points can be made specific to each task or any group of tasks.

3.4.2 Management of Investigation-Derived Waste (IDW)

Waste materials that will be generated during the field investigation may include drill cuttings and fluids, well purge and development water, decontamination fluids, wash water from steam cleaning, disposable sampling equipment, and used personal protective equipment (PPE). Procedures for handling IDW are described in this section which has been prepared in accordance with TtNUS SOP SA-7.1, Section 5.4 (Waste Handling) (S7).

TtNUS will be responsible for removing and disposing of all investigative waste materials (well purge water, soil cuttings, and PPE) following completion of the field investigation program. This waste disposal program will be conducted following each element of work described in the previous sections. In this manner, large quantities of wastes will not be stockpiled for disposal at the end of the investigation program.

Containers of IDW will be labeled as to their point of origin and date collected. Containers of IDW that are found to be hazardous will be characterized and disposed of within 90 days.

3.4.2.1 Solid Wastes

Disposable personal protective equipment (gloves, tyvek coveralls, and disposable boots) will be decontaminated, double bagged, and disposed of in an off-site industrial dumpster.

3.4.2.2 Soil Wastes

Excess drill cuttings, discarded sample material, and other soil wastes will be containerized and labeled as to location of origin. Laboratory analysis of samples collected during the investigation program will be used to characterize the materials, as required by state and federal disposal requirements. Soils that are found to not contain elevated concentrations of contaminants will be replaced onsite as general fill. Soils that are confirmed by laboratory analysis to contain elevated concentrations of contaminants will be further characterized for off-site disposal.

Additional samples will be analyzed for other parameters to characterize the waste. Typical disposal parameters are listed below:

- Toxicity Characterization Loading Procedure (TCLP) Volatile Organic Compounds
- TCLP PCB/Pesticide Compounds
- TCLP Metals
- Flash Point, Reactivity, Corrosivity
- Free Liquid

Analysis of representative samples of waste materials for disposal parameters will be the responsibility of an outside disposal subcontractor. All soil wastes will be shipped off site by this same subcontractor.

3.4.2.3 Aqueous Wastes

Decontamination fluids, well purge and development water, and drilling fluids will be initially contained in 55-gallon drums or portable tanks approved for such use, and labeled as to location of origin. Drums of drilling water, purge water, and development water originating from wells that are found to not contain elevated concentrations of contaminants through laboratory analysis will be discharged onsite. Containers of water that are confirmed by laboratory analysis to contain elevated concentrations of contaminants will be further characterized for off-site disposal. The wastes will be sampled for RCRA disposal parameters based on the findings of the field investigation, and in accordance with state waste generation and disposal requirements. Samples may be analyzed for, but not limited to VOCs, SVOCs, metals, PCBs, pesticides, TPH, and flash point. This material will be combined at the conclusion of the project and shipped off site for disposal in accordance with RIDEM, USEPA, and DOT Regulations.

3.4.3 Cleaning and Decontamination of Equipment

The detailed decontamination and waste handling procedures are described in this section, which has been prepared in accordance with TtNUS SOP No. SA-7.1 (S7), provided in Appendix C. The non-disposable equipment that will come in contact with the media to be sampled and that will require decontamination is identified in the table below. 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. Sterile disposable sampling materials, which are individually packaged from the factory, will not require decontamination before sampling. Disposable sampling materials will be kept to a minimum to reduce the amount of solid IDW requiring disposal.

Equipment that will be used at Site 17 to collect soil, sediment, biota, and groundwater samples is summarized in the table below:

Matrix: Soil/Sediment	Parameter		
Equipment	Inorganics including Cyanide	SVOCs, DRO, Pesticide/PCBs, Percent Moisture	VOCs
Drill Rig & Drilling tools	X	X	X
Stainless Steel Trowel	X	X	
Split-Barrel sampler or core tube	X	X	X
Stainless Steel Bowl	X	X	
Disposable Sampling Trowel	X	X	
Sediment Core tube, Dredge	X	X	X
Disposable 10 ml Syringe			X
PPE	X	X	X

Matrix: Groundwater	Parameter	
Equipment	Inorganics including Cyanide	VOCs, SVOCs, DRO, Pesticide/PCBs, TOC, Alkalinity, Sulfides
HDPE Tubing	X	X
Pharmaceutical-grade Silicon Tubing	X	X
Submersible or Bladder Pumps	X	X
PPE	X	X

Matrix: Ecological Tissue	Parameter	
Equipment	Inorganics including Cyanide	SVOCs, Pesticide/PCBs
Stainless Steel Knife	X	X
Stainless Steel Bowl	X	X
PPE	X	X

Decontamination Procedure

Prior to the initiation of drilling activities all downhole drilling equipment and tools will be high-pressure steam-cleaned at a decontamination pad to be constructed at the Site. This decontamination procedure will apply to all downhole tools, the rear of the drill rig, any tool racks, and support vehicles which come into contact with contaminated media. This decontamination procedure will be repeated between each soil boring and prior to demobilization of this equipment from the Site.

Non-disposable sampling equipment such as split-barrel samplers, submersible pumps and stainless-steel supplies will undergo the following decontamination procedure prior to being used and between samples:

1. Potable water rinse
2. Alconox or Liquinox detergent wash
3. Potable water wash
4. Deionized water rinse
5. Pesticide-grade Isopropyl alcohol rinse
6. Pesticide-grade Hexane rinse
7. Thorough deionized water rinse
8. Air dry
9. Wrap in aluminum foil for storage if not reused

3.4.4 Field Equipment Calibration

Calibration of direct read instruments will be performed as described in this section, which has been prepared in accordance with TtNUS SOP SA-2.2 (Air Monitoring) (S8).

The Field Instrument Calibration TtNUS SOPs for the Photovac 2020 PID (ME-12) and the Photovac MicroFID (ME-15) (S4 & S5) are provided in Appendix C, in addition to TtNUS SOP SA-2.2, Section 5.6 (Air Monitoring and Sampling) (S8). Field analytical equipment will be calibrated prior to each day's use and the calibration will be checked at the end of each day. The calibration procedures used will conform to manufacturer's standard instructions. Records of instrument calibration will be maintained in a field log. Field personnel will maintain instrument manuals onsite.

3.4.5 Field Equipment Maintenance, Testing, and Inspection Requirements

Equipment, instruments, gauges, and other items requiring preventive maintenance will be serviced 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 operator to adhere to this maintenance schedule and to promptly arrange any necessary service required. Service to the equipment, instruments, tools, gauges, etc. shall be performed by qualified personnel. Logs shall be established to record maintenance, service procedures, and schedules. Maintenance records will be documented and traceable to the specific equipment, instruments, and gauges.

3.4.6 Inspection and Acceptance Requirements for Supplies/Sample Containers

It will be the responsibility of the field personnel 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 sampling containers.

If the field crew encounters any problem with supplies, the FOL should consult the QA/QC Officer for instruction. The QA/QC Officer will instruct the field crew on any corrective actions that should be implemented.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

This Quality Assurance/Quality Control (QA/QC) section includes information on: project quality objectives, project action limits, measurement performance criteria, and sample collection documentation requirements. Additionally, the sample identification system, sample handling and custody procedures, analytical method requirements, sampling and analytical quality control requirements, analytical documentation and data management, data validation and verification requirements and procedures, and QA assessment and management efforts are provided.

Achieving the study objectives for this RI requires that the data collected from the field conform to an appropriate level of quality, adequate to be used for baseline risk assessments. The quality of a data set is measured by certain characteristics of the data, which are described in this section.

4.1 PROJECT QUALITY OBJECTIVES

The data quality objectives (DQOs) and methods for sampling and laboratory analysis described in this Work Plan are selected to provide data adequate for the development or support and human health and ecological risk assessments. If the data meet the quality objectives, they will be used for this endpoint. This section describes how project data will be reconciled with the project quality objectives, how data quality issues will be addressed, and how limitations on the use of the data will be reported and handled.

TtNUS will perform data quality assessment, including:

- Review of the DQOs and sampling design, review of the proper validation level.
- Review of the data validation criteria, measurement performance criteria, and method QC/QL requirements.
- Correlation of data to expected values, comparison to available historical data (as applicable).

To meet these ends, the following data quality indicators will be evaluated:

<u>Completeness</u>

The data validator performs a Completeness Evidence Audit. During this audit, the validator checks that the laboratory has provided all of the documentation required to support the reported analytical results. If any documentation is missing from the data package, the data validator contacts the laboratory and requests a resubmittal. If the laboratory fails to resubmit a requested document, the data validator notes this on an internal Inventory Sheet and in the data validation cover letter. The Lead Chemist determines

if the missing information makes the data unusable. The Project Manager and data user determine if any missing data is crucial to achieve the data quality objectives.

Precision

Field duplicated sample results, laboratory duplicate results, instrument variation, sampling techniques, as well as possible sample transport problems, sample matrix problems, and sample heterogeneity will be assessed to determine the overall data precision. If the project goals for precision are not met, the potential need for re-sampling will be evaluated.

Accuracy

During data validation, the data validator evaluates the accuracy of the analytical data using the laboratory and field blanks, laboratory control samples, and check standards.

The laboratory and field blanks will indicate accuracy and potential contamination bias of the analytical data results. The analytical accuracy and bias will be evaluated based on the analysis of check standards, matrix spike recoveries, surrogate recoveries, laboratory control samples, calibration linearity, and calibration verification results.

The data assessment will compare overall contamination and accuracy/bias of the groundwater, sediment, soil, and biota sample data from the Site. The impact of any qualitative and /or quantitative data trend will be evaluated. Limitations on the use of the data will be evaluated as well as assessment of the potential need for re-sampling.

Sample Representativeness

The overall and specific sampling group representativeness for the samples for each media will be evaluated. If the data are not usable to address and answer the environmental questions and/or to support the project decision-making requirements due to problems with sampling techniques, sampling preservation, analytical holding times, or field duplicate results, the need for additional sampling will be evaluated. Such evaluations will be held internally, and then with the project group as necessary.

Sensitivity and Quantitation Limits

The required quantitation limits to meet the project action limits specified in Section 4.2 will be evaluated. The sample quantitation limits, the low point instrument calibration standard, matrix

interferences, and sample dilutions will be evaluated to assess if the sensitivity goals were met. The specific sensitivity of the data package results will be evaluated for each medium in order to clearly differentiate between usable and unusable data for the various data users.

Comparability

Standard methods of sample collection and analysis are expected to produce comparable data. Data from each matrix collected at the Site will be compared with historical and expected analytical results. Limitations of the data use by matrix and/or specific sampling locations will be identified.

4.2 PROJECT ACTION LIMITS

Project action limits are provided in this section for both screening data and for fixed laboratory analytical data.

The project action limits for laboratory data have been established for comparison with regulatory criteria and the adequate evaluation of human health and ecological risks in accordance with current risk assessment guidelines. Additionally, similar risk assessments performed for other Navy sites in the area of Narragansett Bay were considered for use of screening benchmarks, and for action limits for contaminants of potential concern.

In the conceptual model presented in Section 2 of this Work Plan, potential contaminants of concern were identified based on former use of the Site, formerly detected contaminants, likely discharge conditions, and fate and transport mechanisms. While these contaminants are only a small subset of the contaminants that may be present and potentially posing a risk to human and/or ecological receptors, they do provide a basis of understanding of what contaminants are likely to be present. In this section, the project action limits are established for these and related contaminants.

Tables 4-1A through 4-4C present the project action limits that will serve as target concentrations for the chemical data provided by the fixed analytical laboratories. Sources of the values are provided as table footnotes and references.

Project action limits, for the purposes of this section, are specific criteria against which the analytical data will be initially screened to support the preparation of human health and ecological risk assessments.

Project action limits in Tables 4-1A through 4-4C were selected from toxicity and regulatory benchmarks applicable to each media. Benchmarks were derived for the "primary site contaminants", or those

contaminants that are indicative of releases of chemicals or chemical wastes from activities associated with the topedo overhaul operations (i.e. cyanide and chlorinated solvents). Additionally, benchmarks are included for contaminants that were previously detected onsite, even though they may not be present as a direct result of Building 32 activities. Finally, some benchmarks were included for contaminants that have not yet been found onsite, but are likely to be, based on activities and expected fate and transport processes. Action limits were selected as described below.

Project action limits for groundwater were selected using the lowest screening values from: 1) USEPA Region IX Preliminary Remediation Goals (PRGs) for tap water, and 2) RIDEM Upper Concentration Limits (UCLs) for GA groundwater. PRGs are provided in Section 5 of this Work Plan. Selected project action limits for VOCs, SVOCs, pesticides, PCBs, and metals in groundwater are provided on Tables 4-1A through 4-1D.

Project action limits for soils were selected using the lowest risk-based or regulatory screening values from: 1) RIDEM direct exposure criteria for industrial soils, 2) USEPA Region IX PRGs for industrial soils, and 3) ecological criteria for surface soils. Risk-based screening values are presented in Section 5 of this Work Plan. Selected project action limits for VOCs, SVOCs, pesticides, PCBs, and metals in soil are provided on Tables 4-2A through 4-2D.

Project action limits for sediments were selected for previously detected contaminants primarily using ecological risk-based criteria for marine sediment. For contaminants that had no ecological risk-based criteria available, USEPA Region IX PRGs for industrial soils were used. Selected project action limits for VOCs, SVOCs, pesticides, PCBs, and metals in sediment are provided on Tables 4-3A through 4-3D.

Project action limits for shellfish consist of USEPA Region III risk based criteria (RBCs) for fish ingestion by humans. Project action limits for SVOCs, pesticides, PCBs, and metals in shellfish tissue are provided on Tables 4-4A through 4-4C. Project action limits for VOCs were not deemed appropriate for shellfish because it is unlikely for the VOCs to come into contact with the shellfish at concentrations that could be taken in and stored by these organisms.

Many contaminants in the standard analysis groups do not have adequate toxicological data to establish risk-based screening criteria that can be used as project action limits. For these contaminants, the action limit is identified as "Not Available", and the method detection limit is presumed to be adequate to determine the presence of the contaminant at measurable concentrations at the Site. As a part of the data evaluation, surrogate toxicity information from other related compounds may be evaluated for use in the screening process. Finally, any literature and/or regulatory information pertaining to these contaminants that comes to light during the study will be used if applicable.

TABLE 4-1A
GROUNDWATER – VOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Achievable Laboratory Limits[3]	
				MDLs (µg/L)	PQLs (µg/L)
Dichlorodifluoromethane	75-71-8	NA	5	0.25	5
Chloromethane	74-87-3	NA	5	0.28	5
Bromomethane	74-83-9	NA	5	0.93	5
***Vinyl Chloride**	75-01-4	0.02[2]	5	0.1	5
Chloroethane	75-00-3	4.6[2]	5	0.27	5
*Methylene Chloride	75-09-2	4.3[2]	5	0.33	5
*Acetone	67-64-1	610[2]	5	2.77	5
Methyl Acetate	79-20-9	NA	5	3.74	5
*Carbon Disulfide	75-15-0	1000[2]	5	0.17	5
Trichlorofluoromethane	75-69-4	1300[2]	5	0.24	5
1,1-Dichloroethene	75-35-4	7[1]	5	0.28	5
1,1,2-Trichloro-1,2,2-trifluoro-ethane	76-13-1	NA	5	0.54	5
1,1- Dichloroethane	75-34-3	810 [2]	5	0.11	5
Methyl tert-Butyl Ether	1634-04-4	NA	5	0.29	5
***cis-1,2- Dichloroethene**	156-59-2	61[2]	5	0.46	5
***trans-1,2- Dichloroethene**	156-60-5	100[1]	5	0.69	5
*Chloroform	67-66-3	6.2[2]	5	0.18	5
1,2- Dichloroethane	107-06-2	0.12[2]	5	0.29	5
2-Butanone	78-93-3	NA	5	1.87	5
1,1,1-Trichloroethane	71-55-6	200[1]	5	0.68	5
Cyclohexane	110-82-7	NA	5	1.55	5
Carbon Tetrachloride	56-23-5	NA	5	0.3	5
*Bromodichloromethane	75-27-4	0.18[2]	5	0.25	5
Methylcyclohexane	108-87-2	5200[2]	5	1.63	5
1,2-Dichloropropane	78-87-5	5[1]	5	0.21	5
cis-1,3- Dichloropropene	10061-01-5	NA	5	0.45	5
***Trichloroethene**	79-01-6	0.028[2]	5	0.6	5
*Dibromochloromethane	124-48-1	0.13[2]	5	0.26	5
1,1,2- Trichloroethane	79-00-5	NA	5	0.31	5
*Benzene	71-43-2	0.34[2]	5	0.13	5
Trans-1,3-Dichloropropene	10061-02-6	NA	5	0.42	5
Isopropylbenzene	98-82-8	660[2]	5	0.2	5
Bromoform	75-25-2	NA	5	0.45	5
4-Methyl-2-Pentanone	108-10-1	NA	5	1.78	5
2-Hexanone	591-78-6	NA	5	1.55	5
***Tetrachlorethene**	127-18-4	0.65[2]	5	0.36	5
1,1,2,2- Tetrachlorethane	79-34-5	NA	5	0.41	5
***Toluene**	108-88-3	720[2]	5	0.18	5
1,2-Dibromoethane	106-93-4	NA	5	0.22	5

TABLE 4-1A (cont.)
GROUNDWATER – VOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Analytes	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Achievable Laboratory Limits[3]	
				MDLs (µg/L)	PQLs (µg/L)
Chlorobenzene	108-90-7	NA	5	0.22	5
***Ethylbenzene**	100-41-4	2.9[2]	5	0.11	5
Styrene	100-42-5	100[1]	5	0.28	5
***Total Xylenes**	1330-20-7	210[2]	5	0.34	5
1,3-Dichlorobenzene	541-73-1	5.5[2]	5	0.22	5
1,4- Dichlorobenzene	106-46-7	0.5[2]	5	0.17	5
1,2- Dichlorobenzene	95-50-1	5.0[2]	5	0.25	5
1,2-Dibromo-3-chloropropane	96-12-8	NA	5	0.65	5
1,2,4-Trichlorobenzene	120-82-1	70[1]	5	0.32	5

Notes:
NA Not applicable or Not Available.
* Contaminant previously detected on site.
Bold Text – Believed to be a site contaminant, based on historical use of the site.
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.
Shaded cells indicate that the Project Quantitation Limit and/or the Method Detection limit are greater than the Project Action Limit.
(1) Rhode Island DEM Rules and Regulations for Hazardous Waste Sites, Upper Concentration Limit for GA Groundwater
(2) Region IX PRG for tap water.
(3) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.

TABLE 4-1B
GROUNDWATER – SEMIVOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Achievable Laboratory Limits[3]	
				MDLs (µg/L)	PQLs (µg/L)
Benzaldehyde	100-52-7	3600 [1]	10	10	10
Phenol	108-95-2	22,000[1]	10	1.93	10
Bis-(2-Chloroethyl) ether	111-44-4	NA	10	1.34	10
2-Chlorophenol	95-57-8	NA	10	2.17	10
2-Methylphenol	95-48-7	NA	10	1.28	10
2,2-oxybis(1-Chloropropane)	108-60-1	NA	10	1.19	10
Acetophenone	98-86-2	NA	10	0.69	10
4-Methylphenol	106-44-5	180[1]	10	1.83	10
N-Nitroso-di-n propylamine	621-64-7	NA	10	1.7	10
Hexachloroethane	67-72-1	NA	10	1.76	10
Nitrobenzene	98-95-3	NA	10	1.27	10
Isophorone	78-59-1	NA	10	0.85	10
2-Nitrophenol	88-75-5	NA	10	1.62	10
2,4-Dimethylphenol	105-67-9	180[1]	10	1.87	10
Bis(2-Chloroethoxy) methane	111-91-1	NA	10	0.85	10
2,4-Dichlorophenol	120-83-2	NA	10	1.83	10
***Naphthalene**	91-20-3	6.2[1]	0.2	0.05[4]	0.2[4]
4-Chloroaniline	106-47-8	NA	10	1.16	10
Hexachlorobutadiene	87-68-3	NA	10	2.23	10
Caprolactam	105-60-2	NA	10	10	10
4-Chloro-3-methylphenol	59-50-7	NA	10	1.29	10
***2-Methylnaphthalene**	91-57-6	30[2]	0.2	0.08[4]	0.2[4]
Hexachlorocyclopentadiene	77-47-4	NA	10	1.32	10
2,4,6-Trichlorophenol	88-06-2	NA	10	1.73	10
2,4,5-Trichlorophenol	95-95-4	NA	25	2.16	25
1,1'-Biphenyl	92-52-4	300[1]	10	10	10
2-Chloronaphthalene	91-58-7	NA	10	2.8	10
2-Nitroaniline	88-74-4	NA	25	0.81	25
Dimethylphthalate	131-11-3	NA	10	0.78	10
2,6-Dinitrotoluene	606-20-2	NA	10	1.59	10
Acenaphthylene	208-96-8	30[2]	0.2	0.05[4]	0.2[4]
3-Nitroaniline	99-09-2	NA	25	1.68	25
***Acenaphthene**	83-32-9	370[1]	0.2	0.08[4]	0.2[4]
2,4-Dinitrophenol	51-28-5	NA	25	5.33	25
4-Nitrophenol	100-02-7	NA	25	2.78	25
***Dibenzofuran**	132-64-9	24[1]	10	1.03	10
2,4-Dinitrotoluene	121-14-2	NA	10	0.73	10
Diethylphthalate	84-66-2	29000[1]	10	0.68	10

TABLE 4-1B (cont.)
GROUNDWATER – SEMIVOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Analytes	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Achievable Laboratory Limits[3]	
				MDLs (µg/L)	PQLs (µg/L)
***Fluorene**	86-73-7	240[1]	0.2	0.06[4]	0.2[4]
4-Chlorophenyl-phenyl ether	7005-72-3	NA	10	1.26	10
4-Nitroaniline	100-01-6	NA	25	1.7	25
4,6-Dinitro-2-methylphenol	534-52-1	NA	25	7.47	25
N-Nitroso diphenylamine	86-30-6	NA	10	1.74	10
4-Bromophenyl-phenylether	101-55-3	NA	10	1.09	10
Hexachlorobenzene	118-74-1	NA	10	0.73	10
Atrazine	1912-24-9	NA	10	10	10
Pentachlorophenol	87-86-5	NA	25	5.5	25
***Phenanthrene**	85-01-8	83[2]	0.2	0.08[4]	0.2[4]
Anthracene	120-12-7	1800[1]	0.2	0.08[4]	0.2[4]
Carbazole	86-74-8	3.4[1]	10	0.89	10
Di-n-butylphthalate	84-74-2	3600[1]	10	2.7	10
Fluoranthene	206-44-0	1500[1]	0.2	0.11[4]	0.2[4]
Pyrene	129-00-0	180[1]	0.2	0.09[4]	0.2[4]
Butylbenzylphthalate	85-68-7	NA	10	0.78	10
3,3'-Dichlorobenzidine	91-94-1	NA	10	1.64	10
Benzo (a) anthracene	56-55-3	0.1[1]	0.2	0.12[4]	0.2[4]
Chrysene	218-01-9	9.2[1]	0.2	0.07[4]	0.2[4]
***bis(2-Ethylhexyl) phthalate**	117-81-7	4.8[1]	10	9.18	10
Di-n-octylphthalate	117-84-0	NA	10	1.42	10
Benzo (b) fluoroanthene	205-99-2	0.1[1]	0.2	0.09[4]	0.2[4]
Benzo (k) fluoroanthene	207-08-9	1.0[1]	0.2	0.08[4]	0.2[4]
Benzo (a) pyrene	50-32-8	0.01[1]	0.2	0.09[4]	0.2[4]
Indeno (1,2,3-cd)-pyrene	193-39-5	0.1[1]	0.2	0.1[4]	0.2[4]
Dibenzo (a,h)-anthracene	53-70-3	0.01[1]	0.2	0.15[4]	0.2[4]
Benzo (g,h,i) perylene	191-24-2	30[2]	0.2	0.08[4]	0.2[4]

Notes:
NA Not Applicable or Not Available.
* **contaminant previously detected on site in groundwater.**
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.
Shaded cells indicate that the Project Quantitation Limit and/or Method Detection Limit are greater than the Project Action Limit.
(1) Region IX PRG for tap water.
(2) Ecological Surface Water Screening Criteria x 10 dilution factor.
(3) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.
(4) These compounds (i.e. polycyclic aromatic hydrocarbons) will be analyzed by SW-846 8270 selective ion monitoring (SIM) which is the best available EPA-approved technology providing the lowest possible detection limits.

TABLE 4-1C
GROUNDWATER - PESTICIDE/PCB CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Achievable Laboratory Limits[3]	
				MDLs (µg/L)	PQLs (µg/L)
alpha-BHC	319-84-6	NA	0.05	0.025	0.05
beta-BHC	319-85-7	NA	0.05	0.042	0.05
delta-BHC	319-86-8	NA	0.05	0.029	0.05
gamma-BHC	58-89-9	NA	0.05	0.022	0.05
Heptachlor	76-44-8	3.6[2]	0.05	0.024	0.05
Aldrin	309-00-2	NA	0.05	0.022	0.05
Heptachlor epoxide	1024-57-3	3.6[2]	0.05	0.023	0.05
Endosulfan I	959-98-8	NA	0.05	0.018	0.05
Dieldrin	60-57-1	0.004[1,4]	0.1	0.017	0.1
4,4'-DDE	72-55-9	0.2[2]	0.1	0.028	0.1
Endrin	72-20-8	NA	0.1	0.018	0.1
Endosulfan II	33213-65-9	220[1]	0.1	0.016	0.1
4,4'-DDD	72-54-8	0.28[1]	0.1	0.028	0.1
Endosulfan sulfate	1031-07-8	NA	0.1	0.023	0.1
4,4'-DDT	50-29-3	0.2[1]	0.1	0.03	0.1
Methoxychlor	72-43-5	NA	0.5	0.045	0.5
Endrin ketone	53494-70-5	NA	0.1	0.02	0.1
Endrin aldehyde	7421-93-4	NA	0.1	0.021	0.1
alpha-Chlordane	5103-71-9	0.2[1]	0.05	0.019	0.05
gamma-Chlordane	5103-74-2	0.2[1]	0.05	0.019	0.05
Toxaphene	8001-35-2	NA	1	0.92	1
Aroclor-1016	12674-11-2	1.0[1]	0.5	0.12	0.5
Aroclor-1221	11104-28-2	0.034[1,4]	0.5	0.3	0.5
Aroclor-1232	11141-16-5	0.034[1,4]	0.5	0.32	0.5
Aroclor-1242	53469-21-9	0.034[1,4]	0.5	0.25	0.5
***Aroclor-1248**	12672-29-6	0.034[1,4]	0.5	0.13	0.5
***Aroclor-1254**	11097-69-1	0.034[1,4]	0.5	0.16	0.5
***Aroclor-1260**	11096-82-5	0.034[1,4]	0.5	0.12	0.5

Notes:

* **Previously detected in groundwater.**
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.
Shaded cells indicate that the Project Quantitation Limit and the Method Detection limit are greater than the Project Action Limit.

NA Not Applicable or Not Available.

(1) Region IX PRG for Groundwater.

(2) Rhode Island DEM Rules and Regulations for Hazardous Waste Sites, Upper Concentration Limit for GA Groundwater.

(3) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.

(4) The Project Action Limits for these compounds cannot be achieved using the best available EPA-approved methods.

TABLE 4-1D
GROUNDWATER –INORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Achievable Laboratory Limits[3]	
				IDLs (µg/L)	PQLs (µg/L)
Aluminum	7429-90-5	36,000[1]	8.2	8.2	300
Antimony	7440-36-0	6[2]	1.3	1.3	8
***Arsenic**	7440-38-2	0.045[7]	1.1	1.1[4]	10[4]
***Barium**	7440-39-3	2000[2]	0.12	0.12	5
Beryllium	7440-41-7	4[2]	0.23	0.23	5
***Cadmium**	7440-43-9	5[2]	0.28	0.28	10
Calcium	7440-70-2	NA	7.1	7.1	50
***Chromium**	7440-47-3	100[2]	0.57	0.57	15
Cobalt	7440-48-4	730[1]	0.44	0.44	30
Copper	7440-50-8	1500[1]	0.91	0.91	25
Cyanide	57-12-5	200[2]	2.1	2.1[5]	10[5]
Iron	7439-89-6	11,000[1]	9.3	9.3	100
***Lead**	7439-92-1	15[2]	0.91	0.91	5
Magnesium	7439-95-4	NA	4.1	4.1	50
Manganese	7439-96-5	880[1]	0.15	0.15	5
***Mercury**	7439-97-6	1.1[6]	0.027	0.027[6]	0.2[6]
Nickel	7440-02-0	100[2]	0.65	0.65	40
Potassium	7440-09-7	NA	15.1	15.1	1000
Selenium	7782-49-2	50[2]	2.1	2.1	10
***Silver**	7440-22-4	180[1]	0.57	0.57	15
Sodium	7440-23-5	NA	184	184	1000
Thallium	7440-28-0	2[2]	0.12	0.12[4]	5[4]
Vanadium	7440-62-2	260[1]	0.36	0.36	25
Zinc	7440-66-6	11,000[1]	0.24	0.24	25

Notes:

NA Not Applicable or Not Available

* **Previously Detected Contaminant.**
Shaded cells indicate that the Project Quantitation Limit and the Method Detection limit are greater than the Project Action Limit.

(1) Region IX PRG for tap water.

(2) Rhode Island DEM Rules and Regulations for Hazardous Waste Sites, Upper Concentration Limit for GA Groundwater.

(3) Instrument Detection Limit (IDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported for method SW-846 6010B except for arsenic, cyanide, mercury, and thallium.

(4) Arsenic and Thallium will be analyzed by SW-846 6020.

(5) Cyanide will be analyzed by SW-846 9010.

(6) Mercury will be analyzed SW-846 7470A.

(7) The Project Action Limit for Arsenic cannot be achieved using the best available EPA-approved method (i.e. ICP-MS).

TABLE 4-2A
SOIL – VOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[3]	
				MDLs (µg/kg)	PQLs (µg/kg)
Dichlorodifluoromethane	75-71-8	NA	5	1.76	5
Chloromethane	74-87-3	NA	5	2.8	5
Bromomethane	74-83-9	800[1]	5	2.33	5
***Vinyl Chloride**	75-01-4	10[4]	5	1.34	5
*Chloroethane	75-00-3	6500[2]	5	2.56	5
*Methylene Chloride	75-09-2	21,000[2]	5	4.04	5
*Acetone	67-64-1	6.0E+6[2]	20	9.08	20
Methyl Acetate	79-20-9	NA	5	5	5
*Carbon Disulfide	75-15-0	7.2E+5[2]	5	1.49	5
Trichlorofluoromethane	75-69-4	NA	5	2.05	5
1,1-Dichloroethene	75-35-4	9,500[1]	5	1.6	5
1,1,2-Trichloro-1,2,2-trifluoro-ethane	76-13-1	NA	5	1.91	5
1,1- Dichloroethane	75-34-3	920,000[1]	5	1.29	5
Methyl tert-Butyl Ether	1634-04-4	NA	5	1.88	5
***Cis-1,2- Dichloroethene**	156-59-2	200[4]	5	1.58	5
***Trans-1,2- Dichloroethene**	156-60-5	200[4]	5	1.49	5
Chloroform	67-66-3	20[4]	5	1.02	5
*1,2- Dichloroethane	107-06-2	20[4]	5	1.23	5
***2-Butanone**	78-93-3	1.0E+7[1]	20	7.46	20
1,1,1-Trichloroethane	71-55-6	1.0E+7[1]	5	1.47	5
Cyclohexane	110-82-7	NA	5	5	5
Carbon Tetrachloride	56-23-5	44,000[1]	5	1.58	5
Bromodichloromethane	75-27-4	92,000[1]	5	1	5
*Methylcyclohexane	108-87-2	8.7E+6[2]	5	5	5
1,2-Dichloropropane	78-87-5	84,000[1]	5	2.03	5
Cis-1,3- Dichloropropene	10061-01-5	NA	5	2.27	5
***Trichloroethene**	79-01-6	110[2]	5	2.14	5
Dibromochloromethane	124-48-1	2,600[2]	5	1.52	5
1,1,2- Trichloroethane	79-00-5	3,600[1]	5	1.33	5
*Benzene	71-43-2	1,300[2]	5	1.19	5
Trans-1,3-Dichloropropene	10061-02-6	NA	5	1.91	5
*Isopropylbenzene	98-82-8	2.0E+6[2]	5	2.04	5
Bromoform	75-25-2	NA	5	1.24	5
4-Methyl-2-Pentanone	108-10-1	NA	20	12.21	20
2-Hexanone	591-78-6	NA	20	8.49	20
***Tetrachlorethene**	127-18-4	3,400[2]	5	1.5	5
1,1,2,2- Tetrachlorethane	79-34-5	29,000[1]	5	2.44	5
***Toluene**	108-88-3	1400[4]	5	2.48	5
1,2-Dibromoethane	106-93-4	NA	5	1.82	5
Chlorobenzene	108-90-7	1.0E+7[1]	5	1.09	5
***Ethylbenzene**	100-41-4	1200[4]	5	1.24	5
Styrene	100-42-5	NA	5	1.02	5

TABLE 4-2A (cont.)
SOIL – VOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[3]	
				MDLs (µg/kg)	PQLs (µg/kg)
***Total Xylenes**	1330-20-7	1,000[4]	5	3	5
1,3-Dichlorobenzene	541-73-1	63,000[2]	5	1.39	5
1,4- Dichlorobenzene	106-46-7	7,900[2]	5	1.53	5
1,2- Dichlorobenzene	95-50-1	370,000[2]	5	0.91	5
1,2-Dibromo-3-chloropropane	96-12-8	NA	5	1.84	5
1,2,4-Trichlorobenzene	120-82-1	3.0E+6[2]	5	2.63	5

Notes:
NA Not Applicable or Not Available.
* Previously detected on site.
Bold Text – Believed to be site contaminant, based on historical use on site.
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.
(1) Rhode Island DEM Rules and Regulations for Hazardous Waste Release Sites. Direct Exposure Criteria for Industrial Use Soils.
(2) USEPA Region IX PRGs for industrial soil.
(3) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.
(4) Ecological Risk-Based Criteria for Surface Soil – Table 5-5.

TABLE 4-2B
SOIL – SEMIVOLATILE ORGANIC CONTAMINANTS OF CONERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[4]	
				MDLs (µg/kg)	PQLs (µg/kg)
***Benzaldehyde**	100-52-7	6.2E+7[2]	330	330	330
Phenol	108-95-2	1.0E+8[2]	330	23.37	330
Bis-(2-Chloroethyl) ether	111-44-4	5,200[1]	330	17.75	330
2-Chlorophenol	95-57-8	1.0E+7[1]	330	21.74	330
2-Methylphenol	95-48-7	NA	330	20.47	330
2,2-oxybis(1-Chloropropane)	108-60-1	NA	330	16.18	330
Acetophenone	98-86-2	NA	330	330	330
4-Methylphenol	106-44-5	3.1E+6[2]	330	19.28	330
N-Nitroso-di-n propylamine	621-64-7	NA	330	14.86	330
Hexachloroethane	67-72-1	410,000[1]	330	11.03	330
Nitrobenzene	98-95-3	NA	330	16.53	330
Isophorone	78-59-1	NA	330	9.4	330
2-Nitrophenol	88-75-5	NA	330	27.08	330
***2,4-Dimethylphenol**	105-67-9	1.0E+7[1]	330	39.63	330
Bis(2-Chloroethoxy) methane	111-91-1	NA	330	15.35	330
2,4-Dichlorophenol	120-83-2	6.1E+6[1]	330	22.05	330
***Naphthalene**	91-20-3	600[3]	330	11.14	330
4-Chloroaniline	106-47-8	8.2E+6[1]	330	11.33	330
Hexachlorobutadiene	87-68-3	22,000[2]	330	12.03	330
Caprolactam	105-60-2	NA	330	330	330
4-Chloro-3-methylphenol	59-50-7	NA	330	30.17	330
***2-Methylnaphthalene**	91-57-6	1.0E+7[1]	330	13.53	330
Hexachlorocyclopentadiene	77-47-4	NA	330	12.53	330
2,4,6-Trichlorophenol	88-06-2	520,000[1]	330	31.07	330
2,4,5-Trichlorophenol	95-95-4	1.0E+7[1]	330	28.58	330
***1,1'-Biphenyl**	92-52-4	60,000[3]	330	330	330
2-Chloronaphthalene	91-58-7	NA	330	14.79	330
2-Nitroaniline	88-74-4	NA	330	13.66	330
Dimethylphthalate	131-11-3	1.0E+7[1]	330	15.04	330
2,6-Dinitrotoluene	606-20-2	NA	330	13.15	330
***Acenaphthylene**	208-96-8	1.0E+7[1]	330	12.12	330
3-Nitroaniline	99-09-2	NA	330	46.81	330
***Acenaphthene**	83-32-9	20,000 [3]	330	16.58	330
2,4-Dinitrophenol	51-28-5	4.1E+6[1]	330	84.6	330
4-Nitrophenol	100-02-7	NA	330	69.22	330
***Dibenzofuran**	132-64-9	3.1E+6 [2]	330	11.37	330
2,4-Dinitrotoluene	121-14-2	8,400[1]	330	11.14	330
Diethylphthalate	84-66-2	1.0E+8[2]	330	13.74	330
***Fluorene**	86-73-7	30,000[3]	330	16.57	330
4-Chlorophenyl-phenyl ether	7005-72-3	NA	330	17.39	330
4-Nitroaniline	100-01-6	NA	330	55.42	330

TABLE 4-2B (cont.)
SOIL - SVOC ORGANIC CONTAMINATION OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[4]	
				MDLs (µg/kg)	PQLs (µg/kg)
4,6-Dinitro-2-methylphenol	534-52-1	NA	330	72.03	330
N-Nitroso diphenylamine	86-30-6	NA	330	30.73	330
4-Bromophenyl-phenylether	101-55-3	NA	330	16.48	330
Hexachlorobenzene	118-74-1	3,600[1]	330	20.35	330
Atrazine	1912-24-9	NA	330	330	330
Pentachlorophenol	87-86-5	48,000[1]	330	63.15	330
***Phenanthrene**	85-01-8	1.0E+7[1]	330	15.98	330
***Anthracene**	120-12-7	1.0 E+8[2]	330	14.4	330
***Carbazole**	86-74-8	86,000[2]	330	19.79	330
***Di-n-butylphthalate**	84-74-2	2.0E+5[3]	330	68.49	330
***Fluoranthene**	206-44-0	1.0 E+7[1]	330	18.09	330
***Pyrene**	129-00-0	1.0 E+7[1]	330	25.73	330
Butylbenzylphthalate	85-68-7	NA	330	22.26	330
3,3'-Dichlorobenzidine	91-94-1	NA	330	63.65	330
***Benzo (a) anthracene**	56-55-3	2,100[2]	330	16.55	330
***Chrysene**	218-01-9	210,000[2]	330	18	330
***bis(2-Ethylhexyl) phthalate**	117-81-7	120,000[2]	330	26.36	330
Di-n-octylphthalate	117-84-0	NA	330	16.73	330
***Benzo (b) fluoroanthene**	205-99-2	2,100[2]	330	12.15	330
***Benzo (k) fluoroanthene**	207-08-9	21,000[2]	330	21.24	330
***Benzo (a) pyrene**	50-32-8	210[2]	330	16.78	330
***Indeno (1,2,3-cd)-pyrene**	193-39-5	2100[2]	330	19.68	330
***Dibenzo (a,h)-anthracene**	53-70-3	210[2]	330	21.32	330
***Benzo (g,h,i) perylene**	191-24-2	1.0E+7[1]	330	22.16	330

Notes:

NA Not Applicable or Not Available.

* **Contaminant previously detected on site.**

Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.

Shaded cells indicate that the Project Quantitation Limit is greater than the Project Action Limit, however the MDLs are below the Project Action Limit.

(1) Rhode Island DEM Rules and Regulations for Hazardous Waste Release Sites, Direct Exposure Criteria for Industrial Use Soils, unless otherwise noted.

(2) Region IX PRGs for Industrial Use Soils – Table 5-1.

(3) Ecological risk based criteria for surface soil – Table 5-5.

(4) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.

TABLE 4-2C
SOIL – PESTICIDES/PCB CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)(2)	Achievable Laboratory Limits(2)	
				MDLs (µg/kg)	PQLs (µg/kg)
alpha-BHC	319-84-6	NA	1.7	0.68	1.7
beta-BHC	319-85-7	NA	1.7	1.02	1.7
delta-BHC	319-86-8	NA	1.7	0.58	1.7
gamma-BHC	58-89-9	NA	1.7	0.59	1.7
Heptachlor	76-44-8	NA	1.7	0.55	1.7
Aldrin	309-00-2	NA	1.7	0.56	1.7
Heptachlor epoxide	1024-57-3	NA	1.7	0.65	1.7
Endosulfan I	959-98-8	NA	1.7	0.61	1.7
*Dieldrin	60-57-1	0.5(3)	3.3	0.6	3.3
*4,4'-DDE	72-55-9	10(3)	3.3	0.62	3.3
Endrin	72-20-8	NA	3.3	0.57	3.3
*Endosulfan II	33213-65-9	0.01(3)	3.3	0.57	3.3
*4,4'-DDD	72-54-8	10(3)	3.3	0.62	3.3
Endosulfan sulfate	1031-07-8	NA	3.3	0.69	3.3
*4,4'-DDT	50-29-3	10(3)	3.3	0.55	3.3
Methoxychlor	72-43-5	NA	17	1.02	17
Endrin ketone	53494-70-5	NA	3.3	0.73	3.3
Endrin aldehyde	7421-93-4	NA	3.3	0.67	3.3
*alpha-Chlordane	5103-71-9	0.3(3)	1.7	0.69	1.7
*Gamma-Chlordane	5103-74-2	0.3(3)	1.7	0.63	1.7
Toxaphene	8001-35-2	NA	33	11.62	33
Aroclor-1016	12674-11-2	20 - Sum of all PCBs(3)	17	6.25	17
Aroclor-1221	11104-28-2		17	14.82	17
Aroclor-1232	11141-16-5		17	9.13	17
Aroclor-1242	53469-21-9		17	6.15	17
***Aroclor-1248**	12672-29-6		17	2.27	17
***Aroclor-1254**	11097-69-1		17	7.19	17
***Aroclor-1260**	11096-82-5		17	3.74	17

Notes:

NA Not applicable, or not available.
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.

* Contaminant previously detected on site.
Bold Text – Considered to be a site contaminant, based on historical presence on site.

(1) Region IX PRGs for Industrial Soils.

(2) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.

(3) Ecological Risk-Based Criteria for surface soil (Table 5-5).

TABLE 4-2D
SOIL – INORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (mg/kg)	Project Quantitation Limit (mg/kg)	Achievable Laboratory Limits[4]	
				IDLs mg/kg	PQLs (mg/kg)
*Aluminum	7429-90-5	50[3]	0.82	0.82	30
*Antimony	7440-36-0	5[3]	0.13	0.13	0.8
*Arsenic	7440-38-2	3.8[1]	0.11[5]	0.11[5]	0.2[5]
***Barium**	7440-39-3	500 [3]	0.012	0.012	0.5
*Beryllium	7440-41-7	1.3 [1]	0.023	0.023	0.5
***Cadmium**	7440-43-9	4[3]	0.028	0.028	1.0
*Calcium	7440-70-2	NA	0.71	0.71	5.0
***Chromium**	7440-47-3	0.4[3]	0.057	0.057	1.5
***Cobalt**	7440-48-4	20[3]	0.044	0.044	3.0
***Copper**	7440-50-8	100[3]	0.091	0.091	2.5
***Cyanide**	57-12-5	0.9[3]	0.1[6]	0.1[6]	1[6]
***Iron**	7439-89-6	100,000[2]	0.93	0.93	10
***Lead**	7439-92-1	50 [3]	0.091	0.091	0.5
*Magnesium	7439-95-4	NA	0.41	0.41	5.0
*Manganese	7439-96-5	10,000[1]	0.015	0.015	0.5
***Mercury**	7439-97-6	0.1[3]	0.0045[7]	0.0045[7]	0.04[7]
***Nickel**	7440-02-0	30[3]	0.065	0.065	4.0
*Potassium	7440-09-7	NA	1.51	1.51	100
***Selenium**	7782-49-2	1 [3]	0.21	0.21	1.0
***Silver**	7440-22-4	2[3]	0.057	0.057	1.5
*Sodium	7440-23-5	NA	18.4	18.4	100
*Thallium	7440-28-0	1[3]	0.012[5]	0.012[5]	1.5[5]
*Vanadium	7440-62-2	2[3]	0.036	0.036	2.5
***Zinc**	7440-66-6	50[3]	0.024	0.024	2.5

Notes:
- NA Not applicable.
- * Previously detected on site.
- **Bold Text – considered site contaminant, based on historical use of the site.**
- (1) Rhode Island DEM Rules and Regulations for Hazardous Waste Release Sites, Direct Exposure Criteria for Industrial Use Soils.
- (2) EPA Region IX PRGs for industrial soils, 2002.
- (3) Ecological Criteria for Surface Soils (Table 5-5).
- (4) Instrument Detection Limit (IDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported for method SW-846 6010B except for arsenic, cyanide, mercury, and thallium.
- (5) Arsenic and Thallium will be analyzed by SW-846 6020.
- (6) Cyanide will be analyzed by SW-846 9012A.
- (7) Mercury will be analyzed SW-846 7471A.

TABLE 4-3A
SEDIMENT – VOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[3]	
				MDLs (µg/kg)	PQLs (µg/kg)
Dichlorodifluoromethane	75-71-8	NA	5	1.76	5
Chloromethane	74-87-3	NA	5	2.8	5
Bromomethane	74-83-9	NA	5	2.33	5
***Vinyl Chloride**	75-01-4	10[1]	5	1.34	5
*Chloroethane	75-00-3	6,500[2]	5	2.56	5
*Methylene Chloride	75-09-2	21,000[2]	5	4.04	5
*Acetone	67-64-1	6.0E+6[2]	20	9.08	20
Methyl Acetate	79-20-9	NA	5	5	5
*Carbon Disulfide	75-15-0	720,000[2]	5	1.49	5
Trichlorofluoromethane	75-69-4	NA	5	2.05	5
1,1-Dichloroethene	75-35-4	NA	5	1.6	5
1,1,2-Trichloro-1,2,2-trifluoro-ethane	76-13-1	NA	5	1.91	5
1,1- Dichloroethane	75-34-3	NA	5	1.29	5
Methyl tert-Butyl Ether	1634-04-4	NA	5	1.88	5
***cis-1,2- Dichloroethene**	156-59-2	200[1]	5	1.58	5
***trans-1,2- Dichloroethene**	156-60-5	200[1]	5	1.49	5
Chloroform	67-66-3	20[1]	5	1.02	5
1,2- Dichloroethane	107-06-2	20[1]	5	1.23	5
***2-Butanone**	78-93-3	NA	5	1.76	5
1,1,1-Trichloroethane	71-55-6	NA	5	2.8	5
Cyclohexane	110-82-7	NA	5	2.33	5
Carbon Tetrachloride	56-23-5	NA	5	1.34	5
Bromodichloromethane	75-27-4	NA	5	2.56	5
*Methylcyclohexane	108-87-2	8.7E+6[2]	5	4.04	5
1,2-Dichloropropane	78-87-5	NA	20	9.08	20
Cis-1,3- Dichloropropene	10061-01-5	NA	5	5	5
***Trichloroethene**	79-01-6	41[1]	5	1.49	5
Dibromochloromethane	124-48-1	NA	5	2.05	5
1,1,2- Trichloroethane	79-00-5	NA	5	1.6	5
*Benzene	71-43-2	57[1]	5	1.91	5
Trans-1,3-Dichloropropene	10061-02-6	NA	5	1.29	5
*Isopropylbenzene	98-82-8	NA	5	1.88	5
Bromoform	75-25-2	NA	5	1.58	5
4-Methyl-2-Pentanone	108-10-1	NA	5	1.49	5
2-Hexanone	591-78-6	NA	5	1.02	5
***Tetrachlorethene**	127-18-4	57[1]	5	1.23	5
1,1,2,2- Tetrachlorethane	79-34-5	NA	5	1.76	5
***Toluene**	108-88-3	670[1]	5	2.8	5
1,2-Dibromoethane	106-93-4	NA	5	2.33	5
Chlorobenzene	108-90-7	NA	5	1.34	5

TABLE 4-3A (cont.)
SEDIMENT – VOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[3]	
				MDLs (µg/kg)	PQLs (µg/kg)
***Ethylbenzene**	100-41-4	4.0[1]	5	2.56	5
Styrene	100-42-5	NA	5	4.04	5
***Total Xylenes**	1330-20-7	4.0[1]	20	9.08	20
1,3-Dichlorobenzene	541-73-1	NA	5	5	5
1,4- Dichlorobenzene	106-46-7	NA	5	1.49	5
1,2- Dichlorobenzene	95-50-1	NA	5	2.05	5
1,2-Dibromo-3-chloropropane	96-12-8	NA	5	1.6	5
1,2,4-Trichlorobenzene	120-82-1	NA	5	1.91	5

Notes:
NA Not Applicable or Not Available.
* Previously Detected on site.
Bold Text – Believed to be a site contaminant, based on historical use of site.
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.
Shaded cells indicate that the Project Quantitation Limit and/or the Method Detection limit are greater than the Project Action Limit.
(1) Ecological risk based criteria for sediment or surface soil (Table 5-5).
(2) EPA Region IX PRGs for industrial use soils.
(3) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.

TABLE 4-3B
SEDIMENT – SEMIVOLATILE ORGANIC CONTAMINANTS OF CONERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[4]	
				MDLs (µg/kg)	PQLs (µg/kg)
***Benzaldehyde**	100-52-7	6.2E+7[2]	330	330	330
Phenol	108-95-2	NA	330	23.37	330
Bis-(2-Chloroethyl) ether	111-44-4	NA	330	17.75	330
2-Chlorophenol	95-57-8	NA	330	21.74	330
2-Methylphenol	95-48-7	NA	330	20.47	330
2,2-oxybis(1-Chloropropane)	108-60-1	NA	330	16.18	330
Acetophenone	98-86-2	NA	330	330	330
***4-Methylphenol**	106-44-5	100[1]	330	19.28	330
N-Nitroso-di-n propylamine	621-64-7	NA	330	14.86	330
Hexachloroethane	67-72-1	NA	330	11.03	330
Nitrobenzene	98-95-3	NA	330	16.53	330
Isophorone	78-59-1	NA	330	9.4	330
2-Nitrophenol	88-75-5	NA	330	27.08	330
***2,4-Dimethylphenol**	105-67-9	18[1]	330	39.63	330
Bis(2-Chloroethoxy) methane	111-91-1	NA	330	15.35	330
2,4-Dichlorophenol	120-83-2	NA	330	22.05	330
***Naphthalene**	91-20-3	160[1]	20	0.89[5]	20[5]
4-Chloroaniline	106-47-8	NA	330	11.33	330
Hexachlorobutadiene	87-68-3	NA	330	12.03	330
Caprolactam	105-60-2	NA	330	330	330
4-Chloro-3-methylphenol	59-50-7	NA	330	30.17	330
***2-Methylnaphthalene**	91-57-6	70[1]	20	0.56[5]	20[5]
Hexachlorocyclopentadiene	77-47-4	NA	330	12.53	330
2,4,6-Trichlorophenol	88-06-2	NA	330	31.07	330
2,4,5-Trichlorophenol	95-95-4	NA	330	28.58	330
***1,1'-Biphenyl**	92-52-4	1100[1]	330	330	330
2-Chloronaphthalene	91-58-7	NA	330	14.79	330
2-Nitroaniline	88-74-4	NA	330	13.66	330
Dimethylphthalate	131-11-3	NA	330	15.04	330
2,6-Dinitrotoluene	606-20-2	NA	330	13.15	330
***Acenaphthylene**	208-96-8	44[1]	20	0.53[5]	20[5]
3-Nitroaniline	99-09-2	NA	330	46.81	330
Acenaphthene	83-32-9	16[1]	20	0.7[5]	20[5]
2,4-Dinitrophenol	51-28-5	NA	330	84.6	330
4-Nitrophenol	100-02-7	NA	330	69.22	330
***Dibenzofuran**	132-64-9	110[1]	330	11.37	330
2,4-Dinitrotoluene	121-14-2	NA	330	11.14	330
Diethylphthalate	84-66-2	NA	330	13.74	330
***Fluorene**	86-73-7	19[1]	20	0.61[5]	20[5]
4-Chlorophenyl-phenyl ether	7005-72-3	NA	330	17.39	330

TABLE 4-3B (cont.)
SEDIMENT – SEMIVOLATILE ORGANIC CONTAMINANTS OF CONERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[4]	
				MDLs (µg/kg)	PQLs (µg/kg)
4-Nitroaniline	100-01-6	NA	330	55.42	330
4,6-Dinitro-2-methylphenol	534-52-1	NA	330	72.03	330
N-Nitroso diphenylamine	86-30-6	NA	330	30.73	330
4-Bromophenyl-phenylether	101-55-3	NA	330	16.48	330
Hexachlorobenzene	118-74-1	NA	330	20.35	330
Atrazine	1912-24-9	NA	330	330	330
Pentachlorophenol	87-86-5	NA	330	63.15	330
***Phenanthrene**	85-01-8	240[1]	20	1.47[5]	20[5]
***Anthracene**	120-12-7	85.3[1]	20	0.81[5]	20[5]
***Carbazole**	86-74-8	86,000[2]	330	19.79	330
***Di-n-butylphthalate**	84-74-2	58[1]	330	68.49	330
***Fluoranthene**	206-44-0	600[1]	20	1.64[5]	20[5]
***Pyrene**	129-00-0	665[1]	20	1.8[5]	20[5]
Butylbenzylphthalate	85-68-7	NA	330	22.26	330
3,3'-Dichlorobenzidine	91-94-1	NA	330	63.65	330
***Benzo (a) anthracene**	56-55-3	261[1]	20	1.01[5]	20[5]
***Chrysene**	218-01-9	384[1]	20	1.23[5]	20[5]
***bis(2-Ethylhexyl) phthalate**	117-81-7	182[1]	330	26.36	330
Di-n-octylphthalate	117-84-0	NA	330	16.73	330
***Benzo (b) fluoroanthene**	205-99-2	1800[1]	20	2.05[5]	20[5]
***Benzo (k) fluoroanthene**	207-08-9	1800[1]	20	1.35[5]	20[5]
***Benzo (a) pyrene**	50-32-8	430[1]	20	0.75[5]	20[5]
***Indeno (1,2,3-cd)-pyrene**	193-39-5	600[1]	20	2.01[5]	20[5]
***Dibenzo (a,h)-anthracene**	53-70-3	63.4[1]	20	2.0[5]	20[5]
***Benzo (g,h,i) perylene**	191-24-2	670[1]	20	1.71[5]	20[5]

Notes:

NA Not applicable, or Not available.

* **Previously detected on site.**
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.
Shaded cells indicate that the Project Quantitation Limit and/or the Method Detection limit are greater than the Project Action Limit.

(1) Ecological risk based screening criteria for sediment (Table 5-5).

(2) USEPA Region IX PRGs for industrial soils (Table 5-1).

(3) RIDEM Direct Exposure Criteria for industrial soils.

(4) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.

(5) These compounds (i.e. polycyclic aromatic hydrocarbons) will be analyzed by SW-846 8270 selective ion monitoring (SIM) which is the best available EPA-approved technology providing the lowest possible detection limits.

TABLE 4-3C
SEDIMENT – PESTICIDES/PCB CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[2]	
				MDLs (µg/kg)	PQLs (µg/kg)
alpha-BHC	319-84-6	NA	1.7	0.68	1.7
beta-BHC	319-85-7	NA	1.7	1.02	1.7
delta-BHC	319-86-8	NA	1.7	0.58	1.7
gamma-BHC	58-89-9	NA	1.7	0.59	1.7
Heptachlor	76-44-8	NA	1.7	0.55	1.7
Aldrin	309-00-2	NA	1.7	0.56	1.7
Heptachlor epoxide	1024-57-3	NA	1.7	0.65	1.7
Endosulfan I	959-98-8	NA	1.7	0.61	1.7
*Dieldrin	60-57-1	0.02[1,3]	3.3	0.6	3.3
*4,4'-DDE	72-55-9	2.2[1,3]	3.3	0.62	3.3
Endrin	72-20-8	NA	3.3	0.57	3.3
*Endosulfan II	33213-65-9	14[1]	3.3	0.57	3.3
*4,4'-DDD	72-54-8	1.22[1,3]	3.3	0.62	3.3
Endosulfan sulfate	1031-07-8	NA	3.3	0.69	3.3
*4,4'-DDT	50-29-3	1.19[1,3]	3.3	0.55	3.3
Methoxychlor	72-43-5	NA	17	1.02	17
Endrin ketone	53494-70-5	NA	3.3	0.73	3.3
Endrin aldehyde	7421-93-4	NA	3.3	0.67	3.3
*alpha-Chlordane	5103-71-9	0.5[1,3]	1.7	0.69	1.7
*gamma-Chlordane	5103-74-2	0.5[1,3]	1.7	0.63	1.7
Toxaphene	8001-35-2	NA	33	11.62	33
*Aroclor-1016	12674-11-2	22.7[1]	17	6.25	17
*Aroclor-1221	11104-28-2	22.7[1]	17	14.82	17
*Aroclor-1232	11141-16-5	22.7[1]	17	9.13	17
*Aroclor-1242	53469-21-9	22.7[1]	17	6.15	17
***Aroclor-1248**	12672-29-6	22.7[1]	17	2.27	17
***Aroclor-1254**	11097-69-1	22.7[1]	17	7.19	17
***Aroclor-1260**	11096-82-5	22.7[1]	17	3.74	17

Notes:
NA Not applicable.
* Previously detected on site.
Bold text – considered to be site contaminant, based on historical presence on site.
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.
Shaded cells indicate that the Project Quantitation Limit and/or the Method Detection Limit are greater than the Project Action Limit.
(1) Ecological Risk Based Criteria – Table 5-5.
(2) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.
(3) The Project Action Limit for these compounds cannot be achieved using the best available EPA-approved method.

TABLE 4-3D
SEDIMENT – INORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (mg/kg)	Project Quantitation Limit (mg/kg)	Achievable Laboratory Limits[3]	
				IDLs (mg/kg)	PQLs (mg/kg)
*Aluminum	7429-90-5	18,000[1]	0.82	0.82	30
*Antimony	7440-36-0	2[1]	0.13	0.13	0.8
*Arsenic	7440-38-2	8.2[1]	0.11[5]	0.11[5]	0.2[4]
***Barium**	7440-39-3	48[1]	0.012	0.012	0.5
*Beryllium	7440-41-7	NA	0.023	0.023	0.5
***Cadmium**	7440-43-9	1.2[1]	0.028	0.028	1.0
*Calcium	7440-70-2	NA	0.71	0.71	5.0
***Chromium**	7440-47-3	81[1]	0.057	0.057	1.5
***Cobalt**	7440-48-4	10[1]	0.044	0.044	3.0
***Copper**	7440-50-8	34[1]	0.091	0.091	2.5
***Cyanide**	57-12-5	12,000[2]	0.1[6]	0.1[6]	1[5]
***Iron**	7439-89-6	220,000[1]	0.93	0.93	10
***Lead**	7439-92-1	46.7[1]	0.091	0.091	0.5
*Magnesium	7439-95-4	NA	0.41	0.41	5.0
*Manganese	7439-96-5	260[1]	0.015	0.015	0.5
***Mercury**	7439-97-6	0.15[1]	0.0045[7]	0.0045[7]	0.04[6]
***Nickel**	7440-02-0	20.9[1]	0.065	0.065	4.0
*Potassium	7440-09-7	NA	1.51	1.51	100
***Selenium**	7782-49-2	1.0[1]	0.21	0.21	1.0
***Silver**	7440-22-4	1.0[1]	0.057	0.057	1.5
*Sodium	7440-23-5	NA	18.4	18.4	100
*Thallium	7440-28-0	67[2]	0.012[5]	0.012[5]	1.5[4]
*Vanadium	7440-62-2	57[1]	0.036	0.036	2.5
***Zinc**	7440-66-6	150[1]	0.024	0.024	2.5

Notes:

NA Not applicable.

* Previously detected on site.

Bold Text – considered site contaminant, based on possible use in Building 32 activities.

(1) Ecological Screening Criteria, Table 5-5.

(2) Region IX Industrial Soil Screening Criteria, Table 5-1.

(3) Instrument Detection Limit (IDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported for method SW-846 6010B except for arsenic, cyanide, mercury, and thallium.

(4) Arsenic and Thallium will be analyzed by SW-846 6020.

(5) Cyanide will be analyzed by SW-846 9012BA

(6) Mercury will be analyzed SW-846 7471A.

TABLE 4-4A
SHELLFISH – SEMIVOLATILE ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit[1] (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[2]	
				MDLs (µg/kg)	PQLs (µg/kg)
***Benzaldehyde**	100-52-7	140,000	330	330	330
Phenol	108-95-2	410,000	330	23.37	330
Bis-(2-Chloroethyl) ether	111-44-4	NA	330	17.75	330
2-Chlorophenol	95-57-8	NA	330	21.74	330
2-Methylphenol	95-48-7	NA	330	20.47	330
2,2-oxybis(1-Chloropropane)	108-60-1	NA	330	16.18	330
Acetophenone	98-86-2	NA	330	330	330
4-Methylphenol	106-44-5	6,800	330	19.28	330
N-Nitroso-di-n propylamine	621-64-7	NA	330	14.86	330
Hexachloroethane	67-72-1	NA	330	11.03	330
Nitrobenzene	98-95-3	NA	330	16.53	330
Isophorone	78-59-1	NA	330	9.4	330
2-Nitrophenol	88-75-5	NA	330	27.08	330
***2,4-Dimethylphenol**	105-67-9	27,100	330	39.63	330
Bis(2-Chloroethoxy) methane	111-91-1	NA	330	15.35	330
2,4-Dichlorophenol	120-83-2	NA	330	22.05	330
***Naphthalene**	91-20-3	27,000	20	0.89[3]	20[3]
4-Chloroaniline	106-47-8	NA	330	11.33	330
Hexachlorobutadiene	87-68-3	NA	330	12.03	330
Caprolactam	105-60-2	NA	330	330	330
4-Chloro-3-methylphenol	59-50-7	NA	330	30.17	330
***2-Methylnaphthalene**	91-57-6	27,000	20	0.56[3]	20[3]
Hexachlorocyclopentadiene	77-47-4	NA	330	12.53	330
2,4,6-Trichlorophenol	88-06-2	NA	330	31.07	330
2,4,5-Trichlorophenol	95-95-4	NA	330	28.58	330
***1,1'-Biphenyl**	92-52-4	68,000	330	330	330
2-Chloronaphthalene	91-58-7	NA	330	14.79	330
2-Nitroaniline	88-74-4	NA	330	13.66	330
Dimethylphthalate	131-11-3	NA	330	15.04	330
2,6-Dinitrotoluene	606-20-2	NA	330	13.15	330
***Acenaphthylene**	208-96-8	NA	20	0.53[3]	20[3]
3-Nitroaniline	99-09-2	NA	330	46.81	330
***Acenaphthene**	83-32-9	81,000	20	0.7[3]	20[3]
2,4-Dinitrophenol	51-28-5	NA	330	84.6	330
4-Nitrophenol	100-02-7	NA	330	69.22	330
***Dibenzofuran**	132-64-9	5,400	330	11.37	330
2,4-Dinitrotoluene	121-14-2	NA	330	11.14	330
Diethylphthalate	84-66-2	NA	330	13.74	330
***Fluorene**	86-73-7	54,000	20	0.61[3]	20[3]

TABLE 4-4A (cont.)
SHELLFISH - SVOC ORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Analytes	CAS Number	Project Action Limit(1) (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits(2)	
				MDLs (µg/kg)	PQLs (µg/kg)
4-Chlorophenyl-phenyl ether	7005-72-3	NA	330	17.39	330
4-Nitroaniline	100-01-6	NA	330	55.42	330
4,6-Dinitro-2-methylphenol	534-52-1	NA	330	72.03	330
N-Nitroso diphenylamine	86-30-6	NA	330	30.73	330
4-Bromophenyl-phenylether	101-55-3	NA	330	16.48	330
Hexachlorobenzene	118-74-1	400	330	20.35	330
Atrazine	1912-24-9	NA	330	330	330
Pentachlorophenol	87-86-5	NA	330	63.15	330
***Phenanthrene**	85-01-8	NA	20	1.47(3)	20(3)
***Anthracene**	120-12-7	410,000	20	0.81(3)	20(3)
***Carbazole**	86-74-8	160	330	19.79	330
***Di-n-butylphthalate**	84-74-2	140,000	330	68.49	330
***Fluoranthene**	206-44-0	54,000	20	1.64(3)	20(3)
***Pyrene**	129-00-0	41,000	20	1.8(3)	20(3)
Butylbenzylphthalate	85-68-7	NA	330	22.26	330
3,3'-Dichlorobenzidine	91-94-1	NA	330	63.65	330
***Benzo (a) anthracene**	56-55-3	4.3	20	1.01(3)	20(3)
***Chrysene**	218-01-9	430	20	1.23(3)	20(3)
***bis(2-Ethylhexyl) phthalate**	117-81-7	230	330	26.36	330
Di-n-octylphthalate	117-84-0	NA	330	16.73	330
***Benzo (b) fluoroanthene**	205-99-2	4.3	20	2.05(3)	20(3)
***Benzo (k) fluoroanthene**	207-08-9	4.3	20	1.35(3)	20(3)
***Benzo (a) pyrene**	50-32-8	0.43	20	0.75(3)	20(3)
***Indeno (1,2,3-cd)-pyrene**	193-39-5	4.3	20	2.01(3)	20(3)
***Dibenzo (a,h)-anthracene**	53-70-3	0.43	20	2.0(3)	20(3)
***Benzo (g,h,i) perylene**	191-24-2	NA	20	1.71(3)	20(3)

Notes:

NA Not Applicable or Not Available.

* **Contaminant previously detected on site.**
Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.
Shaded cells indicate that the Project Quantitation Limit and/or the Method Detection limit are greater than the Project Action Limit.

(1) Region III RBCs for Fish Ingestion, Table 5-1.

(2) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.

(3) These compounds (i.e. polycyclic aromatic hydrocarbons) will be analyzed by SW-846 8270 selective ion monitoring (SIM) which is the best available EPA-approved technology providing the lowest possible detection limits.

TABLE 4-4B
SHELLFISH – PESTICIDES/PCB CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit[1] (µg/kg)	Project Quantitation Limit (µg/kg)	Achievable Laboratory Limits[2]	
				MDLs (µg/kg)	PQLs (µg/kg)
alpha-BHC	319-84-6	NA	1.7	0.68	1.7
beta-BHC	319-85-7	NA	1.7	1.02	1.7
delta-BHC	319-86-8	NA	1.7	0.58	1.7
gamma-BHC	58-89-9	NA	1.7	0.59	1.7
Heptachlor	76-44-8	NA	1.7	0.55	1.7
Aldrin	309-00-2	NA	1.7	0.56	1.7
Heptachlor epoxide	1024-57-3	NA	1.7	0.65	1.7
Endosulfan I	959-98-8	NA	1.7	0.61	1.7
*Dieldrin	60-57-1	0.2	3.3	0.6	3.3
*4,4'-DDE	72-55-9	9.3	3.3	0.62	3.3
Endrin	72-20-8	NA	3.3	0.57	3.3
*Endosulfan II	33213-65-9	8100	3.3	0.57	3.3
*4,4'-DDD	72-54-8	13	3.3	0.62	3.3
Endosulfan sulfate	1031-07-8	NA	3.3	0.69	3.3
*4,4'-DDT	50-29-3	9.3	3.3	0.55	3.3
Methoxychlor	72-43-5	NA	17	1.02	17
Endrin ketone	53494-70-5	NA	3.3	0.73	3.3
Endrin aldehyde	7421-93-4	NA	3.3	0.67	3.3
*alpha-Chlordane	5103-71-9	9.0	1.7	0.69	1.7
*Gamma-Chlordane	5103-74-2	9.0	1.7	0.63	1.7
Toxaphene	8001-35-2	NA	33	11.62	33
Aroclor-1016	12674-11-2	1.6	17	6.25	17
Aroclor-1221	11104-28-2	1.6	17	14.82	17
Aroclor-1232	11141-16-5	1.6	17	9.13	17
Aroclor-1242	53469-21-9	1.6	17	6.15	17
***Aroclor-1248**	12672-29-6	1.6	17	2.27	17
***Aroclor-1254**	11097-69-1	1.6	17	7.19	17
***Aroclor-1260**	11096-82-5	1.6	17	3.74	17

Notes:

NA Not applicable, or not available.

* Contaminant previously detected on site.

Bold Text – Considered to be a site contaminant, based on historical presence on site.

Positive results below the Project Quantitation Limit will be reported down to the Method Detection Limit (MDL) and flagged with a "J" qualifier.

Shaded cells indicate that the Project Quantitation Limit and the Method Detection limit are greater than the Project Action Limit.

(1) Risk-based screening criteria for ingestion of fish, Table 5-1.

(2) Method Detection Limit (MDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported.

TABLE 4-4C
SHELLFISH – INORGANIC CONTAMINANTS OF CONCERN AND OTHER TARGET ANALYTES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Analytes	CAS Number	Project Action Limit (mg/kg) (1)	Project Quantitation Limit (mg/kg)	Achievable Laboratory Limits(2)	
				IDLs (mg/kg)	PQLs (mg/kg)
*Aluminum	7429-90-5	1400	0.82	0.82	30
*Antimony	7440-36-0	0.54	0.13	0.13	0.8
*Arsenic	7440-38-2	0.0021	0.11(3)	0.11(3)	0.2(3)
***Barium**	7440-39-3	95	0.012	0.012	0.5
*Beryllium	7440-41-7	2.7	0.023	0.023	0.5
***Cadmium**	7440-43-9	1.4	0.028	0.028	1.0
*Calcium	7440-70-2	NA	0.71	0.71	5.0
***Chromium**	7440-47-3	4.1	0.057	0.057	1.5
***Cobalt**	7440-48-4	27	0.044	0.044	3.0
***Copper**	7440-50-8	54	0.091	0.091	2.5
***Cyanide**	57-12-5	27	0.1(4)	0.1(4)	1(4)
***Iron**	7439-89-6	410	0.93	0.93	10
***Lead**	7439-92-1	NA	0.091	0.091	0.5
*Magnesium	7439-95-4	NA	0.41	0.41	5.0
*Manganese	7439-96-5	190	0.015	0.015	0.5
***Mercury**	7439-97-6	0.14	0.0045(5)	0.0045(5)	0.04(5)
***Nickel**	7440-02-0	27	0.065	0.065	4.0
*Potassium	7440-09-7	NA	1.51	1.51	100
***Selenium**	7782-49-2	6.8	0.21	0.21	1.0
***Silver**	7440-22-4	6.8	0.057	0.057	1.5
*Sodium	7440-23-5	NA	18.4	18.4	100
*Thallium	7440-28-0	0.095	0.012(3)	0.012(3)	1.5(3)
*Vanadium	7440-62-2	9.5	0.036	0.036	2.5
***Zinc**	7440-66-6	410	0.024	0.024	2.5

Notes:
NA Not applicable.
* Previously detected on site.
Bold Text – considered site contaminant, based on historical use of the site.
(1) Risk-based screening criteria for ingestion of fish, Table 5-1.
(2) Instrument Detection Limit (IDLs) and Practical Quantitation Limits (PQLs) from Katahdin Analytical Services are reported for method SW-846 6010B except for arsenic, cyanide, mercury, and thallium.
(3) Arsenic and Thallium will be analyzed by SW-846 6020.
(4) Cyanide will be analyzed by SW-846 9012B.
(5) Mercury will be analyzed SW-846 7471A.

It should be noted that the citation of any risk screening benchmark or reference value for any contaminant does not necessarily indicate that those contaminants should be associated with site-related contamination. Inclusion of any contaminants in the site model would need to show not only a completed exposure pathway, but also a connection of those contaminants to the site history and operations.

Analytical action limits are established for the use of the physical and screening data collected. The screening analysis will be conducted in order to determine relative high and low concentrations of total volatile organics present in soils during the boring program. The presence of higher concentrations of volatile organics will indicate presence of organic contaminants in saturated or unsaturated soils. This data will be used along with characterization of the soils by the Unified Soil Classification System (USCS) to determine vertical positions of the well screens installed. Because the screening data are only to be used in a qualitative manner, the screening action limits are set at the detection limit of the instruments.

Detection limits of the field instruments vary based on the conditions in which they are operating. The air moisture, temperature and other factors will influence the readings of the FID and PID instruments. Because these instruments will be used to determine a difference between relative high and low concentrations present, any readable response by these instruments on each sample is adequate. An instrument that does not elicit a response during calibration or testing with a known source will be deemed inadequate for use for this purpose.

To comply with RIDEMs requirement of measurement of free product, wells installed will be evaluated for free product by use of field instruments (interface probe). Any measurable free product will be noted on field logs and development data sheets for consideration in the Remedial Investigation Report.

4.3 MEASUREMENT AND PERFORMANCE CRITERIA

Two types of QC checks and samples will be utilized for this project. Batch-specific QC will include QC samples that are handled, prepared and analyzed concurrently with the environmental samples. This data will be used to ensure that the procedures used to collect, transport, and analyze a batch of samples were performed properly and under known, well-defined conditions. Examples of batch-specific QC are trip blanks, equipment blanks, laboratory control samples, and calibration checks. Sample-specific QC will be used to evaluate potential sources of error in the collection, transport and analysis of individual samples. Examples of sample-specific QC are matrix spikes and sample duplicates.

The type and frequency of laboratory quality control checks are defined by the methods listed in Table 3-3.

4.3.1 Sampling Quality Control

The following field quality control samples will be collected to monitor the quality of the sampling to be performed. Table 3-2 summarizes the field quality control sample requirements for soil, sediments, biota, and groundwater.

Rinsate Blank: Rinsate blanks or equipment blanks, are obtained under representative field conditions by running analyte-free deionized water through decontaminated sample collection equipment. Equipment rinsate water is collected in appropriate sample containers and preserved as required by the analysis. Rinsate blanks are used to assess the effectiveness of decontamination procedures. Rinsate blanks are required at a rate of one in ten samples, per matrix, or one per sampling event if less than ten samples are collected.

Trip Blanks: Methanol VOC trip blanks are prepared in the laboratory (or in the field, in an area outside the zone of contamination) prior to the sampling event. Trip blanks are packaged and shipped with the field samples. The results obtained from trip blank analysis are used to assess the purity of the methanol and potential cross-contamination during sample transport and storage. These trip blanks will be prepared with the same methanol used for the field samples. Trip blanks are required at the rate of one in ten samples, or one per shipping container, whichever is greater.

Source Blanks: Source blanks will consist of the source water used in decontamination (includes analyte-free deionized water, potable water from each source, and other waters used in decontamination operations). Source blanks will be prepared at the rate of one per source of water per sampling event.

Field Duplicates: Field duplicates will be submitted at the rate of one for every ten field samples, per matrix. For sediment and soil sampling, field duplicates will be collected by mixing the soil and then dividing it into two containers (with the exception of VOC duplicates, collected prior to mixing). For groundwater sampling, field duplicates are collected by filling one complete set of sample containers for the original sample, and collecting another aliquot for the second (duplicate) sample. For biota samples a co-located second sample is collected from selected locations

Field duplicates provide precision information regarding homogeneity and distribution of the contaminants.

4.3.2 Analytical Quality Control

The analyses to be performed under this project will comply with the requirements and quality control procedures specified in the analytical methods.

4.4 SAMPLE IDENTIFICATION AND TRACKING SYSTEM

Samples will be labeled with identification numbers as soon as they are collected. Sample numbers will reflect the site identifier, medium, location, and depth or date. An alpha-numeric identification system described below is required for use at the Site so that sample data can be easily assigned and uploaded into the Newport Environmental Geographic Information System (EGIS), already prepared for Newport IR sites. The sample identification system is described below:

G32	-	AANN	-	NNNNNN
(Site Identifier)	-	(Medium) & (Sample Location)	-	(Depth or date)

The site identifier for the Building 32 investigation will be G32. The environmental medium from which the sample is taken is identified by a two- or three-character identifier, as shown below.

soil - SB (subsurface soil) or SS (surface soil)
sediment - SD
groundwater - MW (monitoring well)
drainway residue sample – OTS (stands for Other Solids)
ecological tissue - ET

This designation is followed by the location number. Monitoring wells will also have "S", "M" or "D" indicator for shallow, middle and deep overburden (if applicable), and "B" indicator for bedrock, attached to the location number.

Following the sample location identifier, all soil, sediment and other media samples with the exception of groundwater and biota, will be identified with depth, expressed as an interval in feet. Groundwater samples will have a date identification, to differentiate sample collections at the same wells but on different dates.

For example, a soil sample collected from 2-4 feet below ground surface from SB01 will be identified as G32-SB01-0204. A groundwater sample collected from the bedrock well MW01B on December 19, 2003 will be identified as G32-MW01B-121903.

Blind duplicate samples will be designated such that the location designation will be replaced with a chronological number:

Duplicates: G32-SD-DUP##

Source blanks will be designated such that they can be clearly identified as source blanks. The designation must be able to be referenced to the source (e.g. DIUF or HPLC water) using the field paperwork.

Source Blanks: G32-DIUF-SB##

Rinsate blanks will be identified using a blind code for the sample, although the field paperwork must be able to identify the tool that was last used, so possible quality assurance issues can be clearly identified.

Rinsate Blanks: G32-RB##

Trip blanks will be designated so that they can clearly be identified using an identifier (TB) and its chronological number.

Trip Blanks: G32-TB##

Matrix spike samples are simply marked as Lab QC in the "Remarks" section of the Chain-of-Custody record form.

4.5 SAMPLE HANDLING, TRACKING, AND CUSTODY REQUIREMENTS

Custody of samples must be maintained and documented at all times. To ensure the integrity of a sample from collection through analysis, an accurate written record is necessary to trace the possession and handling of the sample. This documentation is referred to as the "chain of custody". Chain of custody begins when samples are collected in the field, and is maintained by storing the samples in secure areas until custody can be passed on. All samples will be accompanied by a chain-of-custody form that will describe the sample identifiers, the analytical parameters, and the persons who are responsible for the sample integrity.

Following collection, samples will be placed on ice in a secure cooler and attended by TtNUS personnel or placed in locked vehicles or designated storage areas until analysis or shipment to an off-site

laboratory. Chain-of-custody procedures are described in further detail in the following SOPs (presented in Appendix C).

SA-6.3 Field Documentation
SA-6.1 Non-Radiological Sample Handling

The samples will be shipped to the laboratories in coolers packed with ice and vermiculite, or equivalent packing material, to cushion the samples to prevent breakage and to maintain the required temperature for the samples. A container filled with water and labeled "Temperature Blank" will be included in each cooler. The temperature of this blank will be measured by the laboratory upon sample receipt to verify acceptable cooling of samples. The coolers will be taped and sealed with a signed custody seal to ensure the chain of custody is maintained. The chain-of-custody forms are shipped to the laboratory with the samples.

Samples will be shipped to the laboratories by an overnight courier (Federal Express) to ensure that maximum sample holding times are not exceeded. The maximum allowable sample holding times before sample extraction, digestion, or analysis are presented in Table 3-3. This table also lists the sample containers and preservatives used to maintain the integrity of the sample.

Each sample collected will be assigned a unique sampling tracking number, as described in Section 4.4. The sample number, sample collection date and time, person collecting the sample and a list of the analytes that sample is to be analyzed for will be recorded on each container, and also on the chain-of-custody form. The chain-of-custody form is a two-part form, the original accompanies the samples to the analytical laboratory, and the copy is retained by the sampling staff until it is forwarded to the data validators.

4.6 DOCUMENTATION OF FIELD ACTIVITIES

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

4.6.1 Field Notes

Documentation of field observations will be recorded in field logbooks and/or sampling log sheets. Field logbooks utilized on this project will consist of bound, water-resistant logbooks. All pages of the logbook will be numbered sequentially and observations will be recorded with indelible ink. Field logbooks will be

maintained according to TtNUS SOP No. SA-6.3, Section 5.2 (Appendix C). Sample log sheets will be used to document sample collection details, while other observations and activities will be recorded in the field logbook. Instrument calibration logs will be used to record the daily instrument calibration activities.

For sampling and other field activities, the following types of information may be recorded:

- Project name
- Date and time of logbook entries
- Personnel
- Weather conditions
- Activities involved with the sampling
- Subcontractor information
- Site observations
- Site sketches
- Visitors
- Health & Safety issues including Personal Protective Equipment (PPE)
- Log of photographs

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 and Sediment Sampling

Sample Log Sheets – Solid Phase forms will be used to document each soil and sediment sample collected. The following information will be recorded:

- Personnel performing the sampling
- Diagram of soil sampling locations
- Date and time of sample collection
- Sample location identification number
- Depth interval of sample collection
- Parameters to be analyzed
- Description of sampling procedures
- PID/FID readings
- Description of visual observations of soil or sediment properties (type, color, odors, etc.)
- General observations

- Identification and description of any duplicate samples

Groundwater Sampling

Groundwater Sample Log Sheets will be used to document each groundwater sample collection. The following information will be recorded:

- Personnel performing the sampling
- Date and time of sample collection
- Sample location identification number
- Low-flow well purge data
- Parameters to be analyzed
- Description of sampling procedures
- General observations
- Identification and description of any duplicate samples

Shellfish Sampling

Shellfish Sample Log Sheets will be used to document each mussel sample collected. The following information will be recorded:

- Personnel performing the sampling
- Date and time of sample collection
- Sample location identification number
- Parameters to be analyzed
- Description of sampling procedures
- General observations
- Identification and description of any duplicate samples
- Size of collection area
- Number of animals collected
- Measurements of each shellfish including: length, width, breadth, total weight and shucked tissue weight
- Species type
- Description of substrate the sample was collected from
- Water depth of station corrected for tidal level

Drilling

Boring Log Sheets will be used to document each soil boring including the small diameter borings and borings advanced using drive and wash and bedrock coring methods. The following information will be recorded:

- Drilling subcontractor
- Name of the rig geologist
- Soils/fill/bedrock description using the Unified Soils Classification System
- Depth of water, if applicable
- General observations
- Blow Counts, sample depths, penetration and recovery lengths, if applicable
- PID/FID Screening and jar headspace results
- Depth to bedrock, if encountered
- End of boring depth

Well Construction

Well Construction Log Sheets will be used to document each well installation. The following information will be recorded:

- Drilling subcontractor
- Name of the geologist performing oversight of the installation
- Diagram of well installation activities
- Depth of water
- Well construction materials and design
- Well depth and screen intervals
- Depth to bedrock, if encountered
- Description of any atypical installation procedures
- General observations

The field logbooks and sample log sheets will remain on site for the duration of the field investigation. After the investigation, all documentation will be stored in the project files.

4.6.2 Field Documentation Management

After the investigation is completed, the field sampling log sheets will be organized by date and media and filed in the project files. The field logbooks for this project will be used only for this Site, and will also be categorized and maintained in the project files 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 titled based on date and activity.

4.6.3 Calibration Documentation

Field equipment normally requiring calibration will be calibrated and operated in accordance with the manufacturer's instructions and manuals. A log will be kept on site, documenting the periodic calibration results for each field instrument.

Calibration procedures for laboratory equipment used in the analysis of environmental samples will be performed in accordance with NFESC requirements and contract requirements under the Master Agreements, i.e., CLP requirements for Level IV.

4.7 FIXED LABORATORY ANALYTICAL METHOD REQUIREMENTS

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

4.7.1 Fixed Laboratory Analytical Methods and SOPs

Contract laboratories, to be solicited at a later date, will perform soil, sediment, groundwater, and shellfish analyses. Analytical methods, instrument maintenance, instrument calibration, quality control samples, and acceptable limits will be specified in the subcontract specifications. However, the laboratories selected will be required to meet the project action limits as described in Section 4.2 of this Work Plan.

4.7.2 Fixed Laboratory Instrument/Equipment Maintenance, Testing, and Inspection Requirements

The specific laboratory equipment maintenance and calibration procedures are set by the laboratories, specific to the equipment used. Generalized procedures likely to be required of these subcontracted laboratories to ensure that the laboratory instruments are available and in working order to meet the required turn-around time of the analyses applicable to this Work Plan are provided in Table 4-5.

The subcontracted laboratories will check the instruments used for the analyses as described in Table 4-5. The instruments shall be monitored on a daily basis for potential failure. The analysis of 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. Records of equipment maintenance logs are maintained for the gas chromatograph, mass spectrometer, ICP, and all instruments used.

The subcontracted laboratories will perform instrument/equipment maintenance and inspection as required in the laboratory specifications.

4.7.3 Fixed Laboratory Inspection and Acceptance Requirements for Supplies

All supplies used by the subcontracted 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 Master Agreements and laboratory specifications will be followed if laboratory contamination is detected.

4.7.4 Screening Data Reduction, Review, and Reporting

Field data will be periodically reviewed by technical lead personnel and the TtNUS PM to ensure that the data collected is well documented, clearly described, and meets a standard appropriate for the investigation and its ultimate use. Review of the jar headspace field screening data will include evaluation and review of the calibration procedures and records, data recording procedures, and field techniques. Proper handling techniques for screening sample collection and analysis are critical: samples must be handled consistently, as the data from each sample will be compared with others from the boring. Quality control procedures that are set up to evaluate comparability in laboratory analysis are not available for screening analysis. Therefore, field audits described elsewhere in this section will be used to evaluate the consistency and appropriateness of the jar headspace screening methods and procedures.

TABLE 4-5
GENERAL LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NEWPORT, RHODE ISLAND

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
GC	Pesticides/ PCBs	• Perform daily check of standards. If the daily check fails, the standard must be checked and re-prepared if needed. If the standard is acceptable, the analytical system must be evaluated. Front end maintenance as described above including septum replacement may be needed. ECDs may require thermal cleaning if a high background signal is indicated. All maintenance on the ECDs beyond thermal cleaning is performed by the manufacturer.	Prior to sample analysis	%RSD $\leq$ 20	Use linear regression per SW-846 or recalibrate	Analyst
GC/MS	VOC SVOC DRO (EPH)	Instruments are monitored on a daily basis by the bench analyst for any potential failure. The analysis of blanks and control standards at the start of the day and as analysis continues helps to provide real time feedback to the analyst on the condition of the instruments. Routine maintenance for the (1) mass spec, (2) sample introduction system, and (3) GC are presented below.	Prior to sample analysis	%RSD $\leq$ 30% for all "Standard" compounds and %RSD $\leq$ 40% for all "Non-standard" compounds	Correct problem then repeat initial calibration curve	Analyst
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	90 - 110%	Recalibrate	Analyst/Supervisor
			ICV – Immediately after every ICAL	90 – 110%	Recalibrate or reanalyze affected data	Analyst/Supervisor
			CCV – Every 10 samples or every two hours	90 – 110%	Recalibrate or reanalyze affected data	Analyst//Supervisor

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TABLE 4-5 (CONT.)
GENERAL LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION
REMEDIAL INVESTIGATION WORK PLAN
SITE 17 REMEDIAL INVESTIGATION
NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
CVAA	Mercury	Replace peristaltic pump tubing, replace mercury lamp as necessary, clean optical cell, clean liquid/gas separator as needed. 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	90 – 110%	Recalibrate	Analyst/Supervisor
			ICV – Immediately after every ICAL	90 – 110%	Recalibrate or reanalyze affected data	Analyst/Supervisor
			CCV – Every 10 samples or every two hours	90 – 110%	Recalibrate or reanalyze affected data	Analyst/Supervisor

1) Mass Spectrometers
- Daily check of vacuum ion gauge (Increase in ion count indicates a potential leak)
- Daily (every 24 hours) autotune check with BFB
- Cleaning of ion source on quarterly basis or as needed
- The oil level and quality is visually checked on a monthly basis to insure proper vacuum pump function, and oil is changed every 6 months.

2) Sample Introduction System
- The mass flow controller used for sample introduction is sent for off-site calibration against a NIST-certifiable source once every two years.
- To ensure a clean sample introduction system, if necessary, the lines and trap are "steam-cleaned" by analyzing a humidified system blank. This takes place every day following standards (i.e., CCV) analysis. Humidified system blanks are also analyzed after saturation-level detections in samples.

3) Gas Chromatograph

Basic maintenance includes the following: (Every 6 months or more frequently if needed)
- Clip 3 feet off the front end of the capillary column, and if necessary, the back end as well.
- Replace the injection port liner. The liner is replaced by removing the inlet cap using a wrench and releasing the liner from the inlet body using a pair of tweezers. Care should be taken not to get finger prints on any inside surface.
- Once per week change septa on the GC and once per day change the septa on the valve syringe interface (injection port). Always use Supelco Thermogreen septa and take care not to leave finger prints on any inside heated surface. Wear a pair of white cotton gloves or use tweezers to handle the septa. Lower the oven temperature to 40° C. Remove the inlet cap with a wrench, remove the old septa with a pair of tweezers and insert the new septa.
- The column is replaced when chromatography peak shape or resolution degrades. Similarly, if the column bleed profile rises with age then the column needs replacing. Use new black graphite ferrules each time and clip off approximately 1" of column after inserting it through the ferrule. This will remove any graphite particles that may have scraped off into the column. Tighten the column nut and ferrule finger tight and one quarter turn with a wrench. Tightening any more only crushes the ferrule and may damage the column.
- The branch analyst will document any routine or major maintenance in the bound instrument logbook assigned to each instrument. The date of the maintenance, what work was performed and analyst initials are included.

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4.8 DATA DOCUMENTATION AND RECORDS MANAGEMENT

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

4.8.1 Project Documentation and Records

A summary of Site records and documentation to be generated and stored in the TtNUS project files is provided in Table 4-6.

4.8.2 Field Screening Data Management

The only field screening analyses are PID and/or FID headspace results (and breathing zone readings for safety purposes). The total volatile organics readings provided by the jar headspace analysis will be recorded on the boring logs on which the other boring information is being recorded. The total VOCs will be expressed in ppmv (parts per million by volume) to a detection level determined by the field geologist.

Breathing zone readings for health and safety purposes will be recorded on field sampling sheets, boring logs, or in the field logbooks.

4.8.3 Fixed Laboratory Data Package Deliverables

A turn-around time of 21 days will be requested for all the laboratory analyses. Typical itemized data package deliverables for the laboratory analyses are presented in Table 4-7. Lab electronic deliverables formatted according to the requirements of the laboratory specifications will be provided by the subcontracted laboratories.

4.8.4 Data Reporting Formats

Field data will be recorded in the field log books and field forms. All log book and log sheet entries must be made in indelible ink (black pen is preferred). No erasures or liquid paper/white out are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark, and initialed and dated.

The field personnel will sign and date the log book pages and field forms. Examples of the forms to be used in the field are presented in Appendix D of this Work Plan.

TABLE 4-6
PROJECT DOCUMENTATION AND RECORDS
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Sample Collection And Other Field Records	Fixed Laboratory Records	Data Assessment Records
Field Logbooks	Sample Receipt, Custody and Tracking Records	Field Sampling Audit Check Lists
Sample Log Sheets-Solid Phase	Standards Traceability Logs	Fixed Laboratory Check Lists
Sample Log Sheets-Liquid Phase	Equipment Calibration Logs	Audit Report and Quality Notices
Sample Log Sheets-"Low Flow" Groundwater	Sample Prep Logs	Data Validation Reports
Sample Log Sheets - Shellfish	Sample Analysis Logs	Telephone Logs
Boring Logs	Equipment Maintenance and Testing Logs	
Well Construction Logs	Corrective Action Forms	
Well Development Logs	Data Results Forms	
Chain-Of Custody Records	Reported Results for Standards, QC Checks, and QC Samples	
Air Bills	Instrument Print-outs for Samples and Standards	
Sample Tags	Data Verification Check List	
Custody Seals	Sample Disposal Records	
Telephone Logs	Telephone Logs	
Field Modification Records		
Field Instrument Calibration Logs		

TABLE 4-7
LABORATORY DATA PACKAGE ELEMENTS
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

DATA PACKAGE ELEMENTS	VOA	SVOC & DRO EPH	Pest/ PCB	Metals & Cyanide	TOC	Alkalinity	Sulfide
♦ **INVENTORY SHEET (Org. and Inorg. DC-2 Form)**	X	X	X	X	X	X	X
♦ **NARRATIVE (Org. Narrative, Inorg. Cover Page)**	X	X	X	X	X	X	X
♦ **EPA SHIPPING/RECEIVING DOCUMENTS AND INTERNAL LABORATORY COC RECORDS:**							
- Airbills	X	X	X	X	X	X	X
- Chain-of-Custody Records/Forms (Traffic Report)	X	X	X	X	X	X	X
- Sample Tags		X	X	X			
- Sample Log-In Sheet (Org. and Inorg. DC-1 Form)	X	X	X	X	X	X	X
- Miscellaneous Shipping/Receiving Records	X	X	X	X	X	X	X
- Internal Lab. Sample Transfer Records and Tracking Sheets	X	X	X	X	X	X	X
♦ **SAMPLE DATA:**							
- Tabulated Summary Form for Field Sample and PE Sample Results (Org. and Inorg. Form I)	X	X	X	X	X	X	X
- Tentatively Identified Compounds Tabulate Summary Form (Org. Form I TIC)	X	X					
- Reconstructed Total Ion Chromatogram (RIC) for each sample	X	X					
- Raw spectra of target compound and background subtracted spectrum of target compound for each sample	X	X					
- Mass spectra of all reported TICs/three best library matches for each sample	X	X					
- Chromatograms from both columns for each sample			X				
- GC Integration report or data system printouts and calibration plots for each sample	X	X	X	X	X	X	X
- Pesticide/PCB Identification Tabulated Summary Form (Org. Form X)			X				
- For Pest/PCB confirmed by GC/MS, copies of raw spectra and background subtracted spectrum of target compounds			X				
- GPC sample chromatograms		X	X				
- Manual worksheets	X	X	X	X	X	X	X
- Sample preparation/extraction/digestion log (Inorg. Form XIII) and logbook pages	X	X	X	X	X	X	X
- Sample analysis run log (Inorg. Form XIV) and logbook pages	X	X	X	X	X	X	X
- ICP Raw Data				X			
- Furnace AA Raw Data							

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TABLE 4-7 (CONT.)
LABORATORY DATA PACKAGE ELEMENTS
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 3

DATA PACKAGE ELEMENTS	VOA	SVOC & DRO EPH	Pest/ PCB	Metals & Cyanide	TOC	Alkalinity	Sulfide
♦ **SAMPLE DATA(continued):**							
- Mercury Raw Data				X			
- Cyanide Raw Data							
- Other Analytical Raw Data	X	X	X	X	X	X	X
♦ **STANDARDS DATA:**							
- Method Detection Limit Study Tabulated Summary Form							
- Initial Calibration Tabulated Summary Form (Org. Form VI, Inorg. Form IIA)	X	X	X	X	X	X	X
- Continuing Calibration Tabulated Summary Form (Org. Form VII, Inorg. Form IIA)	X	X	X	X	X	X	X
- RICs and Quan Reports for all GC/MS standards	X	X					
- Pesticides Analyte Resolution tabulated Summary Form (Org. Form VI, Pest-4)			X				
- Pesticides Calibration Verification Tabulated Summary Form (Org. Form VII, Pest-1 and Pest-2)			X				
- Pesticide Analytical Sequence Tabulated Summary Form (Org. Form VIII-Pest)			X				
- GC Chromatograms and data system printouts for all GC standards			X				
- For Pesticides/Aroclors confirmed by GC/MS, copies of spectra for standards data			X				
- GPC Calibration Tabulated Summary Form (Org. Form IX, Pest-2)		X	X				
- Florisil Cartridge Check Tabulated Summary Form (Org. Form IX, Pest-1)		X	X				
- Instrument Detection Limits Tabulated Summary Form (Inorg. Form X)				X			
- ICP Interelement Correction Factors Tabulated Summary Form (Inorg. Form XIA and XIB)				X			
- ICP Linear Ranges Tabulated Summary Form (Inorg. Form XII)				X			
- CRDL Standards for AA and ICP Tabulated Summary Form (Inorg. Form IIB)				X			
- Standards preparation logbook pages	X	X	X	X	X	X	X
♦ **QC DATA:**							
- Tuning and Mass Calibration Tabulated Summary Form (Org. Form V)	X	X					
- Surrogate Percent Recovery Tabulated Summary Form (Org. Form II)	X	X	X				
- MS/MSD Recovery Tabulated Summary Form (Org. Form III)	X	X	X				

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TABLE 4-7 (CONT.)
LABORATORY DATA PACKAGE ELEMENTS
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 3 OF 3

DATA PACKAGE ELEMENTS	VOA	SVOC & DRO EPH	Pest/ PCB	Metals & Cyanide	TOC	Alkalinity	Sulfide
♦ **QC DATA (continued):**							
- Method Blank Tabulated Summary Form (Org. Form IV and Inorg. Form III)	X	X	X	X	X	X	X
- Internal Standard Area and RT Tabulated Summary Form (Org. Form VIII)	X	X					
- QC Raw Data – RICs, Chromatograms, Quan Reports, Integration Reports, Mass Spectra, etc.	X	X	X	X	X	X	X
- Spike Sample Recovery Tabulated Summary Form (Inorg. Form IV)				X			
- Duplicates Tabulated Summary Form (Inorg. Form VI)				X	X		
- Internal Laboratory Control Sample Tabulated Summary Form (Inorg. Form VII)				X	X		
- Continuing Calibration Tabulated Summary Form (Org. Form VII, Inorg. Form IIA)	X	X	X	X	X	X	X
- Standard Addition Results Tabulated Summary Form (Inorg. Form VIII)				X			
- ICP Serial Dilutions Tabulated Summary Form (Inorg. Form IV)				X			
- QC Raw Data – ICP, Furnace, Mercury computer printouts, etc.				X			
- QC sample preparation logbook pages	X	X	X	X	X	X	X
♦ **MISCELLANEOUS DATA:**							
- Original preparation and analysis forms or copies of preparation and analysis logbook pages	X	X	X	X	X	X	X
- Screening records	X	X	X	X	X	X	X
- All instrument output, including strip charts from screening activities	X	X	X	X	X	X	X
- Preparation Logs Raw Data	X	X	X	X	X	X	X
- Percent Solids Determination Log	X	X	X	X	X	X	X
- Other Records (ex. Telephone Communication Log)	X	X	X	X	X	X	X

VOA = volatile organic compounds
SVOC = semivolatile organic compounds
PEST = pesticide organic compounds
PCB = polychlorinated biphenyls
TOC = Total Organic Carbon
( ) = Form Number

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4.8.5 Data Handling and Management

The data handling procedures to be followed by the laboratories will meet the requirements of the subcontracts.

4.8.6 Data Tracking and Control

Data Tracking. Data is tracked from the time of its generation to its archiving in the TtNUS project-specific files. The TtNUS Project Manager is responsible for tracking the data generated for the project. The Lead Chemist is responsible for tracking the samples collected and shipped to the subcontracted laboratories. In addition, the Lead Chemist receives the data packages and oversees the data validation effort.

Data Storage, Archiving, and Retrieval. The data packages received from the subcontract laboratories are tracked in the data validation log book. After the data is validated, the data packages are entered into the TtNUS Doc-u-log system and archived in secure files.

The field records, including field log books, sample logs, chain-of-custody records, and field calibration logs will be submitted by the FOL to be entered into the Doc-u-log system prior to archiving in secure project files. The project files are audited for accuracy and completeness. At the completion of the Navy contract, the records are stored by TtNUS.

Data Security. Data security is the responsibility of the Project Manager. The TtNUS project files are restricted to designated personnel only. Records can only be borrowed temporarily from the project file using a sign-out system. The TtNUS Data Manager maintains the electronic data files. Access to the data files is restricted to qualified personnel only. File and data backup procedures are routinely performed.

4.9 VERIFICATION AND VALIDATION PROCEDURES

This section describes the procedures that will be followed to meet the data verification and validation requirements for this project.

4.9.1 Verification

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

- Site Logbooks
- Instrument Calibration Logs
- Chain-of-Custody Forms
- Field Summary Reports
- Field Modification Records

Field audits and laboratory internal data reviews are important elements of the data verification process. Each of these elements is discussed in detail in Table 4-8.

4.9.2 Validation

TtNUS will validate the analytical data at a Tier II level in accordance with the Region I, EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses. The laboratory data results for alkalinity, sulfide, and total organic carbon analyses will be validated at a Tier I level in accordance with the Region I, EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses.

The steps to be followed by TtNUS in the data validation process are as follows:

1. The FOL gives a copy of the chain-of-custody forms to the Lead Chemist. The Lead Chemist forwards a copy to a data entry person.

2. A Database Specialist creates a Microsoft Access (or equivalent) database for the project.

3. The data entry person inputs the information from the chain-of-custody records including the TtNUS sample location I.D., date sampled, matrix, and QC type (e.g. blank, duplicate) into the database.

4. The Lead Chemist receives the data packages and electronic data deliverables from the subcontract laboratories. The data packages are logged into the Data Validation Tracking Log.

TABLE 4-8
VERIFICATION TASKS AND PROCEDURES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Verification Task	Description	I – INTERNAL E - EXTERNAL	Responsible for Verification (Name, Organization)
Site Logbook	The site logbook is a hardbound, paginated, controlled-distribution record book. Entries are made for every day that onsite activities take place. Upon completion of the fieldwork, the site logbook becomes part of the project's central file. All logbook, notebook, and log sheet entries are made in indelible ink. No erasures are permitted. If an incorrect entry is made, the data is crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used are signed and dated. The Field Operations Leader signs the site logbook at the end of each day.	I	Field Operations Leader, TtNUS
Instrument Calibration Log	Field team members calibrate or check the calibration of monitoring instruments in accordance with the SOPs. The field team member completes a calibration logsheet, initials it, and dates it. Equipment, which does not calibrate properly, is taken out of service. The FOL collects and submits the calibration logsheets to the project file.	I	Field Team Members, TtNUS
Chain-of-Custody Form	The FOL designates one field team member as shipment coordinator. The shipment coordinator organizes the samples into Sample Delivery Groups by matrix, analysis, and destination and fills out the C-O-C and airbill for each SDG. The samplers sign the C-O-C. The shipping coordinator assigns each SDG to a field team member for packing in coolers. The packer checks each cooler's contents against the C-O-C before sealing it. The original C-O-C is shipped with the samples. The FOL provides a copy of the C-O-C to the Data Validators and submits a copy to the project file. The Data Validators use the C-O-C to track the progress of the shipment.	I	Field Team Members, TtNUS
Field Summary Report	The FOL sends Field Summary Reports to the TtNUS Project Manager to document field activities. The Project Manager submits the reports to the project file and sends a copy of each month's reports to the file, and to the Navy RPM if requested.	I	Field Operations Leader, TtNUS
Field Modification Record	Changes in field operating procedures may be necessary as a result of changed field conditions or unanticipated events. If a substantial change is required, the FOL or designee notifies the TtNUS Project Manager of the need for the change. If necessary, the Project Manager will discuss the change with pertinent individuals, e.g., the Navy RPM, and will provide verbal approval or denial to the FOL or assistant FOL for the proposed change. The FOL will document the change on a Field Modification Record form and forward the form to the TtNUS Project Manager at the earliest convenient time. The Project Manager will sign the form and distribute copies to the TtNUS Program Manager, Navy RPM, and others as needed. A copy of the completed Field Modification Record form will also be attached to the field copy of the work plan.	I	Field Operations Leader, TtNUS

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TABLE 4-8 (CONT'D)
VERIFICATION TASKS AND PROCEDURES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Verification Task	Description	I – INTERNAL E - EXTERNAL	Responsible for Verification (Name, Organization)
Field Audit	The Quality Assurance Manager or designated representative audits fieldwork according to audit checklists or audit guides. The QA Manager immediately informs the FOL and Project Manager of any findings that require immediate corrective action. The audits verify adherence to the Work Plan and all applicable SOPs. The QA Manager records each finding of nonconformance on a Quality Notice report and submits it to the Project Manager. The QA Manager prepares an audit report summarizing the findings, which is distributed to the CLEAN Program Manager, the Project Manager, the FOL, and the Program and Project QA/QC files.	I	Quality Assurance Officer, TtNUS
Laboratory Internal Data Review	There are five categories of review performed in the laboratory: 1. Analytical review performed by the bench chemist. It includes a review of raw data, verification of all method- and project-specific QC requirements, the addition of data qualifier flags when needed, and documentation of any unusual circumstances. 2. Technical review performed by team leader or QA-approved peer. 3. QA review performed by a quality assurance specialist emphasizing overall quality of the data. 4. Data report review by the Reporting Manager, Team Leader, or approved peer to ensure the accuracy of the final report. 5. Electronic deliverable review to ensure the accuracy of the final electronic report.	I	Contracted Laboratory Manager or designee
Laboratory Internal Data Review	All data packages are verified internally by the laboratory according to the applicable laboratory master agreement and or TtNUS technical specifications. The laboratory completes DC-2 forms documenting the organization and completeness of each data package.	I	Laboratory Manager or designee

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5. The Lead Chemist assigns a data validator for each data package and transfers the hard copy data packages.

6. The Lead Chemist gives the electronic data deliverables (EDD) to the database specialist.

7. The database specialist uploads the EDD into the project database using a TtNUS-developed file conversion program. The program identifies some common EDD problems (e.g., missing or incorrect SDG number, parameter naming issues) and provides an interface for their resolution. In some cases, queries are run against the EDD to find and fix minor errors. If the errors are serious, e.g. any error affecting the numerical results, the database specialist contacts the laboratory and requests a revised EDD. The upload program checks to see if the incoming data has a corresponding sample number in the database from the chain-of-custody forms. If not, the incoming data is prevented from uploading. The upload program sequesters laboratory QC sample results in a separate table.

8. The database specialist prints a draft data validation table in Microsoft Excel format for distribution to the data validator.

9. The data validator checks the draft data validation tables against the data results (Form I's) in the data package and against the chain-of-custody records to ensure that the database matches the data package. The data validator notifies the database specialist immediately of any major problems (e.g., missing samples). In some cases, the database specialist may ask the laboratory to revise and resubmit the EDD.

10. The data validator performs the Tier I or Tier II validation, assessing potential data quality/usability issues, data completeness and writes the data validation report. The data validator marks up the draft data validation table and submits the complete data report to the Lead Chemist for review.

11. The Lead Chemist reviews the documents and returns them to the data validator for revision.

12. The data validator revises the documents and gives the marked-up draft data validation table to the database specialist.

13. The database specialist (or data entry person) revises the database and prints a final data validation table. The database specialist gives the final data validation table to the data validator along with the marked-up draft data validation table.

14. The data validator compares the final data validation table to the marked-up draft data validation table to make sure that all changes were incorporated into the database. The data validator assembles the data validation reports for approval and submits them for copying and distribution.

4.10 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 to ensure project quality objectives are met.

4.10.1 Report Documentation

The information to be included in each of the QA Management Reports listed in Table 4-9 is summarized as follows.

Verbal Status Reports

The Lead Chemist, FOL, and project personnel will give verbal status reports to the Project Manager 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.

Project Status Reports

Project Status Reports will be submitted by the FOL to the TtNUS Project Manager on a weekly basis. The project status reports will include daily site activities performed, any unexpected site conditions, problem resolutions, and corrective actions or violations of this Work Plan that have been discovered or addressed. Any findings that require input from Navy will be communicated promptly to the RPM.

TABLE 4-9
QA MANAGEMENT REPORTS
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Type of Report	Frequency	Project Delivery Date	Person Responsible for Report Preparation	Report Recipients
Verbal Status Reports	Daily during field activities	At the end of every day of field activities or as needed	TtNUS Field personnel TtNUS FOL: L. Seydewitz TtNUS Lead Chemist: Kelly Johnson-Carper	TtNUS PM: S. Parker
Project Status Reports	Weekly during field activities	At the end of each week of field activities	TtNUS FOL: L. Seydewitz	TtNUS PM: S. Parker Program Manager: J. Trepanowski Navy RPM, as requested
Field Audit Reports	At discretion of QA Officer during field activities	10 days after audit	TtNUS QA Officer	TtNUS PM: S. Parker Program Manager: J. Trepanowski
Data Validation Reports	One per data package	3 weeks after date received	Data Validators	Project File Data Management Group TtNUS PM: S. Parker

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Field Audit Report

Quality assurance audits will be performed by the Quality Assurance Officer (QAO) or QA Representative during field investigations. The audits will include checks on adherence to this Work Plan and all applicable SOPs. The QAO will then 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 CLEAN Program Manager, the Project Manager, the FOL, and the Program and Project QA/QC files. Any findings that require immediate corrective action will be communicated immediately to the FOL and to the Project Manager.

Data Validation Reports

Tier I and Tier II data validation reports will be developed for this project. Tier I validation will be conducted for alkalinity, sulfide and TOC results. Tier II validation will be performed for the VOCs, SVOCs, pesticides, PCBs, EPH, cyanide and metals results. The data validation reports will be distributed to the TtNUS Project Manager, TtNUS Lead Chemist, and project file.

4.10.2 Assessments and Response Actions

Assessment activities ensure that the resultant data quality is adequate for its intended use and that appropriate corrective actions are implemented to address non-conformances and deviations from the Work Plan. The assessments planned for this project are discussed below.

Field Audit

The TtNUS Project Manager will be responsible for this field investigation. The Project Manager will communicate daily with the Field Operations Leader. In addition, senior geologists, hydrogeologists, and environmental engineers will technically oversee the field tasks. The Project Manager will keep the Navy RPM up to date on the field activities and the progress of the investigation.

Quality assurance audits will be performed by the QAO or QA Representative during field investigations. The audits will include checks on adherence to the Work Plan and all applicable SOPs. The QAO will prepare audit checklists or audit guides. The depth and scope of the audit will be determined and incorporated into the checklist or guidelines. As a minimum, the audit will cover the following items:

- Adherence to sample collection as detailed in the Work Plan and SOPs
- Chain of custody

- Documentation of field activities consistent with the Work Plan and SOPs
- Equipment maintenance and calibration
- Training requirements for site workers

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 4-10 describes which individuals will be responsible for deviations and project deficiencies that may be identified through the planned project assessments.

Additional Work Plan Non-conformances

Deviations from the Work Plan noted by project personnel outside of the formal assessment process will be documented and resolved using the procedures and personnel that were detailed for the planned project assessments as described above.

TABLE 4-10
PROJECT ASSESSMENT
WORK PLAN FOR REMEDIAL INVESTIGATION
SITE 17 GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) responsible for performing assessment, title and organizational affiliation	Person(s) responsible for responding to assessment findings, title and organizational affiliation	Person(s) responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person(s) responsible for monitoring effectiveness of CA, title and organizational affiliation
Project Oversight	Continuously	I	TtNUS	TtNUS PM: S. Parker	TtNUS Field Personnel	TtNUS Field Personnel	TtNUS CLEAN Program Manager: J. Trepanowski
Field Audit	Once during field activities	I	TtNUS	TtNUS QAO: Kelly Carper	TtNUS PM: S. Parker	TtNUS FOL: L. Seydewitz	TtNUS QAO: Kelly Carper
Lab Blank Samples	Periodic	I	Subcontract Laboratory	Laboratory Manager	Laboratory Manager	TtNUS Data Validator	TtNUS Data Validator

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5.0 REPORTING

Following the completion of the field sampling and analytical work described in Sections 3 and 4 of this Work Plan, the results will be described in the form of a Remedial Investigation (RI) report. The RI report will contain seven major sections in accordance with EPA Guidance for RI/FS, including background, nature and extent of contamination, fate and transport of contaminants, and the human health and ecological risk assessments. Information to be included in these RI report sections is discussed in the subsections below.

5.1 BACKGROUND AND FINDINGS OF THE INVESTIGATIONS

Section 1.0 of the RI report will describe the background and history of the Site and the purpose of the report. The Site background section will include information from the previous studies conducted in the vicinity of Building 32. Additional background information discovered during this investigation and activities at the Site since the publication of the previous investigations will be described in detail and incorporated into the Site background section.

Section 2.0 will describe the investigations that are the focus of this Work Plan. Specifically, this section will be based on Section 3.0 of the Work Plan and on any modifications to the field work, if applicable, during the period of activity.

Section 3.0 will describe the physical characteristics of the study area as they exist at the time of the investigation. This description will address the major surface features (buildings, pipelines, roadways, fences, etc). The subsurface features, including the geology, hydrogeology, soil types, soil depths, and discharge pipelines, will be described as determined by field work explorations. The cultural and ecological settings of the Site will be summarized in this section, with an expanded and more detailed ecological characterization presented in Section 7.0, the ecological risk assessment. Offshore features, including discharge outfall locations and bottom sediment descriptions in the study area, will be characterized. Figures will be prepared depicting aerial and/or cross-sectional views of Site features, including geology, maximum and minimum water table elevations, depth to bedrock, ecological setting, and sample locations.

Section 4.0 will describe the nature and extent of the contaminants found during this and previous investigations. The conceptual site model presented in Section 2 of this Work Plan will be expanded to describe how the findings of the RI resolve any of the as yet unknown contaminant sources and types. Additional source areas identified will be added, and/or some of those originally targeted may be eliminated, based on data obtained during the RI. All the chemical analytical data generated from the

field work will be presented in this section. Primary site contaminants will be identified based on frequency of detection and concentrations found.

Summary data tables will be included in Section 4.0 of the RI report for all of the matrices sampled. In these tables, the contaminant concentrations that exceed documented regional background conditions, site-specific reference sample concentrations, and regulatory standards will be identified, as appropriate. Pertinent information such as contaminant concentrations and sample locations will be included in Section 4.0 figures.

Section 5.0 will describe the expected fate and transport mechanisms available to the primary site contaminants. The focus of the discussion will likely be the discharge and leachability of metal contamination and degreasing contaminants associated with the operations at Building 32. Other contaminants detected will have similar evaluations performed. The direct discharge of the contaminants through the drainage system, as well as the possibility of transport of these contaminants to groundwater (from leaks, discharges, or spills) and subsequently into off-shore waters and sediments will be discussed. An evaluation of the contaminants' propensity to bioaccumulate, their persistence, and their mobility in the different media present at the Site, will be included. In addition, other relevant contaminant migration pathways identified for organic compounds will be discussed if they are identified.

The conceptual site model will be updated in Section 5 as well, showing how the contaminants detected will be available to receptors through available transport mechanisms, degradation and dilution, as well as accumulation and biomagnification.

5.2 HUMAN HEALTH RISK ASSESSMENT

Section 6.0 of the RI report will consist of a human health risk assessment. This risk assessment will be prepared in accordance with Navy and EPA guidance documents for evaluation of risk at Superfund sites. The risk assessment will include data evaluation through risk-based screening steps, toxicity assessment, exposure assessment, and risk characterization steps, and a discussion of uncertainty.

The chemicals detected at the Site will be grouped by media for screening against applicable criteria. All media sampled will be screened in the human health risk assessment. However, some media may not be suitable for screening against available criteria. For instance, off-shore sediments pose little risk of exposure to humans and should not be used for human health screening or risk calculation since the exposure scenarios limit expected interaction with these media. The current use and foreseeable future use of the property is industrial/military. There is no foreseeable future residential use at Gould Island, therefore residential screening criteria are inappropriate for use at this Site. Applicable risk-based

criteria (RBCs) will include EPA Region IX industrial preliminary remediation goals (PRGs), EPA Region III risk-based concentrations for fish ingestion, EPA Region IX tap water PRGs, as well as applicable RIDEM direct exposure criteria for media sampled at the Site. Surface soils, subsurface soils, and intertidal sediments will be screened against industrial criteria. Since there are no Region IX recreational criteria available for screening purposes, and due to the limited accessibility of the Site, industrial criteria are considered adequate. Shellfish sampling results will be screened against Region III fish ingestion RBCs. Groundwater will be screened against residential tap water criteria. The RBCs will be set at a level of 1E-06 for carcinogens and 0.1 for noncarcinogens. A chemical will be eliminated as a contaminant of potential concern (COPC) for the media if the maximum detected concentration for the chemical is less than applicable screening criteria. Table 5-1 presents screening criteria described above for the contaminants that were previously detected at the Site, and for some related contaminants.

Additionally, chemical data will be screened against documented regional background conditions and site-specific reference samples. Some analytical data will be eliminated from site-specific risk calculation if it is appropriate, based on these comparisons. Contaminants that are screened out due to comparison to background concentrations will be described in the uncertainty section as to concentrations detected in Site samples and background samples, and their possible contribution to total Site risk.

Chemicals that lack toxicity values will be evaluated qualitatively in the risk assessment. A qualitative evaluation will include a discussion of the presence of the chemical at the specific sample stations where it was detected, a discussion of the toxicity of similar chemicals found at these stations or elsewhere at the Site (if applicable), and an opinion of the impact of this chemical on the risk assessment results (i.e. will the omission of this chemical from the risk assessment be significant or not).

Chemicals that are breakdown products of selected COPCs or chemicals that are in the same family as selected COPCs (carcinogenic PAHs) will also be included as COPCs. The final list of COPCs will be carried forward for toxicity assessment and risk characterization.

Statistical analysis will be performed on the data to determine reasonable maximum and average exposure concentrations for identification of COPCs. In general, the 95 percent Upper Concentration Limit of the mean (UCL) will be selected as the exposure point concentration (EPC) for both reasonable maximum exposure (RME) and central tendency exposure (CTE) evaluations. The Shapiro-Wilk W-Test will be used to determine the distribution of data sets. In cases where the 95 percent UCL exceeds the maximum detected concentration, the maximum will be used as the EPC for the RME evaluation and the average will be used as the EPC for the CTE evaluation. The exposure point concentrations will then be used in subsequent quantitative risk calculations.

TABLE 5-1
HUMAN HEALTH RISK SCREENING CRITERIA
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT RHODE ISLAND

PARAMETER	Soil Screening Values	Groundwater Screening Values	Shellfish Screening Values
	Region IX PRGs - Industrial Soil	Region IX PRGs - Tap Water	Region III RBCs - Fish Ingestion
Units	mg/kg	ug/L	mg/kg
Inorganics			
Aluminum [s,d]	100000	36000	1400
Antimony [s,d]	410	15	0.54
Arsenic [g,s,d]	1.6	0.045	0.0021
Barium [g,s,d]	67000	2600	95
Beryllium [s,d]	1900	73	2.7
Cadmium [g,s,d]	450	18	1.4
Calcium [s,d]			
Chromium [g,s,d]	64	110	4.1
Cobalt [s,d]	1900	730	27
Copper [s,d]	41000	1500	54
Cyanide [s,d]	12000	730	27
Iron [s,d]	100000	11000	410
Lead [g,s,d]	750	NA	NA
Magnesium [s,d]			
Manganese [s,d]	19000	880	190
Mercury [g,s,d]	310	11	0.14
Nickel [s,d]	20000	730	27
Potassium [s,d]			
Selenium [s,d]	5100	180	6.8
Silver [g,s,d]	5100	180	6.8
Sodium [s,d]			
Thallium [s,d]	67	2.4	0.095
Vanadium [s,d]	7200	260	9.5
Zinc [s,d]	100000	11000	410
Semivolatile Organic Compounds			
1,1-Biphenyl [s,d]	350	300	68
2-Methylnaphthalene [g,s,d]			27
2,4-Dimethylphenol [s,d]	12000	730	27
4-Methylphenol [s,d]	3100	180	6.8
Acenaphthene [g,s]	29,000	370	81
Acenaphthylene [s,d]	NA	NA	NA
Anthracene [s,d]	100000	1800	410
Benzaldehyde [s,d]	62000	3600	140
Benzo(a)anthracene [s,d]	2.1	0.092	0.0043
Benzo(a)pyrene [s,d]	0.21	0.0092	0.00043
Benzo(b)fluoranthene [s,d]	2.1	0.092	0.0043
Benzo(g,h,i)perylene [s,d]	NA	NA	NA
Benzo(k)fluoranthene [s,d]	21	0.92	0.043
bis(2-Ethylhexyl)phthalate [g,s,d]	120	4.8	0.23
Carbazole [s,d]	86	3.4	0.16
Chrysene [s,d]	210	9.2	0.43

TABLE 5-1 (CONT.)
HUMAN HEALTH RISK SCREENING CRITERIA
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVSTA NEWPORT, RHODE ISLAND
PAGE 2 OF 3

PARAMETER	Soil Screening Values	Groundwater Screening Values	Shellfish Screening Values
	Region IX PRGs - Industrial Soil	Region IX PRGs - Tap Water	Region III RBCs - Fish Ingestion
Units	mg/kg	ug/L	mg/kg
Di-n-Butylphthalate [s,d]	62,000	3600	140
Dibenzo(a,h)anthracene [s,d]	0.21	0.0092	0.00043
Dibenzofuran [g,s,d]	3100	24	5.4
Diethylphthalate	100,000	29000	1,100
Fluoranthene [s,d]	22000	1500	54
Fluorene [g,s,d]	26000	240	54
Indeno(1,2,3-cd)pyrene [s,d]	2.1	0.092	0.0043
Phenanthrene [g,s,d]	NA	NA	NA
Phenol	100,000	22,000	410
Pyrene [s,d]	29000	180	41
Volatile Organic Compounds			
1,1,1-Trichloroethane	1200	3200	380
1,1-Dichloroethane	1700	810	140
1,2,4-Trichlorobenzene	3000	190	14
1,2,4-Trimethylbenzene	170	12	68
1,2-Dichlorobenzene	370	370	120
1,2-Dichloroethane [s]	0.6	0.12	0.035
cis-1,2-Dichloroethene [g,s,d]	150	61	14
trans-1,2-Dichloroethene [g,s,d]	230	120	27
1,3,5-Trimethylbenzene	70	12	68
1,3-Dichlorobenzene	63	5.5	41
1,4-Dichlorobenzene	7.9	0.5	0.13
2-Chlorotoluene	160	73	27
4-Chlorotoluene	160	73	27
Acetone [g,s,d]	6000	610	140
Benzene [g,s]	1.3	0.34	0.057
Bromodichloromethane [g]	1.8	0.18	0.051
n-Butylbenzene	240	240	54
sec-Butylbenzene	220	240	54
tert-Butylbenzene	390	240	54
Carbon Disulfide [g,s,d]	720	1000	140
Chloroethane [s,d]	6.5	4.6	1.1
Chloroform [g]	12	6.2	14
Dibromochloromethane [g]	2.6	0.13	0.038
Ethylbenzene [g,s,d]	20	2.9	140
Hexachlorobutadiene	22	0.86	0.04
Isopropylbenzene [s,d]	2000	660	140
Methylcyclohexane [s,d]	8700	5200	
Methylene Chloride [g,s,d]	21	4.3	0.42
n-Propylbenzene	240	240	54
Styrene	1700	1600	270
Tetrachloroethene [g,s,d]	3.4	0.66	0.061
Toluene [g,s,d]	520	720	270

TABLE 5-1 (CONT.)
HUMAN HEALTH RISK SCREENING CRITERIA
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVSTA NEWPORT, RHODE ISLAND
PAGE 3 OF 3

PARAMETER	Soil Screening Values	Groundwater Screening Values	Shellfish Screening Values
	Region IX PRGs - Industrial Soil	Region IX PRGs - Tap Water	Region III RBCs - Fish Ingestion
Units	mg/kg	ug/L	mg/kg
Total Xylenes [g,s,d]	420	210	2700
Trichloroethene [g,s]	0.11	0.028	0.0079
Trichlorofluoromethane	2000	1300	410
Vinyl Chloride [g,s,d]	0.75	0.02	0.0044
Pesticides/PCBs			
4,4'-DDD [s,d]	10	0.28	0.013
4,4'-DDE [s,d]	7	0.2	0.0093
4,4'-DDT [s,d]	7	0.2	0.0093
alpha-Chlordane [s,d]	6.5	0.19	0.009
Aroclor-1016 [d]	21	0.96	0.045
Aroclor-1221 [d]	0.74	0.034	0.0016
Aroclor-1232 [d]	0.74	0.034	0.0016
Aroclor-1242 [d]	0.74	0.034	0.0016
Aroclor-1248 [g,s,d]	0.74	0.034	0.0016
Aroclor-1254 [g,s,d]	0.74	0.034	0.0016
Aroclor-1260 [g,s,d]	0.74	0.034	0.0016
Dieldrin [s,d]	0.11	0.0042	0.0002
Endosulfan II [s,d]	3,700	220	8.1
gamma-Chlordane [s,d]	6.5	0.19	0.009
OTHER			
TPH	NA	NA	NA
Free Product (NAPL)	NA	NA	NA

Notes:
g Considered to be a groundwater site contaminant
s Considered to be a soil site contantaminant
d Considered to be a sediment site contaminant

The site conceptual model will be evaluated using the exposure point concentrations (EPCs) and information used for the model development to determine if a completed exposure pathway may exist for receptors present. In accordance with Navy policy, the risk assessment must first demonstrate that a contaminant is present above a risk-based concentration, and that there is a possibility for receptor exposure, prior to conducting the subsequent steps of the quantified human health risk assessment.

The Toxicity Assessment will present available reference doses (RfDs), cancer slope factors (CSFs), EPA weights of evidence, response parameter adjustments, and any other relevant information pertaining to COPCs selected in data evaluation. Quantitative toxicity indices, where available, will be presented in this section. Additionally, a toxicological profile will be developed for each COPC.

A quantified exposure assessment will be prepared to identify potential exposures to receptors. Exposure scenarios will be used for the recreational and trespassing receptors using basic scenarios. Current and future exposures will be evaluated using these scenarios.

- Current and Future Trespasser (adolescent) - A trespasser is an adolescent assumed to trespass at the Site at a stated frequency in days per year. Trespassing receptors can possibly be exposed to COPCs in surface soil through incidental ingestion, dermal contact, and inhalation of fugitive dust and to COPCs in sediment through incidental ingestion and dermal contact.

- Current and Future Recreational Receptor - The recreational receptor can be an adult or child using the Site for passive recreation, including walking, hiking, picnicking, hunting, or fishing. Recreational exposures are based on a given frequency of visitation in days per year. Recreational exposures can occur through ingestion, dermal contact, and inhalation of COPCs in surface soil and ingestion and dermal contact of COPCs in sediment. In addition, recreational receptors may be exposed through ingestion of shellfish.

- Current and Future Industrial Worker - The industrial worker will be an adult, working at the Site for a period of 25 years at a frequency of 250 days per year. This person can have limited contact with surface and subsurface soil only through incidental ingestion, dermal contact, and inhalation of fugitive dust. Future industrial workers may also be exposed to volatile groundwater contaminants through inhalation of indoor air.

- Future Construction Worker - The construction worker receptor will be an adult, working at the Site for a limited period of time (one year) on a frequency of 130 days per year (one half of the available working time in a year). This receptor can be exposed to surface soil, subsurface soil and (if it is available) groundwater through ingestion, dermal contact, and inhalation of COPCs.

Exposure parameters for each of the above scenarios are presented on Tables 5-2 through 5-4. Table 5-2 presents exposure parameters for soil and sediment exposures. Table 5-3 presents exposure parameters for shellfish ingestion. Table 5-4 presents exposure parameters for indoor air exposures resulting from volatilization of groundwater contaminants into indoor air spaces of future buildings.

The risk characterization will present the approaches and results of the estimation of carcinogenic and noncarcinogenic risks. The risk characterization will evaluate the potential for adverse health effects from exposure to COPC concentrations in site media by integrating information developed during the toxicity and exposure assessments. Applicable receptor risks will be presented in a tabular format, with accompanying text to interpret the results of the estimation of risks from selected COPCs. Finally, discussion of uncertainties related to risk assessment will be presented.

The risk assessment will be prepared in accordance with current U.S. EPA and Navy guidance. This guidance is contained in various documents that include, but are not limited to, the following:

- "Region IX Preliminary Remediation Goals Table," USEPA, Region IX, November 2002.
- "Integrated Risk Information System (IRIS)," Computer Database, EPA, Washington, D.C., 2003.
- Health Effects Assessment Summary Tables (HEAST), Update FY 1997, EPA 540-R-97-036, prepared by International Consultants Inc. for the National Center for Environmental Assessment, USEPA Cincinnati, Ohio.
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Peer review draft March 2001, OSWER 9355.4-24 Office of Emergency and Remedial Response, USEPA.
- Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual (Part A). December 1989. EPA/540/1-89/002.
- Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual - Supplemental Guidance - "Standard Default Exposure Factors". March 25, 1991. OSWER Directive 9285.6-03.
- Final Guidance for Data Usability in Risk Assessment (Parts A and B), OSWER Directive 92857-09A and 09B, 1992.

TABLE 5-2
SUMMARY OF HUMAN HEALTH RISK EXPOSURE INPUT PARAMETERS - SEDIMENT/SOIL
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Exposure Input Parameter	Industrial Worker		Construction Worker		Recreational User (Adult/Child)		Adolescent Trespasser (7-18 yrs)	
	RME	CTE	RME	CTE	RME	CTE	RME	CTE
C (mg/kg)	95% UCL[2]							
EF (day/year)	250[8]	219[3]	130[1]	52[1]	48[1]	24[1]	48[1]	24[1]
ED (years)	25[7]	9[7]	1[1]	1[1]	24/6[7]	9/2[7]	12[7]	6[7]
ET (hr/day)	8[1]	8[1]	8[1]	8[1]	8[1]	4[1]	8[1]	4[1]
BW (kg)	70[7]	70[7]	70[7]	70[7]	70/15[7]	70/15[7]	50[7]	50[7]
IR (mg/day)	100[7]	50[7]	200[7]	100[7]	100/200[7]	50/100[7]	100[7]	50[7]
InhR (m3/hr)	1.6[7]	0.6[7]	3.3[7]	1.5[7]	1.6/200[7]	0.6/100[7]	1.2[7]	0.6[7]
PEF (m3/kg)	1.36E+9[9]	1.36E+9[9]	6.8E+3[9]	6.8E+3[9]	1.36E+9[9]	1.36E+9[9]	1.36E+9[9]	1.36E+9[9]
ABS (unitless)	Chemical Specific Dermal Absorption Factors							
Soil AF (mg/cm^2)	0.2[8]	0.02[8]	0.3[8]	0.1[8]	0.07/0.2[8]	0.01/0.04[8]	0.4[8]	0.04[8]
Sediment AF (mg/cm^2)					0.07/0.2[8]	0.01/0.04[8]	1[8]	0.2[8]
SA (cm^2/day) [10]	3,300[8]	3,300[8]	3,300[8]	3,300[8]	5,700/2,800[8]	5,700/2,800[8]	4,050[7]	4,050[7]

RME Reasonable Maximum Exposure.
CTE Central Tendency Exposure.
C Exposure concentrations.
UCL Upper confidence limit.
EF Exposure Frequency.
ED Exposure duration.
ET Exposure Time.
BW Body weight.
IR Ingestion rate.
InhR Inhalation Rate.
PEF Particulate Emission Factor.
ABS Absorption Factor.
AF Soil-to-skin adherence factor.
SA Skin surface area available for contact.

(1) The value presented represents professional judgment.
(2) For datasets with greater than 10 samples: EPCs represent the 95 UCL of the arithmetic mean, unless the 95 percent UCL is greater than the maximum detected concentration. If the 95 percent UCL is greater than the maximum, the maximum is selected as the EPC for the RME case and the arithmetic mean is selected as the EPC for the CTE case. For datasets with 10 or less samples: the maximum detected and arithmetic mean concentration are selected as the EPCs for the RME and CTE cases, respectively.
(3) EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and RME-Draft. Working Draft, November 1993.
(4) EPA, 1994: USEPA Region I Waste Management Division, USEPA Risk Update No. 2, Aug. 1994.
(5) USEPA Region I, August 1994; Exposure Factors Handbook (August 1997); the body weight for A3 assumes that a 3 to 6 yr old child is the receptor.
(6) EPA, 1996: Soil Screening Guidance: Technical Background Document, May 1996.
(7) EPA, 1997: Exposure Factors Handbook. Volume I, Aug. 1997, EPA/600/P-25/002FA.
(8) EPA, 2001: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. December 2001.
(9) EPA, 2001b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, August 2001, calculated.

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TABLE 5-3
SUMMARY OF HUMAN HEALTH RISK EXPOSURE INPUT PARAMETERS – SHELLFISH
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Exposure Input Parameter	Adult		Child	
	RME	CTE	RME	CTE
C (mg/kg)	95% UCL(1)			
FI	1(2)	1(2)	1(2)	1(2)
EF (day/year)	350(3)	350(3)	350(3)	350(3)
ED (years)	24(3)	9(3)	6(3)	2(3)
BW (kg)	70(3)	70(3)	16.6(3)	16.6(3)
IR (mg/day)	10300(4)	5150(5)	3300(6)	1650(7)

RME Reasonable Maximum Exposure.
CTE Central Tendency Exposure.
C Exposure concentrations.
UCL Upper confidence limit.
FI Fraction Ingested
EF Exposure Frequency.
ED Exposure duration.
BW Body weight.
IR Ingestion rate.

(1) For datasets with greater than 10 samples: EPCs represent the 95 UCL of the arithmetic mean, unless the 95 percent UCL is greater than the maximum detected concentration. If the 95 percent UCL is greater than the maximum, the maximum is selected as the EPC for the RME case and the arithmetic mean is selected as the EPC for the CTE case. For datasets with 10 or less samples: the maximum detected and arithmetic mean concentration are selected as the EPCs for the RME and CTE cases, respectively.
(2) The value presented represents professional judgment.
(3) EPA, 1997: Exposure Factors Handbook. Volume I, Aug. 1997, EPA/600/P-25/002FA.
(4) 150,000 mg seafood per serving * 24 servings per year * 1 year/350 days = 10,300 mg/day. Source: Narragansett Bay Project. NBP-92-105, Brown et.al., Clark University, 1992.
(5) 150,000 mg seafood per serving * 12 servings per year * 1 year/350 days = 5,150 mg/day. Source: Narragansett Bay Project. NBP-92-105, Brown et.al., Clark University, 1992.
(6) 48,000 mg seafood per serving * 24 servings per year * 1 year/350 days = 3,300 mg/day. Source: Narragansett Bay Project. NBP-92-105, Brown et.al., Clark University, 1992.
(7) 48,000 mg seafood per serving * 12 servings per year * 1 year/350 days = 1,650 mg/day. Source: Narragansett Bay Project. NBP-92-105, Brown et.al., Clark University, 1992.

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TABLE 5-4
SUMMARY OF HUMAN HEALTH EXPOSURE INPUT PARAMETERS – INDOOR AIR
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVSTA NEWPORT, NEWPORT, RHODE ISLAND

Exposure Input Parameter	Adult	
	RME	CTE
C (ug/m^3)	Modeled indoor air concentration[1]	
InhR (m^3/hour)	1.6[3]	0.6[3]
ET (hr/day)	8[2]	8[2]
EF (day/year)	250[4]	219[5]
ED (years)	25[3]	9[3]
BW (kg)	70[3]	70[3]

RME	Reasonable Maximum Exposure.	ET	Exposure Time
CTE	Central Tendency Exposure.	EF	Exposure Frequency.
C	Exposure concentrations.	ED	Exposure duration.
UCL	Upper confidence limit.	BW	Body weight.
FI	Fraction Ingested	InhR	Inhalation rate.

(1) Indoor air concentration modeled from groundwater concentrations using Johnson & Ettinger Vapor Intrusion model.
(2) The value presented represents professional judgment.
(3) EPA, 1997: Exposure Factors Handbook. Volume I, Aug. 1997, EPA/600/P-25/002FA.
(4) EPA, 2001: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. December 2001.
(5) EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and RME-Draft. Working Draft, November 1993.

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- EPA Guidance for Data Assessment. 1997. EPA/600/R-96/084.

- Supplemental Guidance to RAGS: Calculating the Concentration Term. May 1992. OSWER Publication 9285.7-08I.

- Exposure Factors Handbook: 1997
  - Volume 1. EPA/600/P-95/002Fa.
  - Volume 2. EPA/600/P-95/002Fb.
  - Volume 3. EPA/600/P-95/002Fc.

- Risk Assessment Guidance for Superfund (RAGs) - Volume I - Human Health Evaluation Manual (Part E) - Supplemental Guidance for Dermal Risk Assessment. Interim. September 2001, EPA/540/R/99/005.

- Soil Screening Guidance Technical Background Document. USEPA 1996 EPA/540/R-95/128.

- Region I Supplemental Risk Assessment Guidance for the Superfund Program. June 1989. EPA/901/5-89/001.

- USEPA Region I Risk Updates:
  - No. 2, August 1994.
  - No. 3, August 1995.
  - No. 4, November 1996.
  - No. 5, September 1999.

- USEPA, Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Part D. December 2001.

5.3 ECOLOGICAL RISK ASSESSMENT

Section 7.0 of the RI report will include the Tier 1 ecological risk assessment (ERA). This section of the work plan presents the general methodology that will be used to conduct the ERA for Site 17.

The goal of the ERA is to evaluate the potential for adverse ecological impacts of site-related contamination and to determine the need for further investigation and/or remedial action at the site. This ERA will contain information to enable scientists and managers to conclude either that ecological risks at

the Site are most likely negligible or that further information is necessary to evaluate potential ecological risks at the Site.

The ERA methodology is in accordance with the following guidance documents:

- Navy Policy for Conducting Ecological Risk Assessment, Navy, 1999.
- Final Guidelines for Ecological Risk Assessment, USEPA, 1998.
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, USEPA, 1997a.

The Tier I ERA will consist of Steps 1, 2, and 3a of the eight steps required by the above guidance documents. The first two steps will be the screening level ecological risk assessment (SERA). Step 3a is the first step of the baseline ecological risk assessment (BERA) and consists of refining the list of COPCs that are retained following Steps 1 and 2. Steps 3b through 7 consist of additional site-specific investigations/biological studies. However, Steps 3b through 7 are not included in this general methodology section because it is not yet known if (or what) specific studies will need to be conducted at the Site. Finally, Step 8, Risk Management, is incorporated throughout the ERA process in cooperation with the Region 1 Biological Technical Assistance Group (BTAG).

STEP 1: Screening-Level Problem Formulation and Ecological Effects Evaluation

Problem formulation is the first step of an ERA. The problem formulation process enables the risk assessor to identify the ecological resources to be protected (known as assessment endpoints); the measurements that will be used to evaluate risks to those resources (known as measurement endpoints); and the chemicals, geographic areas, and environmental media relevant to the risk assessment. Problem formulation includes identification of the following:

- Ecosystems potentially at risk
- Source and stressor characteristics
- Exposure characteristics
- Ecological effects

As described in Section 2.0 of this Work Plan, the Site is an abandoned industrial facility. A detailed ecological characterization of the Site described in Section 3.0 of this Work Plan will serve to identify the potential ecological receptors associated with the Site. The environmental checklist presented in

Representative Sampling Guidance Document, Volume 3: Ecological (U.S. EPA, 1997b; Appendix B) will be used and a Site visit will be conducted, as described in Section 3.2.4 of this Work Plan. During an initial Site walkover, a shrub/scrub habitat with opportunistic vegetation was observed encroaching on the deteriorating building and concrete surfaces. Similarly, opportunistic animal species, such as gulls, pigeons, and rodents, are suspected to use the Site for feeding and nesting. Recently, aboveground structures have been demolished, although pavement and foundations remain.

Assessment endpoints are explicit expressions of the environmental value that is to be protected (USEPA, 1997a). Measurement endpoints are estimates of biological impacts (e.g., mortality, growth, reproduction) that are used to evaluate the assessment endpoints.

Based on the habitat description at Site 17, the preliminary assessment endpoints for the ERA will be the protection of the following groups of receptors which may need to be protected from adverse effects of contaminants on their growth, survival, and reproduction:

- Soil invertebrates
- Terrestrial vegetation
- Herbivorous birds and mammals
- Carnivorous birds and mammals
  - Insectivorous birds and mammals
  - Piscivorous birds and mammals
- Benthic invertebrates
- Fish and other marine organisms

The following measurement endpoints will be used to evaluate the assessment endpoints in this ERA:

- Soil screening values - Mortality, growth, and reproduction of plants and soil invertebrates will be evaluated by comparing chemical concentrations in surface soil to screening values designed to be protective of these ecological receptors.

- No-observed-adverse effects levels (NOAELs) for representative wildlife species – Mortality, reproduction, and/or developmental effects to birds and mammals will be evaluated by comparing estimated ingested doses of contaminants in sediment, surface soil, plants, invertebrates, and/or mussels to these NOAELs.

- Sediment screening values - Mortality and other adverse effects (e.g., those on growth, feeding rates, behavior) of benthic macroinvertebrates will be evaluated by comparing chemical

concentrations in sediment to screening values designed to be protective of these ecological receptors.

- Surface water screening values - Mortality and other adverse effects (e.g., those on growth, feeding rates, behavior) of marine organisms will be evaluated by conservatively comparing chemical concentrations in groundwater to surface water screening values designed to be protective of these ecological receptors, based on the presumption that groundwater may discharge to the marine environment.

The following surrogate species will be used for the food chain modeling:

- Herbivorous mammal: meadow vole
- Herbivorous bird: bobwhite quail
- Insectivorous mammal: short-tailed shrew
- Insectivorous bird: American woodcock
- Piscivorous mammal: raccoon
- Piscivorous bird: herring gull

Note that the selected assessment and measurement endpoints may be modified after the completion of detailed ecological characterization of the Site, described in Section 3.0 of this Work Plan.

The preliminary ecological effects evaluation is an investigation of the relationship between the exposure to a chemical and the potential for adverse effects resulting from exposure. In this step, conservative screening levels for evaluating the toxicity to ecological receptors from the detected levels of chemicals at the sites are compiled.

Risks to terrestrial plants/invertebrates and marine receptors resulting from direct exposure to chemicals will be evaluated by comparing the chemical concentrations in the surface soil, groundwater, and sediment to screening levels. Table 5-5 presents the screening levels along with the sources that were used to compile the values. Site-related contaminants for which appropriate screening benchmarks cannot be identified will be discussed qualitatively in the ecological assessment. These toxicity values are expressed in units of concentration because the media of concern are in intimate contact (direct exposure) with terrestrial plants/invertebrates and marine receptors.

Risks to wildlife receptors for exposures to chemicals found in the surface soil and sediment will be determined by estimating the Chronic Daily Intake (CDI) and comparing the CDI to toxicity reference values (TRVs) representing acceptable daily doses in mg/kg-day. The TRVs, including NOAELs, and

TABLE 5-5
ECOLOGICAL SCREEING VALUES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

	Soil Screening Values				Sediment Screening Values		Surface Water Values	
	Plant		Invertebrate		Aquatic Receptors		Aquatic Receptors	
Parameter	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**
Inorganics								
Aluminum [s,d]	50	Efroymson, 1997a			18000	Buchman, 1999	87[(1)]	USEPA, 2002
Antimony [s,d]	5	Efroymson, 1997a			2	Long and Morgan, 1991	500	Buchman, 1999
Arsenic [g,s,d]	10	Efroymson, 1997a	60	Efroymson, 1997b	8.2	Long et al., 1995	36[(2)]	USEPA, 2002
Barium [g,s,d]	500	Efroymson, 1997a			48	Buchman, 1999	4[(1)]	Suter and Tsao, 1996
Beryllium [s,d]	10	Efroymson, 1997a					5.3[(1)]	Buchman, 1999
Cadmium [g,s,d]	4	Efroymson, 1997a	20	Efroymson, 1997b	1.2	Long et al., 1995	8.8[(2)]	USEPA, 2002
Calcium [s,d]								
Chromium [g,s,d]	1	Efroymson, 1997a	0.4	Efroymson, 1997b	81	Long et al., 1995	50[(2)]	USEPA, 2002
Cobalt [s,d]	20	Efroymson, 1997a			10	Buchman, 1999		
Copper [s,d]	100	Efroymson, 1997a	50	Efroymson, 1997b	34	Long et al., 1995	3.1[(2)]	USEPA, 2002
Cyanide [s,d]	0.9	CCME, 1997	0.9	CCME, 1997			1	USEPA, 2002
Iron [s,d]					220,000	Buchman, 1999	1000[(1)]	USEPA, 2002
Lead [g,s,d]	50	Efroymson, 1997a	500	Efroymson, 1997b	46.7	Long et al., 1995	8.1[(2)]	USEPA, 2002
Magnesium [s,d]								
Manganese [s,d]	500	Efroymson, 1997a			260	Buchman, 1999	120[(1)]	Suter and Tsao, 1996
Mercury [g,s,d]	0.3	Efroymson, 1997a	0.1	Efroymson, 1997b	0.15	Long et al., 1995	0.94[(2)]	USEPA, 2002
Nickel [s,d]	30	Efroymson, 1997a	200	Efroymson, 1997b	20.9	Long et al., 1995	8.2[(2)]	USEPA, 2002
Potassium [s,d]								
Selenium [s,d]	1	Efroymson, 1997a	70	Efroymson, 1997b	1	Buchman, 1999	71[(2)]	USEPA, 2002
Silver [g,s,d]	2	Efroymson, 1997a			1	Long et al., 1995	0.19[(3)]	USEPA, 2002
Sodium [s,d]								
Thallium [s,d]	1	Efroymson, 1997a					21.3[(5)]	Buchman, 1999
Vanadium [s,d]	2	Efroymson, 1997a	130	CCME, 1997	57	Buchman, 1999		
Zinc [s,d]	50	Efroymson, 1997a	200	Efroymson, 1997b	150	Long et al., 1995	81[(2)]	USEPA, 2002
Semivolatile Organic Compounds								
1,1-Biphenyl [s,d]	60000	Efroymson, 1997a			1100[(1)]	USEPA, 1996		
2-Methylnaphthalene [g,s,d]					70	Long et al., 1995	3[(5)]	Buchman, 1999
2,4-Dimethylphenol [s,d]					18	Buchman, 1999	21.2[(1,5)]	Buchman, 1999
4-Methylphenol [s,d]					100	Buchman, 1999		
Acenaphthene [g,s]	20,000	Efroymson, 1997a			16	Long et al., 1995	40	USEPA, 1996
Acenaphthylene [s,d]					44	Long et al., 1995	3[(5)]	Buchman, 1999
Anthracene [s,d]					85.3	Long et al., 1995	3[(5)]	Buchman, 1999
Benzaldehyde [s,d]								
Benzo(a)anthracene [s,d]					261	Long et al., 1995	3[(5)]	Buchman, 1999
Benzo(a)pyrene [s,d]	700	CCME, 1997	700	CCME, 1997	430	Long et al., 1995	3[(5)]	Buchman, 1999
Benzo(b)fluoranthene [s,d]					1800	Buchman, 1999	3[(5)]	Buchman, 1999
Benzo(g,h,i)perylene [s,d]					670	Buchman, 1999	3[(5)]	Buchman, 1999
Benzo(k)fluoranthene [s,d]					1800	Buchman, 1999	3[(5)]	Buchman, 1999
bis(2-Ethylhexyl)phthalate [g,s,d]					182	McDonald, 1994	360	Buchman, 1999
Carbazole [s,d]								

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TABLE 5-5 (cont.)
ECOLOGICAL SCREEING VALUES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Parameter	Soil Screening Values				Sediment Screening Values		Surface Water Values	
	Plant		Invertebrate		Aquatic Receptors		Aquatic Receptors	
	Value	Source	Value	Source	Value	Source	Value	Source
Chrysene [s,d]					384	Long et al., 1995	3[5]	Buchman, 1999
Di-n-Butylphthalate [s,d]	200,000	Efroymson, 1997a			58	Buchman, 1999	0.34[4]	Buchman, 1999
Dibenzo(a,h)anthracene [s,d]					63.4	Long et al., 1995	3[5]	Buchman, 1999
Dibenzofuran [g,s,d]					110	Buchman, 1999		
Fluoranthene [s,d]					600	Long et al., 1995	11	USEPA, 1996
Fluorene [g,s,d]			30,000	Efroymson, 1997b	19	Long et al., 1995	3[5]	Buchman, 1999
Indeno(1,2,3-cd)pyrene [s,d]					600	Buchman, 1999	3[5]	Buchman, 1999
Naphthalene [g,s,d]	600	CCME, 1997	600	CCME, 1997	160	Long et al., 1995	23.5[5]	Buchman, 1999
Phenanthrene [g,s,d]					240	Long et al., 1995	8.3	USEPA, 1996
Pyrene [s,d]					665	Long et al., 1995	3[5]	Buchman, 1999
High Molecular Weight PAHs[7]					552	Long et al., 1995		
Low Molecular Weight PAHs[7]					1700	Long et al., 1995		
Total PAHs[7]					4022	Long et al., 1995		
Volatile Organic Compounds								
Vinyl Chloride [g,s,d]	10	MHSPE, 1994						
Chloroethane [s,d]								
Methylene Chloride [g,s,d]							640[4]	Buchman, 1999
Acetone [g,s,d]								
Carbon Disulfide [g,s,d]								
cis-1,2-Dichloroethene [g,s,d]	200	MHSPE, 1994	200	MHSPE, 1994			2240[5]	Buchman, 1999
trans-1,2-Dichloroethene [g,s,d]	200	MHSPE, 1994	200	MHSPE, 1994			2240[5]	Buchman, 1999
Chloroform [g]	20	MHSPE, 1994	20	MHSPE, 1994			124[1,4]	Buchman, 1999
1,2-Dichloroethane [s]	20	MHSPE, 1994	20	MHSPE, 1994			1130[5]	Buchman, 1999
2-Butanone [s,d]								
Bromodichloromethane [g]							640[4]	Buchman, 1999
Methylcyclohexane [s,d]								
Trichloroethene [g,s]	3000	CCME, 1997	3000	CCME, 1997	41	Buchman, 1999	20[5]	Buchman, 1999
Dibromochloromethane [g]							640[4]	Buchman, 1999
Benzene [g,s]	5000	CCME, 1997	5000	CCME, 1997	57[1]	USEPA, 1996	70[4]	Buchman, 1999
Isopropylbenzene [s,d]								
Tetrachloroethene [g,s,d]	3800	CCME, 1997	3800	CCME, 1997	57	Buchman, 1999	45[4]	Buchman, 1999
Toluene [g,s,d]	200000	Efroymson, 1997a	1400	CCME, 1997	670[1]	USEPA, 1996	500[4]	Buchman, 1999
Ethylbenzene [g,s,d]	1200	CCME, 1997	1200	CCME, 1997	4	Buchman, 1999	4.3[5]	Buchman, 1999
Total Xylenes [g,s,d]	1000	CCME, 1997	1000	CCME, 1997	4	Buchman, 1999		
Pesticides/PCBs								
4,4'-DDD [s,d]	10[8]	MHSPE, 1994	10	MHSPE, 1994	1.22	McDonald, 1994	0.001[6]	USEPA, 2002
4,4'-DDE [s,d]					2.2	Long et al., 1995	0.001[6]	USEPA, 2002
4,4'-DDT [s,d]					1.19	McDonald, 1994	0.001	USEPA, 2002
alpha-Chlordane [s,d]	0.03[8]	MHSPE, 1994	0.03[8]	MHSPE, 1994	0.5	Long and Morgan, 1991	0.004	USEPA, 2002
gamma-Chlordane [s,d]					0.5	Long and Morgan, 1991	0.004	USEPA, 2002

TABLE 5-5 (cont.)
ECOLOGICAL SCREEING VALUES
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Parameter	Soil Screening Values				Sediment Screening Values		Surface Water Values	
	Plant		Invertebrate		Aquatic Receptors		Aquatic Receptors	
	Value	Source	Value	Source	Value	Source	Value	Source
Aroclor-1016 [d]	40,000[8]	Efroymson, 1997a			22.7[8]	Long et al., 1995	0.03[8]	USEPA, 2002
Aroclor-1221 [d]								
Aroclor-1232 [d]								
Aroclor-1242 [d]								
Aroclor-1248 [g,s,d]								
Aroclor-1254 [g,s,d]								
Aroclor-1260 [g,s,d]								
Dieldrin [s,d]	0.5	MHSPE, 1994	0.5	MHSPE, 1994	0.02	Long and Morgan, 1991	0.0019	USEPA, 2002
Endosulfan II [s,d]	0.01	MHSPE, 1994	0.01	MHSPE, 1994	14[1]	USEPA, 1996	0.0087	USEPA, 2002

Notes:

g Previously detected in site groundwater
s Previously detected in site soil
d Previously detected in site sediment

Units: Soil and sediment parameters are in mg/kg for metals and ug/kg for organics
Surface water parameters are in ug/L for all chemicals

Buchman, M. F., 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration. http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

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USEPA (U.S. Environmental Protection Agency), 1996. ECO Update, Ecotox Thresholds. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Intermittent Bulletin, Volume 3, Number 2. EPA540/F-95/038. January.

USEPA (U.S. Environmental Protection Agency), 2002. National Recommended Water Quality Criteria: 2002. Office of Water. EPA 822-R-02-047. November.

1 - Based on freshwater criteria
2 - Based on dissolved concentrations
3 - Estimated by multiplying acute criteria by 0.1
4 - Calculated by multiplying the chronic LOEL by 0.1 to estimate a chronic NOEL
5 - Calculated by multiplying the acute LOEL by 0.01 to estimate a chronic NOEL
6 - Based on DDT criteria
7 - High Molecular Weight PAHs include [benzo(a)anthracene, benzo(a)pyrene, chrysene,dibenzo(a,h)anthracene, fluoranthene, pyrene]
Low Molecular Weight PAHs include [acenaphthene, acenaphylene, anthracene, fluorene, 2-methylnaphthalene, naphthalene, and phenanthrene]
Total PAHs include sum of low and high molecular weight PAHs
8 - Total value

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lowest-observed-adverse-effect-levels (LOAELs) obtained from wildlife studies presented in Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996), will be supplemented with other toxicity information when necessary.

Section 2.4 describes the preliminary conceptual site model for Site 17. This conceptual site model will be updated in the ERA after the additional analytical data are collected and ecological characterizations are conducted. In general, terrestrial ecological receptors such as plants, soil invertebrates, mammals, and birds can be exposed to contaminated surface soil through direct contact. Mammals and birds can also ingest contaminated surface soil and food items in which contaminants have accumulated. Marine ecological receptors such as fish and benthic macroinvertebrates can be exposed to chemical contamination through direct contact and ingestion of contaminated surface water or sediment. Fish and piscivorous (fish-eating) wildlife can also feed on other marine biota that have accumulated chemical contaminants from the surface water and sediment.

STEP 2: Screening-Level Exposure Estimate and Risk Quotients

In order to determine if a chemical has the potential to cause a risk to an ecological receptor, a chemical concentration or chemical dose that will be compared to the screening levels/TRVs must be determined. These chemical concentrations/doses are termed exposure point concentrations (EPCs). The following paragraphs indicate the EPCs that will be used for each set of ecological receptors. Information to be considered for the ecological assessment will include analytical data for surface soils (depth range: 0-2 feet) and sediments (depth range 0-12 inches) and analytical data from groundwater, under the presumption that it discharges to the marine environment.

Terrestrial soil invertebrates and plants are exposed to contaminants in the surface soil through direct contact and/or ingestion. Marine receptors (such as fish and benthic invertebrates) are exposed to contaminants in the surface water and sediment through direct contact and/or ingestion. As indicated above, the screening values that were developed for these receptors are in units of chemical concentration in each medium. Therefore, the EPCs for these receptors will be the maximum and average chemical concentrations in each medium. The maximum EPCs will be used for the screening step to select the list of COPCs.

The EPCs for terrestrial wildlife will be estimated in mg/kg-day using exposure dose equations. The exposure factors for the preliminary food chain model surrogate receptors are presented in Table 5-6. EPCs for terrestrial wildlife will only be calculated for chemicals identified by USEPA as bioaccumulative (USEPA, 2000). Note that the food chain models will be conducted on a dry weight basis to be

TABLE 5-6
EXPOSURE PARAMETERS FOR THE TERRESTRIAL WILDLIFE MODEL
REMEDIAL INVESTIGATION WORK PLAN
SITE 17, GOULD ISLAND
NAVSTA, NEWPORT, RHODE ISLAND

Species/Exposure Inputs	Conservative Inputs		Average Inputs	
	Values	Units	Values	Units
Bobwhite Quail				
Body Weight = BW	1.540E-01	kg	1.751E-01	kg
Food Ingestion Rate = If	4.880E-03	kg/day	4.080E-03	kg/day
Water Ingestion Rate = Iw	2.276E-02	L/day	1.926E-02	L/day
Soil Ingestion Rate = Is	4.002E-04	kg/day	3.346E-04	kg/day
Home Range = HR	Assume 100% on site		1.880E+01	acres
Meadow Vole				
Body Weight = BW	1.700E-02	kg	3.580E-02	kg
Food Ingestion Rate = If	3.756E-03	kg/day	3.488E-03	kg/day
Water Ingestion Rate = Iw	7.513E-03	L/day	6.261E-03	L/day
Soil Ingestion Rate = Is	9.015E-05	kg/day	8.371E-05	kg/day
Home Range = HR	Assume 100% on site		6.590E-02	acres
American Woodcock				
Body Weight = BW	1.340E-01	kg	1.731E-01	kg
Food Ingestion Rate = If	2.686E-02	kg/day	2.132E-02	kg/day
Water Ingestion Rate = Iw	2.180E-02	L/day	1.731E-02	L/day
Soil Ingestion Rate - Is	3.153E-03	kg/day	1.424E-03	kg/day
Home Range = HR	Assume 100% on site			acres
Short-Tailed Shrew				
Body Weight = BW	1.500E-02	kg	1.610E-02	kg
Food Ingestion Rate = If	1.600E-03	kg/day	1.433E-03	kg/day
Water Ingestion Rate = Iw	4.280E-03	L/day	3.600E-03	L/day
Soil Ingestion Rate - Is	4.801E-05	kg/day	2.149E-05	kg/day
Home Range = HR	Assume 100% on site		9.699E-01	acres
Raccoon				
Body Weight = BW	3.670E+00	kg	5.636E+00	kg
Food Ingestion Rate = If	2.370E-01	kg/day	1.840E-01	kg/day
Water Ingestion Rate = Iw	4.680E-01	L/day	4.650E-01	L/day
Sediment Ingestion Rate = Is	2.228E-02	kg/day	1.730E-02	kg/day
Home Range = HR	Assume 100% on site		1.558E+03	acres
Herring Gull				
Body Weight = BW	9.510E-01	kg	1.092E+00	kg
Food Ingestion Rate = If	3.438E-02	kg/day	3.356E-02	kg/day
Water Ingestion Rate = Iw	6.440E-02	L/day	6.222E-02	L/day
Sediment Ingestion Rate = Is	2.819E-03	kg/day	2.752E-03	kg/day
Home Range = HR	Assume 100% on site		1.000E+01	km-radius

Notes:

The soil/sediment ingestion rates were calculated by multiplying the food ingestion rates by the following incidential soil/sediment ingestion rates:

	Conservative	Average	Source
Bobwhite quail	8.2%	8.2%	1, 3
Meadow Vole	2.4%	2.4%	2
American Woodcock	11.74%	6.68%	1
Short-tailed Shrew	3%	1.5%	1
Raccoon	9.4%	9.4%	2
Herring Gull	8.2%	8.2%	1, 3

1 - USEPA (U.S. Environmental Protection Agency), 2000. Ecological Soil Screening Level Guidance, Draft. Office of Emergency and Remedial Response. July.

2 - Beyer, N., E. Connor, and S. Gerould. 1994. Estimates of Soil Ingestion by Wildlife. Journal of Wildlife Management 58(2) pp. 375-382.

3 - Based on a Canada goose

consistent with the sediment and soil concentrations which are reported on a dry weight basis. Therefore, the concentrations in the food items will be converted to dry weight concentrations.

Contaminant concentrations in terrestrial food items (i.e., plants and invertebrates) will be calculated using bioaccumulation factors (BAFs) from the following published sources:

- Plant BAFs (Organics): Toxicity and Chemical-Specific Factors Database (ORNL, 2002).
- Plant BAFs (Inorganics): Empirical Model for the Uptake of Inorganic Chemicals from Soil by Plants (ORNL, 1998a).
- Soil Invertebrate BAFs: Development and Validation of Bioaccumulation Models for Earthworms (Sample et al., 1998).

The actual BAFs that are selected will be referenced in the ERA. A default value of 1.0 will be used for the BAF if chemical-specific data are not available. Since mussel tissue samples will be collected, they will be used as input concentrations for the food chain models for the raccoon and the herring gull. Therefore, sediment accumulation factors (BAFs) are not needed.

The food chain model scenarios will be calculated using various exposure assumptions and TRVs to present a range of risks. For selecting chemicals as COPCs, the following set of exposure assumptions will be used:

- Maximum soil, sediment, and mussel concentration
- 90th percentile BAFs (or maximum value if a 90th percentile value is not available)
- Conservative receptor body weight and ingestion rates
- Receptors spend 100% of their time at the Site

For refining the list of COPCs in Step 3a, the following set of exposure assumptions will be used:

- Average soil, sediment, and mussel concentrations
- Median BAFs
- Average receptor body weights and ingestion rates
- Site-specific area use factors will be applied, as appropriate

The risk characterization compares exposure to ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a stressor is evaluated. A screening-level risk

hazard quotient (HQ) will be determined using the exposure estimates and the screening ecotoxicity values developed as part of the previous steps. The HQ approach, which compares point estimates of screening ecotoxicity values and exposure values risk calculation, will be used to estimate risk. Therefore, for each contaminant and environmental medium, the HQ will be expressed as the ratio of a potential exposure level to the applicable screening level/dose. A HQ of less than one indicates that the contaminant alone is unlikely to cause adverse ecological effects. If multiple contaminants of potential ecological concern exist at the Site, the HQ will be summed for receptors that could be simultaneously exposed to the contaminants that produce effects by the same toxic mechanism. The sum of the HQ is called a hazard index (HI) and an HI of less than one indicates that the group of contaminants is unlikely to cause adverse ecological effects.

The final part of the screening evaluation includes the selection of ecological COPCs. Chemicals that are not retained as COPCs are assumed to only cause negligible risk to ecological receptors and will not be evaluated further in the ERA. Chemicals that are retained as COPCs will be further evaluated in Step 3a to determine if they are carried through as chemicals of concern (COCs). The ecological COPCs will be selected by the following procedures:

- Chemicals with HQs greater than 1.0 (using screening values) will be retained as COPCs for further evaluation because they have a potential to cause risk to ecological receptors.
- All chemicals that are considered important bioaccumulative compounds (USEPA, 2000) will be retained as COPCs and included in the food chain model.
- Chemicals with HQs greater than 1.0 based on the food chain model using NOAELs will be retained as COPCs because they have the potential to cause risks to higher trophic level mammals and birds.
- Chemicals without screening levels will be retained as COPCs but will be evaluated only qualitatively.
- Calcium, magnesium, potassium, and sodium will not be retained as COPCs in any medium because they are essential nutrients that can be tolerated by living systems even at high concentrations. There is no evidence to support that these chemicals are related to Site operations, and these four parameters are not considered hazardous chemicals.

The screening-level risk calculation is a conservative estimate to ensure that potential ecological threats are not overlooked. At the end of this step, one of the following possible decisions will be made: either there is adequate information to conclude that ecological risks are negligible, and therefore no quantifiable ecological risk exists; or, there may be quantifiable ecological risk, and additional evaluations are required.

STEP 3a: COPC Refinement

The Step 3a consists of refining the preliminary problem formulation and conceptual site model and refining the list of COPCs using more appropriate benchmarks and average exposure assumptions/concentrations to estimate potential risks to ecological receptors (i.e., fish, plants, invertebrates, and wildlife receptors). This Step 3a evaluation includes (but is not necessarily limited to) a consideration of the following topics:

- Spatial distribution and frequency of chemical detection: The spatial distribution of a chemical will be evaluated to determine the spatial area that the chemical concentration represents. In addition, a chemical that is detected at a low frequency typically will be of less concern than a chemical detected at higher frequency, if toxicity and concentrations of the chemicals are similar.

- Contaminant bioavailability: Many contaminants (especially metals) are present in the environment in forms that are typically not bioavailable, and the limited bioavailability will be considered when evaluating the exposures of receptors to Site contaminants.

- Habitat: Although exceedances of criteria may occur, potential risks to ecological receptors may be minimal if there is little habitat for those receptors. Therefore, the extent of habitat will be used qualitatively when evaluating the data.

- Food Chain Modeling: Exposure via the food chain is a major pathway of concern for chemicals known to significantly bioaccumulate and/or biomagnify. Thus, potential risk to upper level receptors will be evaluated using food chain models. The conservative exposure doses calculated for terrestrial wildlife will be recalculated using less conservative exposure assumptions and toxicity data based on Lowest Observed Adverse Effects Levels (LOAELS).

- Magnitude of criterion exceedance: Although risks may not relate directly to the magnitude of a criterion exceedance, the magnitude is one item that will be used in a lines-of-evidence approach to determine the need for further site evaluation.

- More Appropriate Benchmarks: The chemicals that are retained as COPCs will be reevaluated using more appropriate benchmarks to determine if the detected concentrations warrant retention as COCs.

- Background: Soil and sediment data will also be compared to documented regional background conditions for these media. This effort will be conducted to assist in the evaluation of site-specific risk, as opposed to risk provided by regional, ubiquitous contaminants.

After the Step 3a evaluation is completed, the risk managers will be presented with a list of COCs, the reasons why a particular COPC was not retained as a COC, and the potential risks and uncertainties associated with the COCs. This information will allow the risk managers to determine if the chemicals need to be further evaluated through the collection of additional data or if no further actions based on ecological risks are warranted. This further evaluation may involve development of evaluation procedures for assessment endpoints (i.e. toxicity tests, growth tests, colonization tests, diversity studies, etc.) specific to the contaminants present, the receptors to be evaluated, and the mechanisms by which the exposure would occur. It is appropriate to design and execute such risk assessment processes specific to the conditions of the problem formulation and conceptual site model, after they are completely developed. Therefore, this Work Plan does not cover the details of a quantified ERA. If the Tier 1 ERA identifies the necessity for a quantified ecological risk assessment, a supporting Work Plan will be developed to design additional sampling and toxicity evaluations to support that risk assessment.

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APPENDIX A

BACKGROUND SUMMARY REPORT
SITE 17, BUILDING 32, GOULD ISLAND
TtNUS, NOVEMBER 2002

Background Summary Report

for

Site 17
Building 32, Gould Island

Naval Station Newport
Newport, Rhode Island

Environmental Field Activity Northeast
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888
Contract Task Order 0842

July 2003

W5202276F

BACKGROUND SUMMARY REPORT

FOR

SITE 17
BUILDING 32, GOULD ISLAND

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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

Submitted by:
Tetra Tech NUS, Inc.
600 Clark Avenue, Suite 3
King of Prussia, Pennsylvania 19406-1433

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0842

July 2003

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1.0 INTRODUCTION

This document was prepared under the Comprehensive Long Term Environmental Action Navy (CLEAN) Contract No. N62467-94-D-0888, Contract Task Order (CTO) 842. The statement of work requires Tetra Tech NUS, Inc. (TtNUS) to perform a Background Report for Study Area 17, which consists of the Building 32 area on Gould Island, which is part of Jamestown, Rhode Island.

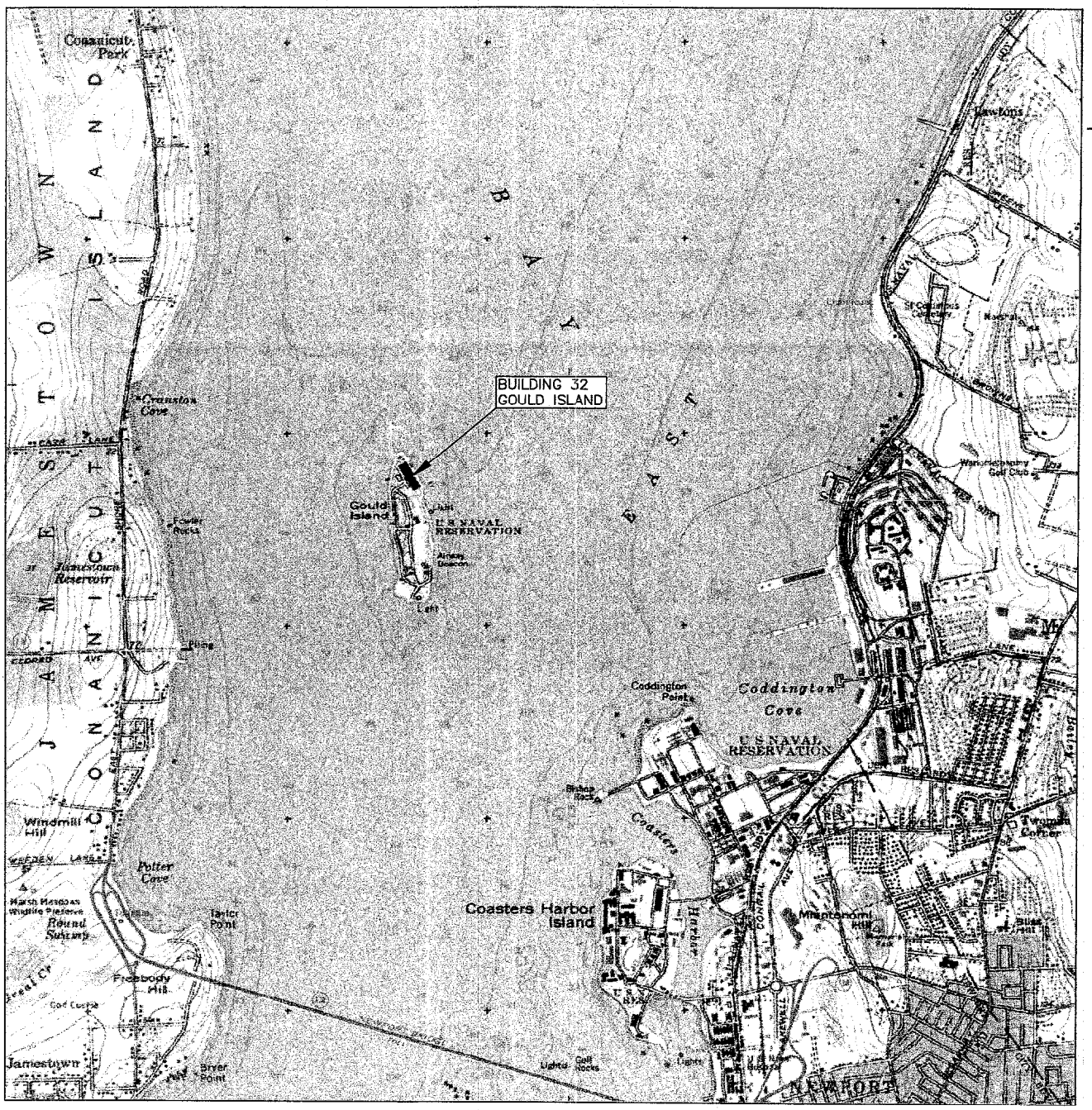
Gould Island is located in the East Passage of Narragansett Bay in Rhode Island, approximately 1.5 miles from the Naval Station Newport (NSN) shoreline. Gould Island is located between Aquidneck and Conanicut Islands, and occupies approximately 52 acres (Figure 1-1). Building 32, located on the northeast end of Gould Island, served as a torpedo overhaul shop that has been inactive since the 1950's (Figure 1-2). The electroplating shop, consisting of three rooms located within Building 32 was initially identified as a Study Area (SA 17) in the Federal Facilities Agreement (FFA). Evaluation of data collected in April 2000 resulted in agreement that the SA should be considered a "site" as defined in the FFA and that the site be inclusive of Building 32 and the area surrounding it.

This background memorandum has been prepared to summarize the many activities and data collected at Building 32 and surrounding areas that may be pertinent to the development of a remedial investigation work plan for the site. Several investigation work plans have previously been prepared for the site, however, extensive removal actions, investigations and building demolitions have occurred in recent years, and much of the background information in those work plans has become dated. This background report includes a summary of historical and recent activities conducted and the data collected so that the remedial investigation can be planned without duplication of previous sampling and data collection efforts.

The following major efforts have been summarized for this Background Report:

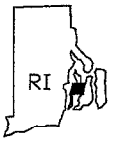
Tank Closures:

- An underground storage tank (UST) closure and follow-up monitoring was conducted at the former Building 44, located to the north of Building 32. This included two 5,000-gallon steel tanks and five 50,000-gallon concrete tanks. Records show that three concrete tanks stored No. 5 fuel oil, two stored No. 2 fuel oil, while one of the 5,000-gallon steel USTs stored No. 2 fuel oil and the other stored alcohol. The two 5,000-gallon USTs were emptied and removed from the site in 1989. The five 50,000-gallon USTs were also emptied and cleaned and then backfilled in place with clean fill (Tetra Tech NUS, Inc., 1999).



BASE MAP IS A PORTION OF THE FOLLOWING 7.5 X 15 MINUTE U.S.G.S. QUADRANGLE:
PRUDENCE ISLAND, RHODE ISLAND, 1955, PHOTOREVISED 1970 AND 1975

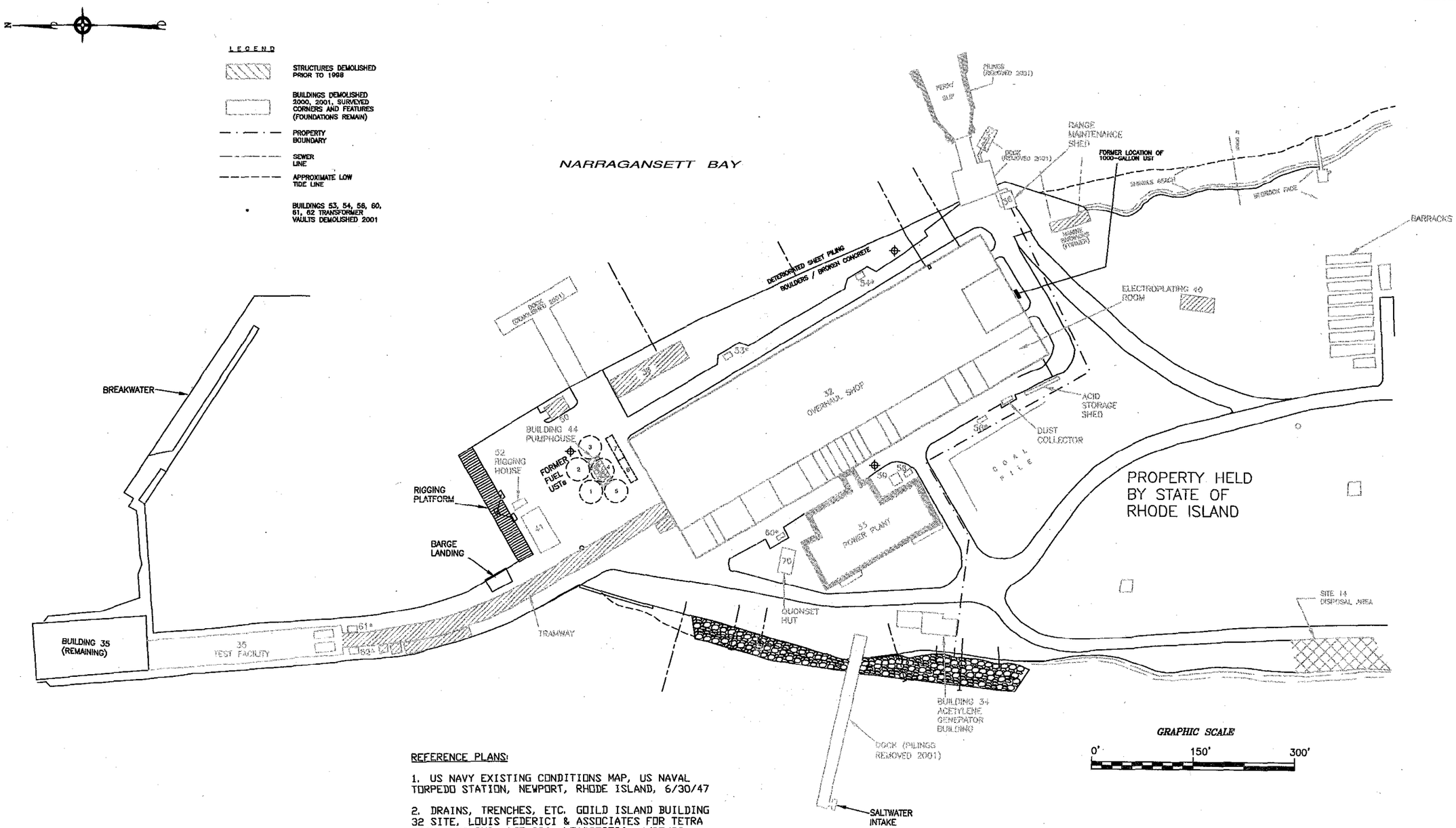
GRAPHIC SCALE
0 0.5 MILE 1 MILE



QUADRANGLE LOCATION

SITE LOCUS		FIGURE 1–1	
BUILDING 32, GOULD ISLAND		TETRA TECH NUS, INC.	
NAVSTA NEWPORT, RHODE ISLAND			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	S. PARKER	DATE:	OCTOBER 7, 2002
SCALE:	AS NOTED	ACAD NAME:	DWG\5152\0410\FIG_1–1.DWG

55 Jonspin Road Wilmington, MA 01887
(978)658–7899



NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOILD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 - GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/9/00

HISTORICAL FEATURES			FIGURE 1-2
SITE 17, GOULD ISLAND			TETRA TECH NUS, INC.
NAVSTA NEWPORT, RHODE ISLAND			55 Jonspin Road Wilmington, MA 01887 (978)658-7899
DRAWN BY: D.W. MACDOUGALL	REV.: 0		
CHECKED BY: L. SEYDEWITZ	DATE: APRIL 29, 2003		
SCALE: AS SHOWN	FILE NO.: DWG\5152\0450\FIG_1-2.DWG		

- A UST closure was conducted in July 1997 on a 1,000-gallon UST on the south side of Building 32. This UST reportedly contained No. 2 fuel oil.

Waste Characterization and Removal:

- A waste inventory was performed in 1992 to determine the contents of miscellaneous drums and other containers in the buildings in this area for disposal. Bulk hazardous materials were subsequently removed.

Environmental Investigations:

- Early sampling efforts identified the presence of metals and cyanide in the sediment and mussels around Gould Island (Loureiro Engineering Associates, 1986).

- As part of the Building 44 closures, groundwater monitoring wells were installed to monitor contamination and a soil gas survey was conducted. Volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were detected in the groundwater and similar contaminants were identified in the soil gas surveys, including the VOC trichloroethene (TCE) in both soil gas and groundwater.

- The first phase of a Study Area Screening Evaluation (SASE) was conducted at Building 32 in March and April 2000. The SASE found chlorinated solvents and polynuclear aromatic hydrocarbons (PAHs) in soil gas and found metals in sludge and soil samples collected.

Demolition and Removal:

- A number of buildings were removed due to their deterioration and the physical hazards they presented. This work commenced on May 1, 2000 and consisted of asbestos abatement, hazardous materials removals, and demolition of buildings to the slab elevation only.

- Polychlorinated biphenyl (PCB) sampling was conducted under Toxic Substances Control Act (TSCA) regulations. PCBs were found in concrete and soil in, under, and near transformer buildings, which were demolished in 2001 and 2002.

- Demolition of many of the underwater structures, including the former ferry slip, the fuel docks, and other unnecessary pilings is noted, but not detailed.

2.0 SITE HISTORY AND DESCRIPTION

This section presents a history of the site and general description, including topography, geology, and groundwater characteristics. This description was developed from previous investigations and published reports.

2.1 GENERAL DESCRIPTION

Gould Island is located in the East Passage of Narragansett Bay in Rhode Island, approximately 1.5 miles from the NSN shoreline. Gould Island is located between Aquidneck and Conanicut Islands, and occupies approximately 52 acres. Building 32, located on the northeast end of Gould Island, served as a torpedo overhaul shop that has been inactive since the 1950's. A Navy torpedo testing range is located on the northern tip of the island and is still active. The remainder of the island is inactive.

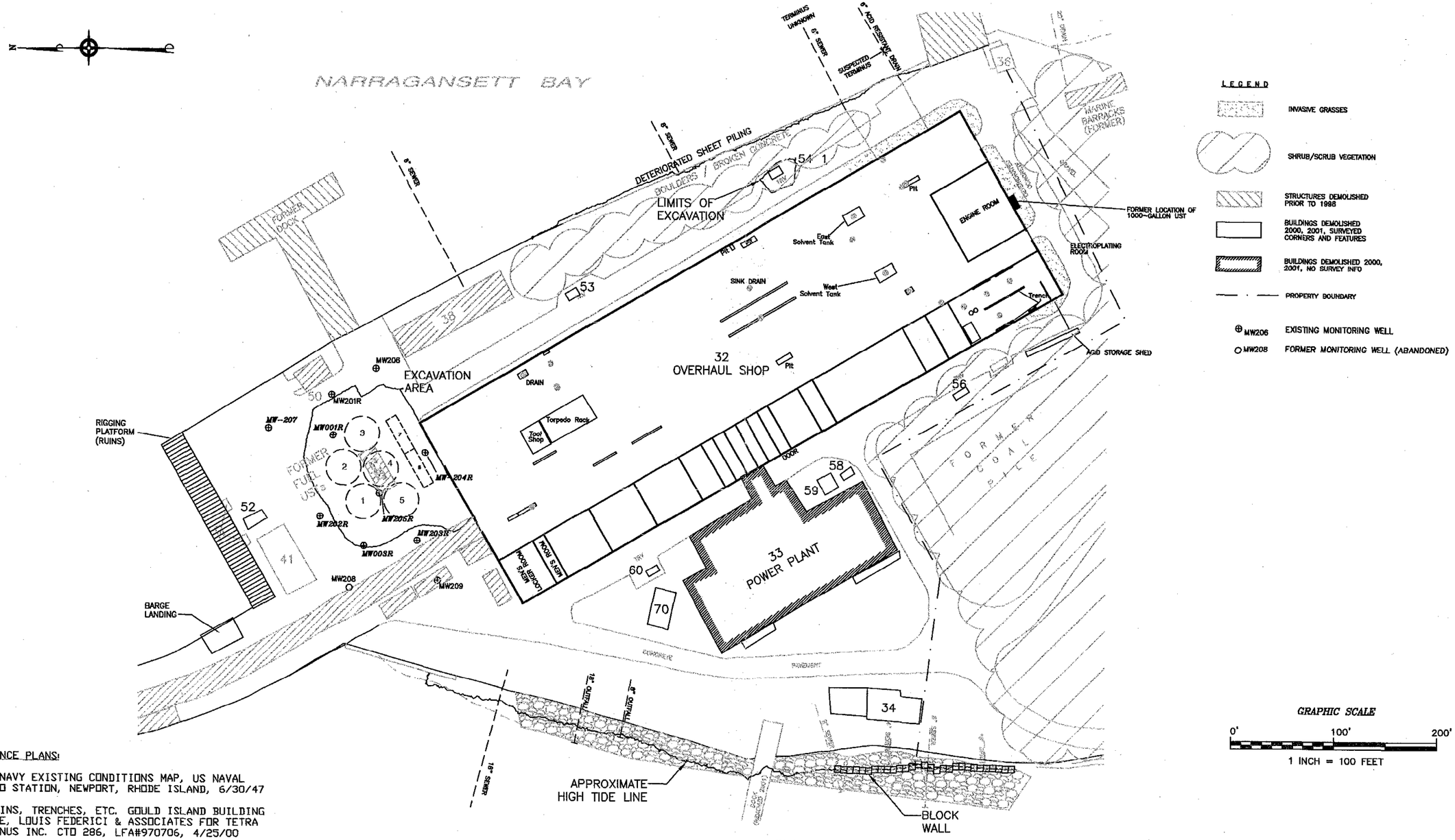
Gould Island was developed in the 1940s as a weapons support center for naval vessels. Photos taken during construction and provided in Appendix A show the island was redeveloped with housing, administration buildings and a seaplane hanger at the south end of the island; the power plant, the torpedo overhaul shop, a covered tramway, and a torpedo test firing pier were at the north end. In addition, fueling docks, two large coal piles, ammunition bunkers, and a number of other structures were present.

Gould Island is only accessible by boat and is off limits to the public, although trespassing by recreational boaters is possible.

Ownership of the southern three-fourths of the island has been transferred from the Navy to the State of Rhode Island. Naval Station Newport retains ownership of the northern end of the island, where Building 32 was located. A fence separates the two areas, as indicated on Figure 2-1.

The following is a list of structures and known activities that occurred on the Navy-held portion of the island.

- Building 32 - Torpedo Overhaul Shop
- Building 33 - Steam Plant
- Building 34 – Acetylene Generator Building
- Building 35 (South) – Support for Torpedo Firing Pier
- Building 36 – Range Maintenance Shop



REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47

2. DRAINS, TRENCHES, ETC. GOULD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00

3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03

4. LOCATION OF MONITORING WELLS AT BUILDING 32 - GOULD ISLAND, U.S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/9/00

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

PRIMARY SITE FEATURES			FIGURE 2-1
SITE 17, GOULD ISLAND			TETRA TECH NUS, INC.
NAVSTA NEWPORT, RHODE ISLAND			55 Jonspin Road Wilmington, MA 01887 (978)658-7899
DRAWN BY: D.W. MACDOUGALL	REV.: 0		
CHECKED BY: L. SEYDEWITZ	DATE: APRIL 25, 2003		
SCALE: 1" = 100'	FILE NO.: DWG\5152\0450\FIG_2-1.DWG		

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CTO 842

03b5A082

- Building 38 – Administration
- Building 41 – Riggers storage
- Building 44 – Fuel Pump House
- Building 50 – Use unknown
- Building 52 - Riggers House
- Buildings 53, 54, 56, 60, 61, 62 – Transformer Vaults
- Building 59 – Transformer Vault and Switch House
- Building 58 - Deep Well Pump House
- Building 70 – Quonset Hut
- Acid Storage Shed – Storage of material for electroplating
- Covered Tramway – Torpedo transfer from overhaul shop to firing pier
- "T" Dock - fueling, equipment transfer
- Ferry Dock – Personnel transportation
- Salt Water Intake Pier
- Rigging Platform – Heavy equipment transfer

In addition to the above, numerous temporary or portable shed structures are visible on the historic air photos. It is likely that these structures were used for storage of materials or equipment, both during construction and during operation of the facilities on the island.

2.2 SITE OWNERSHIP HISTORY

Gould Island was purchased from private landowners by the Navy in 1918 (Presidential Proclamation 1918). Prior to that date, the land was used agriculturally. Early construction of seaplane facilities at the south end of the island was conducted through the 1920's, and construction of a weapons support center for naval vessels at the north end of the island began in the early 1940s. Air photos from this construction show that most of the vegetation was removed from the island, and the soils were nearly completely reworked. The northern portion of the site included a torpedo overhaul and testing facility, a power plant, a fuel storage facility, and miscellaneous support structures, including a rigging platform, a stillwater basin for boat docks, an acetylene generator building, and what appear to be semi-portable storage sheds.

2.3 SITE USE HISTORY

The Building 32 facility was used for overhaul and storage of torpedoes during WW II. The building included the electroplating shop, a grinding and buffing shop, degreasing units, and equipment formerly used to overhaul torpedoes. Reportedly, extensive electroplating and degreasing operations were performed in the building between 1942 and 1945.

It is not known where or how waste materials generated from the plating and degreasing activities were disposed. It is assumed that most of the wastes (including electroplating shop wastes) from the floor trenches and floor drains were likely to have been discharged through offshore outfall pipes. The electroplating shop wastes were probably discharged through the outfall on the east side of Gould Island (Figure 2-2). The Confirmation Study Report (Louriero, 1986) suggested that the plating sludges were probably discharged in a disposal area (landfill) located on the west side of Gould Island, outside the boundary of the area of interest (Figure 1-2). Additional detail on waste generation and disposal is provided in other sections of this Background Summary Report.

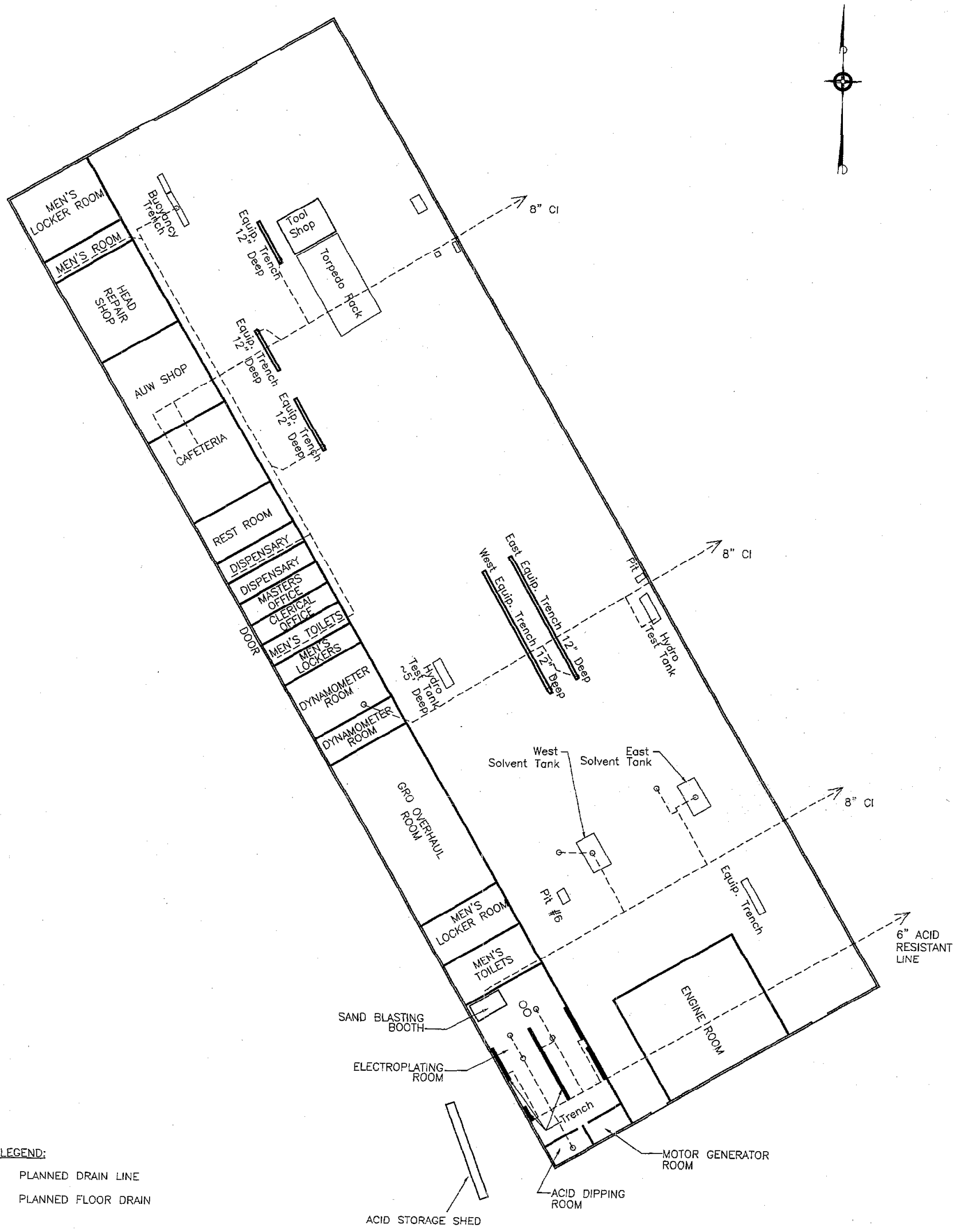
In the 1950s, use of the facility was discontinued. In 1998, the buildings were deemed unsafe and were demolished in 2000. The only structure still remaining is Building 35, located on the firing pier, to the north of former Building 32.

2.4 BUILDING 32 DESCRIPTION

The interior layout of Building 32 is presented in Figure 2-2. The building includes the plating rooms, a grinding and buffing shop, degreasing units, and equipment formerly used to overhaul torpedoes. Construction plans for Building 32 obtained from the NETC Public Works Department (known at the time as US Naval Operating Base, Public Works) were used to identify the interior construction, drainage, and plumbing details.

As shown on Figure 2-2, the building was designed with floor trenches and floor drains in many locations throughout the overhaul shop. There were several trenches and pits installed in the building. Some were used as sumps for mechanical equipment, and others were used to test buoyancy and other aspects of torpedo behavior in the water. In the electroplating rooms, trenches were clearly installed for capturing and disposing the waste from the electroplating tanks and systems. The design drawings indicate that trenches and drains associated with the electroplating shop are connected to a single 6-inch diameter acid-resistant pipeline that discharges to the east side of Gould Island near the former ferry slip.

The plumbing drawings for Building 32 show that floor drains as well as waste drains from the bathrooms and locker rooms were all directed into a series of 8- and 10- inch ID cast iron drain lines that ran north and east, outside the building and into the ocean. No leaching fields are shown on any of the design drawings for Building 32. The drawings also show roof drains connected to these drain lines. Other drawings show roadway drains on a different system, but also discharging storm water runoff through a series of cast iron pipes to the ocean north and east of Building 32.



LEGEND:

- - - - - - PLANNED DRAIN LINE

o PLANNED FLOOR DRAIN

NOTES:

1. NOT FOR DESIGN
2. ALL LOCATIONS ARE APPROXIMATE
3. VERTICAL DATUM IS BASED ON THE NAVY BM H-2, LOCATED AT THE NORTHEAST NUT ON VALVE HYDRANT OPPOSITE SOUTHWEST CORNER OF BUILDING #32, ESTABLISHED BY P.W. SURVEY PARTY, DATED 1/3/45, BOOK NUMBER 20-B PAGE 10, MLW ELEVATION (LOCAL) 14.12.
4. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1983.
5. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.

GRAPHIC SCALE

0' 60' 120'

1 INCH = 60 FEET

BUILDING 32 LAYOUT AND DRAINAGE PLAN		FIGURE 2-2
SITE 17, GOULD ISLAND		
NEWPORT, RHODE ISLAND		TETRA TECH NUS, INC.
DRAWN BY: D.W. MACDOUGALL	REV.: 0	
CHECKED BY: S. PARKER	DATE: OCTOBER 30, 2002	55 Jonspin Road Wilmington, MA 01887 (978)658-7899
SCALE: 1" = 60'	FILE NO.: DWG\5152\0410\FIG_2-2.DWG	

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TtNUS (formerly Brown & Root Environmental (B&RE)) conducted several site walkovers in preparation of first phase investigations, the earliest being in March 1997 (including B&RE, Navy, U.S. Environmental Protection Agency (EPA), Rhode Island Department of Environmental Management (RIDEM), etc.). During this walk, TtNUS confirmed earlier observations of the study area made by TRC (TRC, 1992), which included the following:

- Numerous metal vats were present in the plating room.

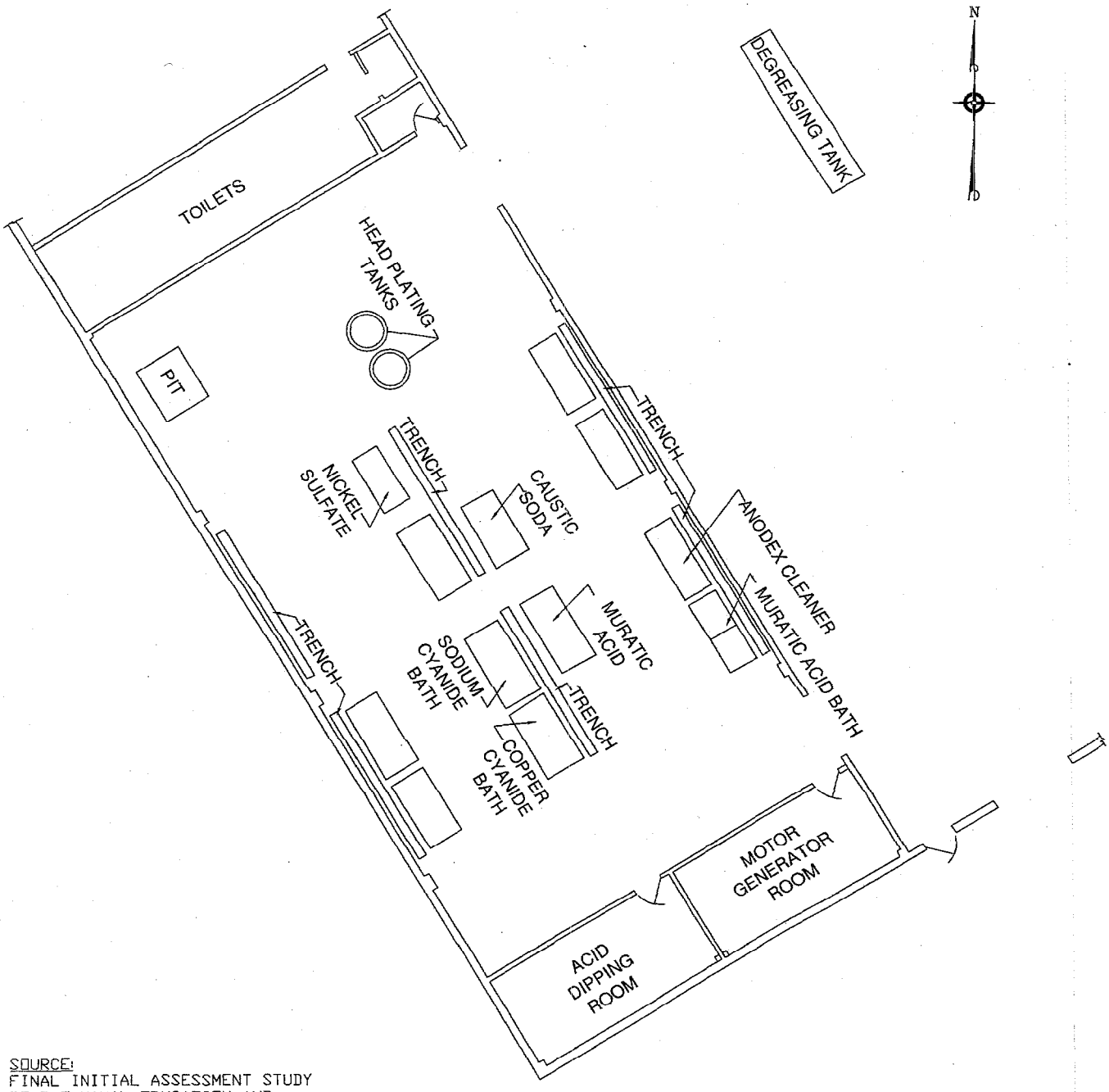
- A series of three trench drains were present running along the floor of the plating room. These drains were located along the long axis of the plating room, one on each side of the room with the third in the middle. These trench drains were partially covered with metal grates (Figure 2-2). Floor trenches were also present in the main area of Building 32.

- Several floor drains were present in the concrete floor of the plating shop and the main areas of Building 32 (Figure 2-2).

- Overhead signs were observed above several tanks. In the plating shop, individual signs read: "Chromic Acid", "Muriatic Acid", "Sulfuric and Nitric Acid", and "Caustic Soda".

Figure 2-3 depicts the layout of the electroplating room. The layout originated from the 1983 Initial Assessment Study (Envirodyne Engineers, Inc. 1983). Additional tanks are identified including: muractic and chronic acid, caustic soda, nickel sulfate, sodium cyanide, and copper cyanide. This layout was likely based on, and reflects, the signage over the tanks in 1996.

In 1997, TtNUS began development of a Study Area Screening Evaluation (SASE) work plan for electroplating rooms, which included evaluation of air photos, construction drawings, and other records for the electroplating shop. As a part of this effort, TtNUS conducted another inspection of Building 32 in March 1998 to confirm existing conditions relative to the construction drawings. At that time it was observed that the trenches and testing tanks shown on the construction drawings were present as specified. However, floor drains and drainway clean outs were not installed where they are shown on the drawings. A close inspection of the building floor found floor drains in the electroplating room, the engine room, and the lavatories. While not observed directly, it was assumed at the time that drains were present in the trenches and testing tanks throughout the building, as there was little or no standing water in these trenches and tanks.



SOURCE:
FINAL INITIAL ASSESSMENT STUDY
OF THE NAVAL EDUCATION AND
TRAINING CENTER, NEWPORT, RI,
ENVIRODYNE ENGINEERS, INC. (EEI),
MARCH 1983

ELECTROPLATING ROOM LAYOUT			FIGURE 2-3
SITE 17, GOULD ISLAND			TETRA TECH NUS, INC.
NEWPORT, RHODE ISLAND			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	APRIL 29, 2003
SCALE:	NOT TO SCALE	ACAD NAME:	DWG\5152\0450\FIG_2-3.DWG

55 Jonspin Road Wilmington, MA 01887
(978)658-7899

The main portion (overhaul and storage area) of the building (excluding the plating shop) was mostly open space. Most of the cement floor in the shop area was covered with a non-conductive wood block floor finish that had signs of significant water damage (buckling and staining). Several floor trenches and floor drains were located in the storage area. Debris from the deteriorated ceiling/roof was scattered on the floor area.

Two solvent tanks and washing systems were present in the main shop area, situated partially within two large sumps in the floor. A series of torpedo racks were present in the north central portion of the overhaul shop, and a large quantity of piping covered with asbestos-containing pipe insulation was stacked on the floor in the north section of the building wrapped in polyethylene sheeting.

The plating shop rooms were occupied by: numerous square, metal, open - top vats ("baths"); two concrete, open-top, round, vertical plating tanks ("pits"); several wooden benches; a small sandblasting room; a motor generator room; a small "acid dipping room" with additional baths; a small office; and floor trenches and drains (TRC, 1992). The metal baths were approximately 3 feet wide by 5 to 15 feet long. The two vertical pits were approximately 4 feet in diameter by 8 feet deep and appeared to be constructed of steel, surrounded by a thick layer of rubber. All plating room equipment was visibly empty and clean.

2.5 ENVIRONMENTAL SETTING

This section presents a general description of site features including topography, and geological, groundwater, and surface water characteristics.

2.5.1 Soil and Bedrock Characteristics

Gould Island is located at the southeastern end of the Narragansett Basin. This basin is a complex north-south-trending synclinal mass of Pennsylvanian age sedimentary rocks and is the most prominent geologic feature in eastern Rhode Island and adjacent Massachusetts. The basin is approximately 55 miles long and varies from 15 to 25 miles wide.

The rocks of the Narragansett Basin are non-marine sedimentary rocks, predominately conglomerates, sandstones, shales, and anthracite coal. Total thickness of the strata in the Narragansett Basin has been estimated at 12,000 feet. Many folds and some faults occur throughout the basin, but the character and amount of the folding and faulting are not clearly known. Bedrock of the Narragansett Basin has been divided into five units that include the Rhode Island Formation, which underlies NETC Newport.

The Rhode Island Formation is the most extensive and thickest of the Pennsylvanian formations in Rhode Island. The Rhode Island Formation in the northern portion of the basin is not metamorphosed. However, in the southern portion of the basin, as in the vicinity of NETC, the unit is metamorphosed. Bedrock types include schist of various grades, phyllites, conglomerates, and feldspathic quartzite. Thin beds of metaanthracite and anthracite were mined from many areas within the basin.

No bedrock exposures have been observed at the northern end of Gould Island. However, bedrock is exposed south of Building 32 on the east side of the island, along the shoreline. Bedrock in the vicinity of the site is mainly metamorphic rock, predominately phyllites and schists, which are exposed at outcrops at the main-base area of NETC approximately 2 miles to the east of Gould Island.

Overlying the Pennsylvanian rocks of the Narragansett Basin are surficial deposits of Pleistocene sediments. These sediments owe their origin to the Wisconsin glaciation that covered the area with ice several thousand feet thick. As the glaciers began to recede 10,000 to 12,000 years ago, unconsolidated glacial materials of variable thickness were deposited throughout the Narragansett Basin area. The unconsolidated glacial material ranges from approximately 1 to 150 feet thick; it is thicker in the valleys and thinner in the uplands. Glacial material consists of a loose till and outwash deposits characterized by sands, silty sands, and gravels. These deposits were derived from shale, sandstone, conglomerate, and, in a few places, coal. Metamorphic rock, predominantly phyllite, is also included in glacial materials that lie above the Rhode Island Formation, as observed at the Naval Station.

Soils found at the site and throughout Gould Island are classified as Newport Series by the Soil Survey of Rhode Island. These soils are formed in compact glacial till derived from dark sandstone, conglomerate, argillite, and phyllites. Permeability is generally moderate at the surface and low in the substratum (B&RE, November 1997).

2.5.2 Topographic and Groundwater Characteristics

Historic information (U.S. Navy, 1959) indicates that four water supply wells were drilled on Gould Island in the early 1940s. These wells were installed at different locations in an effort to find a usable fresh water supply. Two of the wells were reportedly advanced to a depth of 330 feet, while the remaining two wells were advanced to a depth of approximately 530 feet. No additional information (construction or boring logs) is available.

The reported flow capacities of the two 330-foot wells and two 530-foot wells were 7 to 35 gallons per minute (gpm) and 6 to 10 gpm, respectively. The wells yield was deemed inadequate to support island needs and therefore a fresh water supply line was extended from Aquidneck Island (U.S. Navy, 1943 and

U.S. Navy, 1959). Plumbing shop drawings also show that salt water was piped through Building 32 for use in fire control systems and as flush water in the sanitary system.

Based upon a review of Gould Island topography and the island setting, shallow groundwater is anticipated to flow radially outward from the center of the island toward Narragansett Bay. Three monitoring wells installed for the UST Closure Assessment Report for the small tank on the south end of Building 32 were used to develop a limited groundwater contour map for that location. These data indicated local groundwater flows north-northeast toward Narragansett Bay with a gradient of 0.021 foot/foot. Groundwater depths at these wells ranged between 0.77 and 2.43 feet below ground surface in August 1997. Data from the Building 44 UST closures were also used to develop a groundwater contour map for the area, at the north end of Building 32. These data indicate that groundwater at this location flows radially north, east and west toward the shoreline. Groundwater elevations range from 0.51 to 1.11 feet above mean sea level (MSL). According to the Initial Assessment Study (IAS) report (Envirodyne, 1983), groundwater on Gould Island "is generally within a depth of 10 feet".

The Prudence Island Broadway well is the closest public groundwater supply well to Gould Island. This well is located approximately 4.5 miles north of the study area across Narragansett Bay. No public supply wells are present on Gould Island.

The groundwater at the site has been classified by RIDEM as a class GA, suitable for public or private drinking water use without treatment. Several specific areas of the island have been classified as GA Non-Attainment (GA-NA). Non-attainment areas are those areas that have pollutant concentrations greater than the groundwater quality standards for the applicable classification. The goal for non-attainment areas is restoration to the groundwater quality consistent with the standards of the applicable class, in this case, GA. The non-attainment areas are apparently the sites and study areas delineated in the IAS study, described elsewhere in this report. One such non-attainment area is shown by Rhode Island Geographic Information System (RIGIS) on the southwest corner of the former Building 32 footprint, which is the former location of the electroplating shop.

2.5.3 Surface Water Characteristics

Gould Island is surrounded by Narragansett Bay. RIDEM has assigned this portion of Narragansett Bay a surface water classification of SA. Class SA waters are protected for the following uses: bathing and contact recreation, shellfish harvesting for direct human consumption, fish and wildlife habitat, boating and other secondary contact recreational activities, industrial cooling, and good aesthetic value.

3.0 OIL AND HAZARDOUS MATERIALS

This section presents information relating to the use, storage, and disposal of oil and hazardous materials at the site.

3.1 STORAGE TANKS

The following sections provide a brief description of storage tanks located at and near the Building 32 site. Findings from related investigations are presented in Section 4 of this report.

3.1.1 Building 44, Fuel Pumphouse Area

Building 44 was located immediately to the north of Building 32. Building 44 served as the pump house for the seven USTs during their use. The USTs consisted of two 5,000-gallon steel tanks and five 50,000-gallon concrete tanks. These USTs were installed in the 1940s to supply fuel to the power generation plant on Gould Island (Building 33). The 50,000-gallon USTs were constructed of reinforced concrete and were cast in place. The UST area is located north of Building 32. The locations of the former USTs and of Buildings 44 and 32 are shown on Figure 2-1.

The UST Closure Assessment report prepared by Environmental Resource Associates, Inc. (September, 1994) indicates that three of the concrete tanks stored No. 5 fuel oil and two stored No. 2 fuel oil. One of the steel USTs stored No. 2 fuel oil and the other stored alcohol. In 1989, a contract was issued by NETC to close the USTs and demolish Building 44. As a result, the two 5,000-gallon USTs were emptied and removed from the site. The five 50,000-gallon USTs were emptied and cleaned, the tank covers were destroyed, and the tanks were backfilled.

After several investigations (described in Section 4.3 of this report), the Building 44 area underwent a soil removal action in 2000. Soils exceeding the RIDEM action level for total petroleum hydrocarbons (TPH) were removed from the ground and removed from the island via dump truck and barge.

3.1.2 Building 32 UST

A 1,000-gallon steel UST containing No. 2 fuel oil was removed from the south of Building 32 in July 1997 by Brown and Root Environmental. The tank contents were removed by a portable vacuum unit, and the concrete pavement above the tank was demolished. During removal, the tank and the bedding material were inspected for evidence of release. Two corrosion holes were noted on the bottom of the tank near the western end. Water collected in the bedding material after UST removal, and a petroleum odor and a

slight sheen were present on the observed groundwater (B&R Environmental, November 1997). A full description of data collected during closure operations is presented in Section 4.4 of this report.

3.2 HAZARDOUS SUBSTANCES

As previously stated, the Building 32 facility was used for overhaul and storage of torpedoes during WW II. Reportedly, extensive electroplating and degreasing operations were performed in the building between 1942 and 1945.

It is not directly known where or how waste materials generated from the plating and degreasing activities were disposed. It is assumed that any wastes (including electroplating shop wastes) released to the floor trenches and floor drains in the building were likely to have been discharged through offshore outfall pipes, as the construction drawings suggest direct discharge to the ocean (Section 2 of this report). Much of the liquid waste from the electroplating shop was probably discharged through an acid resistant drain to an outfall on the east side of Gould Island. The Confirmation Study Report (Louriero, 1986) suggested that the plating sludges were probably discharged in a disposal area, Site 14, located on the west side of Gould Island (Figure 1-2).

Waste Inventory and Sampling Reports (Halliburton NUS and ENSR, February, 1992, and July, 1992) were prepared to inventory and characterize waste materials present in Buildings 32, 33, 34, 35, and 58. The sections that follow describe the findings of these reports.

3.2.1 Waste Inventory and Sampling Report, Building 32- January 1992

Building 32 was inspected for hazardous waste materials in October 1991. Eight samples were collected from within the electroplating shop, and one sample was collected from a manhole located just outside of the doorway leading to the electroplating room from the interior of Building 32 (Figure 2-2). Five of these were liquid samples and were analyzed for corrosivity (pH), reactivity (cyanide and sulfide), flashpoint, PCBs, and all TCLP parameters. Two samples were specifically referred to as "plating solutions" and collected from vats located in the "acid dipping room" portion of the electroplating shop. The TCLP sample results showed concentrations of lead (7.8 mg/l) and cadmium (7,000 mg/l) in samples of plating solutions, which are greater than the hazardous waste characterization regulatory limits (40 CFR Part 261 Subpart C) for lead (5.0 ppm) and cadmium (1.0 ppm).

In addition, composite liquid samples were also collected and analyzed for a broad range of parameters to further characterize the materials for disposal purposes. Composite sample 1 consisted of seven samples. Composite 2 consisted of two samples. A third composite was collected of 9 aqueous sample

aliquots from floor trenches in other portions of Building 32, including liquid from floor trenches near the solvent tanks, a vat in the grinding area, and the manhole outside the electroplating room. Results from the composite sample analyses are summarized in Table 3-1.

Analyses of the composite samples included BTU value, flashpoint, corrosivity (pH), reactivity (sulfide and cyanide), priority pollutant volatiles, priority pollutant semivolatiles, priority pollutant pesticides/PCBs, and metals (antimony, arsenic, cadmium, chromium, lead, manganese, potassium, sodium, and selenium).

The analytical results indicate concentrations of heavy metals in composite samples 2 and 3. Elevated levels of total cadmium (8,080 mg/l) and lead (11 mg/l) were detected in Composite 2. In addition, low levels of a volatile organic compound (bromomethane at 19 µg/l) and semivolatile organic tentatively identified compounds (TICs) at 1,476 µg/l were detected in Composite 2.

The analytical results of Composite 3 identified concentrations of total metals, two volatile organic compounds (chlorobenzene at 14J µg/l and trichloroethane at 16 µg/l), and semivolatile organic compounds (pyridine at 720 µg/l and TICs at 2,368 µg/l). Results from analysis of Composite 3 also indicated the presence of cadmium (2.1 mg/l).

3.2.2 Waste Inventory and Sampling, Building 33

ENSR reported that Building 33 was used to supply compressed air, electricity, and steam for process and heating purposes on Gould Island. The following equipment was believed to be present in Building 33:

- Four diesel engine-driven generators
- Five diesel engine-driven air compressors
- Four synchronous motor-driven air compressors
- One electric motor-driven fire pump
- One gasoline-driven fire pump
- Four low pressure, hand-fired heating boilers
- One high pressure, hand-fired heating boiler

Other file information indicated that one diesel generator and one generator in the boiler house were added in 1942. Additional auxiliary equipment was also present, such as switchboards, accumulators for compressed air, motor generators, network transformers and pumps.

The waste materials found within Building 33 were initially identified as to their likely origin, which included oil, lubrication oil, compressor oil, hydraulic oil, transformer oil, grease, tar, and glycerine, as well as sodium sulfite and sodium phosphate. In addition, two compressed gas cylinders were present, one containing oxygen, and another containing acetylene. From these materials, a series of composite samples were collected in conjunction with the materials found in Building 58. The sample results predictably indicated high concentrations of oils, hydrocarbons and varying contents of metals, including cadmium and lead. Pesticides were not detected in these samples, although low concentrations of PCBs were detected in two samples: Aroclor 1254, 5.9 mg/kg and Aroclor 1260, 13 mg/kg. These results were used for categorization of the waste under RCRA rules and for transport and disposal.

3.2.3 Waste Inventory and Sampling, Building 34: Acetylene Generator Building

Building 34 was reportedly constructed in 1942 with a footprint of approximately 1200 square feet. ENSR staff inspected the building two times in 1992 and found no potential hazardous waste materials that necessitated sampling or removal.

3.2.4 Waste Inventory and Sampling, Building 35: Firing Pier Support Structure

Little information is available as to the use of Building 35, although it included the covered tramway used for transport of the torpedos from the overhaul shop to the firing pier. It is presumed that the pier was also used to load and unload torpedos from smaller warships at dock.

Three composite samples were taken from materials within this building, as well as three discreet waste samples of unknown waste materials. Eleven drums were evaluated and sampled, as well as numerous small containers and storage bins.

One composite sample was found to contain acetone and low concentrations of metals including potassium, sodium, lead and mercury. The second composite sample was found to contain high concentrations of PAHs (napthalene, fluorine, and phenanthrene) as well as barium, chromium and lead at low concentrations. The third composite sample and one waste sample were both found to contain toluene, ethylbenzene and xylenes, as well as napthalene in the 1 % range. Traces of metals were also found in these samples, including cadmium, lead and mercury.

3.2.5 Waste Inventory and Sampling, Building 58: Deep Well House

Building 58 is identified on site maps as the deep well house. This structure is approximately 80 square feet, and had a basement and main floor at ground level. The basement contained the well head and

pumping system for the well. A number of small containers of materials were present in the building and were investigated for the presence of hazardous waste.

These containers were initially evaluated as to their likely contents, which included grease, caulking compound, varnish, corrosion preventer, lubrication oil, motor oil and paints. From these materials, a series of composite samples were collected in conjunction with the materials found in Building 33. The sample results predictably indicated high concentrations of oils, hydrocarbons and varying contents of metals, including cadmium and lead. Pesticides were not detected in these samples, although low concentrations of PCBs were detected in two samples: Aroclor 1254, 5.9 mg/kg and Aroclor 1260, 13 mg/kg. These results were used for categorization of the waste under RCRA rules and for transport and disposal.

3.2.6 PCB Transformers

Buildings 53, 53, 56, 59, 60, 61, and 62 were all identified on historic drawings as transformer vaults. These small concrete buildings were later confirmed to house electrical transformers that contained PCB oil. The PCB transformers were removed prior to building demolition in 2000. Concrete chip sampling for PCB contamination was subsequently conducted on the floors and walls of the transformer vault buildings under TSCA regulations. This effort led to additional soil testing, concrete and soil removal actions, and other investigations, as detailed in Section 5 of this report.

TABLE 3-1
ANALYTICAL RESULTS FOR COMPOSITE LIQUID SAMPLES
FROM THE "WASTE INVENTORY SAMPLING REPORT" (ENSR, 1992)
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

SAMPLE NUMBER	COMPOSITE 1	COMPOSITE 2	COMPOSITE 3
DESCRIPTION OF COMPOSITES	T-16, T-17, T-24, T-25, T-28, T-29, T-30	T-26, T-27	T-6:(L1, L2), T-7, T-8, T-9, T-10, T-12, T-22, T-23, MH-1
ANALYSIS			
BTU (BTU/LB)	157	0	16
Flashpoint (C)	>60	>60	>60
Corrosivity (SI units)	6.5	6.5	7.5
Reactive Sulfide (mg/l)	<1.0	<1.0	<1.0
Reactive Cyanide (mg/l)	<0.25	<0.25	<0.25
Volatiles (µg/l)			
Bromomethane	ND	19	ND
Chlorobenzene	ND	ND	14 J
Trichloroethane	ND	ND	16
Semivolatiles (µg/l)	ND	ND	ND
Tentatively ID'd Compounds (TICs)	25	1476	2368
1Methyl, 2-Benzene	ND	104	ND
Pyridine	ND	ND	720
Pesticides/PCB (µg/l)	ND	ND	ND
Metals (total) (mg/l)			
Antimony	0.030	0.30	
Arsenic	0.004		0.007
Cadmium	0.580	8,080	2.10
Chromium	0.073	1.10	0.15
Lead	1.500	11.0	1.7
Lithium		0.33	0.62
Manganese	1.870	20.7	2.4
Potassium	66.5	445	397
Silver		0.41	0.10
Sodium	167	6,560	2,260
Strontium	0.140	13.5	0.90

NOTE: - Available sample locations are presented in Appendix D.

Reference: ENSR Consulting and Engineering, February 14, 1992, Waste Inventory and Sampling Report for Buildings 32 and 35 (Inactive), Naval Underwater Systems Center (NUSC), Gould Island Annex, Newport, Rhode Island, prepared for the Northern Division, Naval Facilities Engineering Command under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program.

4.0 PREVIOUS ENVIRONMENTAL INVESTIGATIONS AND FINDINGS

This section presents a discussion of site use history and the findings of previous environmental investigations performed at the site.

4.1 INITIAL ASSESSMENT STUDY (ENVIRODYNE ENGINEERS, 1983)

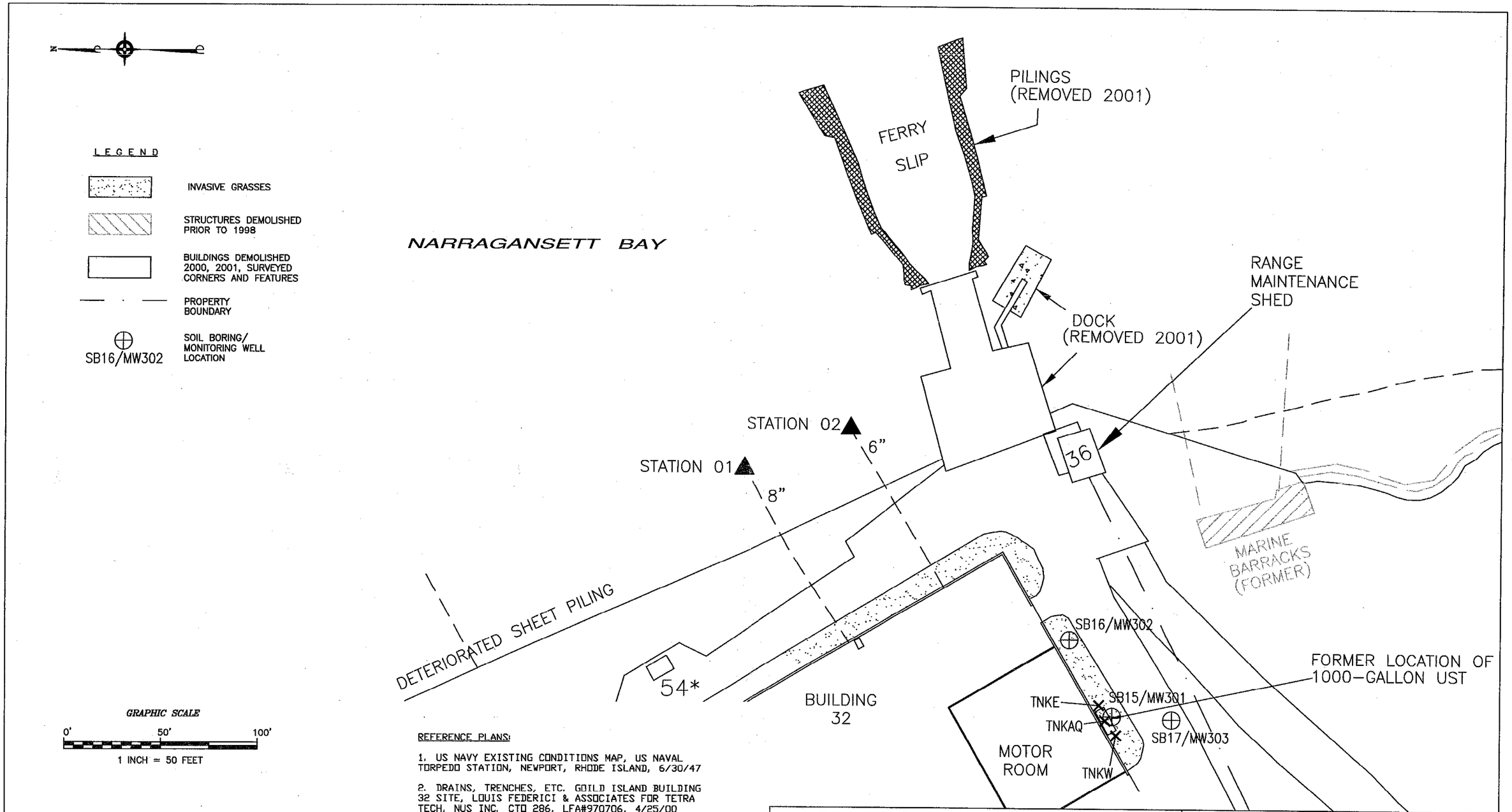
The Initial Assessment Study (IAS) was performed in 1983 by Envirodyne Engineers. The IAS was an evaluation of the entire NETC property to identify possible environmental disposal sites. During this study Envirodyne identified the Gould Island Electroplating Shop as a location where potential contamination from past waste disposal or handling practices may pose human health or environmental risks. During the Envirodyne study, bulk chemicals, including electroplating solutions were still present in some of the tanks and baths located in the unused electroplating rooms of Building 32 (Section 3.2 of this report). Because of the history of use of the chemicals in the electroplating rooms and because the fate of the wastes that were generated was unknown, the IAS recommended the site be investigated further. Therefore, Verification and Confirmation Studies were performed in 1984 and 1986, respectively.

4.2 VERIFICATION STUDY AND CONFIRMATION STUDY (LOURIERO ENGINEERING, 1984 AND 1986)

After the submittal of the IAS, a "verification step" was performed, to verify the presence of contaminants at the "Sites" identified in the IAS. Subsequently a "confirmation study" was also performed two years after the "Verification Step", both the verification and confirmation studies involved limited sampling programs. The Confirmation Study (CS) indicated that two offshore discharge pipes were present directly east of Building 32 in Narragansett Bay. The general locations of the discharge pipes are shown on Figure 4-1. The end of one of the discharge pipes was located during the CS. The end of the other pipe was not located, reportedly due to the presence of silt and vegetation over the pipe.

Sediment samples were collected from Stations 01 and 02, which were reportedly approximately 25 feet off shore in 1 to 3 feet of water. The sediment deposits, collected from a depth of 0 to 4 inches, were reportedly stony silt and sand. The mussel samples were collected from the intertidal zone shoreward of sediment sampling Stations 01 and 02 (Figure 4-1).

Sediment and mussel samples were analyzed for metals (lead, copper, chromium, nickel, cadmium, mercury, silver) and cyanide (sediments only) as reported in the CS report. Sediment and mussel samples were also collected from two control stations (NI and N2) and were analyzed for metals and cyanide (sediment only). Control Station N-1 was located on Aquidneck Island (end of Corey Lane in Portsmouth) and control station N-2 was located off Conanicut Island (off Route 138 north of the Newport Bridge). It was



GRAPHIC SCALE

0' 50' 100'

1 INCH = 50 FEET

NOTES:

1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

REFERENCE PLANS:

1. US NAVY EXISTING CONDITIONS MAP, US NAVAL TORPEDO STATION, NEWPORT, RHODE ISLAND, 6/30/47
2. DRAINS, TRENCHES, ETC. GOILD ISLAND BUILDING 32 SITE, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC. CTO 286, LFA#970706, 4/25/00
3. GEOTECHNICAL SURVEY PLAN AT FORMER BUILDING 44 AND 32, US NAVAL BASE ON GOULD ISLAND, LOUIS FEDERICI & ASSOCIATES FOR BROWN & ROOT ENVIRONMENTAL, 9/8/97, DWG#970706-03
4. LOCATION OF MONITORING WELLS AT BUILDING 32 - GOULD ISLAND, U. S. NAVAL BASE NEWPORT, RHODE ISLAND, LOUIS FEDERICI & ASSOCIATES FOR TETRA TECH, NUS INC., 5/9/00

PREVIOUS SAMPLING LOCATIONS		FIGURE 4-1
SITE 17, GOULD ISLAND		
NAVSTA NEWPORT, RHODE ISLAND		TETRA TECH NUS, INC.
DRAWN BY: D.W. MACDOUGALL	REV.: 0	
CHECKED BY: S. PARKER	DATE: APRIL 25, 2003	
SCALE: 1" = 50'	FILE NO.: DWG\5152\0450\FIG_4-1.DWG	

55 Jonspin Road Wilmington, MA 01887
(978)658-7899

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observed at the time that control Station N-1 was located adjacent to a sewage outfall. The control station sediments were reported as being stony at both locations, particularly at Station N-1. Data from this effort is presented on Table 4-1.

The "Verification Step" sediment sample data does show that cyanide was detected at concentrations higher (approximately four times greater) than those detected in the control samples, and copper was detected at an elevated level (above the control sample) in the Station 01 sediment sample. In addition, copper was also detected at a higher concentration in the Station 02 mussel sample (26.3 ppm) than that detected in the Station 01 mussel sample (6 ppm) and the control mussel samples (4.3 and 7.2 ppm).

Under the "Characterization Step" of the CS, the mussels at Station 02 were re-sampled as a check on the metals concentrations detected previously in the "Verification Step". This single mussel sample was analyzed for lead, copper, chromium, and nickel. The sample results indicate that the detected metals concentrations in mussel at Station 02 are similar to those detected in the "Verification Step" control samples.

The CS recommended that "no further studies or remedial actions are needed at this site because the levels of contaminants found are not significantly high" (Louriero Engineering, 1986).

4.3 STUDIES FOR BUILDING 44 - PUMPHOUSE

Several studies have also been conducted to assess the former Pump House (Building 44) which was located approximately 50 feet north of Building 32. These studies included a UST Closure Assessment Report (Environmental Resource Associates, Inc., 1994), Site Investigation -Groundwater Investigation [Quad Three Group (Q3G), 1995], Phase I Environmental Assessment (Q3G, 1996), Supplemental Site Investigation (Q3G, 1997), and Underground Storage Tank Site Investigation Report (B&RE, 1997). Figure 4-2 depicts the Building 44 area discussed in this section.

4.3.1 Building 44 UST Closure Assessment-1994

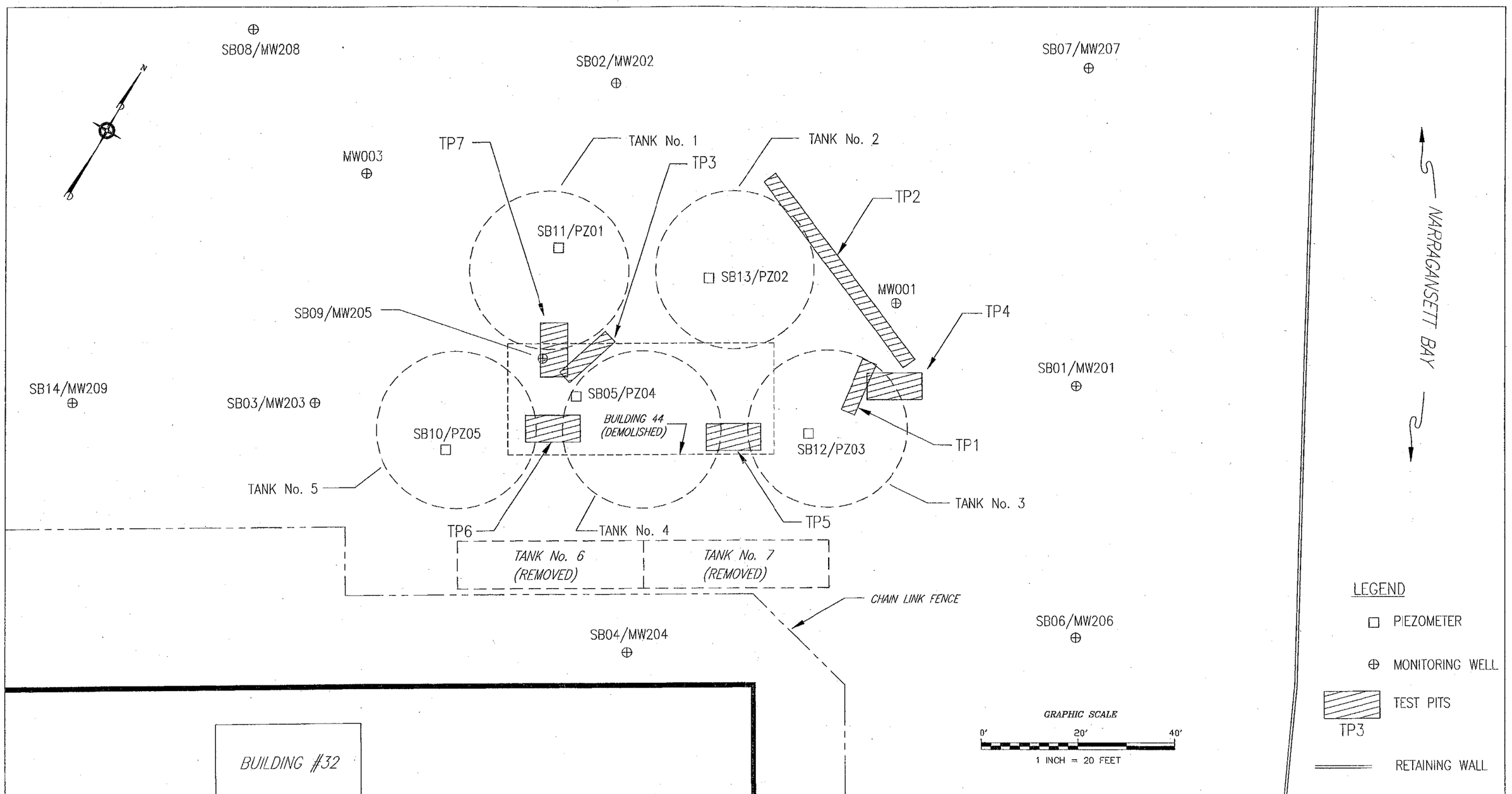
A UST closure assessment report was prepared for the Building 44 area by Environmental Resource Associates in September 1994. This assessment, conducted in July 1994, confirmed that the tanks had been abandoned and recommended that RIDEM issue a Certificate of Closure to the NETC. However, test pits excavated in the vicinity of the former USTs revealed significant free-floating product that appeared to be weathered black oil.

TABLE 4-1
ANALYTICAL RESULTS FOR SEDIMENT AND MUSSEL SAMPLES
FROM THE "CONFIRMATION STUDY REPORT" (LOUREIRO ENGINEERING, 1986)
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

STATION NUMBER	01	02	N-1 (control station)	N-2 (control station)	N-2 (control duplicate)
MEDIA AND ANALYSIS					
SEDIMENT - December 1983					
Cyanide	0.121	0.111	0.031	0.027	NA
Chromium	<0.25	<0.25	11.5	8.0	NA
Cadmium	<0.05	<0.05	<0.05	<0.05	NA
Lead	<0.5	6.5	27.5	6.8	NA
Mercury	<0.02	<0.02	<0.02	<0.02	NA
Silver	<0.5	<0.5	<0.5	<0.5	NA
Copper	26.0	17.4	18.3	10.3	NA
Nickel	<0.25	<0.25	21.3	11.3	NA
MUSSELS - December 1983					
Chromium	<2.5	<2.5	<2.5	<2.5	NA
Cadmium	<0.5	<0.5	<0.5	<0.5	NA
Lead	<1.0	<1.0	<1.0	<1.0	NA
Mercury	<0.04	<0.04	<0.04	<0.04	NA
Silver	<1.0	<1.0	<1.0	<1.0	NA
Copper	6.0	26.3	7.2	4.3	NA
Nickel	<2.5	<2.5	<2.5	<2.5	NA
MUSSELS - September 1984					
Chromium	NS	1.0	1.1	2.8	1.4
Lead	NS	5.0	4.9	3.8	5.2
Copper	NS	6.6	6.8	8.2	5.4
Nickel	NS	3.9	4.9	5.1	4.9

NOTES:
- All results in ug/gm (dry weight basis).
- Available sample locations are presented in Appendix D.
- Sediments reportedly collected from a depth of 0 to 4 inches.
- NS = not sampled
- NA = not applicable

Reference: Loureiro Engineering Associates, May 15, 1986, Confirmation Study Report on Hazardous Waste Sites at Naval Education and Training Center, Newport, RI, prepared for the Northern Division, Naval Facilities Engineering Command.



BUILDING 44 UST CLOSURE ASSESSMENT SAMPLE STATIONS			FIGURE 4–2
SITE 17, GOULD ISLAND			TETRA TECH NUS, INC.
NAVSTA NEWPORT, RHODE ISLAND			55 Jonspin Road Wilmington, MA 01887 (978)658–7899
DRAWN BY: D.W. MACDOUGALL	REV.: 0		
CHECKED BY: S. PARKER	DATE: NOVEMBER 4, 2002		
SCALE: 1" = 20'	FILE NO.: DWG\5152\0410\FIG_4–2.DWG		

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4.3.2 Building 44 Phase 1 Environmental Assessment - 1995 and 1996

A Site Investigation was conducted by Q3G in April 1995, which concluded that groundwater and soil at the former Building 44 site had been impacted by petroleum contamination. Their report published in May 1995 recommended further investigation.

A Phase I Environmental Assessment, dated March 1996, and a Supplemental Site Investigation (SSI), dated September 1996, both conducted by Q3G, followed the May 1995 investigation at Building 44. The SSI report identified the USTs as the source of impact to groundwater and recommended the installation of four groundwater monitoring wells and development of a site-specific corrective action plan (CAP). One of the tasks performed by the Q3G for the SSI was a soil gas survey. This was accomplished in the area North of Building 32 and extending to the base of the Firing Pier. Sixty-nine "Gore-Sorber" modules were placed in a grid formation in this area. This study found petroleum - related compounds, particularly benzene, toluene, ethyl benzene, and xylenes in most of the modules placed within this area. Trichloroethene (TCE) was also detected, with highest concentrations located 75 feet northwest of Building 32, and 150 feet west of the former Building 44 location.

Q3G conducted a supplemental site investigation that focused on underground utility conduits, aboveground and underground storage tanks, and structures within the study area. A Gore-Sorber soil gas screening survey was conducted along with soil sampling to determine if there was a relationship between soil gas and soil contaminants. After a comparison of the Gore-Sorber sample results with the soil analytical results, Q3G concluded that no direct correlation existed between the soil contamination and contaminants in the soil vapor. Q3G concluded that the source of contaminants identified by the Gore-Sorber soil gas survey modules was contaminated groundwater. Q3G concluded that metals found in the soil originated from sources other than the USTs. This investigation recommended that four additional groundwater monitoring wells be installed in those areas identified by the Gore-Sorber modules as being the most severely impacted.

4.3.3 UST Site Investigation of Building 44 Area - 1997

A UST Site Investigation was conducted by B&RE and reported in November 1997. Tasks included overburden soil boring advancement and soil sample collection, monitoring well installation, groundwater sampling, test pitting, hydraulic conductivity testing, groundwater-level measurements, and tidal influence testing. Figure 4-2 depicts the soil testing locations. Table 4-2 presents a summary of the analysis on soil samples collected during this 1997 investigation.

TABLE 4-2
SOIL SAMPLE DATA SUMMARY
FROM THE BUILDING 44 SITE INVESTIGATION REPORT
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION NO.	SB01-0911	SB02-0911	SB03-0407	SB04-0507	SB04-0507 DUP. SB40	SB06-0810	RIDEM DIRECT EXPOSURE CRITERIA[1]	
							RES[2]	IND/COM[(3]
SAMPLE MEDIUM	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	mg/kg	mg/kg
PARAMETERS (mg/kg)								
Total Petroleum Hydrocarbons	240	1400	3800	140	210	63	500	2500
TCL VOCs (mg/kg)								
Methylene Chloride	0.046	0.072	0.42	0.03	0.03	0.003	45	760
Acetone	0.12	0.12	0.073	0.015J	0.016J	ND	7800	10000
Carbon disulfide	0.0009J	ND	ND	ND	ND	ND	-	-
Chloroform	ND	ND	ND	ND	ND	ND	1.2	940
2-Butanone	ND	ND	ND	ND	ND	ND	-	-
Toluene	ND	ND	0.004	ND	ND	ND	190	10000
Ethylbenzene	ND	ND	ND	ND	ND	ND	71	10000
Total Xylenes	ND	ND	ND	ND	ND	ND	110	10000
TCL SVOCs (mg/kg)								
Naphthalene	0.44	ND	ND	ND	ND	ND	54	10000
2-Methylnaphthalene	2.0	ND	ND	ND	ND	ND	123	10000
Acenaphthene	ND	ND	ND	ND	ND	ND	43	10000
Dibenzofuran	0.24J	0.62	ND	ND	ND	ND	-	-
Fluorene	0.32J	0.65	0.5	ND	ND	ND	28	10000
Phenanthrene	0.31J	0.48	0.42	ND	0.3J	0.19J	40	10000
Anthracene	ND	ND	ND	ND	ND	ND	35	10000
Carbazole	ND	ND	ND	ND	ND	ND	-	-
Di-n-butylphthalate	ND	ND	ND	ND	0.27J	ND	-	-
Fluoranthene	ND	ND	0.44	ND	0.35J	0.58	20	10000
Pyrene	ND	ND	0.55	ND	0.25J	0.53	13	10000
Benzo(a)anthracene	ND	ND	0.32J	ND	ND	0.23J	0.9	7.8
Chrysene	ND	ND	0.32J	ND	ND	0.25J	0.4	780
Bis(2-ethylhexyl) phthalate	0.49	0.63	1.7	0.3J	ND	ND	46	410
Benzo(b)fluoranthene	ND	ND	0.21J	ND	ND	0.22J	0.9	7.8
Benzo(k)fluoranthene	ND	ND	0.18J	ND	ND	ND	0.9	78
Benzo(a)pyrene	ND	ND	0.25J	ND	ND	0.22J	0.4	0.8
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	0.9	7.8
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND	0.8	10000

TABLE 4-2 (cont.)
SOIL SAMPLE DATA SUMMARY
FROM THE BUILDING 44 SITE INVESTIGATION REPORT
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 3

SAMPLE IDENTIFICATION NO.	SB07-0810	SB08-0709	SB09-0608	SB14-0608	RIDEM DIRECT EXPOSURE CRITERIA[1]	
					RES[2]	IND/COM[(3]
SAMPLE MEDIUM	SOIL	SOIL	SOIL	SOIL	mg/kg	mg/kg
PARAMETERS (mg/kg)						
Total Petroleum Hydrocarbons	78	28	2700	ND	500	2500
TCL VOCs (mg/kg)						
Methylene Chloride	0.038	0.008	0.013	0.005	45	760
Acetone	0.027	0.012	0.034	0.006	7800	10000
Carbon disulfide	ND	ND	ND	ND	-	-
Chloroform	0.002	0.002	0.002	ND	1.2	940
2-Butanone	0.007	0.003J	0.011	ND	-	-
Toluene	0.002	ND	0.002	0.002	190	10000
Ethylbenzene	0.0007J	0.0006J	0.006	0.0006J	71	10000
Total Xylenes	0.002	0.003	0.004	0.003	110	10000
TCL SVOCs (mg/kg)						
Naphthalene	ND	ND	0.3J	ND	54	10000
2-Methylnaphthalene	ND	ND	1100	ND	123	10000
Acenaphthene	3.1	ND	ND	ND	43	10000
Dibenzofuran	2.2	ND	0.34J	ND	-	-
Fluorene	3.3	ND	0.6	ND	28	10000
Phenanthrene	7.5	ND	0.82	ND	40	10000
Anthracene	3.1	ND	ND	ND	35	10000
Carbazole	0.73	ND	ND	ND	-	-
Di-n-butylphthalate	0.31J	0.027J	0.29J	ND	-	-
Fluoranthene	8.2	ND	0.26J	ND	20	10000
Pyrene	5.3	ND	0.29J	ND	13	10000
Benzo(a)anthracene	1.9	ND	ND	ND	0.9	7.8
Chrysene	2	ND	ND	ND	0.4	780
Bis(2-ethylhexyl) phthalate	0.32J	0.028J	ND	0.19J	46	410
Benzo(b)fluoranthene	0.81	ND	ND	ND	0.9	7.8
Benzo(k)fluoranthene	0.94	ND	ND	ND	0.9	78
Benzo(a)pyrene	0.91	ND	ND	ND	0.4	0.8
Indeno(1,2,3-cd)pyrene	0.37	ND	ND	ND	0.9	7.8
Benzo(g,h,i)perylene	0.28J	ND	ND	ND	0.8	10000

TABLE 4-2 (cont.)
SOIL SAMPLE DATA SUMMARY
FROM THE BUILDING 44 SITE INVESTIGATION REPORT
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 3 OF 3

SAMPLE IDENTIFICATION NO.	SB01-0911	SB02-0911	SB03-0407	SB04-0507	SB04-0507	SB06-0810	RIDEM DIRECT EXPOSURE CRITERIA[1]	
							RES[2]	IND/COM[(3]
SAMPLE MEDIUM	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	mg/kg	mg/kg
INORGANICS (mg/kg)								
Arsenic	0.79	0.99	0.91	1.2	1	2	1.7	820
Barium	16.7	13.8	22.1	12.4	11.7	28.9	5500	10000
Cadmium	0.08	0.07	0.14	ND	0.08	0.21	39	1000
Chromium	11.3	9.2	10.2	7.8	8.6	7.9	390[4]	10000[4]
Lead	5.4	4.6	6.9	4.9	5.4	18	150	500
Mercury	0.03	0.02	ND	0.01	ND	0.1	23	610
Selenium	ND	ND	0.3	0.29	ND	0.36	390	10000

SAMPLE IDENTIFICATION NO.	SB07-0810	SB08-0709	SB09-0608	SB14-0608	RIDEM DIRECT EXPOSURE CRITERIA[1]	
					RES[2]	IND/COM[(3]
SAMPLE MEDIUM	SOIL	SOIL	SOIL	SOIL	mg/kg	mg/kg
INORGANICS (mg/kg)						
Arsenic	1.4	1.6	1.4	1.4	1.7	820
Barium	18.2	24.8	27.4	25.0	5500	10000
Cadmium	0.07	0.11	0.15	.008	39	1000
Chromium	8.8	9.6	9.5	10.4	390[4]	10000[4]
Lead	39.7	4.8	11.3	6.2	150	500
Mercury	ND	ND	ND	ND	23	610
Selenium	0.32	ND	ND	ND	390	10000

Notes: (1) Rhode Island Department of Environmental Protection Remediation Regulations - March 31, 1993; Amended August 1996
(2) RES is the Residential Direct Exposure Criterion
(3) IND/COM is the Industrial/Commercial Direct Exposure Criterion
(4) Exposure Criteria for Chromium VI
J - Estimated value
ND - Not detected

The UST Site Investigation found TPH concentrations exceeding RIDEM GA Leachability Criteria (500 mg/kg), RIDEM Residential Direct Exposure Criteria (500 mg/kg) or exceeding RIDEM Industrial/Commercial Direct Exposure Criteria (2,500 mg/kg) at three of the 10 sample locations (SB02, SB03, SB09). One SVOC, benzo(a)pyrene (0.91 mg/kg) exceeded the RIDEM Residential and Industrial/Commercial Direct Exposure Criteria (0.8 mg/kg). The three compounds identified at levels exceeding the residential criteria are benzo(a)anthracene (1.9 mg/kg), chrysene (2 mg/kg), and benzo(k)fluoranthene (0.94 mg/kg). No VOCs were detected in soils exceeding RIDEM Residential or Industrial/Commercial Direct Exposure Criteria, or RIDEM GA Leachability Criteria. For metals analyses, arsenic was identified in soil at one boring location (2 mg/kg at SB06) exceeding the RIDEM Residential Direct Exposure Criteria of 1.7 mg/kg.

A summary of the analysis of groundwater samples collected during this investigation is presented in Table 4-3. Analysis of groundwater samples indicated the presence of TPH in four of the eleven wells tested. TPH was identified at one location at 1,700 mg/L (MW001) and the remaining three locations at 1.8 to 6.4 mg/L. One volatile organic compound was identified (methylene chloride at 73 ug/L at MW001) exceeding the GA Groundwater Objective of 5 ug/L at one well location. One SVOC (naphthalene at 200 ug/L) was detected in excess of the GA Groundwater Objective of 20 ug/L at MW001. For metals analyses, lead was identified in samples obtained from seven of the 10 sampled wells at levels exceeding the RIDEM Groundwater Objective for GA areas of 15 ug/L. Exceedances ranged from 15.8 ug/L (MW204) to 243 ug/L (MW003).

Tidal influence testing was performed on two piezometers (PZ-02 and PZ-05, placed in the UST cavities) and one well (MW-201) to the east of the former tank locations. The piezometers showed no tidal influence, and MW-201, located within 50 feet of the east shoreline, showed a tidal fluctuation of 0.75 feet. Tidal change at the shoreline during the period was measured at 4 feet (B&R Environmental, November 1997).

Also as a part of the 1997 site investigation, a series of test pits were excavated to determine the nature of anomalies detected in the subsurface materials by Q3G in 1996. These were found to be likely a result of fragments of the piping systems that remained in the ground following the UST closures. However, oil-stained soils and non-aqueous phase oil was found in the ground during test pit operations (see below, Section 4.3.4).

4.3.4 Building 44 Corrective Action Excavation – 2000

A corrective action plan prepared by TtNUS recommended removal of the affected soils and long-term groundwater monitoring. In the fall of 2000 Foster Wheeler Environmental Corporation completed the UST removal and soil excavation phase in conjunction with the Building 32 demolition activities.

TABLE 4-3
GROUNDWATER SAMPLE DATA SUMMARY
FROM THE BUILDING 44 SITE INVESTIGATION REPORT
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION NO.	MW201	MW202	MW203	MW204	MW205	MW206	MW207	GA GROUNDWATER OBJECTIVE[1]
SAMPLE MEDIUM	AQ	AQ	AQ	AQ	AQ	AQ	AQ	µg/l
PARAMETERS (mg/L)								
Total Petroleum Hydrocarbons	1.8	1.8	6.4	ND	-	ND	ND	-
TCL VOCs (µg/L)								
Methylene Chloride	1	2	3	3	2	3	3	5
Acetone	ND	4J	3J	ND	8	4J	ND	-
Carbon disulfide	ND	ND	ND	ND	ND	ND	ND	-
Chloroform	ND	ND	ND	4	0.8J	3	ND	100[2]
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	100[2]
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	5
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	100[2]
Benzene	0.8J	ND	ND	ND	ND	ND	ND	5
Toluene	ND	ND	ND	ND	ND	ND	ND	1000
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	700
Total Xylenes	ND	0.7J	ND	0.7J	ND	ND	ND	10,000
TCL SVOCs (µg/L)								
Naphthalene	ND	ND	ND	ND	ND	ND	ND	20
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	-
Acenaphthene	ND	ND	ND	ND	ND	ND	15	-
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	-
Fluorene	ND	ND	ND	ND	ND	ND	ND	-
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	-
Bis(2-ethylhexyl) phthalate	5J	69	8J	17	11J	19	5J	-

TABLE 4-3 (cont.)
GROUNDWATER SAMPLE DATA SUMMARY
FROM THE BUILDING 44 SITE INVESTIGATION REPORT
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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SAMPLE IDENTIFICATION NO.	MW208	MW209	MW210 DUP. MW201	MW211 DUP. MW 203	MW001	MW003	GA GROUNDWATER OBJECTIVE[1]
SAMPLE MEDIUM	AQ	AQ	AQ	AQ	AQ	AQ	µg/l
PARAMETERS (mg/L)							
Total Petroleum Hydrocarbons	ND	ND	2.6	5.9	1700	ND	-
TCL VOCs (µg/L)							
Methylene Chloride	2	1	1	3	73	2	5
Acetone	3J	3J	3J	5J	79J	3J	-
Carbon disulfide	ND	ND	ND	3	ND	ND	-
Chloroform	ND	1	ND	ND	ND	ND	100[2]
Bromodichloromethane	ND	1J	ND	ND	ND	ND	100[2]
Trichloroethene	ND	1	ND	ND	ND	ND	5
Dibromochloromethane	ND	0.8J	ND	ND	ND	ND	100[2]
Benzene	ND	ND	0.9J	ND	ND	ND	5
Toluene	ND	ND	ND	ND	69	ND	100
Ethylbenzene	ND	ND	ND	ND	37	ND	700
Total Xylenes	ND	ND	ND	ND	120	2	10,000
TCL SVOCs (µg/L)							
Naphthalene	ND	ND	ND	ND	200	ND	20
2-Methylnaphthalene	ND	ND	ND	ND	720	ND	-
Acenaphthene	ND	ND	ND	ND	ND	ND	-
Dibenzofuran	ND	ND	ND	ND	60	ND	-
Fluorene	ND	ND	ND	ND	42	ND	-
Phenanthrene	ND	ND	ND	ND	65	ND	-
Bis(2-ethylhexyl) phthalate	18	6J	12	17	ND	7J	-

TABLE 4-3 (cont.)
GROUNDWATER SAMPLE DATA SUMMARY
FROM THE BUILDING 44 SITE INVESTIGATION REPORT
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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SAMPLE IDENTIFICATION NO.	MW201	MW202	MW203	MW204	MW205	MW206	MW207	GA GROUNDWATER OBJECTIVE(1)
SAMPLE MEDIUM	AQ	AQ	AQ	AQ	AQ	AQ	AQ	µg/l
INORGANICS (µg/L)								
Arsenic	14	3	14	6.2	14.1	8.8	8.3	-
Barium	212	65.7	179	99.2	164	168	144	2000
Cadmium	ND	0.20	ND	ND	ND	ND	0.25	5
Chromium	49.4	5.9	50.7	21.1	30	21	36.5	100
Lead	30	10.2	38.1	15.8	49.9	37.3	35.7	15
Mercury	0.01	0.03	ND	ND	0.02	0.07	0.03	2
Silver	ND	ND	ND	ND	ND	ND	ND	-

SAMPLE IDENTIFICATION NO.	MW208	MW209	MW210 DUP. MW201	MW211 DUP. MW203	MW003	GA GROUNDWATER OBJECTIVE(1)
SAMPLE MEDIUM	AQ	AQ	AQ	AQ	AQ	µg/l
INORGANICS (µg/L)						
Arsenic	4.4	4.2	18.4	12.3	20.7	-
Barium	53.1	98.9	317	171	258	2000
Cadmium	ND	ND	ND	ND	8.8	5
Chromium	8.5	24.6	80	43.4	16.2	100
Lead	12.7	12.7	48.4	31	243	15
Mercury	0.05	0.03	0.01	ND	0.33	2
Silver	ND	ND	ND	ND	2	-

Notes: (1) Rhode Island Department of Environmental Protection Remediation Regulations - March 31, 1993; Amended August 1996
(2) Total Trihalomethanes GA Groundwater Objective
J - Estimated value
ND - Not detected

Demolition debris (red brick and crushed concrete) was used to back-fill the USTs excavation at the former Building 44 site. Some monitoring wells destroyed during this effort were subsequently replaced for subsequent groundwater monitoring. The approximate excavation area is depicted on Figure 2-1.

4.3.5 Building 44 Interim Monitoring – 2001 and 2002

The groundwater monitoring program was undertaken to confirm residual contamination is not entering the surficial aquifer and to recover mobile free product, if detected. In addition, the monitoring results will be used to determine if the existing network of wells is adequate to monitor any contaminant migration. This section summarizes evaluation of the data from the three rounds of corrective action groundwater monitoring.

Three semi-annual groundwater sampling rounds were conducted at the site, beginning in April 2001. Site monitoring wells are shown in Figure 4-2. The designated wells for the corrective action groundwater monitoring program consisted of seven of the eleven overburden wells that existed at the site prior to the soil remediation. A summary of data from the first three rounds of groundwater monitoring is presented in Tables 4-4 and 4-5.

During each sampling round, designated wells were sampled using bailers and groundwater levels were measured using an electronic oil/water interface probe. The probe was also used to check for the presence of dense or light non-aqueous phase liquid (DNAPL or LNAPL) or free product layers in all serviceable monitoring wells. Samples were shipped to an off-site laboratory to be analyzed for VOCs (USEPA SW-846 Method 8260B); SVOCs (USEPA SW-846 Method 8270C); GRO (USEPA SW-846 Method 8015M); DRO-TPH by USEPA SW-846 Method 8015M/8100M; and total and dissolved metals by USEPA SW-846 Methods 6010B/7471A.

Groundwater elevation measurements during Rounds 1 and 2 indicated that the groundwater flows away from the former UST area to the north, east and west, toward Narragansett Bay. Measurements during Round 3 show a slightly different groundwater pattern at the site in which the highest groundwater elevation was measured in a monitoring well west of the former USTs. Generally, the groundwater flow is toward the north and east through the tank grave with some groundwater flowing west, with all of the groundwater eventually discharging into Narragansett Bay.

TABLE 4-4
GROUNDWATER VOCS AND SVOCS ANALYTICAL SUMMARY
BUILDING 44 GROUNDWATER MONITORING ROUNDS 1 THROUGH 3
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Monitoring Well			MW204R (Upgradient)						MW001R (Source Area)						MW203R (Source Area)					
Round			1		2		3		1		2		3		1		2		3	
Date Sampled	GWQS	PAL	Apr 01		Oct 01		Apr 02		Apr 01		Oct 01		Apr 02		Apr 01		Oct 01		Apr 02	
Volatile Organic Analysis (UG/L)																				
2-Butanone			5	U	5	U	10	U	12	U	6		10	U	5	U	5	U	10	U
4-Methyl-2-Pentanone			5	U	5	U	10	U	3	J	2		2	J	5	U	5	U	10	U
Acetone			5	U	5	U	10	U	67	U	35		29	U	5	U	9	U	10	U
Toluene	1000	500	5	U	5	U	10	U	1	J	1		2	J	5	U	5	U	10	U
Semivolatile Organic Analysis (UG/L)																				
2,4,5-Trichlorophenol			20	U	20	U	20	U	1	J	180	U	20	U	20	U	20	U	20	U
2,4-Dichlorophenol			10	U	10	U	10	U	10	U	90	U	10	U	10	U	10	U	10	U
2,4-Dimethylphenol			10	U	10	U	10	U	8	J	16		8	J	10	U	10	U	10	U
2-Chloronaphthalene			10	U	10	U	10	U	10	U	90	U	10	U	10	U	10	U	10	U
2-Methylnaphthalene			10	U	3	J	10	U	1	J	90	U	2	J	2	J	10	U	10	U
2-Methylphenol			10	U	10	U	10	U	4	J	90	U	4	J	10	U	10	U	10	U
4-Methylphenol			10	U	1	J	10	U	36		71		33		10	U	10	U	10	U
Acenaphthene			3		6	J	10	U	4	J	90	U	5	J	8	J	10	U	1	J
Acenaphthylene			10	U	10	U	10	U	10	U	90	U	10	U	10	U	10	U	10	U
Anthracene			3		3	J	10	U	4	J	90	U	3	J	18		1	J	2	J
Benzo(a)anthracene			10	U	10	U	10	U	3	J	90	U	3	J	32		2	J	7	J
Benzo(a)pyrene	***0.2***	*0.1*	10	U	10	U	10	U	***3***	***J***	90	U	***3***	***J***	***26***		***1***	***J***	***7***	***J***
Benzo(b)fluoranthene			10	U	10	U	10	U	4	J	90	U	4	J	34		2	J	9	J
Benzo(g,h,i)perylene			10	U	10	U	10	U	10	U	90	U	2	J	15		10	U	4	J
Benzo(k)fluoranthene			10	U	10	U	10	U	1	J	90	U	1	J	12		10	U	4	J
bis(2-Ethylhexyl)phthalate	6	3	10	U	10	U	10	U	10	U	90	U	2	J	10	U	10	U	1	J
Carbazole			4		54	J	10	U	5	J	33		5	J	11		3	J	1	J
Chrysene			10	U	10	U	10	U	3	J	90	U	3	J	33		2	J	8	J
Dibenzo(a,h)anthracene			10	U	10	U	10	U	10	U	90	U	10	U	4	J	10	U	1	J
Dibenzofuran			1		4	J	10	U	2	J	90	U	2	J	5	J	10	U	10	U
Diethylphthalate			10	U	10	U	10	U	10	U	90	U	10	U	10	U	10	U	10	U
Fluoranthene			2		1	J	10	U	8	J	90	U	7	J	68		5	J	17	J
Fluorene			1		4	J	10	U	2	J	90	U	2	J	9	J	10	U	1	J
Indeno(1,2,3-cd)pyrene			10	U	10	U	10	U	2	J	90	U	2	J	16		10	U	4	J
Naphthalene	***20***	*10*	3		***22***		10	U	*11*		***22***		*15*		4	J	10	U	10	U
Pentachlorophenol	***1***	*0.5*	***6***		*1*	*J*	20	U	***34***		***77***		***30***		***4***	***J***	20	U	20	U
Phenanthrene			1		4	J	10	U	7	J	90	U	7	J	52		5	J	11	
Phenol			10	U	10	U	10	U	230	*J	980		280	*	10	U	10	U	10	U
Pyrene			2		10	U	10	U	7	J	90	U	6	J	59		4	J	15	J

Bold italics – GWQS exceeded; Italics – PAL exceeded; U – not detected; J – quantitation approximate; UJ – detection limit approximate

TABLE 4-4 (cont.)
GROUNDWATER VOCS AND SVOCS ANALYTICAL SUMMARY
BUILDING 44 GROUNDWATER MONITORING ROUNDS 1 THROUGH 3
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Monitoring Well			MW205R (Source Area)						MW003R (Downgradient)				MW202R (Downgradient)			
Round			1		2		3		2		3		2		3	
Date Sampled	GWQS	PAL	Apr 01		Oct 01		Apr 02		Apr 01		Oct 01		Apr 01		Oct 01	
Volatile Organic Analysis (UG/L)																
2-Butanone			5	U	5	U	10	U	5	U	10	U	5	U	10	U
4-Methyl-2-Pentanone			5	U	5	U	10	U	5	U	10	U	5	U	10	U
Acetone			8	U	5	U	10	U	5	U	10	U	5	U	10	U
Toluene	1000	500	5	U	5	U	10	U	5	U	10	U	5	U	1	J
Semivolatile Organic Analysis (UG/L)																
2,4,5-Trichlorophenol			20	U	20	U	20	U	20	U	20	U	20	U	20	U
2,4-Dichlorophenol			10	U	1	J	10	U	10	U	10	U	10	U	10	U
2,4-Dimethylphenol			10	U	1	J	10	U	10	U	10	U	10	U	10	U
2-Chloronaphthalene			10	U	3	J	10	U	10	U	10	U	8	J	10	U
2-Methylnaphthalene			2	J	5	J	2	J	10	U	10	U	10	U	10	U
2-Methylphenol			10	U	10	U	10	U	10	U	10	U	10	U	10	U
4-Methylphenol			10	U	10	U	10	U	10	U	10	U	10	U	10	U
Acenaphthene			6	J	9	J	4	J	10	U	10	U	1	J	10	U
Acenaphthylene			10	U	10	U	10	U	10	U	10	U	10	U	10	U
Anthracene			4	J	4	J	2	J	1	J	10	U	3	J	10	U
Benzo(a)anthracene			1	J	2	J	1	J	10	U	10	U	10	U	10	U
Benzo(a)pyrene	***0.2***	*0.1*	10	U	***1***	***J***	10	U	10	U	10	U	10	U	10	U
Benzo(b)fluoranthene			1	J	2	J	1	J	10	U	10	U	10	U	10	U
Benzo(g,h,i)perylene			10	U	10	U	10	U	10	U	10	U	10	U	10	U
Benzo(k)fluoranthene			10	U	10	U	10	U	10	U	10	U	10	U	10	U
bis(2-Ethylhexyl)phthalate	6	3	10	U	10	U	2	J	10	U	10	U	10	U	1	J
Carbazole			4	J	36	J	4	J	3	J	10	U	18	J	5	J
Chrysene			1	J	2	J	1	J	10	U	10	U	10	U	10	U
Dibenzo(a,h)anthracene			10	U	10	U	10	U	10	U	10	U	10	U	10	U
Dibenzofuran			4	J	6	J	3	J	10	U	10	U	3	J	1	J
Diethylphthalate			1	J	2	J	10	U	10	U	10	U	10	U	10	U
Fluoranthene			4	J	5	J	3	J	10	U	10	U	10	U	1	J
Fluorene			2	J	7	J	3	J	10	U	10	U	3	J	2	J
Indeno(1,2,3-cd)pyrene			10	U	10	U	10	U	10	U	10	U	10	U	10	U
Naphthalene	***20***	*10*	5	J	***24***		*12*		4	J	10	U	1	J	9	J
Pentachlorophenol	***1***	*0.5*	***16***	***J***	***3***	***J***	***2***	***J***	***4***	***J***	***3***		20	U	20	U
Phenanthrene			1	J	5	J	6	J	10	U	10	U	10	U	10	U
Phenol			10	U	10	U	10	U	10	U	10	U	10	U	10	U
Pyrene			3	J	4	J	2	J	10	U	10	U	10	U	1	J

Bold italics – GWQS exceeded; Italics – PAL exceeded; U – not detected; J – quantitation approximate; UJ – detection limit approximate

TABLE 4-4 (cont.)
GROUNDWATER VOCS AND SVOCS ANALYTICAL SUMMARY
BUILDING 44 GROUNDWATER MONITORING ROUNDS 1 THROUGH 3
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Monitoring Well			MW207 (Downgradient)					
Round			1		2		3	
Date Sampled	GWQS	PAL	Apr 01		Oct 01		Apr 02	
Volatile Organic Analysis (UG/L)								
2-Butanone			5	U	5	U	10	U
4-Methyl-2-Pentanone			5	U	5	U	10	U
Acetone			5	U	5	U	10	U
Toluene	1000	500	5	U	5	U	10	U
Semivolatile Organic Analysis (UG/L)								
2,4,5-Trichlorophenol			20	U	20	U	20	U
2,4-Dichlorophenol			10	U	10	U	10	U
2,4-Dimethylphenol			10	U	10	U	10	U
2-Chloronaphthalene			10	U	1	J	10	U
2-Methylnaphthalene			10	U	10	U	10	U
2-Methylphenol			10	U	10	U	10	U
4-Methylphenol			10	U	10	U	10	U
Acenaphthene			10	U	3	J	20	
Acenaphthylene			10	U	10	U	1	J
Anthracene			10	U	2	J	2	J
Benzo(a)anthracene			10	U	2	J	8	J
Benzo(a)pyrene	***0.2***	*0.1*	10	U	***1***	***J***	***9***	***J***
Benzo(b)fluoranthene			10	U	2	J	13	
Benzo(g,h,i)perylene			10	U	10	U	6	J
Benzo(k)fluoranthene			10	U	10	U	5	J
bis(2-Ethylhexyl)phthalate	6	3	10	U	10	U	10	U
Carbazole			10	U	10	J	7	J
Chrysene			10	U	2	J	11	
Dibenzo(a,h)anthracene			10	U	10	U	10	U
Dibenzofuran			10	U	3	J	8	J
Diethylphthalate			10	U	10	U	10	U
Fluoranthene			1	J	6	J	22	
Fluorene			10	U	2	J	5	J
Indeno(1,2,3-cd)pyrene			10	U	10	U	6	J
Naphthalene	***20***	*10*	10	U	10	U	***39***	
Pentachlorophenol	***1***	*0.5*	20	U	20	U	20	U
Phenanthrene			10	U	4	J	13	
Phenol			10	U	10	U	10	U
Pyrene			10	U	4	J	19	

Bold italics – GWQS exceeded; Italics – PAL exceeded; U – not detected; J – quantitation approximate; UJ – detection limit approximate

TABLE 4-5
GROUNDWATER GRO, DRO-TPH AND METALS ANALYTICAL SUMMARY
BUILDING 44 GROUNDWATER MONITORING ROUNDS 1 THROUGH 3
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Monitoring Well			MW204R (Upgradient)						MW001R (Source Area)						MW203R (Source Area)					
Round			1		2		3		1		2		3		1		2		3	
Date Sampled	GWQS	PAL	Apr 01		Oct 01		Apr 02		Apr 01		Oct 01		Apr 02		Apr 01		Oct 01		Apr 02	
Gasoline Range Organic Analysis (UG/L)																				
Gasoline Range Organics			250	U	250	U	50	U	250	U	250	U	57		250	U	250	U	50	U
Total Petroleum Hydrocarbon Analysis (MG/L)																				
Total Petroleum Hydrocarbons			2.0		1.5		0.69		6.2		5.5		3.5		20		2.2		3.4	
TAL Metal Analysis (UG/L)																				
Arsenic	50	25	3.8		6.4	U	3.0	U	14.5		8.3	U	4.3	J	9.9		11.5	U	9.1	
Barium	2000	1000	70.0	U	57.7		67.9		144	U	177		111		250		162		225	
Cadmium	***5***	2.5	0.88	U	0.56	U	2.0	U	4.1	U	2.6	U	2.0	U	2.3	U	2.4	U	2.0	U
Chromium	100	50	5.6	U	2.4	U	3.7	UJ	11.3	U	8.8		4.8	UJ	6.5	U	1.6	U	35.2	
Lead	***15***	7.5	***16.0***		2.0	U	***29.7***		***278***		***230***		***135***		***123***		2.0	U	***45.9***	
Mercury	***2***	1	0.14	U	0.14	U	***2.1***		1.0		0.42		0.40		0.13	U	0.14	U	0.14	U
Dissolved Metal Analysis (UG/L)																				
Arsenic	50	25	2.6		4.8	U	3.0	U	7.9		7.2	U	3.7	J	6.2		10.7	U	3.0	U
Barium	2000	1000	41.9	U	60.1		53.5		84.6	UJ	82.8		67		169	UJ	152		89.0	
Chromium	100	50	1.8	U	2.3	U	3.0	U	0.61	UJ	0.86	U	3.0	U	0.91	UJ	2.0	U	3.0	U
Lead	***15***	7.5	2.0	U	2.0	U	2.6		***37.0***		***15.2***		6.8		2.0	U	2.0	U	1.0	U
Mercury	2	1	0.13	U	0.16	U	0.14	U	0.15	J	0.36		0.14	U	0.13	U	0.15	U	0.13	U
Silver			1.0	U	1.0	U	2.3	J	1.0	UJ	1.0	U	2.0	U	1.0	UJ	1.0	U	2.2	J

Bold italics – GWQS exceeded; Italics – PAL exceeded; U – not detected; J – quantitation approximate; UJ – detection limit approximate

TABLE 4-5 (cont.)
GROUNDWATER GRO, DRO-TPH AND METALS ANALYTICAL SUMMARY
BUILDING 44 GROUNDWATER MONITORING ROUNDS 1 THROUGH 3
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 3

Monitoring Well			MW205R (Source Area)						MW003R (Downgradient)				MW202R (Downgradient)			
Round			1		2		3		2		3		2		3	
Date Sampled	GWQS	PAL	Apr 01		Oct 01		Apr 02		Apr 01		Oct 01		Apr 01		Oct 01	
Gasoline Range Organic Analysis (UG/L)																
Gasoline Range Organics			250	U	250	U	50	U	250	U	50	U	250	U	140	
Total Petroleum Hydrocarbon Analysis (MG/L)																
Total Petroleum Hydrocarbons			2.1		2.3		1.4		2.1		0.76		2.1		3.4	
TAL Metal Analysis (UG/L)																
Arsenic	50	25	5.9		5.2	U	3.0	U	24.3		11.9		7.7	U	3.0	U
Barium	2000	1000	31.9	U	58.6	U	43.4		166		107		119		92.9	
Cadmium	***5***	2.5	0.40	U	0.40	U	2.0	U	4.3		2.0	U	***5.6***		2.0	U
Chromium	100	50	6.9	U	5.6		3.6	UJ	57.3		34.0		17.0		3.0	U
Lead	***15***	7.5	4.0	U	2.0	U	8.5		***30.6***		***26.6***		6.8		12.8	
Mercury	***2***	1	0.13	U	0.15	U	0.16	UJ	0.14	U	0.16	U	0.14	U	0.13	U
Dissolved Metal Analysis (UG/L)																
Arsenic	50	25	5.4		6.1	U	3.0	U	5.0	U	3.4		2.0	U	3.0	U
Barium	2000	1000	29.2	UJ	58.6		40.0	U	51.1		25.4	U	89.5		66.7	
Chromium	100	50	3.2	UJ	5.5		3.2	J	2.4	U	3.0	U	1.3	U	3.0	U
Lead	***15***	7.5	2.0	U	2.0	U	1.9	J	2.0	U	1.0	U	2.0	U	1.0	U
Mercury	2	1	0.13	U	0.14	U	0.13	U	0.13	U	0.14	U	0.15	U	0.14	U
Silver			1.0	UJ	1.0	U	2.0	U	1.0	U	2.0	U	1.0	U	2.0	U

Bold italics – GWQS exceeded; Italics – PAL exceeded; U – not detected; J – quantitation approximate; UJ – detection limit approximate

TABLE 4-5 (cont.)
GROUNDWATER GRO, DRO-TPH AND METALS ANALYTICAL SUMMARY
BUILDING 44 GROUNDWATER MONITORING ROUNDS 1 THROUGH 3
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 3 OF 3

Monitoring Well			MW207 (Downgradient)					
Round			1		2		3	
Date Sampled	GWQS	PAL	Apr 01		Oct 01		Apr 02	
Gasoline Range Organic Analysis (UG/L)								
Gasoline Range Organics			250	U	250	U	50	U
Total Petroleum Hydrocarbon Analysis (MG/L)								
Total Petroleum Hydrocarbons			2.2		2.0		2.7	
TAL Metal Analysis (UG/L)								
Arsenic	50	25	2.0	U	9.8	U	11.9	
Barium	2000	1000	93.2	U	230		364	
Cadmium	***5***	2.5	0.53	UJ	3.3		4.5	
Chromium	100	50	0.91	UJ	3.8	U	18.4	U
Lead	***15***	7.5	13.1		***256***		***1380***	
Mercury	***2***	1	0.14	U	0.14	U	0.48	
Dissolved Metal Analysis (UG/L)								
Arsenic	50	25	2.0	J	9.3	U	3.0	U
Barium	2000	1000	85.6	UJ	185		133	
Chromium	100	50	0.50	UJ	0.99	UJ	3.0	U
Lead	***15***	7.5	2.0	U	2.0	U	1.0	
Mercury	2	1	0.13	U	0.14	U	0.13	U
Silver			1.0	UJ	1.0	U	2.0	U

Bold italics – GWQS exceeded; Italics – PAL exceeded; U – not detected; J – quantitation approximate; UJ – detection limit approximate

Based on three rounds of groundwater monitoring, it appears that the tank closure and corrective action activities were successful in removing most petroleum-related contamination at the former USTs. No free product was observed in these rounds, therefore product recovery efforts are not necessary. The analytical results indicate that low-level residual petroleum in the subsurface is potentially being released to the groundwater, based on the detection of low-level DRO-TPH in all monitoring wells.

However, even though the soil removal has resulted in a decrease in petroleum-related groundwater contamination, six contaminants were found at levels exceeding the (GWQS) for GA areas. The observed changes in these concentrations occurred after the removal of the USTs at Building 44 and placement of demolition debris backfill in the UST excavation. These six contaminants consist of three SVOCs (benzo(a)pyrene, naphthalene, and pentachlorophenol) and three metals (cadmium, lead, and mercury).

Based on the above findings, it was recommended that three additional semi-annual sampling rounds be conducted, and that they include the same designated wells sampled in Rounds 2 and 3.

4.4 BUILDING 32 UNDERGROUND STORAGE TANK (UST) SITE INVESTIGATION REPORT (B&RE, 1997)

A UST Site Investigation Report describes tank closure and related investigative activities conducted at Building 32 by Brown & Root Environmental (B&RE, 1997). A 1,000-gallon steel UST containing No. 2 fuel oil was removed from the south of Building 32 in July 1997 (Figure 4-1). The investigation included soil borings and installation of 3 groundwater monitoring wells. Soil samples from the soil borings were analyzed for TPH. A summary of chemical results from samples collected during this effort is presented in Tables 4-6 and 4-7.

No TPH concentrations were identified exceeding RIDEM residential Direct Exposure Criteria (500 mg/kg) or exceeding RIDEM Industrial/Commercial Direct Exposure Criteria (2,500 mg/kg). Positive detections ranged from 37 mg/kg for SB16 to 260 mg/kg for sample TNK-W.

Results from groundwater samples collected from the three wells and one groundwater sample collected from the tank grave (TNK-AQ) were submitted for TPH, VOCs, SVOCs, and RCRA metals. TPH was identified in the sample from MW303 at 1.1 mg/L. TPH was not identified in the samples from MW301, MW302, and TNK-AQ. One volatile organic compound was identified at a level above the RIDEM Groundwater Objective for GA areas in the sample obtained from MW301. For this sample, trichloroethene was identified at 6 ug/L, exceeding the GA Groundwater Objective of 5 ug/L. No other VOCs were identified at levels in excess of the RIDEM Groundwater Objective for GA areas. No SVOCs or metals were identified at levels in excess of the RIDEM Groundwater Objective for GA areas.

TABLE 4-6
SOIL SAMPLE DATA SUMMARY
BUILDING 32 TANK CLOSURE ASSESSMENT
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION NO.	TNK-E	TNK-W	SB16-0305	SB17-0305	RIDEM DIRECT EXPOSURE CRITERIA (1)	
					RES(2)	IND/COM(3)
SAMPLE MEDIUM	SOIL	SOIL	SOIL	SOIL	mg/kg	Mg/kg
PARAMETERS (mg/kg)						
Total Petroleum Hydrocarbons	140	260	37	ND	500	2500
Gasoline Range Organics	2.9	NA	ND	ND	-	-

Notes:
1) Rhode Island Department of Environmental Protection Remediation Regulations – March 31, 1993; Amended August 1996
2) RES is the Residential Direct Exposure Criterion
3) IND/COM is the Industrial/Commercial Direct Exposure Criterion
J - Estimated value
ND - Not detected
NA - Not Analyzed

TABLE 4-7
GROUNDWATER SAMPLE DATA SUMMARY
BUILDING 32 TANK CLOSURE ASSESSMENT
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

SAMPLE IDENTIFICATION NO.	TNK-AQ	MW301	MW302	MW303	GA GROUNDWATER OBJECTIVE[1]
SAMPLE MEDIUM	**AQ**	**AQ**	**AQ**	**AQ**	**µg/L**
PARAMETERS (mg/L)					
Total Petroleum Hydrocarbons	ND	ND	ND	1.1	-
TCL VOCs (µg/L)					
Methylene Chloride	NA	0.8J	1	4	5
Acetone	NA	6	5J	8	-
cis-1,2-Dichloroethene	NA	10	1J	ND	70
trans-1,2-Dichloroethene	NA	4	ND	ND	100
Chloroform	NA	0.7J	ND	0.9J	100[2]
Trichloroethene	NA	6	ND	0.8J	5
Toluene	NA	ND	5	ND	1000
Ethylbenzene	NA	ND	2	ND	700
Total Xylenes	NA	ND	8	ND	10000
TCL SVOCs (µg/L)					
Bis(2-ethylhexyl)phthalate	NA	12	6J	32	-
INORGANICS (µg/L)					
Arsenic	NA	5.6	2.3	ND	-
Barium	NA	44.8	64.8	106	2000
Cadmium	NA	0.29	ND	0.55	5
Chromium	NA	9.9	14.6	5.2	100
Lead	NA	8.5	4.0	6.5	15
Mercury	NA	0.01	ND	ND	2

Notes:

1) Rhode Island Department of Environmental Protection Remediation Regulations – March 31, 1993; Amended August 1996.
2) Total Trihalomethanes GA Groundwater Objective
3) IND/COM is the Industrial/Commercial Direct Exposure Criterion

J - Estimated value
ND - Not Detected
NA - Not Analyzed

4.5 STUDY AREA SCREENING EVALUATION (SASE) FOR BUILDING 32 (TtNUS, 2000)

The SASE was performed to determine the presence of any environmental contamination, and to determine if the site conditions warrant a Remedial Investigation (RI). The SASE was conducted in the early months of 2000, and a single draft report was prepared. The SASE included:

- Building 32 Interior Survey, Inspection, and Onshore Survey
- Soil Gas Sampling
- Concrete Sample Collection
- Drain Investigation
- Surface Soil Sampling

The results of the soil gas survey are presented in Appendix B. The analytical results from the concrete, drain residue, and soil sampling are presented in Tables 4-8A, 4-8B, and 4-8C, respectively.

Results of soil gas sampling indicated the possible presence of trichloroethene, naphthalene and diesel range organic compounds in most of the soil gas detectors installed. The extent of the detections presented in the graphic plots showed relative high and low values detected. These plots indicated that soil gas with these contaminants appeared to be captured under the slab foundation of Building 32. However, relative high concentrations of TCE were focused under the northwest corner of the building, and relative low concentrations were present under the rest of the building footprint. This supports the findings of the adjacent soil gas investigation conducted by the Quad Three Group (section 4.3.2 of this report) which reported indications of TCE contamination in the ground with relative high concentrations at the northwest portion of Building 32. Petroleum hydrocarbons were detected in soil gas with relative high concentrations outside the northwest corner of the building, which is consistent with the presence of petroleum associated with the Building 44 releases (Section 4.3 of this report). Naphthalene was present in soil gas throughout the building footprint, without apparent "hot spots".

Results from analysis of concrete chip samples and residue from floor drains indicated the presence of traces of volatile organic compounds including TCE, benzene, toluene, and xylene. Semivolatile organic compounds were detected in some samples at low concentrations, however, some samples had high detection limits. A trace of one PCB compound was detected in one sample (0.3 mg/kg) in the electroplating room. Elevated concentrations of metals were detected in concrete samples from the drainage trenches in the electroplating room, including copper (699 mg/kg), cadmium (482 mg/kg) chromium (2,720 mg/kg), and cyanide (24 mg/kg).

Analytical results from drain residue samples reported VOCs, SVOCs, and metals. Primarily of note was the presence of toluene at a concentration of 7,700 ug/kg, and trichloroethene, detected at 250 ug/kg. The trichloroethene concentrations were highest in the pits beneath the east and west solvent tanks. Semivolatile organic compounds in the drain residue samples were dominated by the presence of PAH compounds, particularly in the electroplating room. Metals in the floor drain residue samples were dominated by iron and zinc, although cyanide, cadmium and copper were detected at high concentrations in the samples taken from the electroplating room.

Results from surface soil samples indicated the presence of PAH compounds and metals exceeding the Rhode Island Direct Exposure Criteria for residential soils.

TABLE 4-8a
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN CONCRETE SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Sample Number	G32-CO-01-03IN		G32-CO-02-03IN		G32-CO-03-03IN		G32-CO-04-03IN		G32-CO-05-03IN		G32-CO-06-03IN		G32-CO-07-03IN		G32-CO-08-03IN		G32-DUP1	
Date Sampled	4/18/00		4/18/00		4/18/00		4/18/00		4/18/00		4/26/00		4/27/00		4/27/00		4/18/00	
QC Identifier	None		None		None		None		Field Dup. G32-CO-05-03IN		None		None		None		Field Dup. G32-CO-05-03IN	
Matrix	Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust	
Percent Solids	90.2		94		97.8		96.4		95		96.3		93.4		93.2		96.5	
Volatile Organic Analysis (UG/KG)																		
2-Butanone	38		17		19	U	6.0	J	14	U	11	UJ	12	UJ	20	J	14	U
2-Hexanone	14		15	U	19	U	18	U	14	U	11	UJ	12	UJ	15	UJ	14	U
4-Methyl-2-Pentanone	9.0	J	15	U	19	U	5.0	J	14	U	11	U	12	U	15	U	14	U
Acetone	67	J	40	J	24	J	27	J	21	J	31	J	24	J	53	J	23	J
Benzene	2.0	J	15	U	19	U	18	U	14	U	11	U	12	U	15	U	14	U
Carbon Disulfide	5.0	J	3.0	J	19	U	18	U	14	U	11	U	12	U	15	U	14	U
Ethylbenzene	2.0	J	15	U	19	U	18	U	14	U	11	U	12	U	2.0	J	14	U
Isopropylbenzene	12	U	15	U	6.0	J	18	U	14	U	11	U	12	U	15	U	14	U
Methylcyclohexane	12	U	15	U	19	U	18	U	14	U	11	U	12	U	2.0	J	14	U
Methylene Chloride	12	U	15	U	19	U	18	U	14	U	8.0	J	4.0	J	6.0	J	14	U
Toluene	7.0	J	2.0	J	19	U	18	U	14	U	11	U	12	U	7.0	J	14	U
Total Xylenes	11	J	4.0	J	9.0	J	18	U	14	U	11	U	3.0	J	10	J	14	U
Trichloroethene	3.0	J	15	U	19	U	18	U	14	U	11	U	12	U	15	U	14	U
Semivolatile Organic Analysis (UG/KG)																		
1,1'-Biphenyl	17000	U	11000	U	11000	U	370	U	370	U	43	J	360	U	11000	U	370	U
2-Methylnaphthalene	17000	U	11000	UJ	11000	U	370	U	370	U	150	J	360	U	11000	U	370	U
Anthracene	17000	U	11000	U	11000	U	370	U	370	U	360	U	360	U	11000	U	31	J
Benzo(a)anthracene	4000	J	11000	U	11000	U	56	J	39	J	51	J	55	J	11000	U	80	J
Benzo(a)pyrene	3500	J	11000	U	11000	U	43	J	370	U	57	J	54	J	11000	U	73	J
Benzo(b)fluoranthene	3800	J	11000	U	11000	U	50	J	33	J	55	J	49	J	11000	U	85	J
Benzo(g,h,i)perylene	17000	UJ	11000	U	11000	UJ	31	J	16	J	360	U	360	U	11000	UJ	36	J
Benzo(k)fluoranthene	3600	J	11000	U	11000	U	54	J	37	J	54	J	47	J	11000	U	81	J
bis(2-Ethylhexyl)phthalate	17000	U	11000	U	11000	U	370	U	38	J	360	U	360	U	11000	U	29	J
Chrysene	4300	J	11000	U	11000	U	71	J	52	J	72	J	67	J	11000	U	110	J
Di-n-Butylphthalate	17000	U	11000	U	11000	U	34	J	370	U	41	J	17000	D	11000	U	54	J
Fluoranthene	9100	J	11000	U	920	J	130	J	100	J	130	J	130		11000	U	210	J
Indeno(1,2,3-cd)pyrene	17000	U	11000	U	11000	U	28	J	370	U	360	U	360	U	11000	UJ	33	J
N-Nitroso-diphenylamine	17000	U	11000	U	11000	U	370	U	370	U	360	U	56	J	11000	U	370	U
Phenanthrene	3700	J	11000	U	11000	U	98	J	56	J	88	J	85	J	11000	U	160	J
Pyrene	7600	J	11000	U	1200	J	110	J	80	J	91	J	110	J	11000	U	160	J

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed

TABLE 4-8a (cont.)
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN CONCRETE SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Sample Number	G32-CO-01-03IN		G32-CO-02-03IN		G32-CO-03-03IN		G32-CO-04-03IN		G32-CO-05-03IN		G32-CO-06-03IN		G32-CO-07-03IN		G32-CO-08-03IN		G32-DUP1	
Date Sampled	4/18/00		4/18/00		4/18/00		4/18/00		4/18/00		4/26/00		4/27/00		4/27/00		4/18/00	
QC Identifier	None		None		None		None		Field Dup. G32-CO-05-03IN		None		None		None		Field Dup. G32-CO-05-03IN	
Matrix	Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust		Concrete Dust	
Percent Solids	90.2		94		97.8		96.4		95		96.3		93.4		93.2		96.5	
Pesticide/PCB Analysis (UG/KG)																		
4,4'-DDT	22	U	24	U	22	U	5.4		7.2		3.6	U	4.1		22	U	4.9	
Aroclor-1254	220	U	240	U	220	U	34	U	320	J	36	U	37	U	220	U	36	UJ
Heptachlor Epoxide	11	U	12	U	11	U	1.7	U	2.3	J	1.8	U	1.8	U	11	U	1.8	UJ
Gasoline Range Organic Analysis (MG/KG)																		
Gasoline Range Organics	0.354		0.28	U	0.528		0.22	U	0.27	UJ	0.21	U	0.23	U	0.25	U	0.27	U
Diesel Range Organic Analysis (MG/KG)																		
Diesel Range Organics	17900		21800		13300		44.1		14.1	J	310		71.2		2420		70.8	J
TAL Metal Analysis (MG/KG)																		
Aluminum	3070		3310		3590		8580		9280		6880		7860		3400		8250	
Antimony	7.7	J	6.4	J	11.4	J	0.52	UJ	0.53	UJ		R	2.1	UJ	3.6	UJ	0.52	UJ
Arsenic	1.6	UJ	3.3	UJ	7.6	J	3.5	UJ	3.8	J	6.3	J	2.9	J	2.5	J	3.3	UJ
Barium	225		76.0		326		181		96.4		90.8	J	282		211		202	
Cadmium	451	J	40.1	J	482	J	8.2	J	18.4	J	20.2	J	2.9	UJ	4.9	J	10.7	J
Calcium	4980		3680		13400		50000		52100		49400		69800		11300		48700	
Chromium	48.1		2720		70.1	J	16.9		15.1		15.8		20.2		16.8		19.9	
Cobalt	4.0		3.7		7.5		5.7		5.9		5.6	J	5.4	J	3.9		6.2	
Copper	840	J	699	J	275	J	38.6	J	12.4	J	1060	J	102	J	45.4	J	53.1	J
Cyanide	23.8		0.53	U	2.9		0.52	U	0.53	U	0.52	U	0.54	U	0.54	U	0.52	U
Iron	15900		15200		63500		17700		16300		21000		16700		11200		19400	
Lead	598	J	526	J	650	J	183	J	40.5	J	246	J	245	J	377	J	275	J
Magnesium	1670		1630		1630		3870		3700		2850		3500		1650		4040	
Manganese	198	J	192	J	423	J	305	J	301	J	301	J	279	J	196	J	288	J
Mercury	0.09	UJ	0.16		0.06	UJ	0.02	U	0.02	U	0.07	U	0.05	U	0.08	U	0.02	UJ
Nickel	369	J	44.4	J	87.8	J	11.2	J	12.0	J	22.9	J	12.6	J	15.3	J	12.8	J
Potassium	794		987		867	J	2470		1160		2230	J	1690	J	585		2520	
Selenium	0.84	U	0.81	U		R	1.2	J	1.6	J	0.79	UJ	0.81	UJ	0.82	UJ	1.8	J
Silver	1.9		2.1		0.51	J	4.1		0.62		0.58		0.63		0.91		1.5	
Sodium	650		878		394	UJ	1680		79.7	U	1340		426		177	U	1800	
Vanadium	40.4		54.3		50.0		11.1		12.3		12.4	J	10.1	J	38.3		10.6	
Zinc	521	J	293	J	513	J	83.7	J	810	J	687	J	339	J	366	J	115	J

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed

TABLE 4-8b
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN DRAIN RESIDUE SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Sample Number	G32-DR-01		G32-DR-02		G32-DR-03		G32-DR-04		G32-DR-05		G32-DR-06		G32-DR-07		G32-DR-08		G32-DR-09	
Date Sampled	4/24/00		4/24/00		4/24/00		4/24/00		4/24/00		4/24/00		4/25/00		4/25/00		4/26/00	
QC Identifier	None		Field Dup. G32-DR-02		None		None		None		None		None		None		None	
Matrix	Drain		Drain		Drain		Drain		Drain		Drain		Drain		Drain		Drain	
Percent Solids	66.5		59.5		58.6		81.9		62.2		75.9		21.1		27.9		11.1	
Volatile Organic Analysis (UG/KG)																		
2-Butanone	14	U	70		33		37	J	26	J	11	U	70	UJ	29	J	140	UJ
Acetone	97	J	290	J	170	J	110	J	170	J	38	J	210	J	73	J	210	J
Benzene	14	U	18	U	3.0	J	6.0	J	16	U	11	U	70	U	34	U	140	U
Carbon Disulfide	14	U	18	U	18	U	11	UJ	3.0	J	11	U	150		34	U	32	J
Chloroethane	14	U	6.0	J	18	U	11	UJ	4.0	J	11	U	70	U	34	U	140	U
Chloromethane	14	U	21		18	U	11	UJ	7.0	J	11	U	70	U	34	U	140	U
cis-1,2-Dichloroethene	14	U	18	U	18	U	11	UJ	16	U	11	U	11	J	28	J	140	U
Ethylbenzene	14	U	18	U	18	U	11	UJ	16	U	11	U	70	U	34	U	140	U
Isopropylbenzene	14	U	18	U	18	U	11	UJ	16	U	11	U	70	U	34	U	140	U
Methylcyclohexane	14	U	18	U	18	U	11	UJ	16	U	11	U	70	U	34	U	140	U
Methylene Chloride	3.0	J	2.0	J	18	U	11	UJ	6.0	J	2.0	J	12	J	7.0	J	150	
Tetrachloroethene	14	U	18	U	18	U	11	UJ	16	U	11	U	70	U	34	U	140	U
Toluene	14	U	18	U	2.0	J	1.0	J	16	U	11	U	70	U	34	U	140	U
Total Xylenes	14	U	18	U	18	U	11	UJ	16	U	11	U	70	U	34	U	140	U
trans-1,2-Dichloroethene	14	U	18	U	18	U	11	UJ	16	U	11	U	70	U	34	J	140	U
Trichloroethene	14	U	18	U	5.0	J	48	J	16	U	11	U	250		69		140	U
Vinyl Chloride	14	U	18	U	18	U	11	UJ	16	U	11	U	70	U	34	U	140	U
Semivolatile Organic Analysis (UG/KG)																		
1,1'-Biphenyl	5100	U	5800	U	6100	U	4100	U	820	J	4500	U	1500	UJ	1200	UJ	5200	J
2,4-Dimethylphenol	5100	U	5800	U	6100	U	4100	U	5300	U	4500	U	1500	UJ	1200	UJ	1300	J
2-Methylnaphthalene	5100	U	5800	U	1300	J	4100	U	2400	J	4500	U	1500	UJ	1200	UJ	18000	J
Acenaphthene	3100	J	5800	U	6200		750	J	9700		4500	U	1500	UJ	1200	UJ	71000	*J
Acenaphthylene	5100	U	5800	U	6100	U	4100	U	1800	J	4500	U	1500	UJ	1200	UJ	39000	J
Anthracene	6000		1000	J	10000		2200	J	57000	*	4500	U	170	J	1200	UJ	220000	*J
Benzaldehyde	5100	U	5800	U	6100	U	4100	U	5300	U	1700	J	1500	UJ	1200	UJ	5800	UJ
Benzo(a)anthracene	18000		2900	J	19000		7600		220000	*	700	J	460	J	1200	UJ	620000	*J
Benzo(a)pyrene	19000		3200	J	17000		6200		150000	*	600	J	320	J	1200	UJ	490000	*J
Benzo(b)fluoranthene	21000		4000	J	17000		6200		150000	*	590	J	270	J	1200	UJ	370000	*J

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed; ND Not Detected (aqueous samples, see Appendix A)

TABLE 4-8b (cont.)
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN DRAIN RESIDUE SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Sample Number	G32-DR-01		G32-DR-02		G32-DR-03		G32-DR-04		G32-DR-05		G32-DR-06		G32-DR-07		G32-DR-08		G32-DR-09	
Date Sampled	4/24/00		4/24/00		4/24/00		4/24/00		4/24/00		4/24/00		4/25/00		4/25/00		4/26/00	
QC Identifier	None		Field Dup. G32-DR-02		None		None		None		None		None		None		None	
Matrix	Drain		Drain		Drain		Drain		Drain		Drain		Drain		Drain		Drain	
Percent Solids	66.5		59.5		58.6		81.9		62.2		75.9		21.1		27.9		11.1	
Benzo(g,h,i)perylene	9700		720	J	5500	J	2300	J	27000		4500	U	1500	UJ	1200	UJ	170000	*J
Benzo(k)fluoranthene	16000		3300	J	16000		7000		140000	*	710	J	320	J	1200	UJ	400000	*J
bis(2-Ethylhexyl)phthalate	7900		5800	U	3900	*	520	J	5300	U	160000	*	1500	UJ	1200	UJ	51000	j
Carbazole	5200		590	J	6100		1400	J	36000		4500	U	1500	UJ	1200	UJ	61000	*J
Chrysene	20000		4100	J	20000		8300		230000	*	1100	J	480	J	1200	UJ	520000	*J
Di-n-Butylphthalate	1100	J	5800	U	6500		4100	U	5300	U	4500	U	1500	UJ	1200	UJ	5800	UJ
Dibenzo(a,h)anthracene	4600	J	5800	U	2900	J	1200	J	17000		4500	U	1500	UJ	1200	UJ	38000	J
Dibenzofuran	1400	J	5800	U	2800	J	540	J	9800		4500	U	1500	UJ	1200	UJ	38000	*J
Fluoranthene	51000	D	7600		53000	*	22000		550000	*	1700	J	1200	J	1200	UJ	1500000	*J
Fluorene	2100	J	5800	U	4600	J	680	J	12000		4500	U	1500	UJ	1200	UJ	5800	UJ
Indeno(1,2,3-cd)pyrene	10000		770	J	5100	J	2400	J	32000		4500	U	1500	UJ	1200	UJ	190000	*J
Naphthalene	1000	J	5800	U	2600	J	770	J	4100	J	4500	U	1500	UJ	1200	UJ	39000	*J
Phenanthrene	34000		6000		51000	*	12000		26000	*	810	J	780	J	1200	UJ	600000	*J
Pyrene	40000		6800		45000	*	17000		470000	*	1400	J	1000	J	1200	UJ	1200000	*J
Pesticide/PCB Analysis (UG/KG)																		
4,4'-DDD	4.9	U	5.9	U	5.7	U	8.9		5.5	U	18		17	UJ	12	UJ	32	UJ
4,4'-DDE	260	*	61	J	13		30		5.5	U	43		17	UJ	12	UJ	32	UJ
4,4'-DDT	200	*	230	*J	72		82	*	5.5	U	55		24	J	12	UJ	32	UJ
alpha-Chlordane	2.4	U	2.9	U	2.8	U	27	J	2.8	U	2.3	U	8.3	UJ	5.9	UJ	16	UJ
Aroclor-1248	1200	*	59	U	57	U	43	U	55	U	46	U	170	UJ	120	UJ	320	UJ
Aroclor-1254	49	U	1400	J	150		340		55	U	320		170	UJ	120	UJ	320	UJ
Aroclor-1260	49	U	1100	J	57	U	43	U	55	U	46	U	170	UJ	120	UJ	320	UJ
Dieldrin	28		17	J	5.7	U	4.3	U	5.5	U	8.7		17	UJ	12	UJ	32	UJ
Endosulfan II	4.9	U	5.9	U	6.0		4.3	U	5.5	U	4.6	U	17	UJ	12	UJ	32	UJ
gamma-Chlordane	2.4	U	2.9	U	2.8	U	18	J	2.8	U	2.3	U	8.3	UJ	5.9	UJ	16	UJ
Gasoline Range Organic Analysis (MG/KG)																		
Gasoline Range Organics	0.52		0.36	UJ	0.31	UJ	0.282	J	0.424		0.275		3.34	J	0.20	U	2.3	UJ

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed; ND Not Detected (aqueous samples, see Appendix A)

TABLE 4-8b (cont.)
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN DRAIN RESIDUE SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Sample Number	G32-DR-01		G32-DR-02		G32-DR-03		G32-DR-04		G32-DR-05		G32-DR-06		G32-DR-07		G32-DR-08		G32-DR-09	
Date Sampled	4/24/00		4/24/00		4/24/00		4/24/00		4/24/00		4/24/00		4/25/00		4/25/00		4/26/00	
QC Identifier	None		Field Dup. G32-DR-02		None		None		None		None		None		None		None	
Matrix	Drain		Drain		Drain		Drain		Drain		Drain		Drain		Drain		Drain	
Percent Solids	66.5		59.5		58.6		81.9		62.2		75.9		21.1		27.9		11.1	
Diesel Range Organic Analysis (MG/KG)																		
Diesel Range Organics	1490		17900	J	1350	J	690		7720		320		35.1	J	98.5	J	12900	J
TAL Metal Analysis (MG/KG)																		
Aluminum	3230	J	3140	J	1100	J	1070	J	1010	J	352	J	996	J	1170	J	1710	J
Antimony	95.8	J		R	541	J	103	J	2100		166	J	63.9	J		R		R
Arsenic	10.3	J	18.5	J	29.8	J	41.7	J	40.4	J	9.5	J	22.2	J	29.8	J	10.5	J
Barium	1250		1340		1640	J	702	J	6090		419	J	1120	J	1150	J	230	J
Beryllium	1.1		0.15	UJ	0.13	UJ	0.76	U	0.10	U	0.08	U		R	0.22	UJ		R
Cadmium	201		95.2	J	1140		4540		435	J	56900		230	J	106	J	73.6	J
Calcium	21500	J	15300	J	8400	J	10200	J	7510	J	3480	J	8470	J	5190	J	15300	J
Chromium	149		219		1480		495		600		11800		149	J	103	J	226	J
Cobalt	16.9	J	17.4	J	36.6	J	35.6	J	48.7	J	22.5	J	17.7	J	21.8	J	13.2	J
Copper	1300		2320		24700		1390	J	1050	J	9540		931	J	1680	J	2160	J
Cyanide	1.3	J	1.6		16.3		194		16.9		865			R		R		R
Iron	78600		199000		331000		334000		377000		177000		314000	J	453000	J	146000	J
Lead	4180		7590		28500		5270		24100		31600		7560	J	2410	J	2500	J
Magnesium	2340		1990		1130		1530		991		328		673	J	1010	J	1300	J
Manganese	462		939		1330		1300		1700		728		878	J	2010	J	641	J
Mercury	1.1	J	0.84	J	2.5	J	0.56	J	0.33	J	6.7	J	0.95	J	0.34	J	1.6	J
Nickel	169	J	285	J	1420	J	276	J	607	J	14100	J	175	J	142	J	980	J
Potassium	1170	J	3060	J		R	2270	J		R	4870	J		R	1020	J	645	J
Selenium	1.1	UJ	1.3	UJ	2.0	J	1.9	UJ	3.1	J	1.0	UJ	5.3	J	8.2	J		R
Silver	3.3		5.7		22.1		10.4		3.4		104		3.3	J	1.2	J	10.3	J
Sodium	560	J	5840	J	290	J	2360	J	160	UJ	7870	J	1070	J	3780	J	561	J
Thallium	1.4	UJ	1.2	UJ	1.3	UJ	1.8	UJ	2.4	UJ	16.0	J		R		R		R
Vanadium	33.9	J	15.3	J	34.5	J	57.6		38.0	J	41.3		15.5	J	13.2	J	19.3	J
Zinc	3050		62900		12100		2770		13700		2290		7420	J	11600	J	1670	J

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed; ND Not Detected (aqueous samples, see Appendix A)

TABLE 4-8b (cont.)
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN DRAIN RESIDUE SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Sample Number	G32-DR-10		G32-DR-11		G32-DUP4		G32-DR-12		G32-DR-13		G32-DR-14		G32-DUP3	
Date Sampled	4/26/00		4/26/00		4/26/00		4/24/00		4/25/00		4/25/00		4/24/00	
QC Identifier	Field Dup. G32-DR-10		None		Field Dup. G32-DR-10		None		None		None		Field Dup. G32-DR-02	
Matrix	Drain		Drain		Drain		Drain		Drain		Drain		Drain	
Percent Solids	AQ Sample		AQ Sample		AQ Sample		55.9		61.1		28.5		65.3	
Volatile Organic Analysis (UG/KG)														
2-Butanone	ND		ND		ND		21		64	J	47	UJ	79	
Acetone	ND		ND		ND		120	J	150	J	130	J	260	J
Benzene	ND		ND		ND		19	U	13	U	47	U	17	U
Carbon Disulfide	ND		ND		ND		19	U	46	J	45	J	17	U
Chloroethane	ND		ND		ND		19	U	13	U	47	U	7.0	J
Chloromethane	ND		ND		ND		19	U	13	U	47	U	25	
cis-1,2-Dichloroethene	ND		ND		ND		19	U	11	J	47	U	17	U
Ethylbenzene	ND		ND		ND		19	U	2.0	J	6.0	J	17	U
Isopropylbenzene	ND		ND		ND		19	U	4.0	J	47	U	17	U
Methylcyclohexane	ND		ND		ND		19	U	12	J	47	U	17	U
Methylene Chloride	ND		ND		ND		3.0	J	2.0	J	9.0	J	2.0	J
Tetrachloroethene	ND		ND		ND		19	U	40	J	47	U	17	U
Toluene	ND		ND		ND		19	U	7700	*	7.0	J	17	U
Total Xylenes	ND		ND		ND		19	U	14	J	29	J	17	U
trans-1,2-Dichloroethene	ND		ND		ND		19	U	13	U	47	U	17	U
Trichloroethene	ND		ND		ND		19	U	13	U	47	U	17	U
Vinyl Chloride	ND		ND		ND		19	U	5.0	J	47	U	17	U
Semivolatile Organic Analysis (UG/KG)														
1,1'-Biphenyl	1100	UJ	330	J	860	U	6100	U	2800	U	1200	UJ	2700	U
2,4-Dimethylphenol	1100	UJ	1100	U	860	U	6100	U	2800	U	1200	UJ	2700	U
2-Methylnaphthalene	1100	UJ	1200		860	U	1000	J	16000		1200	UJ	2700	U
Acenaphthene	1100	UJ	1800		860	U	4700	J	2800	U	1200	UJ	530	J
Acenaphthylene	1100	UJ	1100	U	190	J	6100	U	2800	U	1200	UJ	2700	U
Anthracene	1100	UJ	6300		180	J	11000		1600	J	240	J	1100	J
Benzaldehyde	1100	UJ	1100	U	860	U	6100	U	2800	U	1200	UJ	2700	U
Benzo(a)anthracene	1100	UJ	15000	*	1200		16000		5200		580	J	2600	J
Benzo(a)pyrene	1100	UJ	8500	*	1200		14000		6300		530	J	2600	J
Benzo(b)fluoranthene	1100	UJ	7500	*	1300		13000		7500		520	J	3500	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed; ND Not Detected (aqueous samples, see Appendix A)

TABLE 4-8b (cont.)
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN DRAIN RESIDUE SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Sample Number	G32-DR-10		G32-DR-11		G32-DUP4		G32-DR-12		G32-DR-13		G32-DR-14		G32-DUP3	
Date Sampled	4/26/00		4/26/00		4/26/00		4/24/00		4/25/00		4/25/00		4/24/00	
QC Identifier	Field Dup. G32-DR-10		None		Field Dup. G32-DR-10		None		None		None		Field Dup. G32-DR-02	
Matrix	Drain		Drain		Drain		Drain		Drain		Drain		Drain	
Percent Solids	AQ Sample		AQ Sample		AQ Sample		55.9		61.1		28.5		65.3	
Benzo(g,h,i)perylene	1100	UJ	1900		630	J	3700	J	3000		250	J	2700	U
Benzo(k)fluoranthene	1100	UJ	9000	*	1300		13000		5100		480	J	3800	
bis(2-Ethylhexyl)phthalate	1100	UJ	1100	U	860	U	780	J	1100	J	1200	UJ	2700	U
Carbazole	1100	UJ	3200		860	U	4900	J	2800	U	1200	UJ	540	J
Chrysene	1100	UJ	15000	*	1300		15000		6700		650	J	3400	
Di-n-Butylphthalate	1100	UJ	1100	U	860	U	6100	U	300	J	1200	UJ	520	J
Dibenzo(a,h)anthracene	1100	UJ	1300		310	J	2300	J	1300	J	120	J	2700	U
Dibenzofuran	1100	UJ	2400		860	U	3400	J	2800	U	1200	UJ	360	J
Fluoranthene	120	J	43000	*	1400		46000		12000		1400	J	7700	
Fluorene	1100	UJ	1600		860	U	5500	J	1400	J	1200	UJ	530	J
Indeno(1,2,3-cd)pyrene	1100	UJ	2300		640	J	4000	J	3000		240	J	2700	U
Naphthalene	1100	UJ	3600		860	U	1200	J	2800	U	1200	UJ	2700	U
Phenanthrene	1100	UJ	35000	*	490	J	44000		13000		1000	J	5700	
Pyrene	110	J	33000	*	1100		33000		12000		1200	J	4700	
Pesticide/PCB Analysis (UG/KG)														
4,4'-DDD	11	UJ	11	U	8.7	U	5.9	U	5.3	U	12	UJ	5.4	U
4,4'-DDE	11	UJ	11	U	8.7	U	18		5.3	U	12	UJ	32	J
4,4'-DDT	11	UJ	11	U	8.7	U	34		5.3	U	24	J	55	J
alpha-Chlordane	5.7	UJ	5.3	U	4.3	U	3.0	U	2.6	U	5.9	UJ	2.7	U
Aroclor-1248	110	UJ	110	U	87	U	59	U	53	U	120	UJ	54	U
Aroclor-1254	110	UJ	110	U	87	U	270	J	2300		120	UJ	830	J
Aroclor-1260	110	UJ	110	U	87	U	59	U	53	U	260	J	500	J
Dieldrin	11	UJ	11	U	8.7	U	5.9	U	5.3	U	12	UJ	8.3	J
Endosulfan II	11	UJ	11	U	8.7	U	5.9	U	5.3	U	12	UJ	5.4	U
gamma-Chlordane	5.7	UJ	5.3	U	4.3	U	3.0	U	2.6	U	5.9	UJ	2.7	U
Gasoline Range Organic Analysis (MG/KG)														
Gasoline Range Organics	ND		ND		ND		0.522		57		0.936	J	0.477	J

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed; ND Not Detected (aqueous samples, see Appendix A)

TABLE 4-8b (cont.)
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN DRAIN RESIDUE SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
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Sample Number	G32-DR-10		G32-DR-11		G32-DUP4		G32-DR-12		G32-DR-13		G32-DR-14		G32-DUP3	
Date Sampled	4/26/00		4/26/00		4/26/00		4/24/00		4/25/00		4/25/00		4/24/00	
QC Identifier	Field Dup. G32-DR-10		None		Field Dup. G32-DR-10		None		None		None		Field Dup. G32-DR-02	
Matrix	Drain		Drain		Drain		Drain		Drain		Drain		Drain	
Percent Solids	AQ Sample		AQ Sample		AQ Sample		55.9		61.1		28.5		65.3	
Diesel Range Organic Analysis (MG/KG)														
Diesel Range Organics	123	J	1490		130	J	3600		25900		277	J	10600	J
TAL Metal Analysis (MG/KG)														
Aluminum	5520	J	943		3540		1770	J	2510		1180	J	5970	J
Antimony	13.7	J		R	1.2	UJ		R	26.5	J		R		R
Arsenic	24.9	J	36.0	J	3.2	J	21.1	J	11.0	J	14.3	J	23.7	J
Barium	194	J	120	J	64.5		857	J	108	J	1340	J	1130	J
Beryllium	0.67	UJ	0.18	U	0.43	U	0.11	U	0.21	U	0.32	UJ	0.19	U
Cadmium	67.1	J	39.3	J	30.2	J	46.0	J	16.6	J	73.4	J	64.2	J
Calcium	106000	J	3970	J	52100	J	19400	J	12100	J	18700	J	9090	J
Chromium	133	J	206	J	23.8	J	159		49.5	J	197	J	222	
Cobalt	50.1	J	30.3	J	20.4		18.4	J	11.4	J	21.8	J	25.6	J
Copper	904	J	601	J	299	J	973	J	436	J	322	J	2940	
Cyanide		R	1.5	UJ	1.2	UJ	0.89	U	1.0	J		R	1.6	
Iron	170000	J	605000	J	36900	J	213000		102000	J	250000	J	278000	
Lead	911	J	1300	J	249	J	4300		12700	J	2670	J	7720	
Magnesium	5520	J	3050		3430		2310		1370		31200	J	2010	
Manganese	1160	J	2100	J	582	J	1040		263	J	1360	J	1250	
Mercury	0.22	J	0.38		0.48		0.69	J	0.61		2.6	J	1.8	J
Nickel	132	J	236		44.5		167	J	76.1		228	J	528	J
Potassium	560	J		R	347		826	J	590	J	1110	J	2170	J
Selenium		R	12.2		2.0	UJ	1.4	UJ	1.4	J	3.7	J	1.8	J
Silver	2.8	J	3.4		0.86		2.4		2.6		7.6	J	2.8	
Sodium	203	UJ	794		390		737	J	367		1100	J	3790	J
Thallium		R	2.2	U	1.8	U	1.3	J	1.2	U		R	1.1	UJ
Vanadium	60.8	J	5.2	J	25.2	J	11.4	J	8.5	J	13.9	J	10.0	J
Zinc	8230	J	3610	J	4050	J	2790		1030	J	2200	J	93800	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed; ND Not Detected (aqueous samples, see Appendix A)

TABLE 4-8c
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN SURFACE SOIL SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Sample Number	G32-DUP2		G32-SS-01-06IN		G32-SS-02-06IN		G32-SS-03-06IN		G32-SS-04-06IN		G32-SS-05-06IN		G32-SS-06-06IN		G32-SS-07-06IN		G32-SS-08-06IN	
Date Sampled	4/20/00		4/20/00		4/20/00		4/20/00		4/20/00		4/20/00		4/20/00		4/20/00		4/20/00	
QC Identifier	Field Dup. G32-SS-07-06IN		None		None		None		None		None		None		Field Dup. G32-SS-07-06IN		None	
Matrix	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Percent Solids	68.9		53.1		73.4		29.8		84.6		92.1		83.5		61.7		80.5	
Volatile Organic Analysis (UG/KG)																		
2-Butanone	14	U	28	U	26	U	47	U	9.0	U	11	U	12	J	18	U	13	U
Acetone	75	J	150	J	140	J	140	J	34	J	40	J	74	J	100	J	120	J
Benzene	14	U	28	U	26	U	47	U	9.0	U	11	U	2.0	J	18	U	13	U
Chloromethane	14	U	28	U	26	U	47	U	9.0	U	11	U	5.0	J	18	U	13	U
Methyl Acetate	14	U	20	J	14	J	47	U	9.0	U	11	U	14	U	18	U	13	U
Semivolatile Organic Analysis (UG/KG)																		
1,1'-Biphenyl	65	J	680	U	460	U	1200	U	130	J	360	U	400	U	320	J	130	J
2-Methylnaphthalene	140	J	680	U	460	U	100	J	390	J	360	U	400	U	880	J	440	J
4-Methylphenol	530	U	680	U	460	U	1200	U	400	U	360	U	400	U	600	U	52	J
Acenaphthene	1400		70	J	92	J	750	J	1700		360	U	32	J	6300	*J	1400	J
Acenaphthylene	340	J	680	U	460	U	1200	U	60	J	360	U	34	J	300	J	49	J
Anthracene	3500	*J	130	J	200	J	1400		3400	*J	20	J	90	J	10000	*J	2400	
Benzaldehyde	530	U	680	U	460	U	1200	U	400	U	360	U	400	U	600	U	47	J
Benzo(a)anthracene	12000	*J	410	J	690		4100		8500	*	88	J	600		22000	*J	5300	*
Benzo(a)pyrene	9800	*J	390	J	630		3500		8100	*	85	J	860	J	19000	*J	4800	*
Benzo(b)fluoranthene	10000	*J	450	J	770		3700		6900	*	110	J	1500	J	18000	*J	4000	*
Benzo(g,h,i)perylene	6200	*J	140	J	280	J	1100	J	2900	J	73	J	450	J	14000	*J	1300	
Benzo(k)fluoranthene	9300	*J	360	J	680		3400		6400	*	78	J	1200	J	17000	*J	4500	*
bis(2-Ethylhexyl)phthalate	310	J	680	U	460	U	1200	U	400	U	41	J	400	U	280	J	52	J
Carbazole	2600		81	J	130	J	870	J	1500		360	U	79	J	5800	*J	1600	
Chrysene	14000	*	470	J	810		4400		9200	*	100	J	1000		23000	*	5200	*
Di-n-Butylphthalate	530	U	680	U	460	U	1200	U	400	U	42	J	400	U	600	U	410	U
Dibenzo(a,h)anthracene	2900	*J	88	J	130	J	720	J	1500		360	U	200	J	6600	*J	810	
Dibenzofuran	920		680	U	35	J	410	J	630		360	U	400	U	3300	J	890	
Fluoranthene	30000	*	990		1600		9400	*	20000	*	180	J	560		61000	*J	12000	*
Fluorene	1800		65	J	84	J	750	J	1200		360	U	400	U	5400	*J	1500	
Indeno(1,2,3-cd)pyrene	5900	*J	140	J	270	J	1300		2700		56	J	410	J	12000	*J	1500	
Naphthalene	190	J	680	U	35	J	220	J	1400		360	U	400	U	3500	J	990	J
Phenanthrene	20000	*	680		930		7300		15000	*	83	J	260	J	50000	*J	11000	*
Pyrene	24000	*	830		1500		8400		19000	*	160	J	1300		48000	*J	10000	*J

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed

TABLE 4-8c (cont.)
ANALYTICAL RESULTS - DETECTED COMPOUNDS IN SURFACE SOIL SAMPLES, BUILDING 32 SASE
BACKGROUND SUMMARY
SITE 17, BUILDING 32
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 OF 2

Sample Number	G32-DUP2		G32-SS-01-06IN		G32-SS-02-06IN		G32-SS-03-06IN		G32-SS-04-06IN		G32-SS-05-06IN		G32-SS-06-06IN		G32-SS-07-06IN		G32-SS-08-06IN	
Date Sampled	4/20/00		4/20/00		4/20/00		4/20/00		4/20/00		4/20/00		4/20/00		4/20/00		4/20/00	
QC Identifier	Field Dup. G32-SS-07-06IN		None		None		None		None		None		None		Field Dup. G32-SS-07-06IN		None	
Matrix	Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
Percent Solids	68.9		53.1		73.4		29.8		84.6		92.1		83.5		61.7		80.5	
Pesticide/PCB Analysis (UG/KG)																		
4,4'-DDT	5.3	U	6.9	U	6.2	P	12	P	17		5.5		5.4		6.0	U	6.6	
Aroclor-1254	4000	*	69	U	110		120	U	39	U	37	U	42	U	5800	*	43	U
Gasoline Range Organics (MG/KG)																		
Gasoline Range Organics	0.664		0.55	U	0.44	U	1.0	U	0.283		0.23	U	0.27	U	0.407		0.257	J
Diesel Range Organics (MG/KG)																		
Diesel Range Organics	558		123		410		490		371		364		553		734		94 2	J
TAL Metal Analysis (MG/KG)																		
Aluminum	1950		3480		6920		3840	J	11400		5820		4880		1750		6590	
Antimony	93.0	J	0.94	UJ	0.68	UJ	1.8	J	0.59	UJ	1.7	J	8.7	J	106	J	0.62	UJ
Arsenic	13.9		1.9	UJ	5.9		6.6	J	16.8		3.5	U	9.6		16.4		2.8	U
Barium	203		21.1		39.4		113	J	21.2		20.3		200		352		18.7	
Cadmium	38.1	J	2.3		9.9		511	J	1.4	J	2.6	J	8.1	J	51.8	J	1.7	
Calcium	10500		5420		642		16800	J	2440		1140		2010		12400		1300	
Chromium	79.8	J	7.4		67.3		86.8	J	21.3	J	14.1	J	48.2	J	86.7	J	12.1	
Cobalt	6.8		3.0		9.0		7.8	J	12.5		6.0		11.4		7.6		4.5	
Copper	112	J	27.8		413		146	J	36.3	J	94.0	J	287	J	121	J	26.6	
Cyanide	1.6		0.94	U	0.68	U	2.6	J	0.59	U	0.54	U	0.60	U	0.81	U	0.62	U
Iron	98200		7790		20700		17000	J	33000		25000		97600		113000		14900	
Lead	3140		35.8		225		337	J	106		292		1950		2710		112	
Magnesium	1010		1550		1890		1640	J	3800		2600		2490		767		2600	
Manganese	460		240		142		475	J	399		193		494		461		124	
Mercury	0.04	UJ	0.08	UJ	0.04	UJ	0.45	J	0.02	U	0.04	UJ	0.17		0.05	UJ	0.04	UJ
Nickel	33.3	J	9.2		23.5		64.3	J	24.6	J	13.4	J	47.8	J	44.7	J	13.1	
Potassium	305	J	485	J	429	J	551	J	385	J	655	J	773	J	236	J	928	J
Selenium		R	2.8	J	1.7	J	3.4	J	0.90	U		R		R		R	0.97	J
Silver	0.76	J	0.24	UJ	0.26	UJ	0.82	J	0.12	UJ	0.11	UJ	0.75	J	0.85	J	0.12	U
Vanadium	45.9		11.5		25.8		41.3	J	18.0		14.7		25.7		44.6		63.5	
Zinc	4430		60.2		129		2140	J	205		231		1310		4990		43.6	

U - Not detected; UJ - Detection limit approximate; J - Quantitation approximate;
* - From dilution analysis; R - Rejected; NA - Not Analyzed

5.0 DEMOLITION AND PCB INVESTIGATIONS

5.1 BUILDING DEMOLITION

Due to the deteriorated condition of the buildings at the site, the Navy undertook demolition and removal of the building overhead structures. Work on the demolition commenced in the spring of 2000, and continued until fall 2002. The demolition consisted of asbestos abatement, removal of building equipment and components, and demolition of buildings to the slab elevation only. The following buildings were demolished in this manner:

- Building 32 - Torpedo Overhaul Shop
- Building 33 - Steam Plant
- Building 34 – Acetylene Generator Building
- Building 35 (South) – Support for Torpedo Firing Pier
- Building 70 – Quonset Hut
- Building 52 - Riggers Storage Building
- Building 59 - Switch House/Transformer Vault
- Building 58 - Deep Well House
- Acid Storage Shed
- Buildings 53, 54, 56, 60, 61, 62 – Transformer Vaults

In addition, in 2000, the docks and piers that were in ruins at the shoreline were removed as they presented a navigation hazard. Removal of these structures involved dismantling the remaining above water structure, then cutting the pilings at grade. The following structures were removed in this manner:

- "T" Dock
- Ferry Dock
- Saltwater Intake Pier

During building demolition, concrete samples were taken from the interior floor and walls of the transformer vaults and the switch house to determine disposal options for the material. The results of this sampling indicated PCB contamination in some of the floor samples. Due to this finding, additional PCB investigations were conducted after building component removal. Details on the demolition and disposal of the buildings at Gould Island, conducted by Foster Wheeler Environmental Corporation (FWENC) are pending publication by FWENC.

5.2 PHASE 1 PCB SAMPLING (FOSTER WHEELER, 2002)

During building demolition, concrete samples taken from the interior floor and walls of the transformer vaults and the switch indicated PCB contamination in some of the floor samples. Therefore, FWENC initiated a first phase of PCB investigations to confirm the location of existing PCB contamination and determine the horizontal and vertical delineation of the PCB contamination in soils under the buildings, and in the concrete roadways and soils near those buildings. This first phase involved the concrete roadways, and transformer vaults (TRVs) 53, 54, 56, 59, 60, and 61, and the area around the Riggers Storage Building 52. An interim cleanup goal of 10 mg/kg was used to delineate action areas where excavations were conducted under Phase 2 (Section 5.3 of this report). Appendix C provides excerpts from the Foster Wheeler Draft Phase 1 Sampling Report for the Characterization of PCB Contaminated Soils and Concrete at Gould Island. Figure 4 in Appendix C shows Phase 1 grid sample stations.

PCB sampling was conducted in accordance with The Navy Installation Chemical Data Quality Manual and the Region I USEPA – New England Compendium of Quality Assurance Project Plan Guidance. The sampling and analysis effort involved screening (immunoassay) and laboratory confirmation analysis. Screening data was initially generated using immunoassay testing, with a minimum of 10% confirmed using EPA approved reference methods. Later analysis was all performed using EPA methods reference number 3550 or 3545 and 8082. A limited number of samples were taken using an extended suite of analytical methods, including analysis for VOCs, SVOCs, and TPH.

Samples were taken of debris, concrete, water, wastewater, and soil. Concrete samples were taken from the top one-inch of concrete on the surface of interest. In some locations, deep concrete was also collected, as the lowest one-inch of concrete dust in the component. Soil samples were taken below and around the transformer vault foundations using direct push instruments, at one foot intervals to a depth of two feet below the groundwater level, or two feet below the bottom of the transformer vault, whichever was deeper. At Building 54, sediment samples were collected as the sediment was within one of the grid areas.

Based on the findings of the grid sampling, additional samples were collected in some locations. This approach was based on TSCA rules and agreements with EPA and RIDEM representatives familiar with the project. Sample locations were surveyed to record location data.

Interim action goals were set at 10 mg/kg PCB in most locations, and 1 mg/kg in areas adjacent to the former Building 54 transformer vault, due to its proximity to the shoreline. Data from the Phase 1 study are summarized in Appendix C, Table C-1 (Concrete Sample Analysis) and C-2 (Soil Sample Analysis). Much of the concrete and underlying soils in the roadways analyzed for PCB content had undetectable

concentrations, or had PCBs below the action levels, with the exception of the concrete roadway at the riggers storage building (Building 52) and the roadway near Buildings 56 and 59.

Soil testing under the building foundations was also conducted if PCBs were detected in the concrete overlying those soils. In this manner, some concrete and soils at Buildings 52, 54, 56, 59, and 61 were delineated for later removal from the site.

Concrete and soils with PCBs in excess of the interim cleanup goals were removed from the area and disposed of as TSCA waste as a part of Phase 2 PCB removals (Section 5.3 of this report).

5.3 PHASE 2 PCB CONTAMINATED CONCRETE AND SOIL REMEDIATION (FOSTER WHEELER, 2002)

Phase 2 of the PCB Removal Actions involved actual removal and disposal of the contaminated concrete and soil delineated as described in Section 5.2 of this report. The removal actions have taken place to remove the soils and concrete with concentrations of PCBs in excess of the interim cleanup goals of 10 mg/kg PCB in soil and concrete, and 1 mg/kg in sediments near Building 54. This section describes the removal actions at each area in more detail.

- Concrete Roadways – The concrete roadways throughout the site were sampled as described in Section 5.2. Some sections where PCBs were not detected were removed and disposed of offsite as construction debris. Samples collected from other areas of the concrete roadways near Buildings 54, 56, 59 and 52 showed PCBs in excess of the interim cleanup goal, and these concentrations triggered additional sampling and delineation of removal areas of concrete and underlying soils.

- Building 54 – Concrete samples taken from the floor of this building found concentrations of PCBs (320 mg/kg) in excess of the interim cleanup goal, although the walls did not (2.1 mg/kg). The walls and roof were removed and used as backfill in the Building 44 UST removal area. The floor-slab was removed and disposed of off site as TSCA waste. The small basement area contained a small amount of water and oil that was removed and disposed of as TSCA waste. The foundation and soils underneath were removed to the approximate depth of the foundation. A single sample from the bottom of the excavation indicated PCBs present at concentrations above the interim cleanup goal, and thus a series of borings were performed in the former building foot print, and around the former building. These borings were used to delineate the Phase 2 removal action area.

- Building 56 – Concrete samples taken from the floor slab of this building (270 mg/kg) exceeded the PCB interim cleanup goal. The walls (0.9 mg/kg) did not exceed the criteria, so the material was removed and used as backfill in the Building 44 UST removal area. The floor slab and foundation were removed and disposed of as TSCA waste. Additional concrete samples from the north (roadway) side of Building 56 showed PCBs in excess of the interim cleanup goal also, and additional samples were taken to define the removal action area in this location.

- Building 59 - Concrete samples taken from the floor slab of this building (73 mg/kg) exceeded the PCB interim cleanup goal. The walls (2.9 mg/kg) did not exceed the criteria, so the material was removed and used as backfill in the Building 44 UST removal area. The floor slab and foundation were removed and disposed of as TSCA waste. Additional concrete samples from the north (roadway) side of Building 59 showed PCBs in excess of the interim cleanup goal also, and additional samples were taken to define the removal action area in this location.

- Building 60 - Concrete samples taken from the floor slab of this building (10,000 mg/kg) exceeded the PCB interim cleanup goal. The walls (0.2 mg/kg) did not exceed the criteria, so the material was removed and used as backfill in the Building 44 UST removal area. The floor slab and foundation were removed and disposed of as TSCA waste. Additional concrete samples from the north (roadway) side of Building 60 showed PCBs in excess of the interim cleanup goal also, and additional samples were taken to define the removal action area in this location.

- Building 61 - Concrete samples taken from the floor slab of this building (3,000 mg/kg) exceeded the PCB interim cleanup goal. The walls (0.2 mg/kg) did not exceed the criteria, so the material was removed and used as backfill in the Building 44 UST removal area. The floor slab and foundation were removed and disposed of as TSCA waste. Additional concrete samples from the north (roadway) side of Building 60 showed PCBs in excess of the interim cleanup goal also, and additional samples were taken to define the removal action area in this location.

As of the press date of this Background Summary Report, a report has not been made available that describes the excavations and confirmatory sampling at the site near the buildings listed above. However, data from confirmatory sampling after planned removals has been made available and is provided as Table C-3, Appendix C. Based on these data, it appears that excavations were continued in each area until the action level of 10 mg/kg PCB was met. Therefore it is likely that PCBs remain in the soils at concentrations that are below 10 mg/kg at these locations, and in the Building 44 UST removal action area, as described above.

6.0 SUMMARY

The following presents a brief summary of environmental media and areas of the site known or suspected to contain oil or hazardous materials.

6.1 GROUNDWATER CONTAMINATION

Based on studies performed to date, groundwater appears to contain low concentrations of petroleum, chlorinated solvents, PAHs, and metals. Low concentrations of these contaminants are currently known to exist in the area of former Building 44, and the open areas to the west. Traces of petroleum hydrocarbons may be found in the groundwater south of Building 32 as well, in the area of the former 1000 gallon UST.

Groundwater appears to have a northeastern flow direction, although measured head differences are slight, and tidal fluctuations are likely in this area.

6.2 VADOSE ZONE CONTAMINATION

Based on The Quad 3 Group study in 1997 and the TtNUS SASE study performed in 2000, it is anticipated that there are chlorinated solvents, toluene, and PAHs under the existing slab foundation for Building 32, and also to the north as far as the firing pier. This is consistent with the former use of the building, materials likely to have been used at the site, and history of operations at the site.

6.3 SOIL CONTAMINATION

Based on the PCB sampling efforts conducted by Foster Wheeler in 2001 and 2002, it is apparent that there are soils present containing PCBs at concentrations below 10 mg/kg at the former locations of Buildings 52, 53, 54, 56, 59, 60, and 61.

6.4 SEDIMENT CONTAMINATION

Based on historical records, piping configurations and sampling of sediment and mussels conducted in the 1980s, electroplating fluids were likely to have been discharged to Narragansett Bay, in the subtidal area to the east of Building 32. Additionally, it is likely that chlorinated and non-chlorinated solvents from the degreasing operations conducted in Building 32 may also have been discharged in that area. The subtidal environment at this location is highly active, exposed to the north, south and east. The discharge

pipes have rotted away, and there is very little depositional sediment present. There is an apparently healthy epibenthic ecosystem in place that is typical for Narragansett Bay.

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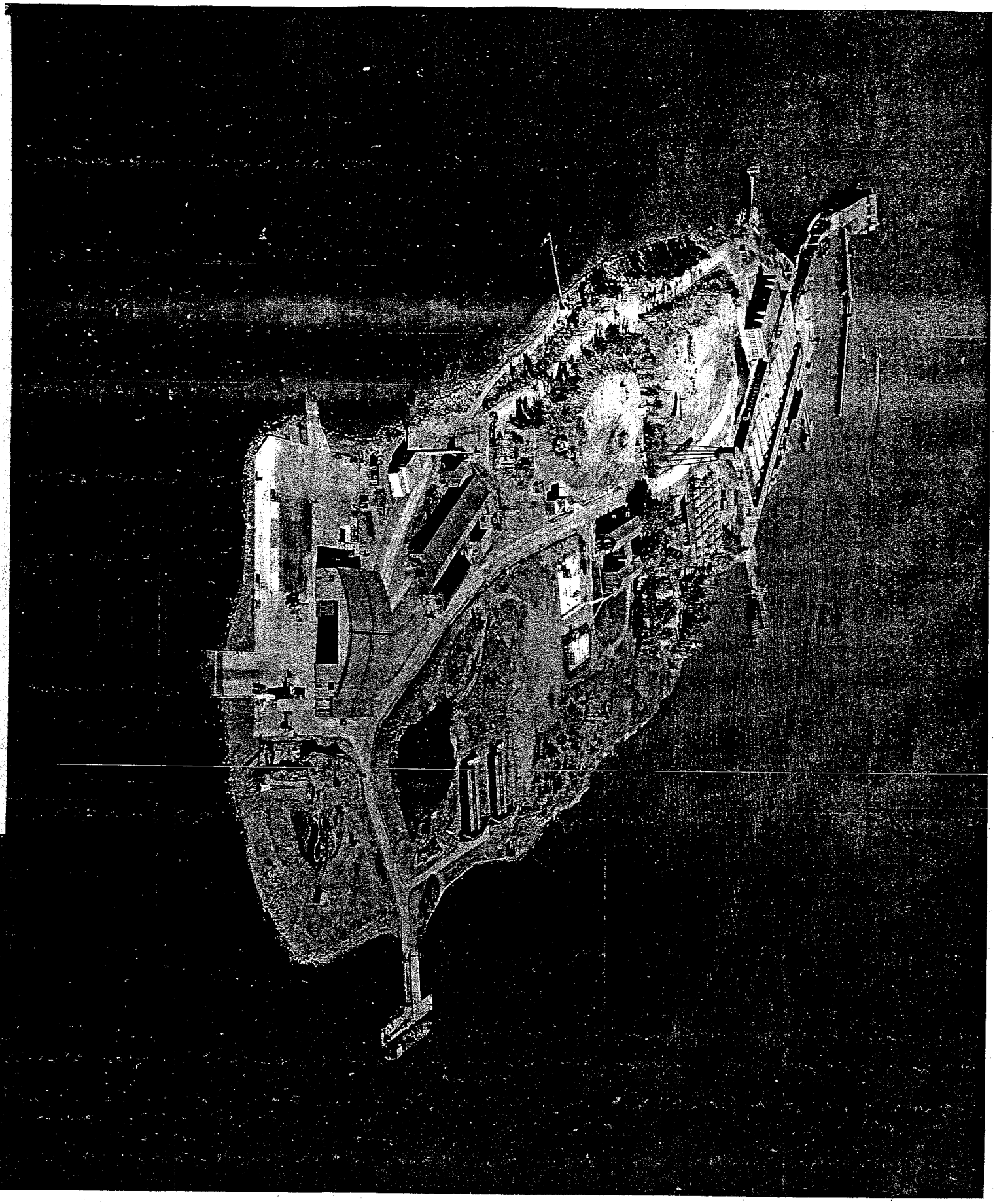
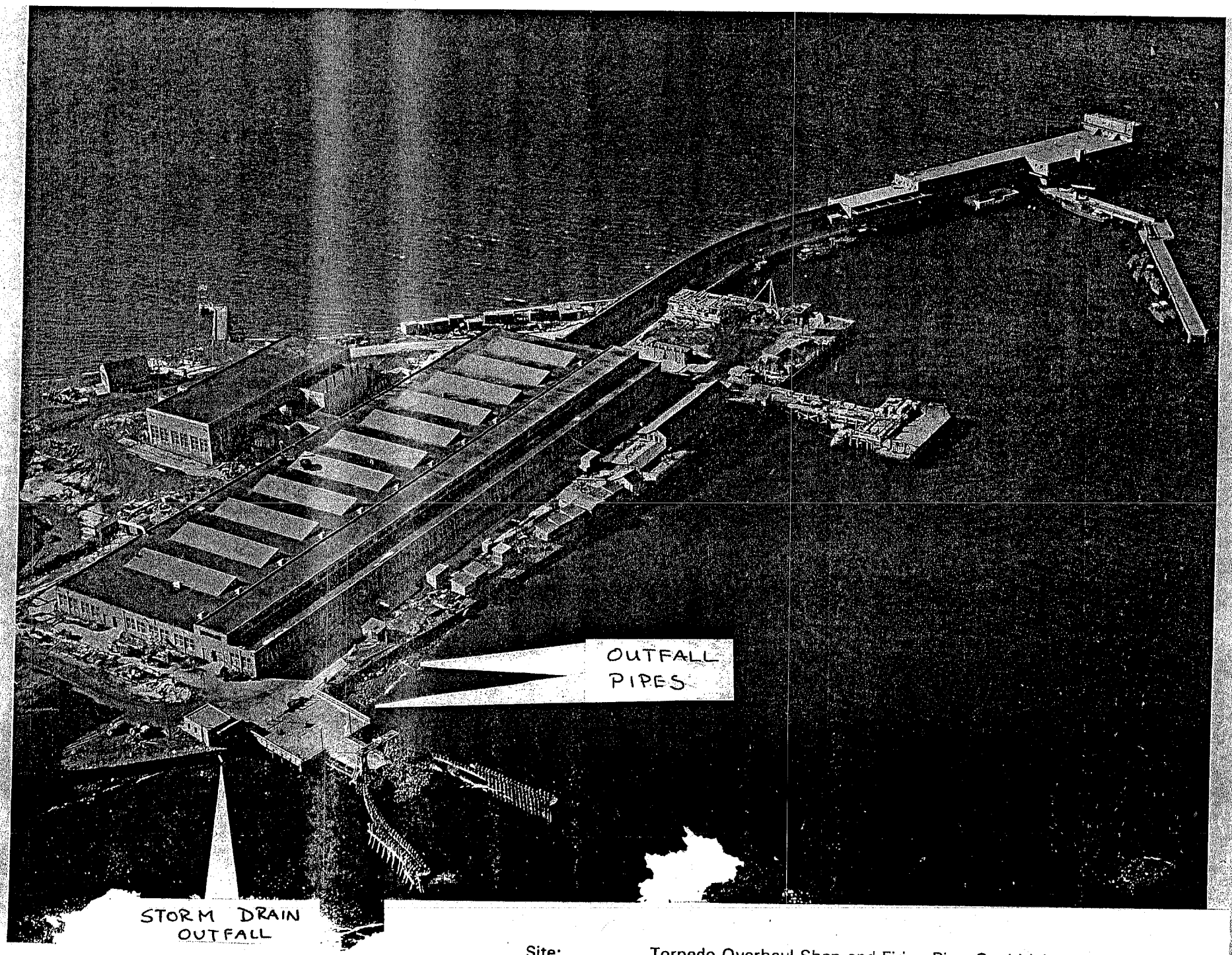
APPENDIX A

SELECTED HISTORICAL AIR PHOTOS, GOULD ISLAND





Site: Torpedo Overhaul Shop and Firing Pier, Gould Island
Date: February 9, 1943

APPENDIX B

SOIL GAS SURVEY RESULTS, APRIL 2000

W. L. GORE & ASSOCIATES, INC.

Creative Technologies Worldwide

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GORE-SORBER® EXPLORATION SURVEY
GORE-SORBER® SCREENING SURVEY

GORE-SORBER® Screening Survey
Final Report

Gould Island Building 32
Newport, RI

May 24, 2000

Gore Production Order No. 10380972

Prepared For:
Tetra Tech NUS, Inc.
55 Jonspin Road
Wilmington, MA 01887

W.L. Gore & Associates, Inc.

Written/Submitted by:
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Reviewed/Approved by:
Ray F. Fenstermacher, P.G., Project Manager

Analytical Data Reviewed by:
Jim E. Whetzel, Chemist

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GORE-SORBER® Screening Survey
Final Report

REPORT DATE: May 24, 2000 **AUTHOR:** JWH

SITE INFORMATION

Site Reference: Gould Island Building 32, Newport, RI
Customer Purchase Order Number: 00-775
Gore Production Order Number: 10380972 **Gore Site Code:** BJM

FIELD PROCEDURES

 # Modules shipped: 76
Installation Date(s): 04/17/2000 **# Modules Installed:** 66
Field work performed by: Tetra Tech NUS, Inc.

Retrieval date(s): 05/01/2000 **Exposure Time:** 14 [days]
 # Modules Retrieved: 61 **# Trip Blanks Returned:** 2
 # Modules Lost in Field: 3 **# Unused Modules Returned:** 0

Date/Time Received by Gore: 05/03/2000 @ 01:15 PM **By:** TS
Chain of Custody Form attached: √
Chain of Custody discrepancies: None
Comments:
Two modules, #327762 and –738, were identified as trip blanks.
Nine modules, #327690-696, -767, and –768, were not returned to Gore.
Three modules, #327745, -753, and –758, were not returned to Gore and indicated as lost on the Chain of Custody.
One module, #327734, was listed as not installed.

GORE-SORBER® Screening Survey
Final Report

ANALYTICAL PROCEDURES

W.L. Gore & Associates´ Screening Module Laboratory operates under the guidelines of its Quality Assurance Manual, Operating Procedures and Methods. The quality assurance program is consistent with Good Laboratory Practices (GLP) and ISO Guide 25, "General Requirements for the Competence of Calibration and Testing Laboratories", third edition, 1990.

Instrumentation consists of state of the art gas chromatographs equipped with mass selective detectors, coupled with automated thermal desorption units. Sample preparation simply involves cutting the tip off the bottom of the sample module and transferring one or more exposed sorbent containers (sorbers, each containing 40mg of a suitable granular adsorbent) to a thermal desorption tube for analysis. Sorbers remain clean and protected from dirt, soil, and ground water by the insertion/retrieval cord, and require no further sample preparation.

Analytical Method Quality Assurance:
The analytical method employed is a modified EPA method 8260A/8270B. Before each run sequence, two instrument blanks, a sorber containing 5µg BFB (Bromofluorobenzene), and a method blank are analyzed. The BFB mass spectra must meet the criteria set forth in the method before samples can be analyzed. A method blank and a sorber containing BFB is also analyzed after every 30 samples and/or trip blanks. Standards containing the selected target compounds at three calibration levels of 5, 20, and 50µg are analyzed at the beginning of each run. The criterion for each target compound is less than 35% RSD (relative standard deviation). If this criterion is not met for any target compound, the analyst has the option of generating second- or third-order standard curves, as appropriate. A second-source reference standard, at a level of 10µg per target compound, is analyzed after every ten samples and/or trip blanks, and at the end of the run sequence. Positive identification of target compounds is determined by 1) the presence of the target ion and at least two secondary ions; 2) retention time versus reference standard; and, 3) the analyst's judgment.

NOTE: All data have been archived. Any replicate sorbers not used in the initial analysis will be discarded fifteen (15) days from the date of analysis.

Laboratory analysis: thermal desorption, gas chromatography, mass selective detection
Quality Assurance Level: 2 (ANA-4/A1)
Instrument ID: # 5 **Chemist:** JW **Data Subdirectory:** 10380972
Compounds/mixtures requested: Custom Target Compounds
Deviations from Standard Method: None
Comments: Soil vapor analytes and abbreviations are tabulated in the Data Table Key (page 6).

GORE-SORBER® Screening Survey
Final Report

DATA TABULATION

 # CONTOUR MAPS ENCLOSED: Three B-sized color contour maps
LIST OF MAPS ENCLOSED:

- Trichloroethene (TCE)
- Naphthalene
- Total Petroleum Hydrocarbons (TPH)

NOTE: All data values presented in Appendix A represent masses of compound(s) desorbed from the GORE-SORBER Screening Modules received and analyzed by W.L. Gore, as identified in the Chain of Custody (Appendix A). The measurement traceability and instrument performance are reproducible and accurate for the measurement process documented. Semi-quantitation of the compound mass is based on either a single-level (QA Level 1) or three-level (QA Level 2) standard calibration.

General Comments:

- This survey reports soil gas mass levels present in the vapor phase. Vapors are subject to a variety of attenuation factors during migration away from the source concentration to the module. Thus, mass levels reported from the module will often be less than concentrations reported in soil and groundwater matrix data. In most instances, the soil gas masses reported on the modules compare favorably with concentrations reported in the soil or groundwater (e.g., where soil gas levels are reported at greater levels relative to other sampled locations on the site, matrix data should reveal the same pattern, and vice versa). However, due to a variety of factors, a perfect comparison between matrix data and soil gas levels can rarely be achieved.
- Soil gas signals reported by this method cannot be identified to soil adsorbed, groundwater, and/or free-product contamination. The soil gas signal reported from each module can evolve from all of these sources. Differentiation between soil and groundwater contamination can only be achieved with prior knowledge of the site history (i.e., the site is known to have groundwater contamination only).
- Currently, soil gas surveys are not designed to replace soil or groundwater matrix sampling. Following a soil gas survey, matrix sampling is recommended in select areas to establish the nature of the contamination (i.e., soil, groundwater, or both), and the relationship to the soil gas levels.

GORE-SORBER® Screening Survey
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- QA/QC trip blank modules were provided to document contamination occurring that was not part of the soil gas signal of interest (i.e., impact during module shipment, installation and retrieval, and storage). The trip blanks are identically manufactured and packaged soil gas modules to those modules placed in the subsurface. However, the trip blanks remain unopened during all phases of the soil gas survey. Levels reported on the trip blanks may indicate potential impact to modules other than the contaminant source of interest.
- Unresolved peak envelopes (UPEs) are represented as a series of compound peaks clustered together around a central GC elution time in the total ion chromatogram. Typically, UPEs are indicative of complex fluid mixtures that are present in the subsurface. UPEs observed early in the chromatogram are considered to indicate the presence of more volatile fluids, while UPEs observed later in the chromatogram may indicate the presence of less volatile fluids. Multiple UPEs may indicate the presence of multiple complex fluids. Attenuation of the VOC/SVOC soil gas components may suggest the presence of a less volatile fluid, when in fact, a more volatile fluid existed but the volatile components have weathered away.

Project Specific Comments:

- The minimum (gray) contour level for individually mapped target analytes is set at the maximum QA blank level observed or the method detection limit (MDL), whichever is greater. For summed compounds, e.g., BTEX, the minimum contour level is arbitrarily set at 0.02 μg or the maximum blank level observed, whichever is greater. No MDLs exist for summed data. The maximum contour level is set at the maximum value observed, by compound(s).
- Stacked total ion chromatograms (TICs) are included in Appendix A. The six digit serial number of each module is incorporated into the TIC identification (e.g.: 123456S.D represents module #123456).
- Nominal QA blank levels were reported for some target analytes. In our experience, TPH, GRPH, and DRPH, present in the blanks at these levels, can be considered "background." Thus, target analyte levels, reported for the field-installed modules, that exceed trip and method blank levels, and the method detection limits, have a high probability of originating from on-site sources.
- Moderate to high soil gas mass levels for petroleum-related and chlorinated compounds were observed. Naphthalene and 2-methylnaphthalene levels were the most abundant.
- Well-defined naphthalene soil gas plumes were observed encompassing modules installed within the building.
- The soil gas plumes appear to extend into areas of the site that were not sampled for soil gas. If the objective of the soil gas survey was to delineate the nature and extent of the contamination, then additional soil gas sampling is recommended in those areas. Subsequent soil gas sampling events can be combined onto one set of maps providing increased resolution of the subsurface impact.

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GORE-SORBER® Screening Survey
Final Report

KEY TO DATA TABLE
Gould Island Building 32, Newport, RI

UNITS	
µg	micrograms (per sorber), reported for compounds
MDL	method detection limit
bdl	below detection limit
nd	non-detect
ANALYTES	
TPH	total petroleum hydrocarbons
GRPH	gasoline-range petroleum hydrocarbons
DRPH	diesel-range petroleum hydrocarbons
2MePHENOL	2-methylphenol
BTEX	benzene, toluene, ethylbenzene and total xylenes combined
BENZ	benzene
TOL	toluene
EtBENZ	ethylbenzene
mpXYL	m-, p-xylene
oXYL	o-xylene
C11, C13, & C15	undecane, tridecane, and pentadecane combined (Diesel Range Alkanes)
UNDEC	undecane
TRIDEC	tridecane
PENTADEC	pentadecane
TMBs	1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene combined
135TMB	1,3,5-trimethylbenzene
124TMB	1,2,4-trimethylbenzene
ct12DCE	cis- & trans-1,2-dichloroethene combined
t12DCE	trans-1,2-dichloroethene
c12DCE	cis-1,2-dichloroethene
NAPH&2-MN	naphthalene and 2-methyl naphthalene combined
NAPH	naphthalene
2MeNAPH	2-methyl naphthalene
MTBE	methyl t-butyl ether
11DCA	1,1-dichloroethane
$CHCl_3$	chloroform
111TCA	1,1,1-trichloroethane
12DCA	1,2-dichloroethane
CCl_4	carbon tetrachloride
TCE	trichloroethene
OCT	octane
PCE	tetrachloroethene
ClBENZ	chlorobenzene
14DCB	1,4-dichlorobenzene
112TCA	1,1,2-trichloroethane
1112TetCA	1,1,1,2-tetrachloroethane
1122TetCA	1,1,2,2-tetrachloroethane
13DCB	1,3-dichlorobenzene
14DCB	1,4-dichlorobenzene
12DCB	1,2-dichlorobenzene
BLANKS	
TBn	unexposed modules (trip blanks), documents ambient impact during field activities
method blank	QA/QC module, documents ambient impact during analysis

APPENDIX A:

1. CHAIN OF CUSTODY
2. DATA TABLE
3. STACKED TOTAL ION CHROMATOGRAMS
4. COLOR CONTOUR MAPS

GORE-SORBER® Screening Survey Chain of Custody

For W.L. Gore & Associates use only
Production Order # 10380972

W. L. Gore & Associates, Inc., Environmental Products Group
100 Chesapeake Boulevard • Elkton, Maryland 21921 • Tel: (410) 392-7600 • Fax (410) 506-4780

Instructions: Customer must complete ALL shaded cells

Customer Name: tetra tech nus inc	Site Name: naval education and training center
Address: 55 jonspin road	Site Address: Newport, RI
wilmington ma	Gould Island Bldg 32
usa	Project Manager: steve parker
Phone: 978-658-7899	Customer Project No.: N7574
FAX: 978-658-7870	Customer P.O. #: 00-775 Quote #: 206557

Serial # of Modules Shipped				# of Modules for Installation 70	# of Trip Blanks 6	
# 327690	- # 327758	#	- #	Total Modules Shipped: 76		Pieces
# 327762	- # 327768	#	- #	Total Modules Received: 76		Pieces
#	- #	#	- #	Total Modules Installed: 66 (- 3 lost)		Pieces
#	- #	#	- #	Serial # of Trip Blanks (*Client Decides*)		#
#	- #	#	- #	# 327762	#	#
#	- #	#	- #	# 327738	#	#
#	- #	#	- #	#	#	#
#	- #	#	- #	#	#	#
#	- #	#	- #	#	#	#
#	- #	#	- #	#	#	#
GORE ANALYTICAL OPTION:				#	#	#
[A 7]				#	#	#

Installation Performed By:	Installation Method(s) (*circle those that apply*):
Name (*please print*): Steve Parker / Dave Masse	Slide Hammer (Hammer Drill) Auger
Company/Affiliation: Tetra Tech NUS	Other:

Installation Start Date and Time:	4 / 17 / 00	7 : 35 (AM) PM
Installation Complete Date and Time:	4 / 17 / 00	3 : 50 AM (PM)

Retrieval Performed By:	Total Modules Retrieved: 63 Pieces
Name (*please print*): Steve Parker / Dave Masse	Total Modules Lost in Field: 3 Pieces
Company/Affiliation: Tetra Tech NUS	Total Unused Modules Returned: 0 Pieces

Retrieval Start Date and Time:	5 / 1 / 00	6 : 55 (AM) PM
Retrieval Complete Date and Time:	5 / 1 / 00	9 : 30 (AM) PM

Relinquished By C. Whi[illegible]	Date 4-13-5	Time 12:50	Received By:	Date	Time
Affiliation: W.L. Gore & Associates, Inc.			Affiliation:		
Relinquished By [illegible]	Date 5-2-00	Time 1600	Received By:	Date	Time
Affiliation: T+N US Inc			Affiliation:		
Relinquished By	Date	Time	Received By: Tony Kolesot	Date	Time
Affiliation			Affiliation: W.L. Gore & Associates, Inc.	5/3/00	11:15 pm

Delivered to Gore by Fed Ex AB# 816917336180

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FORM 8R.5

GORE-SORBER® Screening Survey Installation and Retrieval Log

Page 1 of 2

SITE NAME & LOCATION
Gould Island Building 32
Newport, RI

LINE #	MODULE #	INSTALLATION DATE/TIME	RETRIEVAL DATE/TIME	EVIDENCE OF LIQUID HYDROCARBONS (LPH) or HYDROCARBON ODOR (Check as appropriate)			MODULE IN WATER (check one)		COMMENTS
				LPH	ODOR	NONE	YES	NO	
1.	327690								
2.	327691								
3.	327692								
4.	327693								
5.	327694								
6.	327695								
7.	327696								
8.	327697	4/17/00 / 1550	5/1/00 0930			✓		✓	
9.	327698	4/17/00 / 1550	5/1/00 0930			✓		✓	
10.	327699	4/17/00 / 1545	5/1/00 0928			✓		✓	
11.	327700	4/17/00 1535	5/1/00 0926			✓		✓	
12.	327701	4/17/00 1525	5/1/00 0924			✓		✓	
13.	327702	4/17/00 1525	5/1/00 0924			✓		✓	
14.	327703	4/17/00 1515	5/1/00 0935			✓		✓	
15.	327704	4/17/00 1455	5/1/00 0920			✓		✓	
16.	327705	4/17/00 1445	5/1/00 0918			✓		✓	
17.	327706	4/17/00 1445	5/1/00 0918			✓		✓	
18.	327707	4/17/00 1440	5/1/00 0917			✓		✓	
19.	327708	4/17/00 1429	5/1/00 0915			✓		✓	
20.	327709	4/17/00 1424	5/1/00 0914			✓		✓	
21.	327710	4/17/00 1418	5/1/00 0913			✓		✓	
22.	327711	4/17/00 1411	5/1/00 0912			✓		✓	
23.	327712	4/17/00 1405	5/1/00 0911			✓		✓	
24.	327713	4/17/00 1359	5/1/00 0910			✓		✓	
25.	327714	4/17/00 1340	5/1/00 0908			✓		✓	
26.	327715	4/17/00 1330	5/1/00 0906			✓		✓	
27.	327716	4/17/00 1310	5/1/00 0905			✓		✓	
28.	327717	4/17/00 1304	5/1/00 0902			✓		✓	
29.	327718	4/17/00 1259	5/1/00 0859			✓		✓	
30.	327719	4/17/00 1250	5/1/00 0858			✓		✓	
31.	327720	4/17/00 1242	5/1/00 0856			✓		✓	
32.	327721	4/17/00 1235	5/1/00 0854			✓		✓	
33.	327722	4/17/00 1228	5/1/00 0853			✓		✓	
34.	327723	4/17/00 1224	5/1/00 0851			✓		✓	
35.	327724	4/17/00 1214	5/1/00 0850			✓		✓	
36.	327725	4/17/00 1211	5/1/00 0849			✓		✓	
37.	327726	4/17/00 1118	5/1/00 0839			✓		✓	
38.	327727	4/17/00 1115	5/1/00 0842			✓		✓	
39.	327728	4/17/00 1107	5/1/00 0845			✓		✓	
40.	327729	4/17/00 1058	5/1/00 0836			✓		✓	
41.	327730	4/17/00 1055	5/1/00 0835			✓		✓	
42.	327731	4/17/00 1051	5/1/00 0832			✓		✓	

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GORE-SORBER® Screening Survey
Installation and Retrieval Log

Page 2 of 2.

SITE NAME & LOCATION
Gould Island Building 32
Newport, RI

LINE #	MODULE #	INSTALLATION DATE/TIME	RETRIEVAL DATE/TIME	EVIDENCE OF LIQUID HYDROCARBONS (LPH) or HYDROCARBON ODOR (Check as appropriate)			MODULE IN WATER (check one)		COMMENTS
				LPH	ODOR	NONE	YES	NO	
43.	327732	4/17/00 1046	5/1/00 0829			✓		✓	
44.	327733	4/17/00 1041	5/1/00 0828			✓		✓	
45.	327734	NOT INSTALLED							
46.	327735	4/17/00 1028	5/1/00 0830			✓		✓	
47.	327736	4/17/00 1020	5/1/00 0825			✓		✓	
48.	327737	4/17/00 1010	5/1/00 0823			✓		✓	
49.	327738	4/17/00 1000	5/1/00 0823			✓		✓	
50.	327739	4/17/00 0953	5/1/00 0815			✓		✓	
51.	327740	4/17/00 0953	5/1/00 0815			✓		✓	
52.	327741	4/17/00 0948	5/1/00 0809			✓		✓	
53.	327742	4/17/00 0944	5/1/00 0808			✓		✓	
54.	327743	4/17/00 0942	5/1/00 0807			✓		✓	
55.	327744	4/17/00 0935	5/1/00 0805			✓		✓	
56.	327745	4/17/00 0929	— —						
57.	327746	4/17/00 0920	5/1/00 0751			✓		✓	
58.	327747	4/17/00 0910	5/1/00 0745			✓		✓	
59.	327748	4/17/00 0859	5/1/00 0740			✓		✓	
60.	327749	4/17/00 0855	5/1/00 0738			✓		✓	
61.	327750	4/17/00 0855	5/1/00 0738			✓		✓	
62.	327751	4/17/00 0850	5/1/00 0736			✓		✓	
63.	327752	4/17/00 0845	5/1/00 0734			✓		✓	
64.	327753	4/17/00 0819	~~5/1/00~~ —						
65.	327754	4/17/00 0815	5/1/00 0723			✓		✓	
66.	327755	4/17/00 0829	5/1/00 0711			✓		✓	
67.	327756	4/17/00 0824	5/1/00 0708			✓		✓	
68.	327757	4/17/00 0810	5/1/00 0718			✓		✓	
69.	327758	4/17/00 0805	— —						
70.	327762	4/17/00 0750	5/1/00 0710			✓		✓	
71.	327763	4/17/00 0748	5/1/00 0705			✓		✓	
72.	327764	4/17/00 0745	5/1/00 0704			✓		✓	
73.	327765	4/17/00 0742	5/1/00 0703			✓		✓	
74.	327766	4/17/00 0735	5/1/00 0655			✓		✓	
75.	327767								
76.	327768								
77.									
78.									
79.									
80.									
81.									
82.									
83.									
84.									

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CORE SOPBER SCREENING SURVEY ANALYTICAL RESULTS
TETRA TECH NUS, INC. WILMINGTON, MA
CUSTOM TARGET LIST (MT)
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT RI
SITE BJM - PRODUCTION ORDER 01239372

DATE ANALYZED	SAMPLE NAME	TPH, ug	GRPH, ug	DRPH, ug	BTEX, ug	BENZ, ug	TOL, ug	EBENZ, ug	mpXYL, ug	oXYL, ug	C11-C13, &C15, ug	UNDEC, ug	TRIDEC, ug	PENTADEC, ug	TMBs, ug
	MOL=					1.05	0.03	0.03	0.04	0.03		0.09	0.04	0.01	
05/04/00	327697	4.55	0.07	4.32	0.00	nd	nd	ns	nd	ns	0.17	bdl	0.06	0.11	0.00
05/04/00	327698	3.73	0.07	3.53	0.00	ns	nd	ns	ns	nd	0.12	bdl	0.06	0.07	0.00
05/04/00	327699	24.22	1.90	25.27	0.00	nd	nd	ns	nd	ns	1.26	0.91	0.51	0.44	0.00
05/04/00	327700	19.37	15.78	10.90	41.35	nd	40.86	0.22	0.69	0.22	1.11	0.77	0.22	0.12	0.52
05/04/00	327701	28.24	9.79	23.13	0.13	nd	0.06	nd	0.07	0.03	2.44	1.16	0.97	0.11	1.10
05/04/00	327702	42.53	13.60	36.65	0.03	ns	nd	nd	bd	0.03	4.38	2.35	1.61	0.45	1.39
05/04/00	327703	4.71	2.51	3.37	0.09	ns	nd	ns	0.05	0.04	0.42	0.26	0.19	0.28	0.27
05/04/00	327704	36.58	12.00	30.54	0.27	nd	0.06	nd	0.10	0.12	6.33	3.46	2.37	0.45	2.59
05/04/00	327706	8.17	4.80	5.53	0.22	nd	0.06	0.04	0.07	0.05	2.60	2.48	0.03	0.24	2.37
05/04/00	327708	9.53	10.64	3.34	1.17	0.06	0.19	0.15	0.40	0.27	2.39	2.36	bdl	0.34	2.91
05/04/00	327707	25.49	21.04	14.24	0.33	nd	0.04	0.02	0.13	0.13	3.20	2.98	0.18	0.24	2.53
05/04/00	327709	41.58	33.30	24.75	0.98	nd	0.27	ns	0.06	0.12	2.47	0.91	1.05	0.51	1.82
05/04/00	327709	52.55	22.71	40.14	0.43	bdl	0.11	0.06	0.15	0.12	4.83	1.95	1.50	0.85	2.87
05/04/00	327710	3.77	1.38	3.03	0.03	nd	nd	ns	bd	0.03	2.34	0.23	0.03	0.03	0.29
05/04/00	327711	6.52	0.62	6.55	0.00	nd	nd	ns	bd	ns	2.65	0.12	0.56	0.17	0.12
05/04/00	327712	35.53	6.19	31.50	0.23	nd	0.10	nd	0.07	0.05	4.01	1.47	1.83	0.66	0.70
05/04/00	327713	3.55	3.34	1.88	0.13	nd	nd	bd	0.06	0.05	2.07	0.05	bdl	0.03	0.51
05/04/00	327714	4.15	3.22	2.47	2.23	nd	1.90	0.06	0.21	0.05	2.15	0.12	bdl	0.03	0.00
05/04/00	327715	5.57	3.87	3.83	0.16	nd	0.04	nd	0.07	0.05	2.29	0.27	bdl	0.02	0.50
05/04/00	327715	2.23	1.59	1.45	0.00	nd	nd	ns	bd	bdl	0.04	bdl	bdl	nd	0.17
05/04/00	327717	2.33	0.24	2.25	0.04	nd	0.04	ns	nd	nd	2.04	bdl	bdl	0.04	0.00
05/04/00	327718	7.48	7.06	3.71	5.43	nd	5.43	ns	bd	bdl	2.20	0.04	0.10	0.06	0.00
05/04/00	327719	3.22	1.69	2.32	0.03	nd	nd	nd	bd	0.03	0.14	0.12	bdl	0.02	0.29
05/04/00	327722	13.22	8.00	8.72	0.39	nd	0.18	0.06	0.11	0.03	2.28	2.15	0.07	0.34	2.66
05/04/00	327721	30.83	17.17	21.54	5.93	0.30	4.72	0.33	0.35	0.20	1.75	1.16	0.32	0.32	3.78
05/04/00	327722	14.42	0.13	14.34	0.03	nd	nd	ns	nd	ns	1.70	2.14	1.02	0.55	3.00
05/04/00	327723	5.53	0.27	5.35	0.05	nd	0.06	ns	bd	ns	0.30	0.06	0.12	0.13	3.00
05/04/00	327724	2.53	1.39	1.33	1.29	nd	1.29	ns	bd	bdl	0.10	0.06	bdl	0.34	3.06
05/04/00	327725	45.53	23.20	33.33	0.37	ns	0.27	nd	0.08	0.04	0.80	12.94	0.22	0.33	3.00
05/04/00	327726	1.03	1.70	0.13	0.00	ns	nd	ns	ns	nd	0.00	nd	nd	ns	3.00
05/05/00	327727	0.53	0.77	0.22	0.00	nd	nd	ns	nd	nd	0.02	nd	nd	0.02	3.00
05/05/00	327728	0.17	0.07	0.13	0.00	nd	nd	ns	ns	nd	0.00	nd	nd	ns	3.00
05/05/00	327729	3.32	2.29	3.17	0.00	nd	nd	ns	ns	nd	0.15	0.07	0.06	0.08	3.00
05/05/00	327730	0.28	0.11	0.23	0.06	ns	0.06	ns	ns	nd	0.00	nd	nd	bdl	0.00
05/05/00	327731	3.27	2.64	2.92	0.00	nd	bdl	ns	bd	bdl	2.20	0.10	0.03	2.04	0.03
05/05/00	327732	0.04	0.01	0.03	0.00	ns	nd	ns	nd	ns	2.00	nd	ns	nd	0.03
05/05/00	327733	11.30	0.66	11.25	0.00	ns	nd	ns	nd	ns	2.69	0.23	0.41	2.25	0.03
05/05/00	327735	0.48	0.13	0.42	0.00	ns	nd	ns	ns	ns	2.01	nd	bdl	2.01	0.00
05/05/00	327736	5.09	0.12	0.09	5.00	ns	nd	ns	ns	ns	2.00	nd	ns	nd	0.02
05/05/00	327737	0.69	0.26	0.55	0.00	ns	nd	ns	bd	bdl	0.05	bdl	ns	0.03	0.02
05/05/00	327738	4.12	4.52	1.82	0.00	ns	nd	ns	ns	nd	0.05	bd	nd	0.03	0.02
05/05/00	327740	1.33	0.42	1.10	0.00	ns	nd	ns	ns	nd	0.01	nd	bdl	0.01	0.02
05/05/00	327741	62.82	36.44	41.32	5.00	ns	nd	ns	bd	nd	0.66	0.25	0.18	2.16	0.03
05/05/00	327742	2354.08	2075.06	1244.91	23.41	nd	8.11	10.68	13.92	1.45	35.05	13.81	18.38	7.36	214.15

05/09/2000
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No mdl is available for summed concentrations of analytes. In summed columns (eg. BTEX), the reported values should be considered ESTIMATED. Many of the individual compounds were reported as bdl.

DMT/21.xls

CORE SORBER SCREENING SURVEY ANALYTICAL RESULTS
TETRA TECH NUS, INC. WILMINGTON, NC
CUSTOM TARGET LIST (A7)
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RI
SITE B.W - PRODUCTION ORDER #1095572

DATE ANALYZED	SAMPLE NAME	TPH, ug	GRPH, ug	DRPH, ug	BTEX, ug	BENZ, ug	TOL, ug	EBENZ, ug	mpXYL, ug	oXYL, ug	C11, C13, 2C13, ug	UHDEC, ug	TRIDEC, ug	PENTADEC, ug	TMBs, ug
	MDL=					0.06	0.09	0.08	0.09	0.09		0.09	0.24	0.01	
05/05/00	327743	28.49	7.37	18.85	0.22	nd	bdl	bdl	bdl	bdl	0.40	0.21	0.57	0.12	0.00
05/05/00	327744	2.74	1.81	0.99	0.22	nd	nd	nd	bdl	nd	0.05	0.04	nd	0.02	0.16
05/05/00	327746	3.54	0.22	3.31	0.22	nd	nd	bdl	bdl	bdl	0.03	nd	nd	nd	0.08
05/05/00	327747	78.90	0.17	78.70	0.22	nd	0.09	nd	bdl	bdl	11.73	0.05	5.32	5.60	0.27
05/05/00	327748	4.45	1.37	3.08	0.27	nd	0.07	nd	bdl	nd	0.03	bdl	nd	0.09	0.25
05/05/00	327749	3.60	0.24	3.36	0.03	nd	nd	nd	nd	nd	0.03	nd	nd	nd	0.02
05/05/00	327750	3.36	0.11	3.25	0.22	nd	nd	nd	nd	nd	0.01	nd	nd	nd	0.00
05/05/00	327751	42.75	34.69	24.06	0.00	nd	nd	nd	nd	nd	0.32	0.15	0.18	0.05	0.02
05/05/00	327752	270.76	35.42	241.11	0.00	nd	nd	bdl	bdl	nd	4.74	0.72	0.52	3.10	0.04
05/05/00	327754	6.46	0.28	6.31	0.03	nd	nd	nd	nd	nd	0.03	nd	nd	nd	0.00
05/05/00	327755	0.37	0.12	0.31	0.00	nd	nd	nd	nd	bdl	0.02	nd	nd	nd	0.08
05/05/00	327756	9.23	3.17	4.39	0.00	nd	nd	nd	nd	nd	0.34	0.22	bdl	0.01	0.00
05/05/00	327757	0.24	0.11	0.13	0.00	nd	nd	nd	nd	nd	0.06	nd	nd	nd	0.00
05/05/00	327783	0.28	0.06	0.23	0.00	nd	nd	nd	nd	nd	0.03	bdl	nd	nd	0.00
05/05/00	327784	2.82	0.59	2.81	0.00	nd	nd	nd	nd	nd	0.09	0.04	bdl	0.05	0.00
05/05/00	327785	0.53	0.03	0.53	0.00	nd	nd	nd	nd	nd	0.01	nd	nd	0.01	0.00
05/05/00	327786	0.53	0.22	0.41	0.06	nd	0.05	nd	nd	nd	0.00	bdl	nd	nd	0.00
05/05/00	327793	0.52	0.07	0.43	0.00	nd	nd	nd	nd	nd	0.00	bdl	nd	nd	0.00
05/05/00	327792	0.13	0.00	0.14	0.00	nd	nd	nd	nd	nd	0.00	nd	nd	nd	0.00
05/04/00	method blank	0.02	0.00	0.02	0.00	nd	nd	nd	nd	nd	0.00	nd	nd	nd	0.00
05/04/00	method blank	0.57	0.00	0.57	0.00	nd	nd	nd	nd	nd	0.00	nd	nd	nd	0.00
05/05/00	method blank	0.12	0.02	0.12	0.00	nd	nd	nd	nd	nd	0.00	nd	nd	nd	0.00
	Minimum	2354.62	2075.08	1344.91	41.35	0.50	40.05	10.92	10.92	1.45	35.06	13.81	13.33	7.36	214.15
	Standard Dev.	301.67	265.08	161.07	6.14	0.04	5.25	1.40	1.40	0.19	3.01	2.45	1.94	1.24	27.38
	Mean	35.24	40.37	33.64	1.42	3.01	0.92	0.20	0.28	0.05	1.76	0.82	0.57	3.36	3.85

All nd's available for summed concentrations of analyses. In summed columns (eg., BTEX), the reported values should be considered ESTIMATED if any of the individual compounds were reported as bdl.

BUNCOLS

GORE SORBER SCREENING SURVEY ANALYTICAL RESULTS
TETRA TECH NUS INC., WILMINGTON, NC
CUSTOM TARGET LIST (97)
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RI
SITE 3/4 - PRODUCTION ORDER #10360972

SAMPLE NAME	124TMB, ug	135TMB, ug	c12DCE, ug	t12DCE, ug	t12DCE, ug	NAPHS2-N4, ug	NAPH, ug	2MNAPH, ug	MTBE, ug	11DCA, ug	111TCA, ug	12DCA, ug	TCE, ug	OCT, ug	PCE, ug
MDL=	0.02	0.03		0.03	0.12		0.02	0.22	0.22	2.06	0.14	0.23	0.03	0.10	0.24
327697	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	0.04	nd	nd
327698	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	bdl	nd	nd
327699	nd	nd	0.00	nd	0.05	0.03	0.03	nd	nd	nd	nd	nd	1.03	nd	nd
327700	3.56	3.16	0.00	nd	nd	54.34	40.56	13.63	nd	nd	nd	nd	0.39	bdl	nd
327701	2.66	3.33	0.00	nd	nd	40.18	31.08	9.12	nd	nd	nd	nd	1.27	bdl	nd
327702	3.56	0.43	0.00	nd	nd	49.81	37.00	12.82	nd	nd	nd	nd	1.59	bdl	nd
327703	2.15	3.06	0.00	nd	nd	8.48	7.11	1.37	nd	nd	nd	nd	0.45	bdl	nd
327704	1.76	0.61	0.00	nd	nd	61.08	46.53	14.55	nd	nd	nd	nd	0.39	bdl	0.13
327705	3.26	2.11	0.00	nd	nd	41.53	32.73	8.78	nd	nd	nd	nd	0.35	bdl	1.27
327706	2.80	2.32	0.00	nd	nd	20.73	17.70	3.03	nd	nd	nd	nd	1.53	0.15	1.46
327707	1.55	1.74	0.00	nd	nd	33.09	26.23	6.86	nd	nd	nd	nd	0.33	bdl	2.24
327708	1.17	0.64	0.00	nd	nd	31.23	30.38	4.85	nd	nd	nd	nd	bdl	0.15	2.06
327709	1.92	0.95	0.00	nd	nd	59.45	44.51	14.94	nd	nd	nd	nd	0.12	0.12	2.06
327710	0.225	0.030	0.00	nd	nd	34.85	33.35	5.54	nd	nd	nd	nd	bdl	nd	nd
327711	0.09	0.04	0.00	nd	nd	26.14	18.57	7.48	nd	nd	nd	nd	0.23	nd	nd
327712	0.49	0.27	0.00	nd	nd	72.07	53.97	19.09	nd	nd	nd	nd	0.15	nd	nd
327713	0.35	0.16	0.00	nd	nd	26.55	22.52	4.04	nd	nd	nd	nd	0.33	nd	nd
327714	bdl	nd	0.00	nd	nd	0.23	0.23	2.06	nd	nd	nd	nd	0.13	nd	bdl
327715	0.57	0.14	0.00	nd	nd	39.45	32.63	6.83	nd	nd	nd	nd	0.57	nd	nd
327716	0.12	0.06	0.00	nd	nd	24.55	18.61	5.95	nd	nd	nd	nd	nd	nd	nd
327717	nd	nd	0.00	nd	nd	0.03	0.03	bdl	nd	nd	nd	nd	bdl	nd	3.25
327718	nd	nd	0.00	nd	nd	0.04	0.04	bdl	nd	nd	nd	nd	nd	nd	bdl
327719	0.20	0.03	0.00	nd	nd	37.16	31.95	5.21	nd	nd	nd	nd	bdl	nd	nd
327720	0.33	0.23	0.00	nd	nd	46.25	37.56	8.69	nd	nd	2.86	nd	5.65	bdl	3.16
327721	0.51	0.27	0.00	nd	nd	67.63	49.05	18.58	nd	nd	nd	nd	3.15	3.16	0.07
327722	nd	nd	0.00	nd	nd	2.50	2.21	0.08	nd	nd	nd	nd	nd	nd	0.12
327723	0.03	bdl	0.00	nd	nd	2.27	2.21	2.06	nd	nd	nd	nd	bdl	nd	0.92
327724	0.15	nd	0.00	nd	nd	5.03	3.92	1.11	nd	nd	nd	nd	bdl	nd	bdl
327725	2.13	0.32	0.00	nd	nd	45.66	36.46	9.07	nd	nd	nd	nd	nd	nd	nd
327726	nd	nd	0.00	nd	nd	0.10	0.10	bdl	nd	nd	0.04	nd	nd	bdl	1.55
327727	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327728	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	bdl	nd	nd
327729	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	3.47	0.14	0.07	nd	5.73
327730	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	0.29	nd	nd	nd	0.28
327731	0.15	nd	0.00	nd	nd	20.53	15.79	4.74	nd	nd	nd	nd	nd	bdl	nd
327732	nd	nd	0.00	nd	nd	0.02	0.02	bdl	nd	nd	nd	nd	nd	nd	bdl
327733	bdl	nd	0.00	nd	nd	0.02	0.02	bdl	nd	nd	0.27	nd	nd	nd	5.68
327735	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327736	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	0.12	nd	nd
327737	bdl	nd	0.00	nd	nd	0.03	0.03	nd	nd	nd	nd	nd	nd	nd	nd
327739	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	0.25	nd
327740	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327741	0.15	nd	0.15	nd	0.15	0.02	0.02	nd	nd	nd	nd	nd	1.66	nd	nd
327742	38.44	55.71	0.75	0.17	0.56	19.25	12.63	6.56	nd	nd	nd	nd	2.76	1.80	nd

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No rad is available for summed combinations of analyses in summed columns (eg., BTEX). The reported values should be considered ESTIMATED if any of the individual compounds were reported as nd

Subtitle

GORE SORBER SCREENING SURVEY ANALYTICAL RESULTS
TETRA TECH NUS, INC., WILMINGTON, MA
CUSTOM TARGET LIST (A7)
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RI
SITE BJM - PRODUCTION ORDER #10380972

SAMPLE NAME	124TMB, ug	135TMB, ug	ct12DCE, ug	t12DCE, ug	c12DCE, ug	NAPH&2-MN, ug	NAPH, ug	2MeNAPH, ug	MTBE, ug	11DCA, ug	111TCA, ug	12DCA, ug	TCE, ug	OCT, ug	PCE, ug
MDL=	0.02	0.03		0.03	0.02		0.02	0.02	0.36	0.06	0.04	0.03	0.03	0.10	0.04
327743	0.61	0.19	0.00	nd	nd	0.06	0.04	0.02	nd	nd	nd	nd	0.10	nd	nd
327744	0.15	0.04	0.00	nd	nd	0.02	0.02	bdl	nd	nd	nd	nd	nd	nd	0.30
327746	0.08	bdl	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327747	0.07	bdl	0.00	nd	nd	0.87	0.17	0.70	nd	nd	nd	nd	nd	nd	nd
327748	0.05	bdl	0.00	nd	nd	0.05	0.03	0.02	nd	nd	nd	nd	nd	nd	nd
327749	0.02	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327750	bdl	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327751	0.02	bdl	0.00	nd	nd	0.09	0.09	bdl	nd	nd	nd	nd	nd	nd	nd
327752	0.04	bdl	0.49	0.06	0.42	0.52	0.44	0.08	nd	nd	nd	nd	bdl	nd	nd
327754	bdl	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327755	0.03	bdl	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327756	bdl	bdl	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	0.09	nd	0.09
327757	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	bdl
327763	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	bdl	nd	nd
327764	nd	nd	0.05	nd	0.05	0.05	0.05	bdl	nd	nd	nd	nd	0.08	nd	nd
327765	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	bdl	nd	nd
327766	nd	bdl	0.00	nd	nd	1.45	1.15	0.30	nd	nd	nd	nd	0.03	nd	nd
327738	bdl	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
327762	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
method blank	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
method blank	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
method blank	nd	nd	0.00	nd	nd	0.00	nd	nd	nd	nd	nd	nd	nd	nd	nd
Maximum	158.44	55.71	0.73	0.17	0.56	72.07	53.97	18.54	0.00	0.00	3.41	0.14	61.80	1.80	6.88
Standard Dev.	20.26	7.12	0.11	0.02	0.09	21.14	16.16	5.07	0.00	0.00	0.45	0.02	7.90	0.23	1.14
Mean	2.86	1.03	0.02	0.00	0.02	14.15	10.91	3.24	0.00	0.00	0.08	0.00	1.20	0.06	0.27

No mdl is available for summed combinations of analytes. In summed columns (eg., BTEX), the reported values should be considered *ESTIMATED* if any of the individual compounds were reported as bdl.

GORE SORBER SCREENING SURVEY ANALYTICAL RESULTS
TETRA TECH NUS, INC., WILMINGTON, MA
CUSTOM TARGET LIST (A7)
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RI
SITE BUN - PRODUCTION ORDER #1036372

SAMPLE NUME	14DCB, ug	PHENOL, ug	2MePHENOL, ug	11DCE, ug	CHCL3, ug	CCL4, ug	112TCA, ug	BEBNZ, ug	1112TeCA, ug	1122TeCA, ug	13DCB, ug	12DCB ug
RDL=	0.21	0.08	0.33	0.02	0.33	0.33	0.06	0.002	0.24	0.33	0.03	0.002
327697	0.21	nc	nc	nd	nc	nc	nd	nd	nc	nc	bd	bd
327698	nc	nd	nc	nd	nc	nc	nd	nd	nc	nc	nd	nd
327699	nc	nc	nc	nd	nc	nc	nd	nd	nc	nc	nd	nd
327700	nd	nc	nc	nd	nc	nc	nd	nd	nc	nc	nd	nd
327701	nc	0.09	0.24	nd	nc	nc	nd	nd	nc	nc	nd	nd
327702	nc	0.10	0.24	nd	nc	nc	nd	nd	nc	nc	nd	nd
327703	nc	0.09	nc	nd	nc	nc	nd	nd	nc	nc	nd	nd
327704	nc	bd	bd	nd	nc	nc	nd	nd	nc	nc	nd	nd
327705	nc	0.05	nc	nd	nc	nc	nd	nd	nc	nc	nd	nd
327706	nc	0.28	0.11	nd	nc	nc	nd	nd	nc	nc	nd	nd
327707	bd	bd	bd	nd	nc	nc	nd	nd	nc	bd	nd	nd
327708	nc	bd	nc	nd	nd	nc	nd	nd	nc	bd	nd	nd
327709	nc	bd	nc	nd	nd	nc	nd	nd	nc	bd	nd	nd
327710	nc	nd	nc	nd	nc	nc	nd	nd	nc	nd	nd	nd
327711	nc	nd	nd	nd	nd	nc	nd	nd	nc	nd	nd	nd
327712	nc	bd	nc	nd	nd	nc	nd	nd	nc	nd	nd	nd
327713	nc	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327714	nc	nd	nc	nd	nd	nd	nd	nd	nc	nd	nd	nd
327715	nc	nd	nc	nd	nd	nd	nd	nc	nd	nd	nd	nc
327716	nc	nd	nd	nd	nd	nd	nd	nc	nd	nd	nd	nc
327717	nc	nd	nd	nd	nd	nd	nd	nc	nd	nd	nd	nc
327718	nd	nd	nd	nc	nd	nd	nc	nc	nd	nd	nd	nc
327719	nd	nd	nd	nc	nd	nd	nc	nc	nd	nd	nd	nc
327720	nd	0.09	bd	0.74	nd	nd	nc	nc	nd	nd	nc	nc
327721	nd	bd	bd	nc	nd	nd	nc	nc	nd	nd	nc	nc
327722	nd	nd	nd	nc	nd	nd	nc	nc	nd	nd	nd	nc
327723	nd	nd	nd	nc	nd	nd	nc	nc	nd	nd	nc	nc
327724	nd	nd	nd	nc	nd	nd	nc	nc	nd	nd	nc	nc
327725	nd	nd	nd	nc	nd	nd	nc	nc	nd	nd	nc	nc
327726	nd	nd	nd	nc	nd	nd	nc	nc	nd	nd	nc	nc
327727	nd	nd	nd	nc	nd	nd	nc	nc	nd	nd	nc	nc
327728	nd	nd	nd	nc	nd	nd	nc	nd	nd	nd	nc	nd
327729	nd	nd	nd	0.25	nd	nd	nc	nd	nd	nd	nc	nd
327730	nd	nd	nd	nc	nd	nd	nc	nd	nd	nd	nc	nd
327731	nd	nd	nd	nc	nd	nd	nc	nd	nd	nd	nc	nd
327732	nd	nd	nd	nc	nd	nd	nc	nd	nd	nd	nc	nd
327733	nd	nd	nd	0.04	nc	nd	nd	nd	nd	nc	nc	nd
327735	nd	nd	nd	nc	nc	nd	nd	nd	nd	nc	nc	nd
327736	nd	nd	nd	nc	0.17	nd	nd	nd	nc	nc	nc	nd
327737	nd	0.05	nd	nd	nc	nd	nd	nd	nc	nc	nc	nd
327738	nd	nd	nd	nd	nc	nd	nd	nd	nd	nc	nc	nd
327740	nd	nd	nd	nd	nc	nc	nd	nd	nc	nc	nd	nd
327741	nd	0.02	nd	nd	nc	nc	nd	nd	nd	0.04	nc	nd
327742	nd	0.08	0.38	nd	nc	nd	nd	nd	nd	18.12	nc	nd

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Note: Is available for summed combinations of analytes. In summed columns (Hg, BTEX), the reported values should be considered ESTIMATED. Any of the individual compounds were reported as bd.

S. Wells

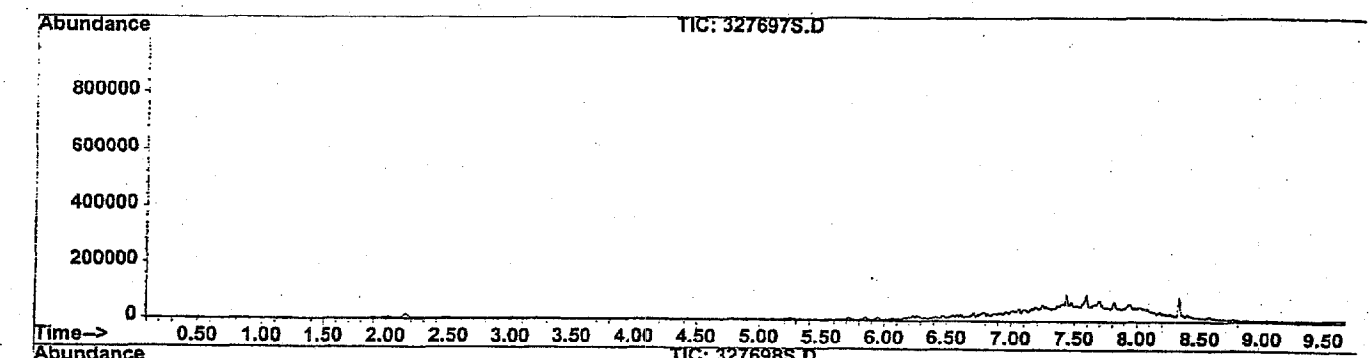
GORE SORBER SCREENING SURVEY ANALYTICAL RESULTS
TETRA TECH NUS INC., WILMINGTON, MA
CUSTOM TARGET LIST (47)
NAVAL EDUCATION AND TRAINING CENTER, NEWPORT, RI
SITE 3UM - PRODUCTION ORDER N0330972

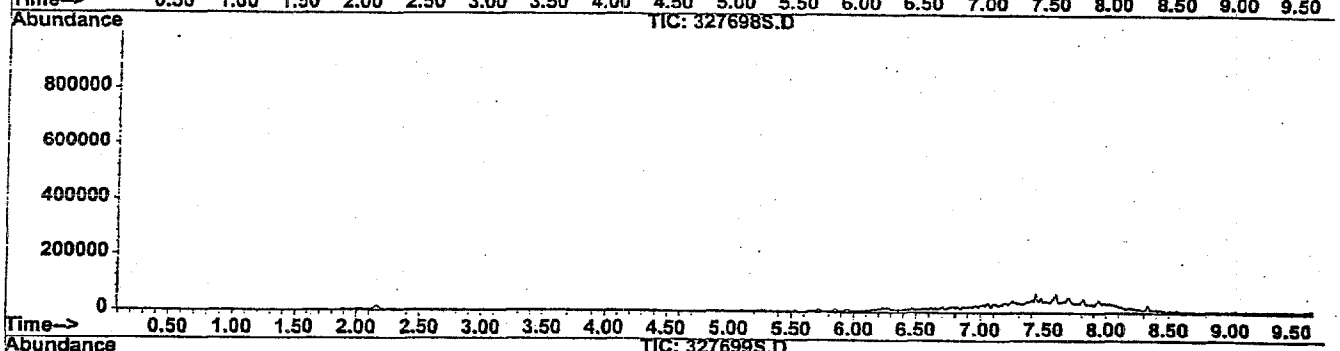
SAMPLE NAME	14DCB ug	P-HEXCL, ug	2MePHEXCL, ug	11DCE, ug	CHCl3, ug	CCl4, ug	112TCA, ug	C BENZ, ug	1112TeCA, ug	1122TeCA, ug	13DCB ug	12DCB ug
MCL=	0.01	0.02	0.03	0.32	0.02	0.05	0.05	0.22	0.04	0.05	0.02	0.02
327743	nd	nd	nd	nd	nd	nd	nd	nd	nd	bdl	nd	nd
327744	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327745	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327747	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327748	nd	0.05	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327749	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327752	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327751	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.07	nd	nd
327752	nd	nd	bdl	nd	nd	nd	nd	nd	nd	0.14	nd	nd
327754	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327755	bdl	nd	nd	nd	nd	nd	nd	nd	nd	nd	bdl	nd
327756	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327757	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327763	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327764	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327765	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327766	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327758	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
327762	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
method blank	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
method blank	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
method blank	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Maximum	0.24	0.09	1.59	0.29	0.17	0.33	0.00	0.00	0.00	18.73	0.01	0.01
Standard Dev.	0.23	0.05	1.06	0.04	0.12	0.23	0.00	0.00	0.00	2.32	0.00	0.00
Mean	0.23	0.02	0.01	0.01	0.00	0.22	0.00	0.00	0.00	0.12	0.00	0.00

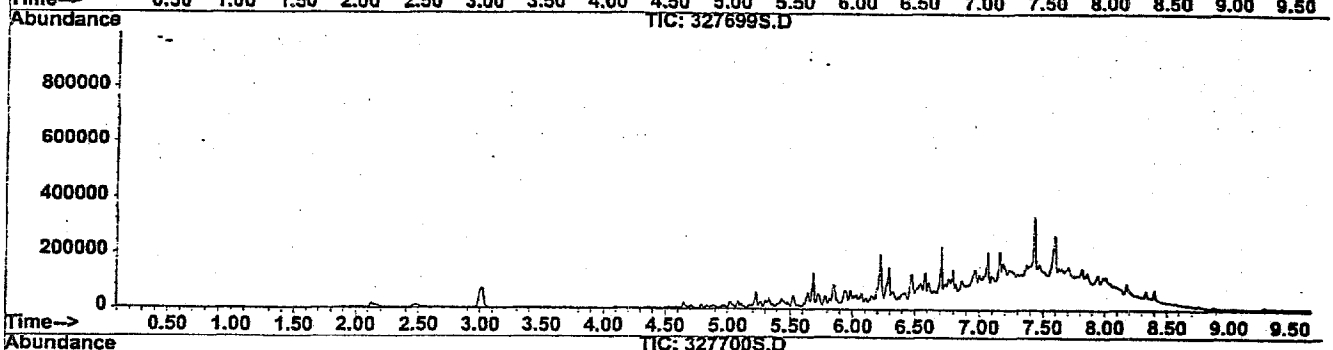
No mdl is available for summed combinations of analytes or summed columns (eg., BTEX). The reported values should be considered ESTIMATED if any of the individual compounds were reported as bdl.

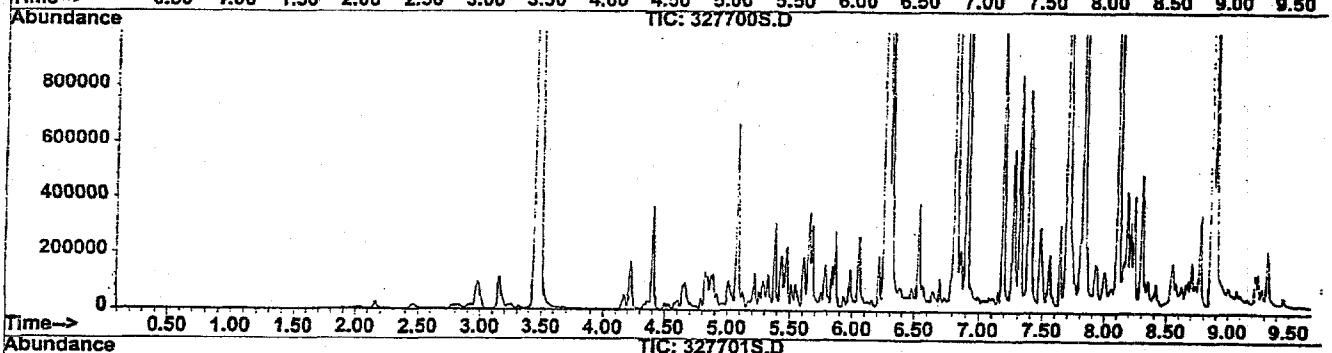
B.Wyck

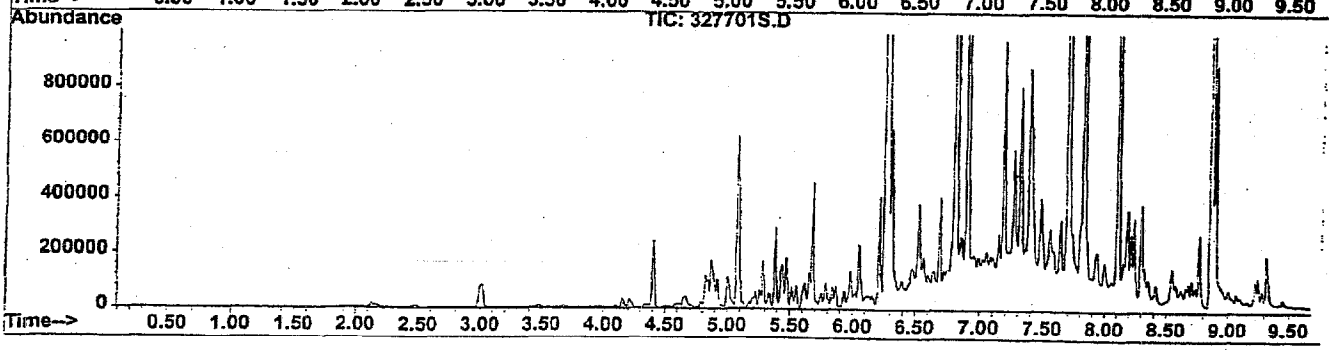
TIC - SITE BJM - PRODUCTION ORDER #10380972
In Numerical Order











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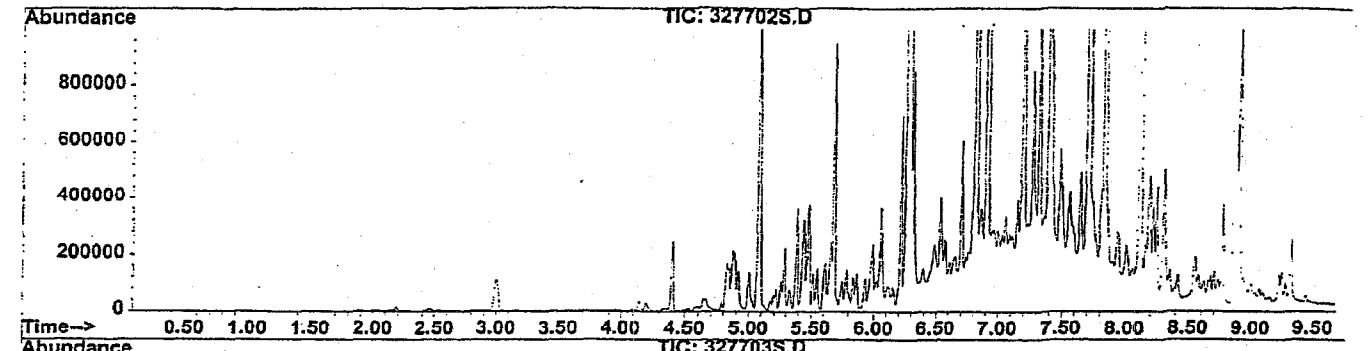
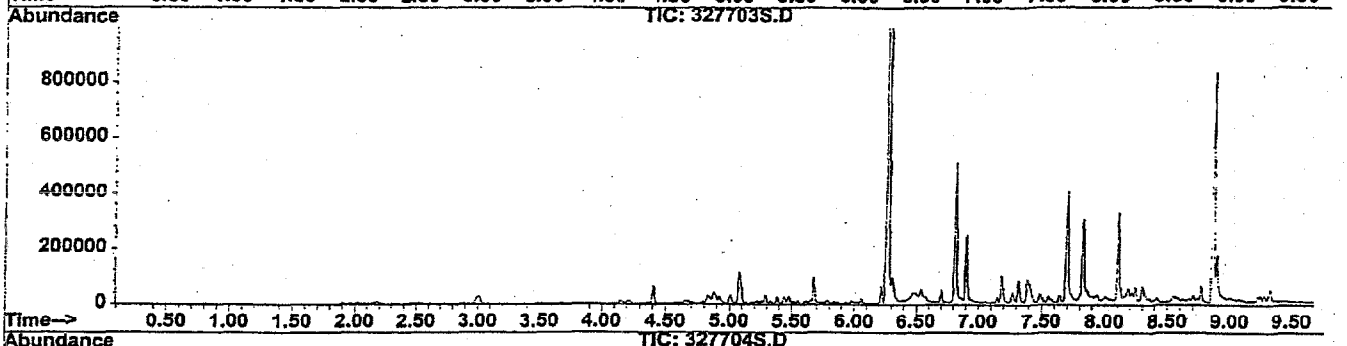
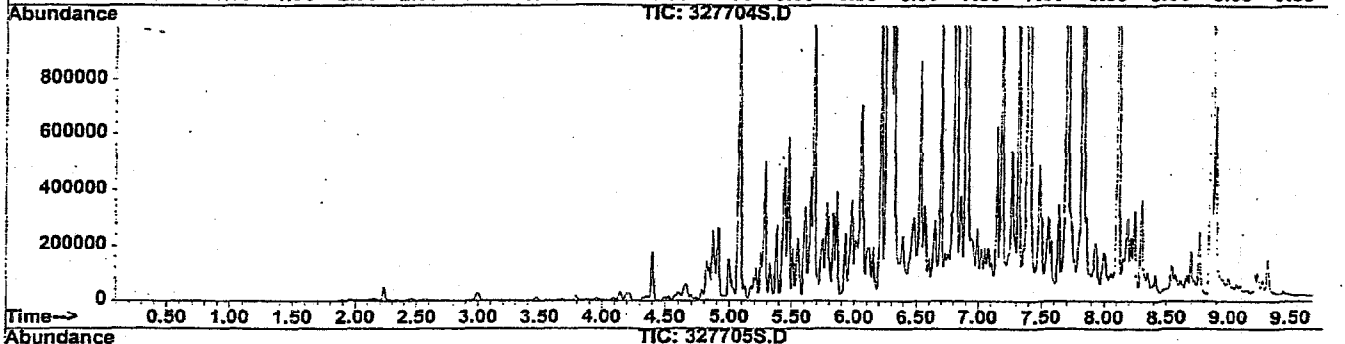
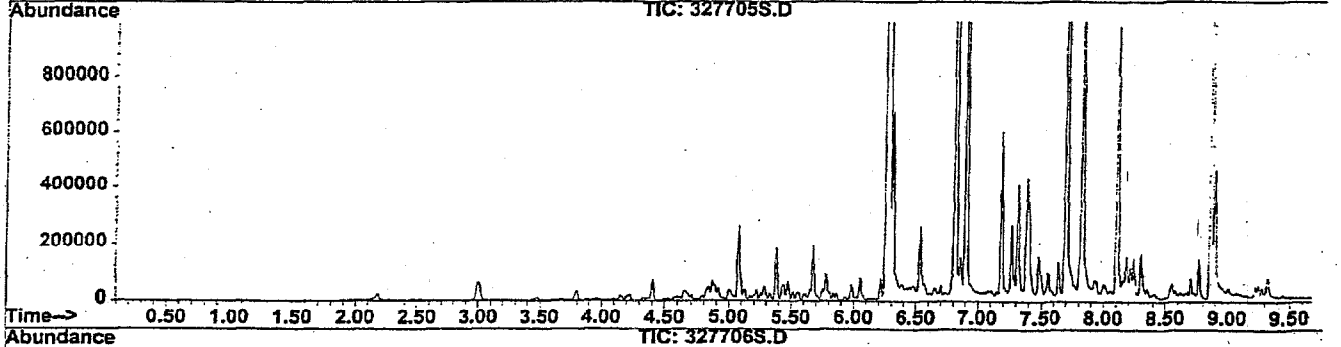
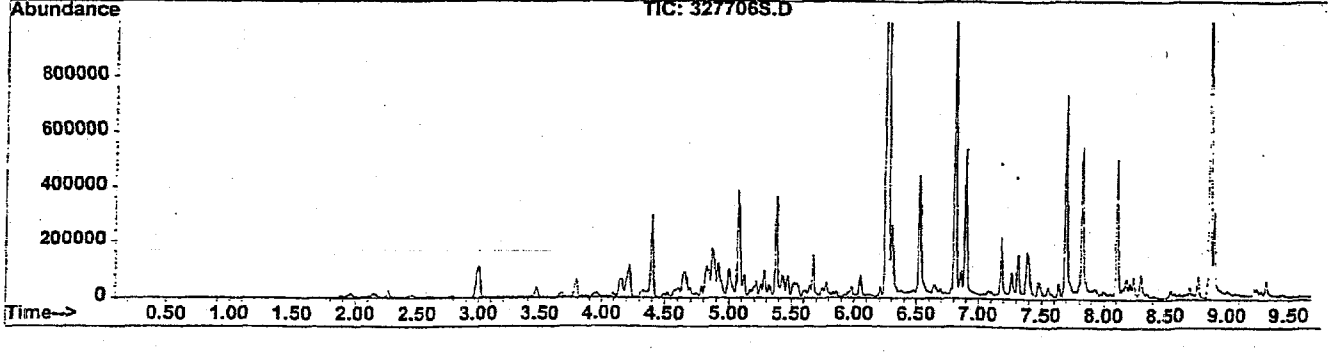
In Numerical Order











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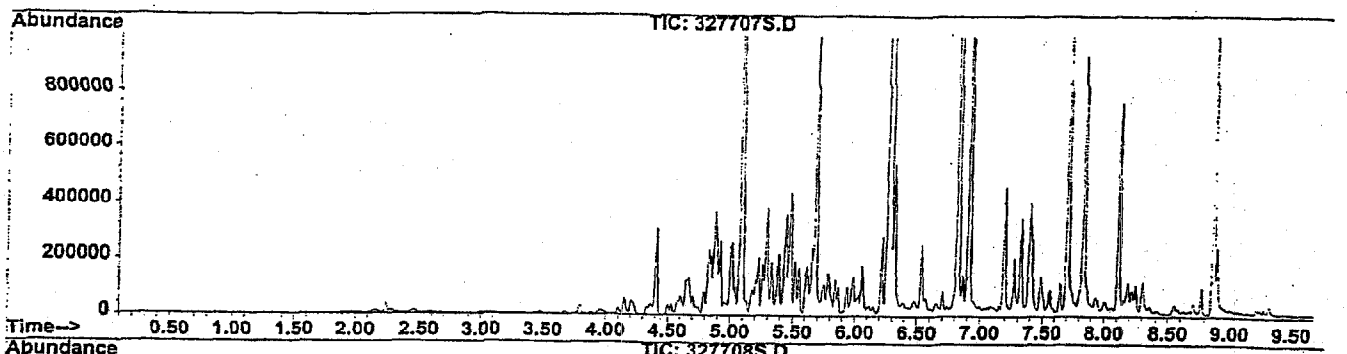

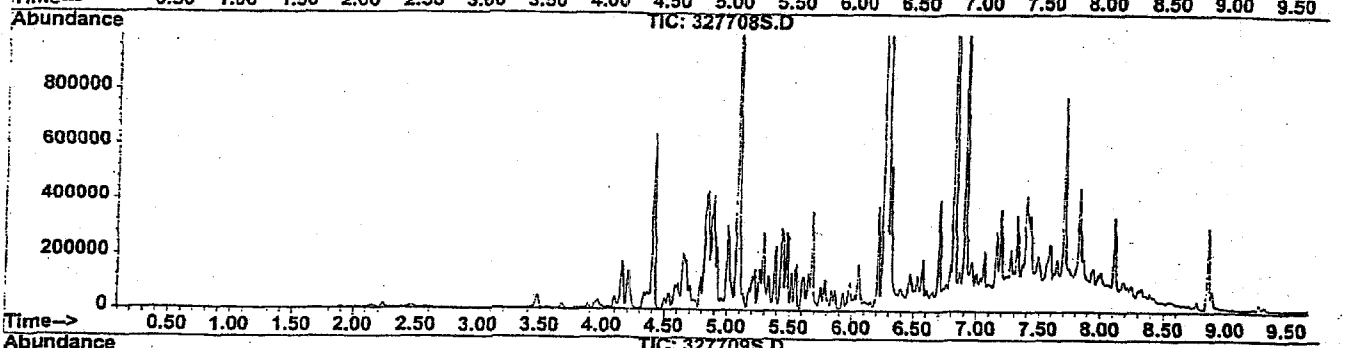

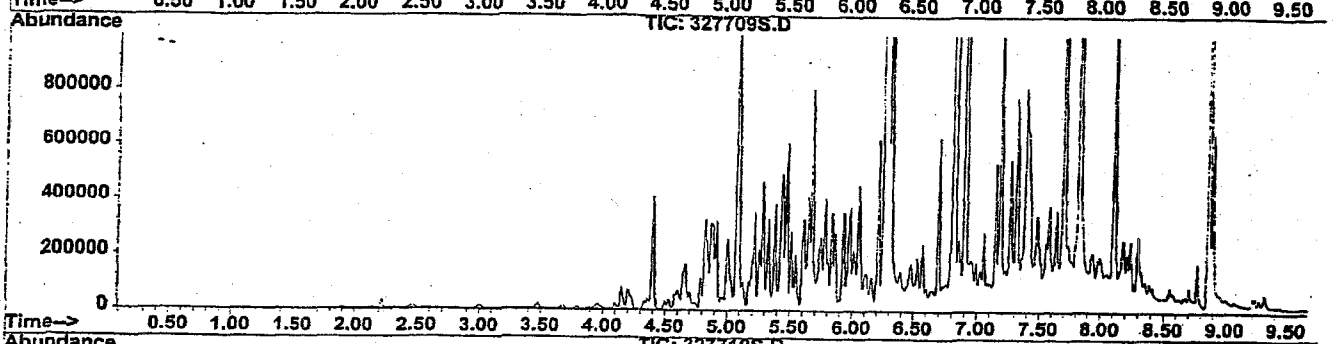

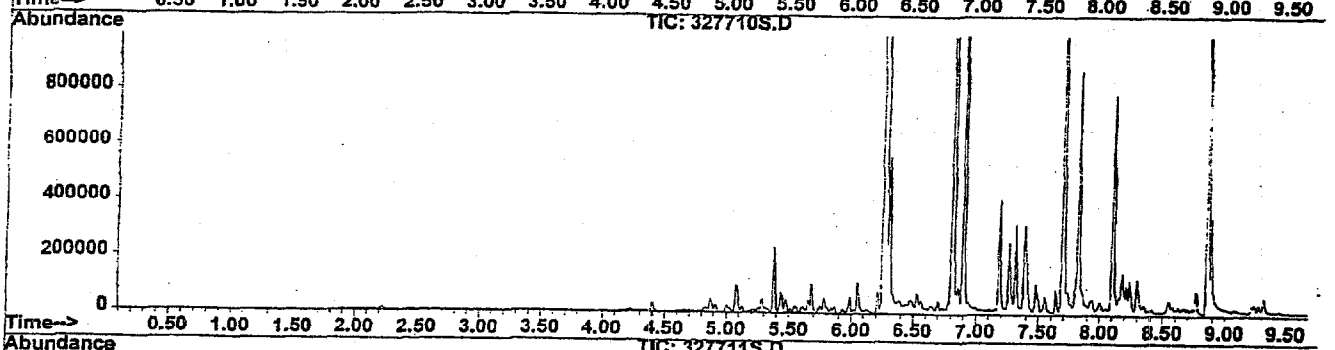

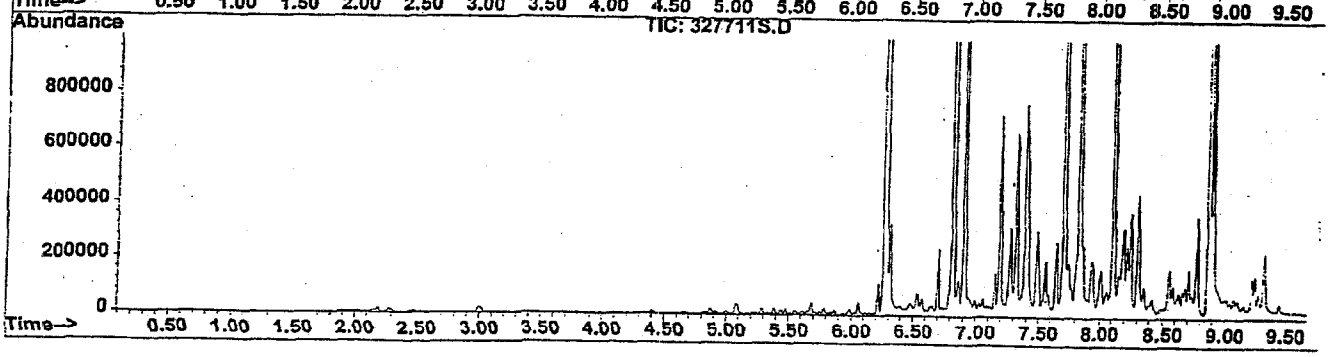

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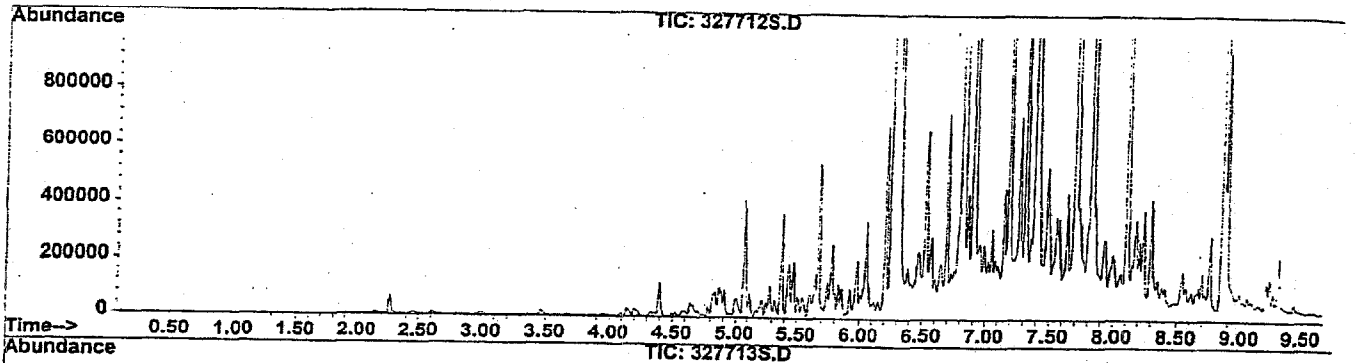

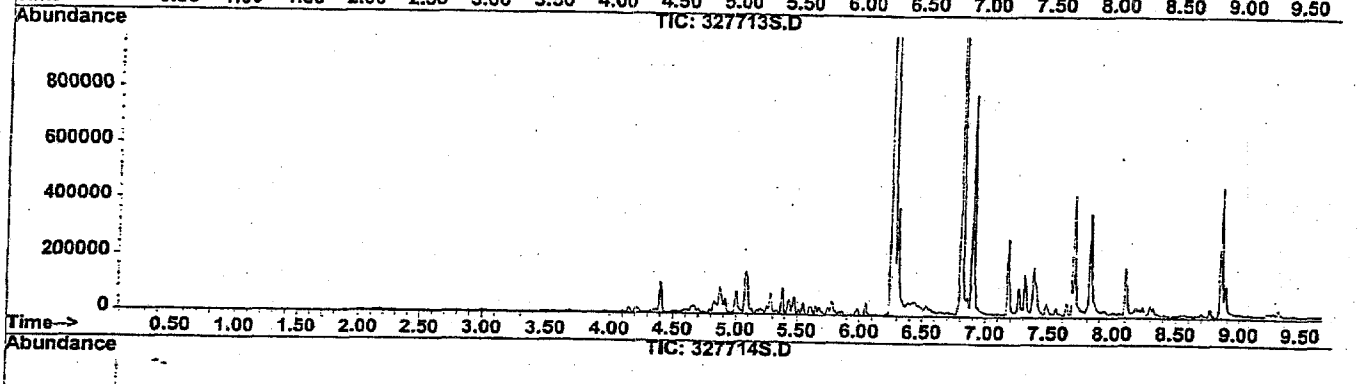

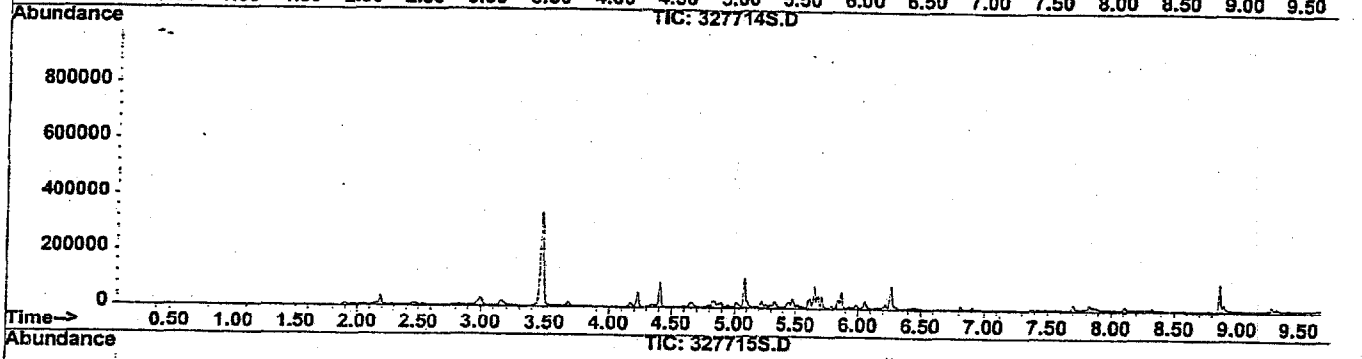

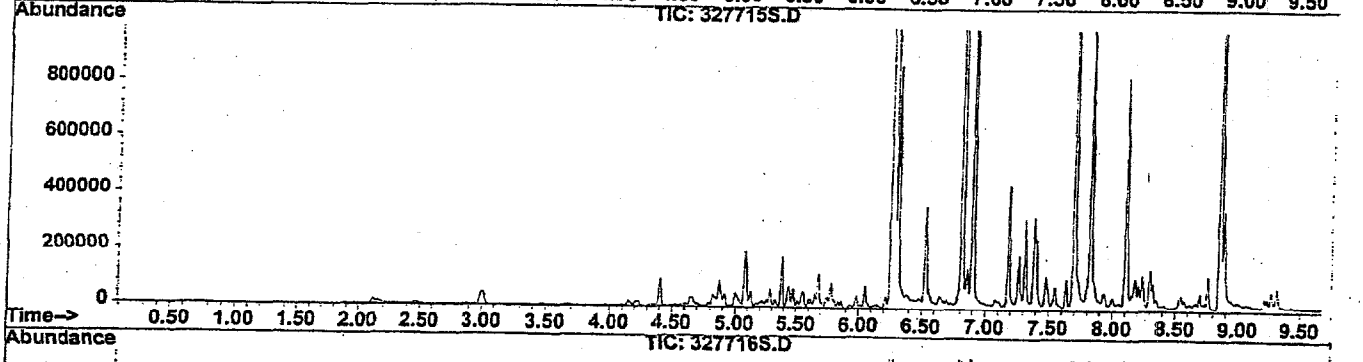

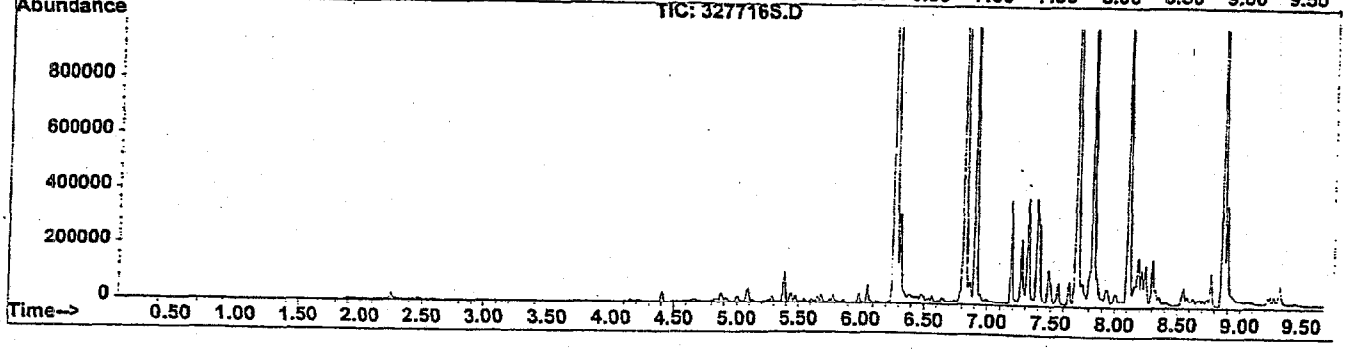

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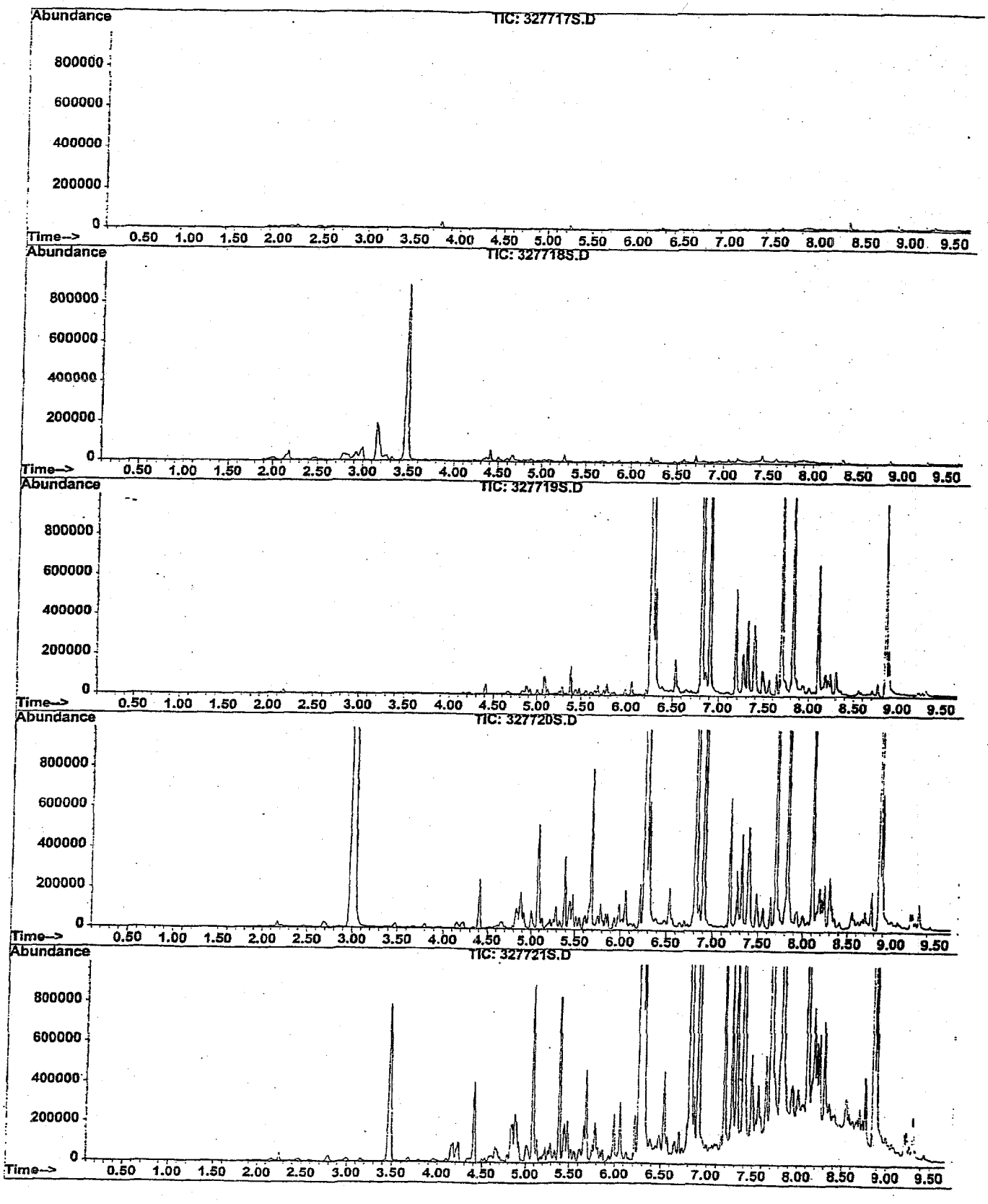

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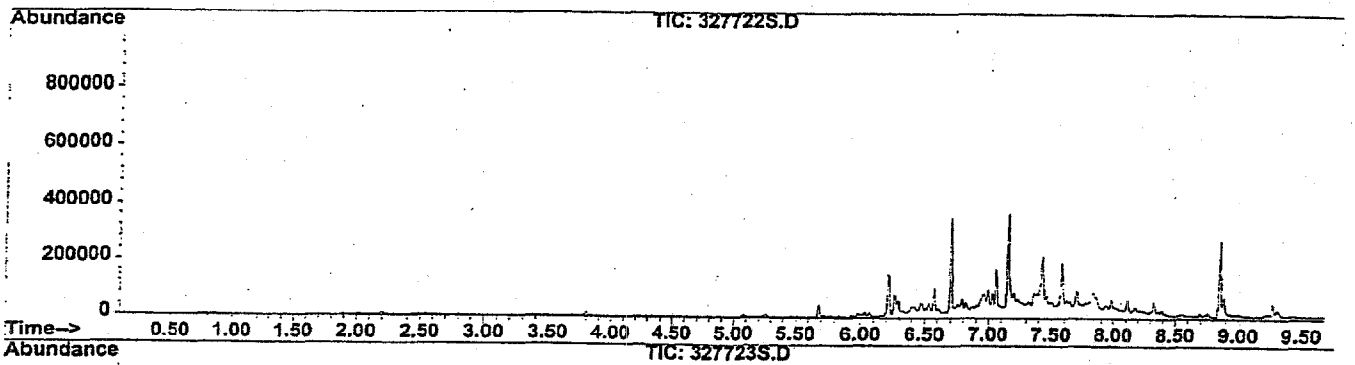

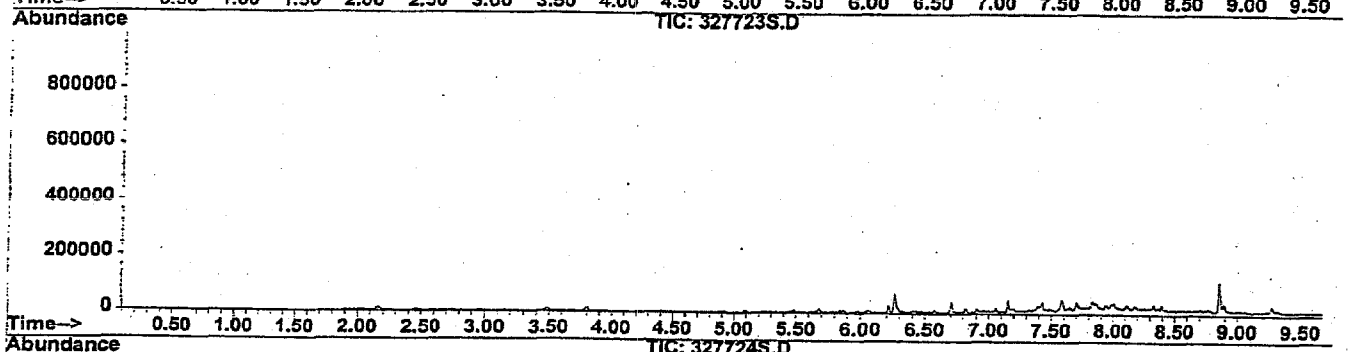

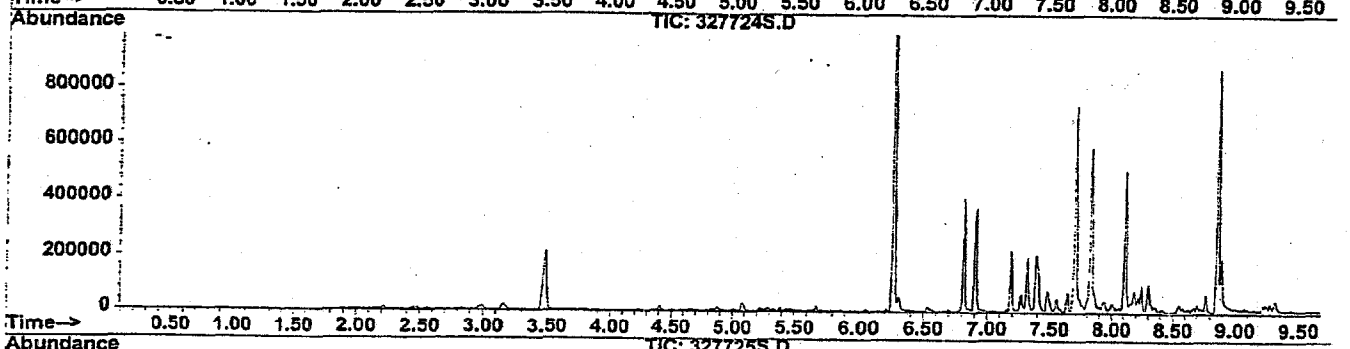

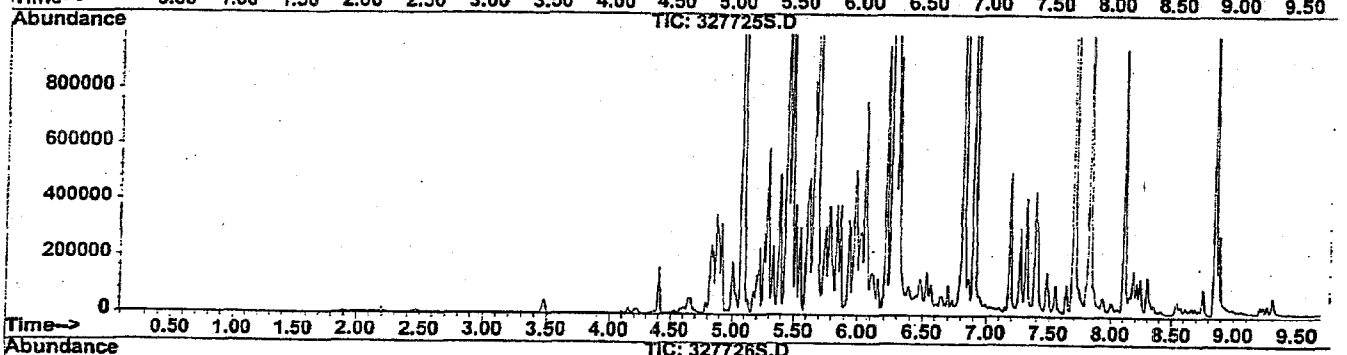

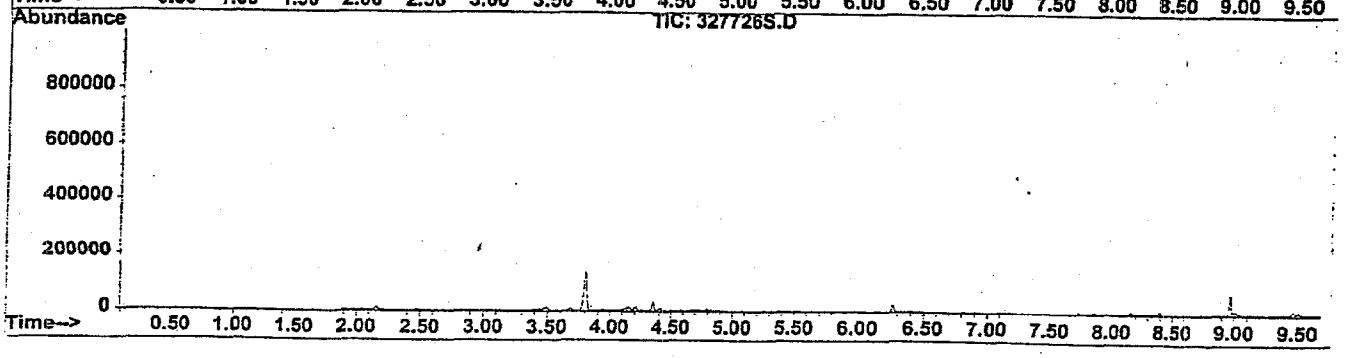

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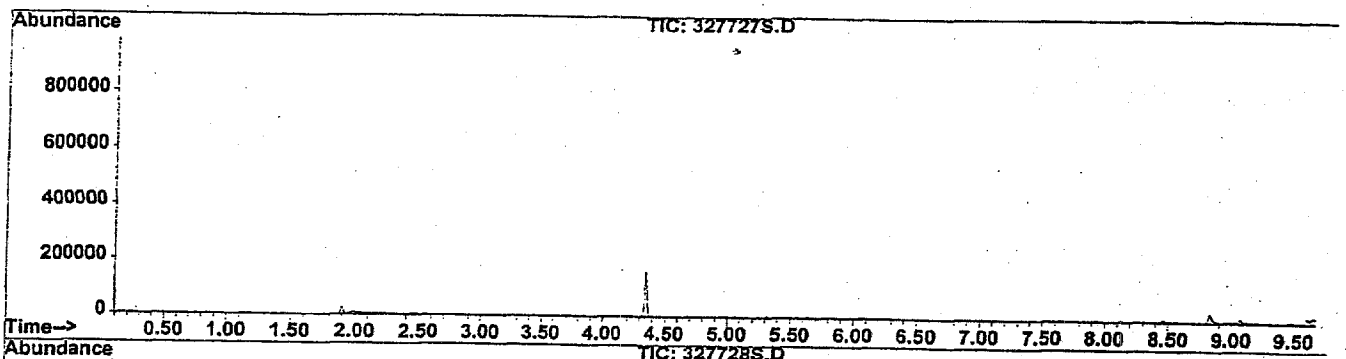
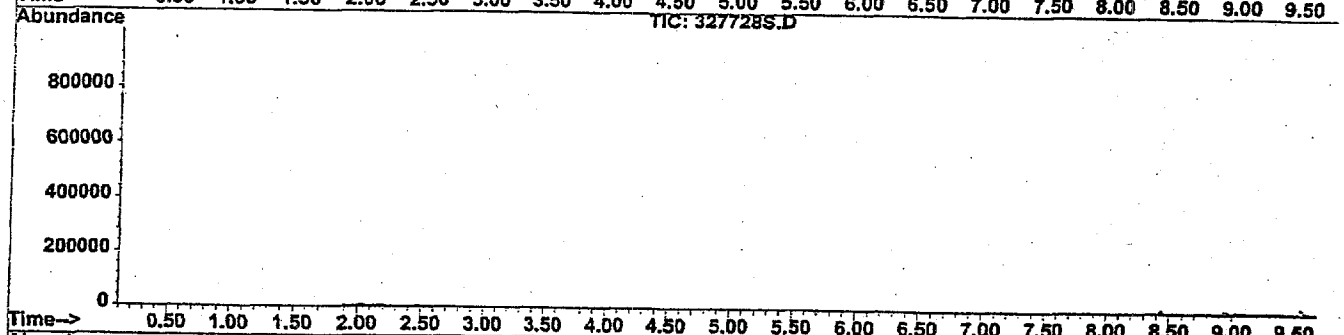
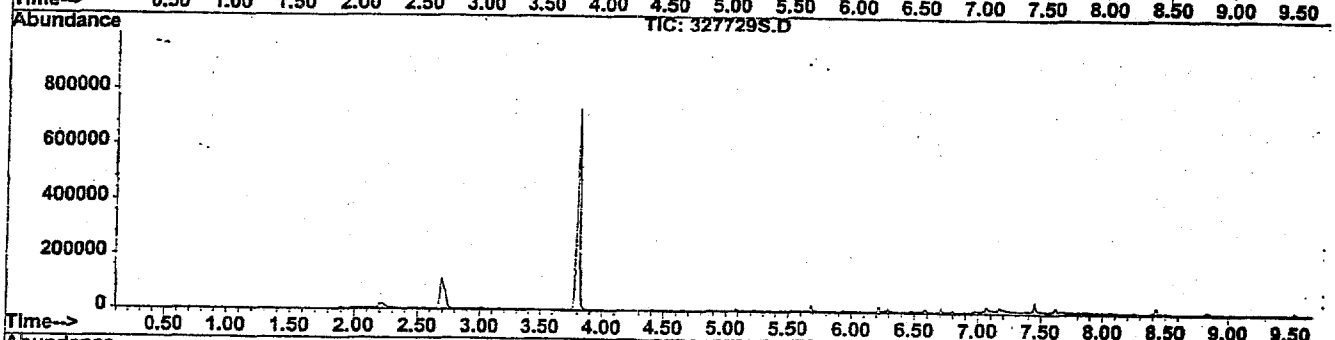
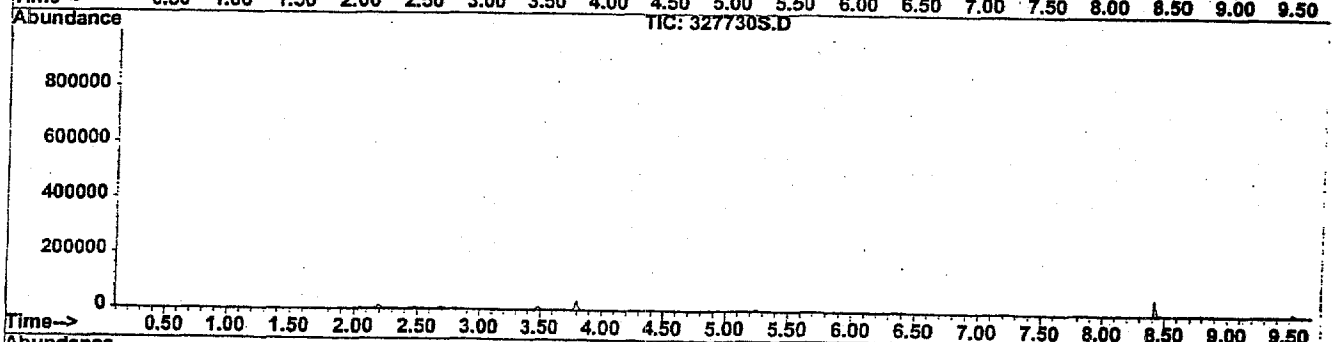
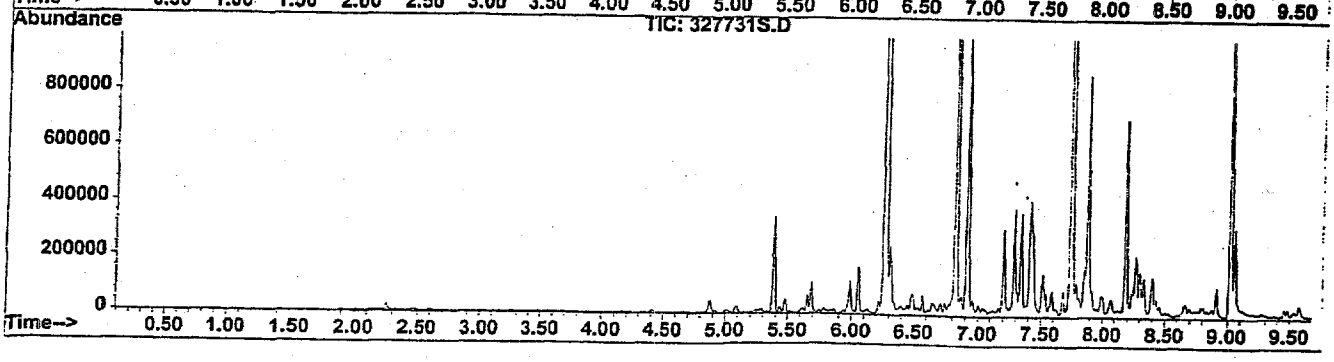


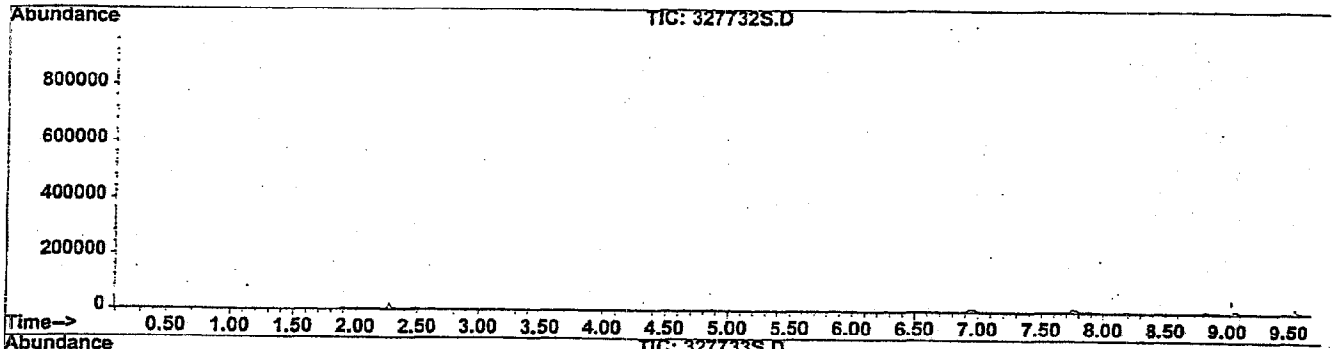


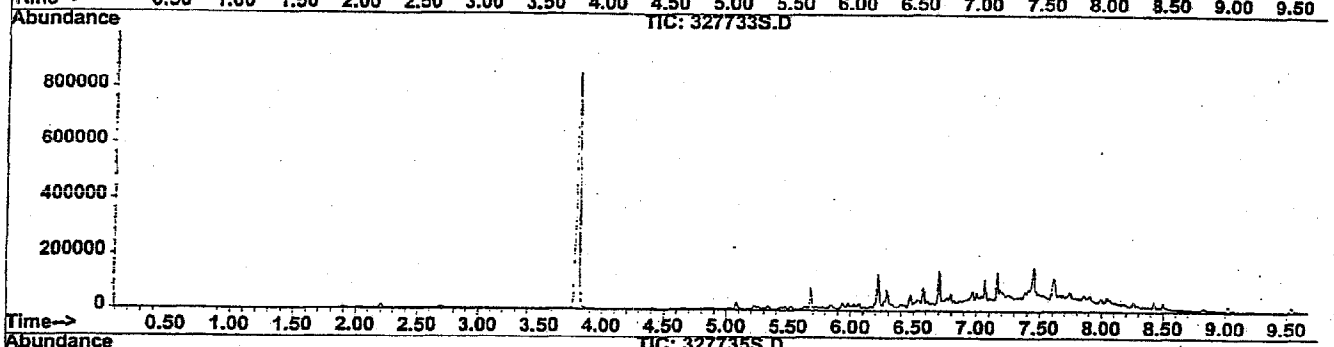


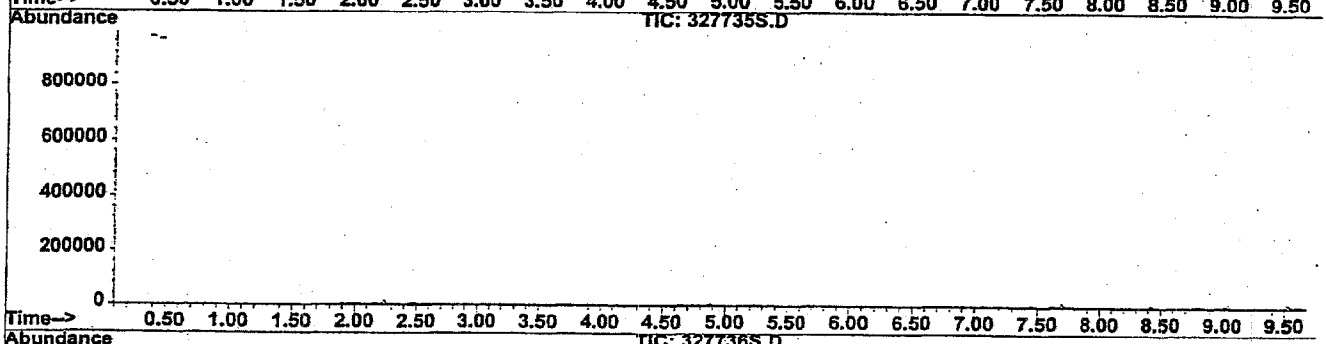


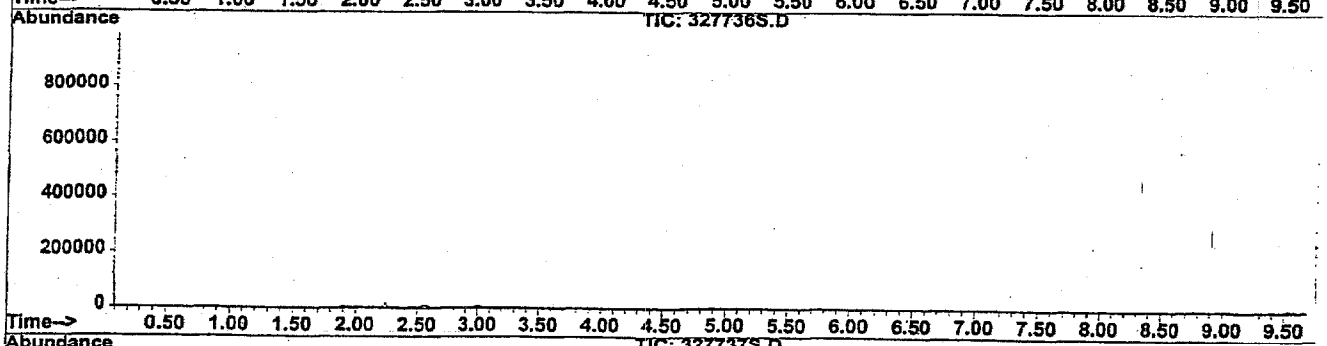


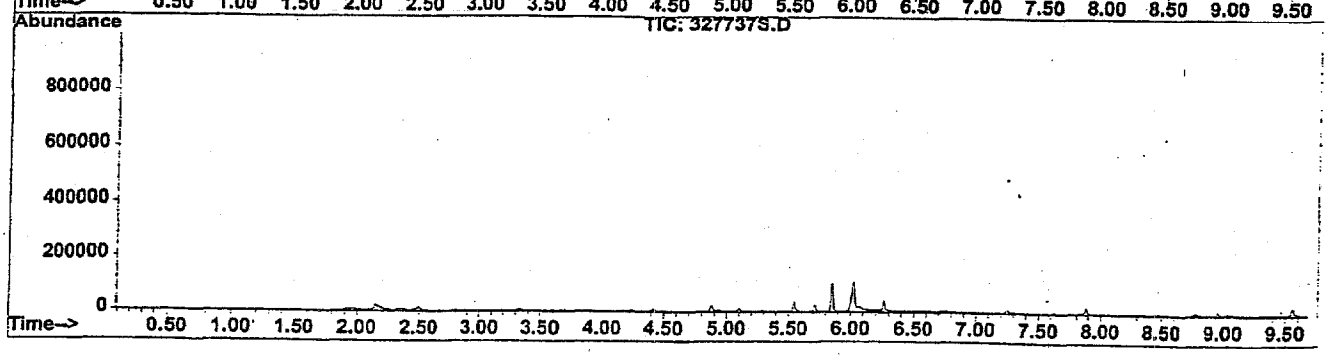
TIC - SITE BJM - PRODUCTION ORDER #10380972
In Numerical Order











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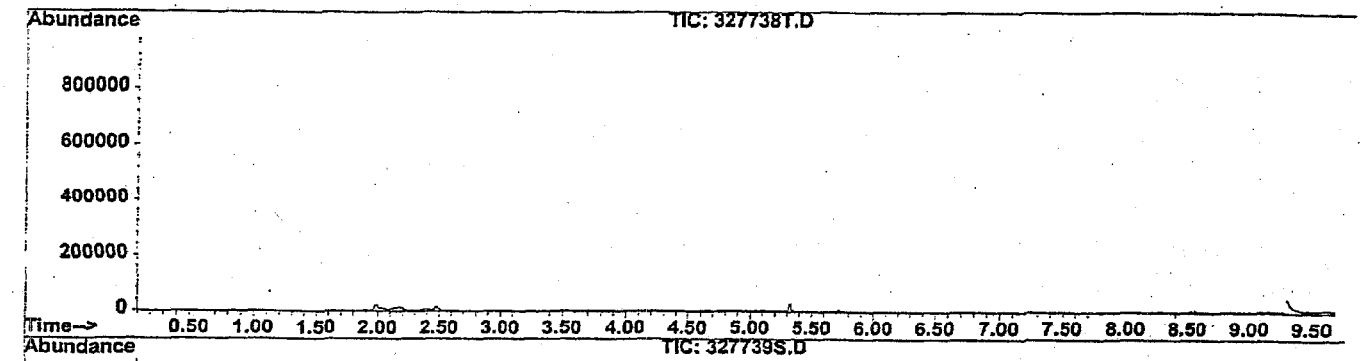

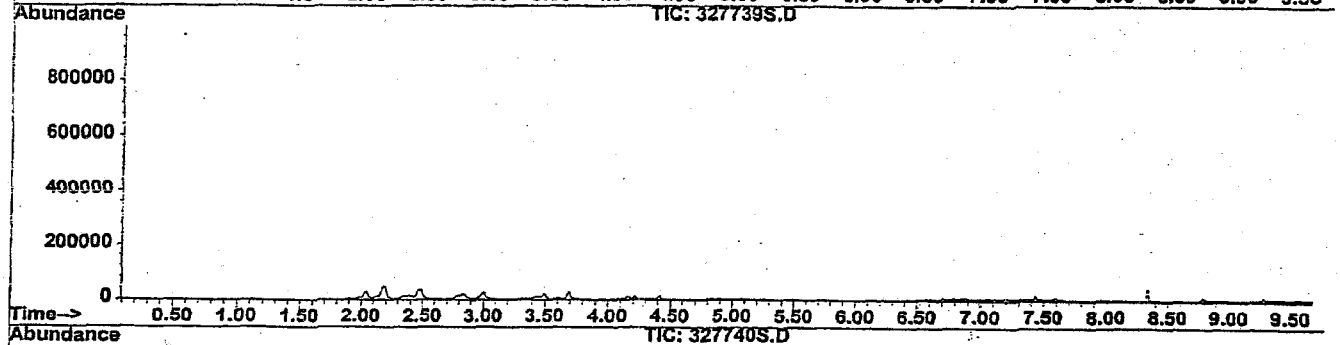

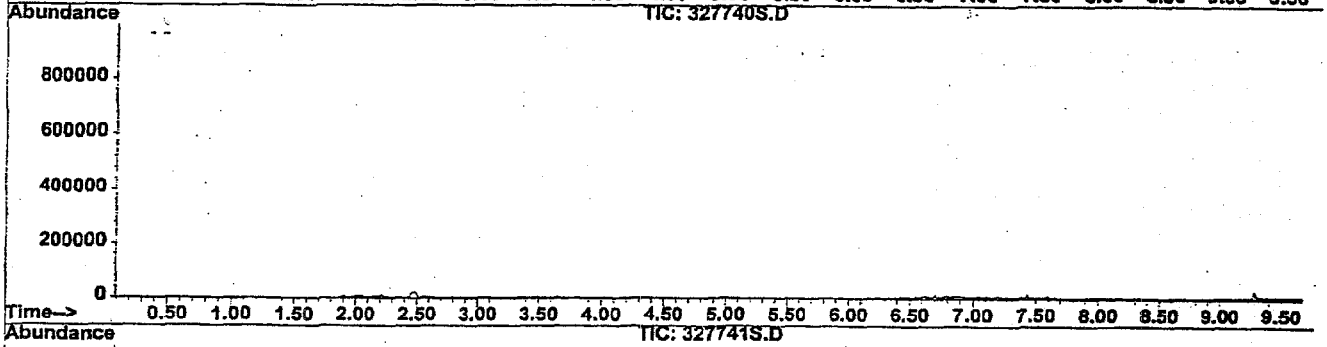

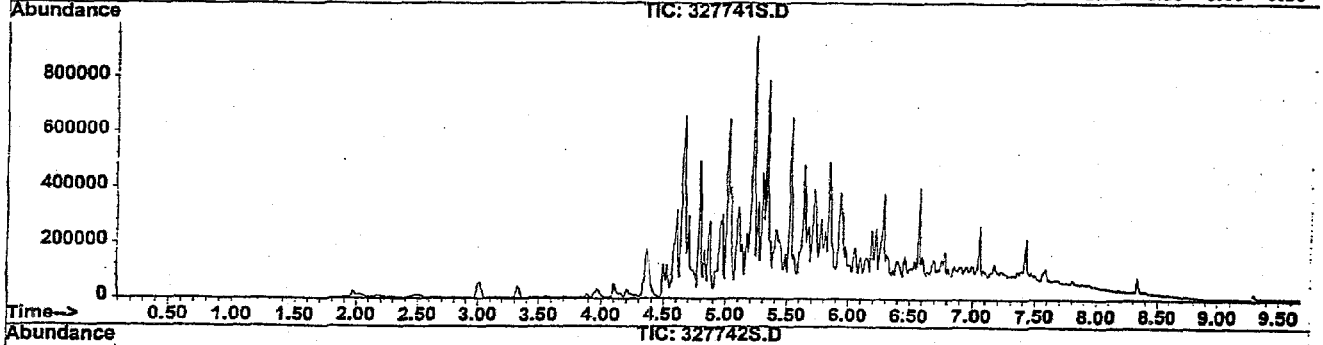

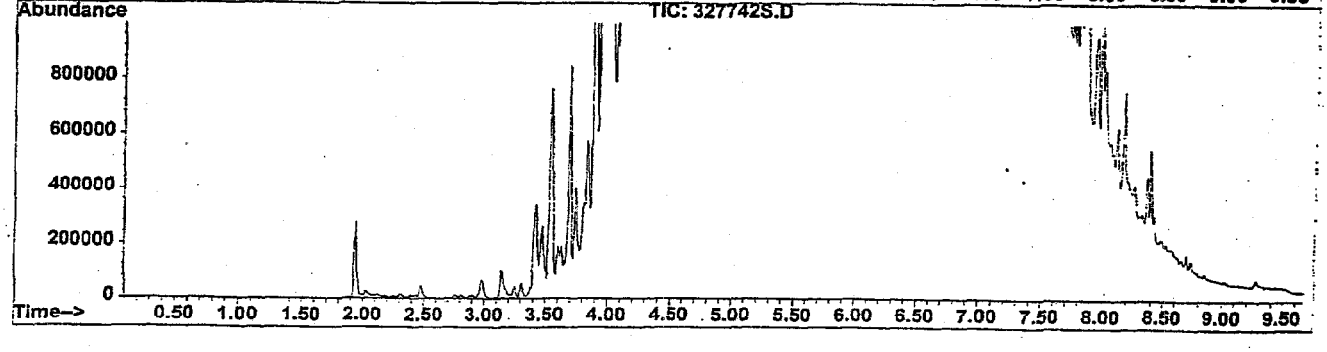

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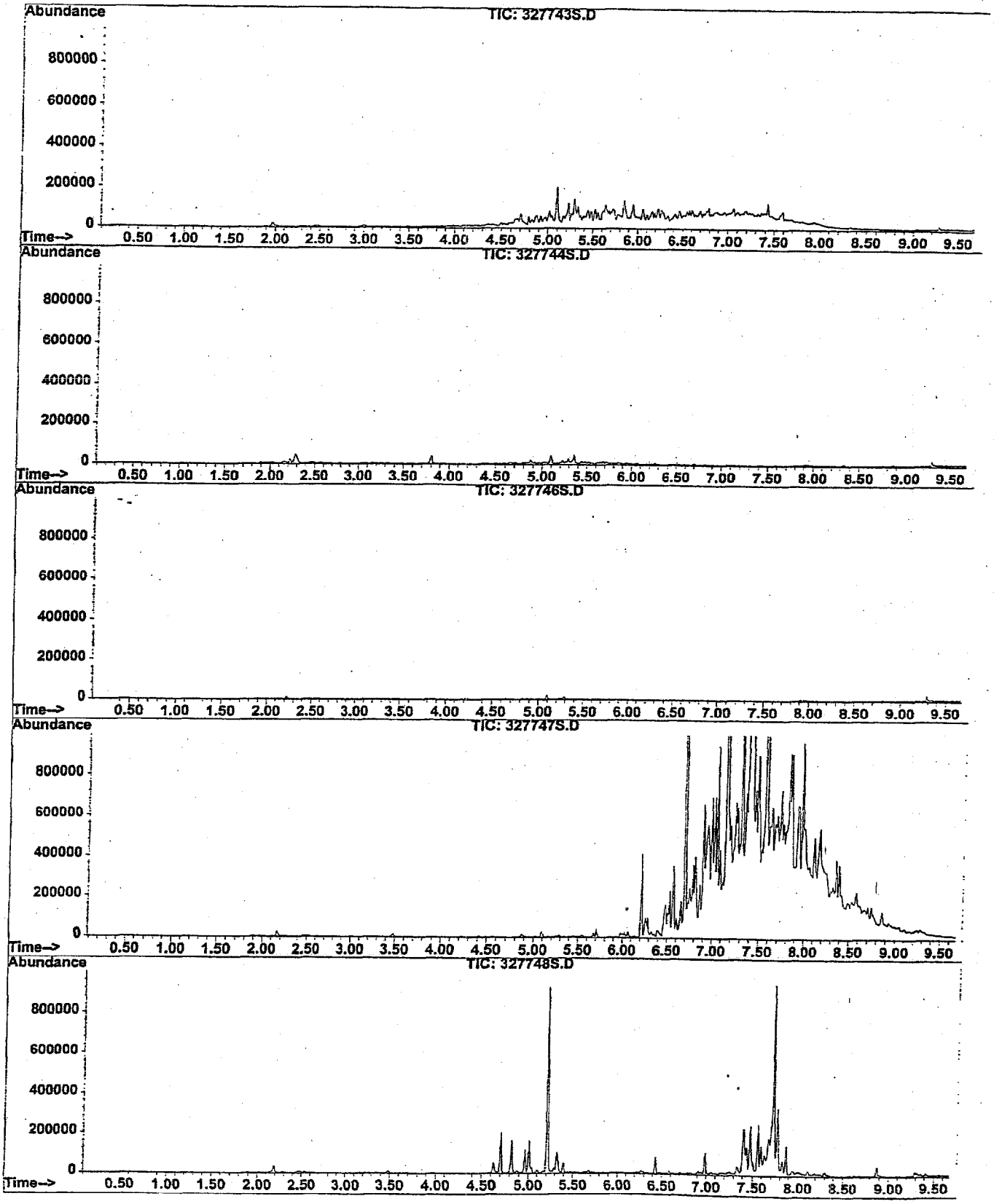

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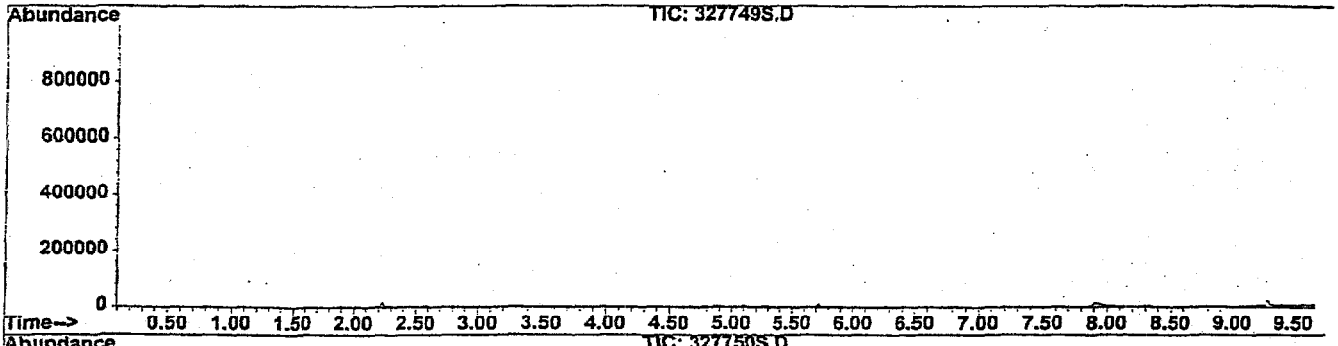

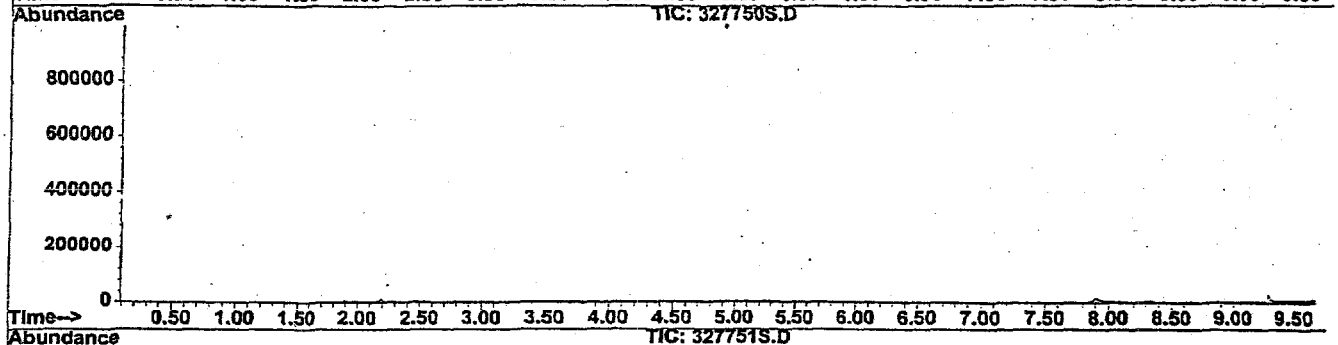

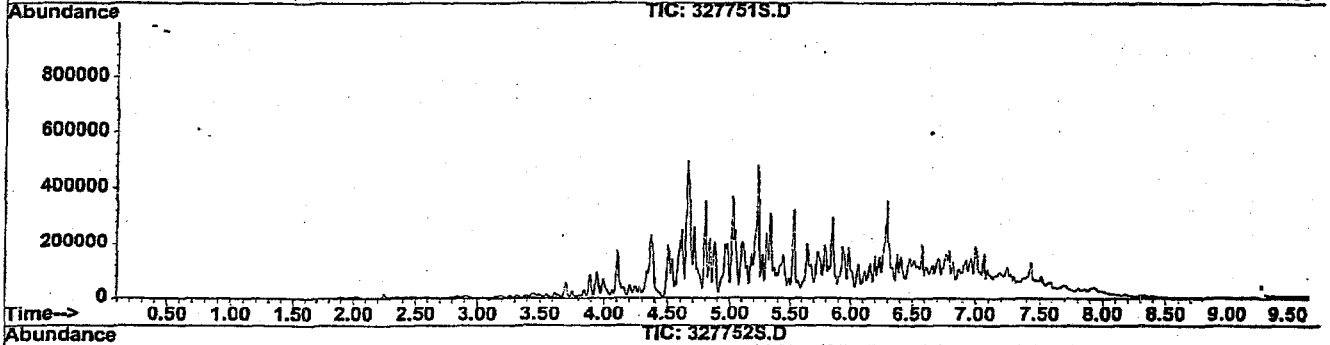

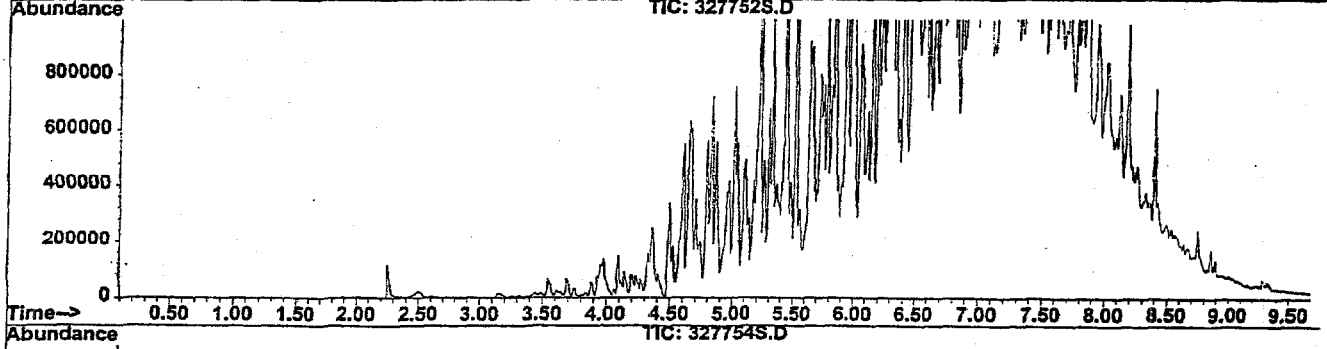

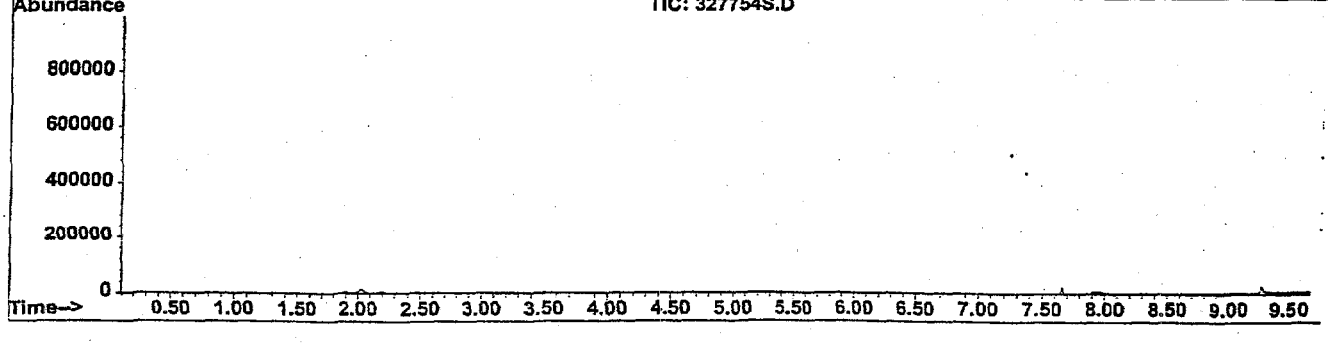

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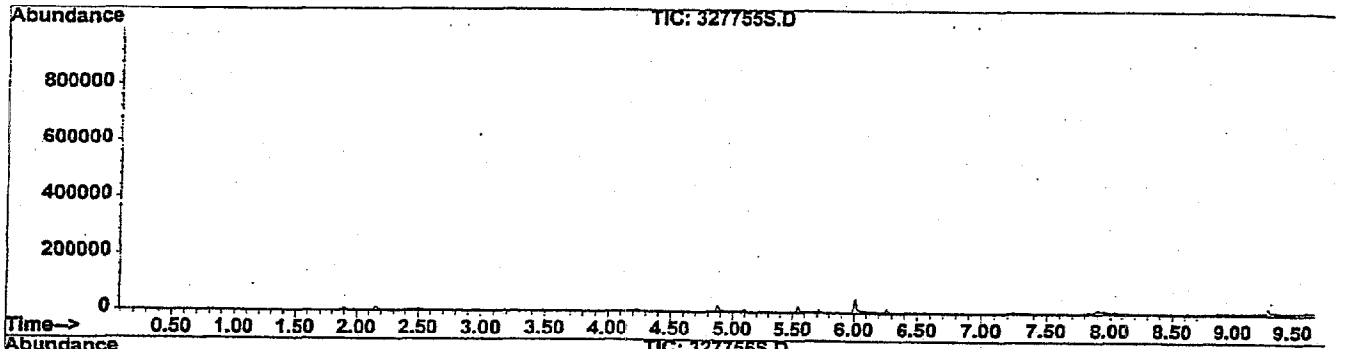

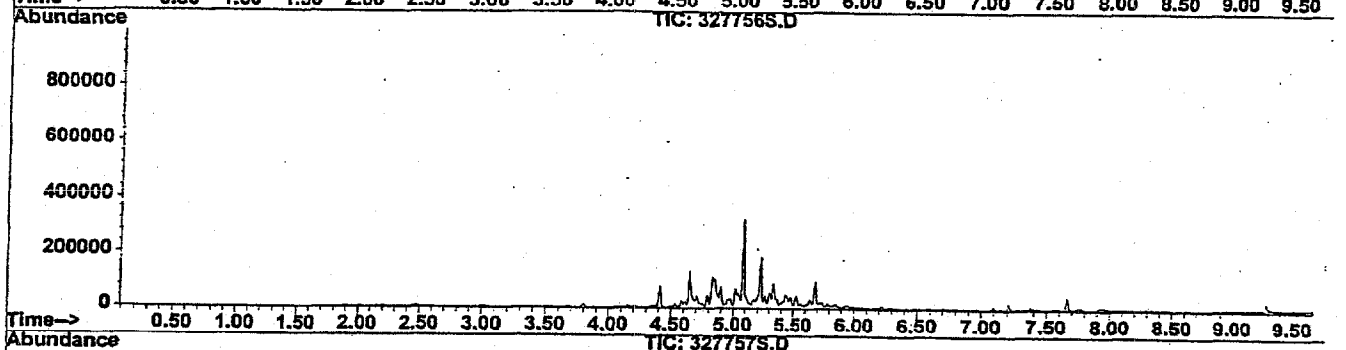

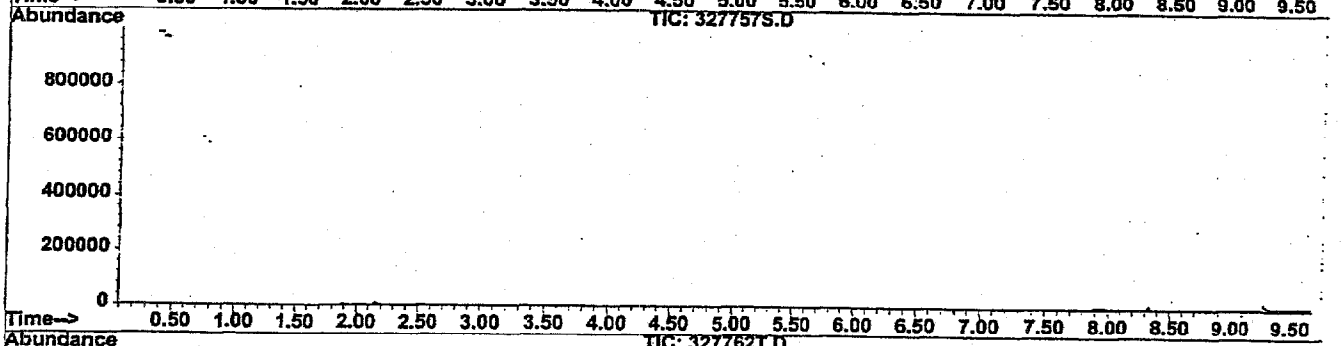

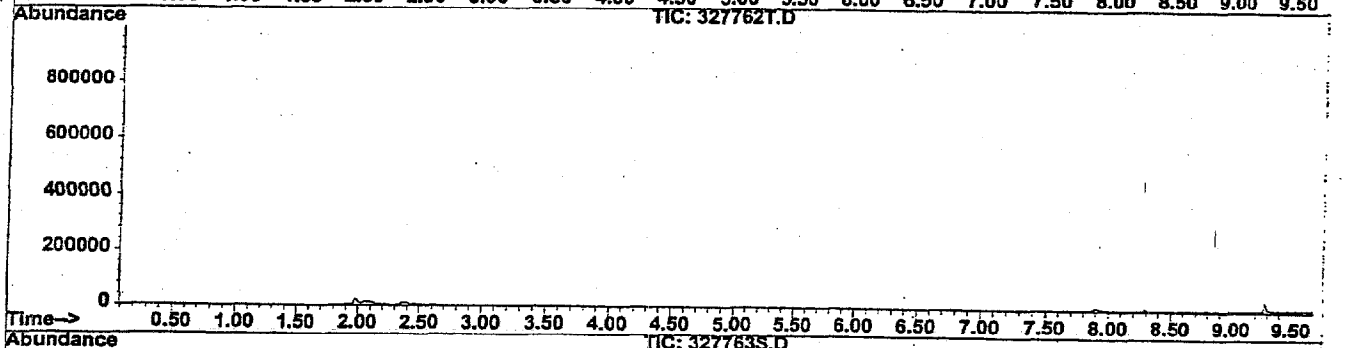

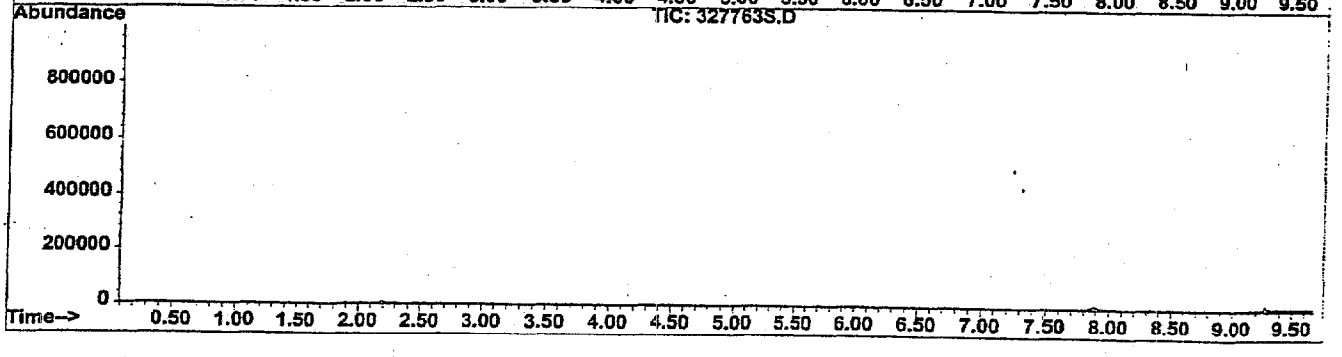

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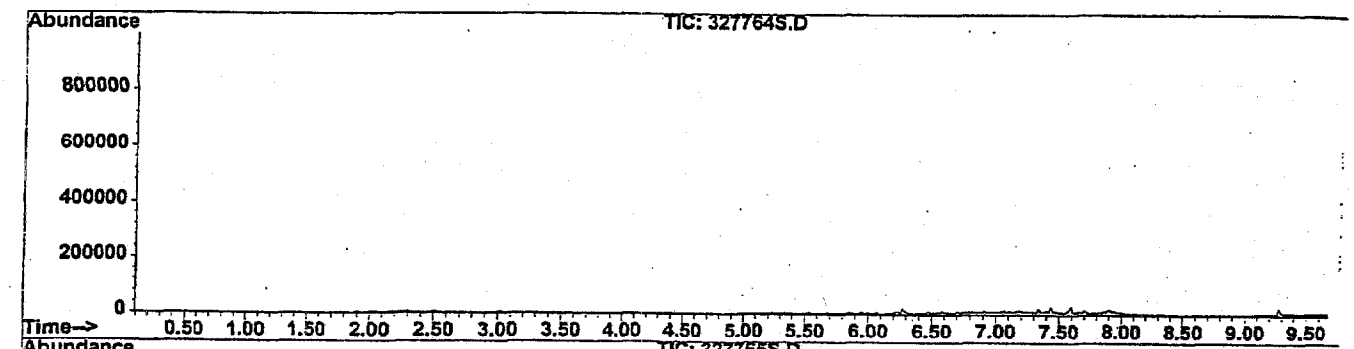
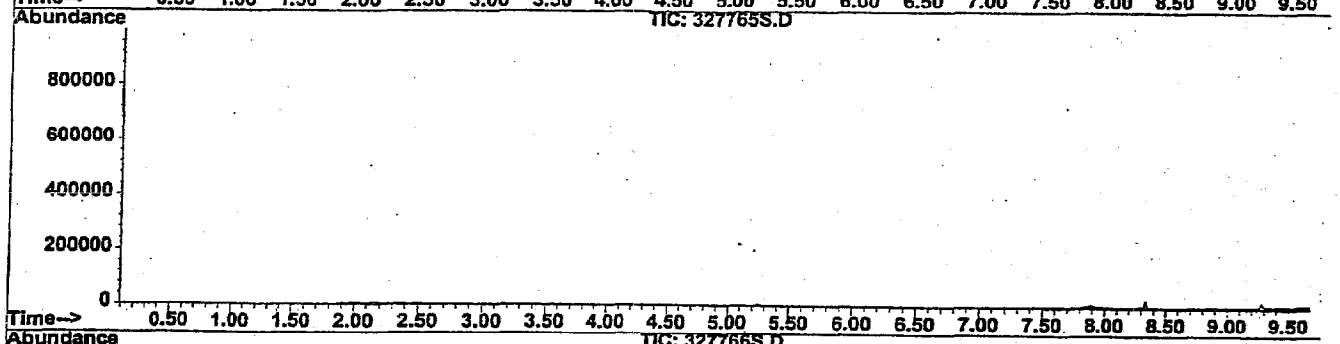
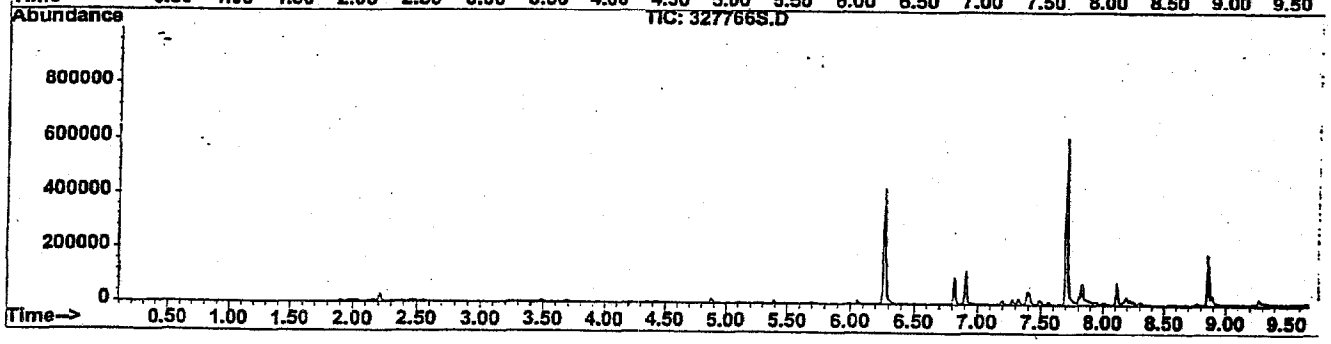
In Numerical Order







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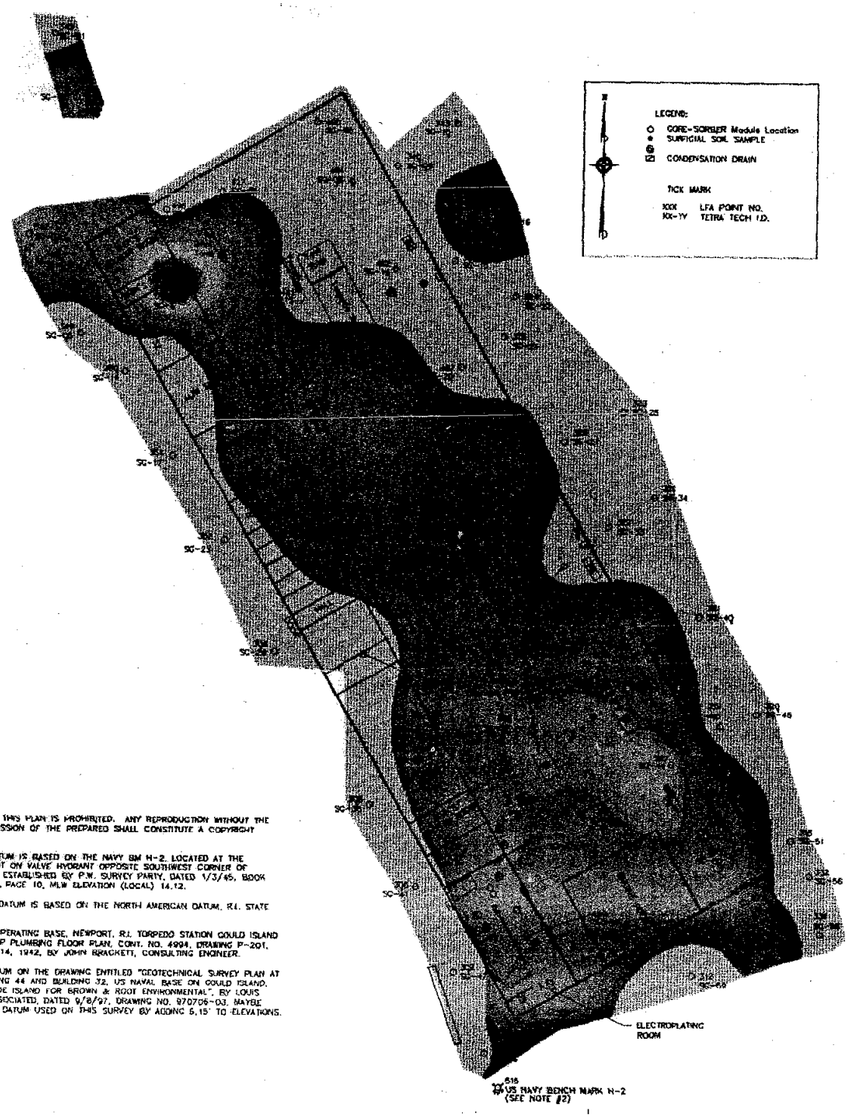

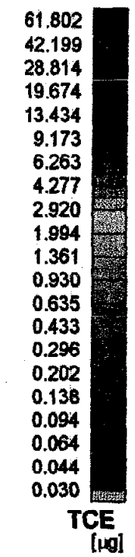

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3. HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM, R.I. STATE PLANE 1983.
4. U.S. NAVAL OPERATING BASE, NEWPORT, R.I. TORPEDO STATION GOULD ISLAND OVERHAUL SHOP PLUMBING FLOOR PLAN, CONT. NO. 4994, DRAWING P-201, DATED MARCH 14, 1942, BY JOHN BRACKETT, CONSULTING ENGINEER.
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Scale 1:1200

50 0 50 100 150 200 250

foot

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(410) 392-7600

Tetra Tech NUS, Inc., Wilmington, MA
Gould Island Building 32, Newport, RI
Trichloroethene

DATE DRAWN: 24 May 2000	DRAWN BY: JH	ORIG. CAD: SOILGAS.dwg	SITE CODE: SJM
REV. DATE:	REV. #:	PROJECT NUMBER: 10380972	

0316.5ABI17

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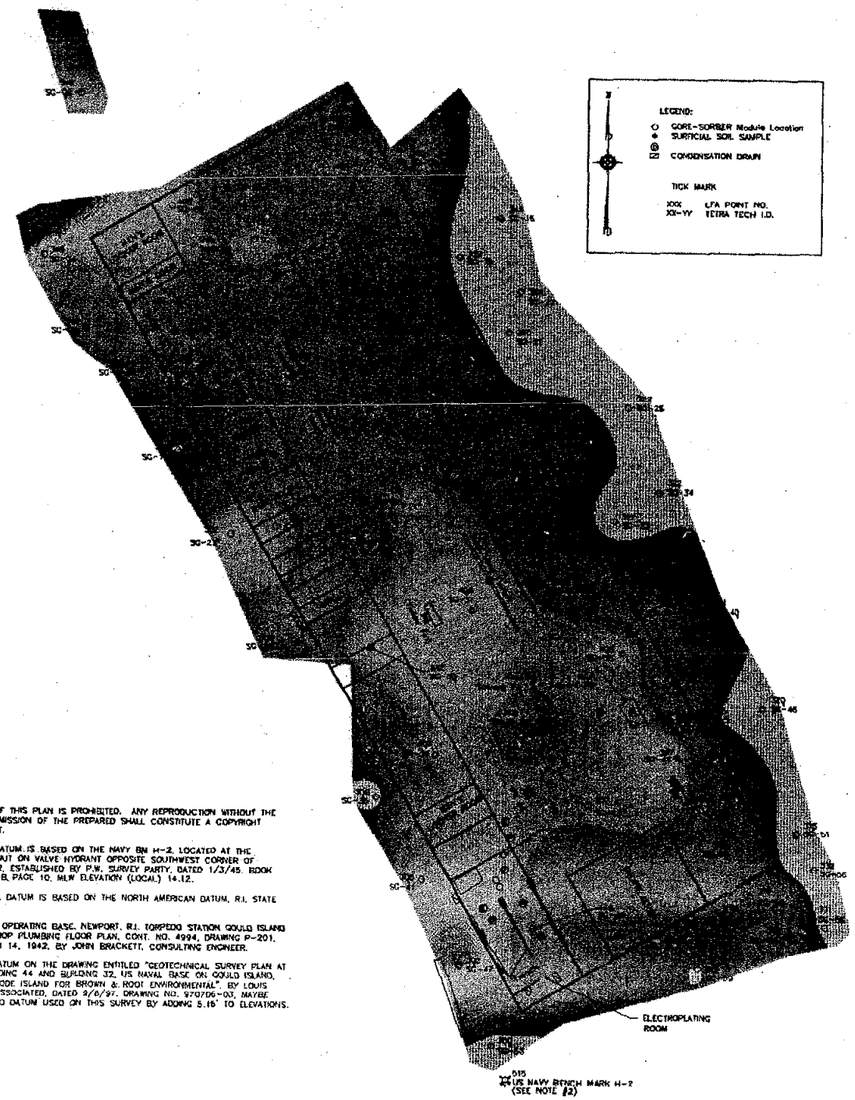

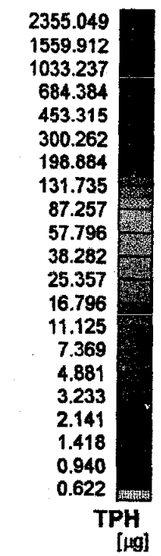

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Gould Island Building 32, Newport, RI
Total Petroleum Hydrocarbons

DATE DRAWN: 24 May 2000	DRAWN BY: JH	ORIG. CAD: SOILGAS.dwg	SITE CODE: BJM
REV. DATE:	REV. #	PROJECT NUMBER: 10480972	

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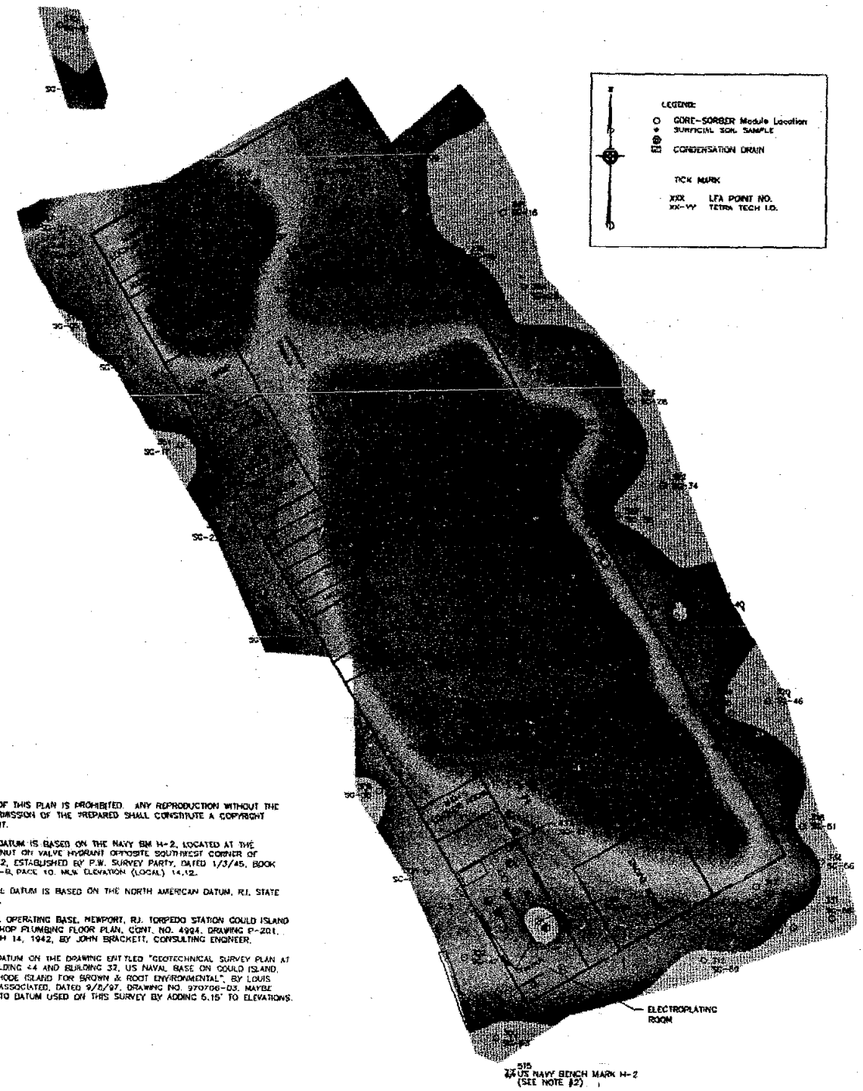

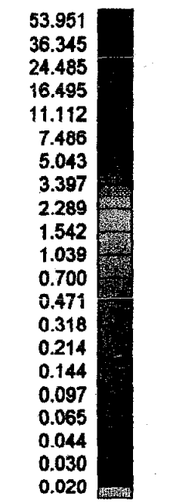

Naphthalene
[µg]

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Gould Island Building 32, Newport, RI
Naphthalene

DATE DRAWN: 24 May 2000	DRAWN BY: JH	ORIG. CAD: SOILGAS.dwg	SITE CODE: BJM
REV. DATE:	REV. #:	PROJECT NUMBER: 10380072	

AAAGO TP2V

APPENDIX C

FIGURES AND DATA FROM PCB CONCRETE AND SOIL REMEDIATION, FOSTER WHEELER ENVIRONMENTAL CORPORATION

TABLE C-1
GOULD ISLAND PCB REMEDIATION
PHASE 1 CONCRETE SAMPLE ANALYSIS

Sample I.D	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Results (ppm)	Comment
GIPI-RD-A6	Concrete	2/7/2002		X	U	
GIPI-RD-A10	Concrete	2/7/2002		X	U	Duplicate of GIPI-RD-A10D
GIPI-RD-A10D	Concrete	2/7/2002		X	U	Duplicate of GIPI-RD-A10
GIPI-RD-A11	Concrete	2/7/2002		X	U	
GIPI-RD-AA29	Concrete	1/28/2002	X		U	
GIPI-RD-AA30	Concrete	1/28/2002	X		U	
GIPI-RD-B1	Concrete	2/7/2002		X	U	
GIPI-RD-B2	Concrete	2/7/2002		X	U	
GIPI-RD-B3	Concrete	1/14/2002	X		U	
GIPI-RD-B4	Concrete	1/15/2002	X		0.097	
GIPI-RD-B5	Concrete	1/15/2002	X		U	
GIPI-RD-B6	Concrete	1/15/2002	X		0.018	
GIPI-RD-B7	Concrete	1/15/2002	X		0.028	Duplicate of GIPI-RD-B7D
GIPI-RD-B7D	Concrete	1/15/2002	X		0.015	Duplicate of GIPI-RD-B7
GIPI-RD-B8	Concrete	1/16/2002	X		U	
GIPI-RD-B9	Concrete	1/24/2002	X		U	
GIPI-RD-B10	Concrete	1/16/2002	X		U	
GIPI-RD-B11	Concrete	2/6/2002		X	U	
GIPI-RD-C1	Concrete	2/7/2002		X	U	
GIPI-RD-C2	Concrete	1/14/2002	X		U	
GIPI-RD-C3	Concrete	1/14/2002	X		U	
GIPI-RD-C4	Concrete	1/14/2002	X		U	
GIPI-RD-C5	Concrete	1/11/2002	X		U	
GIPI-RD-C6	Concrete	1/11/2002	X		U	
GIPI-RD-C10	Concrete	1/16/2002	X		U	
GIPI-RD-C11	Concrete	1/16/2002	X		U	
GIPI-RD-C42	Concrete	2/6/2002		X	U	
GIPI-RD-C43	Concrete	2/6/2002		X	U	
GIPI-RD-D1	Concrete	2/6/2002		X	U	
GIPI-RD-D2	Concrete	12/20/2001	X		0.115	
GIPI-RD-D3	Concrete	1/10/2002	X		U	
GIPI-RD-D4	Concrete	1/14/2002	X		U	
GIPI-RD-D5	Concrete	1/11/2002	X		U	
GIPI-RD-D11	Concrete	1/25/2002	X		U	
GIPI-RD-D12	Concrete	1/25/2002	X		U	
GIPI-RD-D13	Concrete	1/24/2002	X		0.028	
GIPI-RD-D14	Concrete	1/22/2002	X		U	
GIPI-RD-D15	Concrete	1/17/2002	X		U	Duplicate of GIPI-RD-D15D
GIPI-RD-D15D	Concrete	1/17/2002	X		U	Duplicate of GIPI-RD-D15
GIPI-RD-D16	Concrete	1/22/2002	X		U	
GIPI-RD-D17	Concrete	1/25/2002	X		U	
GIPI-RD-D20B5-TOP	Concrete	12/26/2001	X		0.018	
GIPI-RD-D20B5-BOT	Concrete	12/26/2001	X		U	
GIPI-RD-D21B3-TOP	Concrete	12/26/2001	X		U	
GIPI-RD-D21B3-BOT	Concrete	12/26/2001	X		U	
GIPI-RD-D22B10-TOP	Concrete	12/26/2001	X		U	
GIPI-RD-D22B10-BOT	Concrete	12/26/2001	X		U	
GIPI-RD-D42	Concrete	2/6/2002		X	U	
GIPI-RD-D43	Concrete	2/6/2002		X	U	
GIPI-RD-E1	Concrete	2/7/2002		X	0.165	
GIPI-RD-E2	Concrete	1/10/2002	X		0.056	
GIPI-RD-E3-TOP	Concrete	1/10/2002	X		0.083	
GIPI-RD-E3-BOT	Concrete	1/10/2002	X		U	Duplicate of GIPI-RD-E3-BOTD
GIPI-RD-E3-BOTD	Concrete	1/10/2002	X		U	Duplicate of GIPI-RD-E3-BOT
GIPI-RD-E4	Concrete	12/20/2001	X		0.122	
GIPI-RD-E12	Concrete	1/17/2002	X		U	
GIPI-RD-E13	Concrete	1/17/2002	X		U	
GIPI-RD-E14	Concrete	1/17/2002	X		U	
GIPI-RD-E15	Concrete	1/17/2002	X		U	
GIPI-RD-E16	Concrete	1/17/2002	X		U	
GIPI-RD-E17	Concrete	1/16/2002	X		U	
GIPI-RD-E18	Concrete	1/23/2002	X		U	

TABLE C-1
GOULD ISLAND PCB REMEDIATION
PHASE 1 CONCRETE SAMPLE ANALYSIS

Sample I.D	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Results (ppm)	Comment	
GIPI-RD-E19	Concrete	1/22/2002	X		U		
GIPI-RD-E20-TOP	Concrete	12/26/2001	X		U		
GIPI-RD-E20-BOT	Concrete	12/26/2001	X		U		
GIPI-RD-E21B7-TOP	Concrete	12/26/2002	X		U		
GIPI-RD-E21B7-BOT	Concrete	12/26/2001	X		U		
GIPI-RD-E21B9-TOP	Concrete	1/23/2002	X		U		
GIPI-RD-E21B9-BOT	Concrete	1/23/2002	X		U		
GIPI-RD-E22-TOP	Concrete	12/26/2001	X		U		
GIPI-RD-E22-BOT	Concrete	12/26/2001	X		U		
GIPI-RD-E23	Concrete	12/21/2001	X		U		
GIPI-RD-E24	Concrete	1/23/2002	X		U	Duplicate of	GIPI-RD-E24D
GIPI-RD-E24D	Concrete	1/23/2002	X		U	Duplicate of	GIPI-RD-E24
GIPI-RD-E25	Concrete	1/23/2002	X		U		
GIPI-RD-E26	Concrete	1/24/2002	X		U		
GIPI-RD-E27	Concrete	1/24/2002	X		U		
GIPI-RD-E28	Concrete	1/24/2002	X		U		
GIPI-RD-E29	Concrete	1/23/2002	X		U		
GIPI-RD-E30-TOP	Concrete	12/26/2001	X		U		
GIPI-RD-E30-BOT	Concrete	12/27/2001	X		U		
GIPI-RD-E31B1-TOP	Concrete	12/26/2001	X		U		
GIPI-RD-E31B1-BOT	Concrete	12/27/2001	X		0.031		
GIPI-RD-E31B13-TOP	Concrete	12/27/2001	X		0.015		
GIPI-RD-E31B13-BOT	Concrete	12/27/2001	X		0.213		
GIPI-RD-E32B3-TOP	Concrete	12/27/2001	X		U		
GIPI-RD-E32B3-BOT	Concrete	12/27/2001	X		0.029		
GIPI-RD-E32 B11-TOP	Concrete	12/27/2001	X		0.111		
GIPI-RD-E32B11-BOT	Concrete	12/27/2001	X		0.05		
GIPI-RD-E33B5-TOP	Concrete	12/28/2001	X		0.029		
GIPI-RD-E33B5-BOT	Concrete	12/28/2001	X		0.063	Duplicate of	GIPI-RD-E33B5-BOTD
GIPI-RD-E33B5-BOTD	Concrete	12/28/2001	X		0.082	Duplicate of	GIPI-RD-E33B5-BOT
GIPI-RD-E33B9-TOP	Concrete	12/27/2001	X		0.205		
GIPI-RD-E33B9-BOT	Concrete	12/27/2001	X		0.336		
GIPI-RD-F1	Concrete	2/7/2002	X		**2.3**		
GIPI-RD-F1-E	Concrete	2/20/2002	X		**1.85**		
GIPI-RD-F2	Concrete	12/20/2001	X		**291**		
GIPI-RD-F2-N	Concrete	1/24/2002	X		**14.6**		
GIPI-RD-F2-E	Concrete	1/24/2002	X		0.241		
GIPI-RD-F2-S	Concrete	1/24/2002	X		0.192		
GIPI-RD-F2-W	Concrete	1/24/2002	X		**244**		
GIPI-RD-F3	Concrete	12/20/2001	X		0.12		
GIPI-RD-F4	Concrete	12/20/2001	X		0.067		
GIPI-RD-F44	Concrete	12/19/2001	X		U		
GIPI-RD-G1	Concrete	2/7/2002		X	0.685		
GIPI-RD-G2	Concrete	1/8/2002	X		0.192		
GIPI-RD-G3	Concrete	1/9/2002	X		0.132		
GIPI-RD-G4	Concrete	1/10/2002	X		U		
GIPI-RD-G43	Concrete	2/4/2002		X	U		
GIPI-RD-H1	Concrete	2/7/2002		X	U		
GIPI-RD-H2	Concrete	1/8/2002	X		0.061		
GIPI-RD-H3	Concrete	1/9/2002	X		U		
GIPI-RD-H4	Concrete	1/9/2002	X		U		
GIPI-RD-H43	Concrete	2/4/2002		X	U		
GIPI-RD-I1	Concrete	2/7/2002		X	U		
GIPI-RD-I2	Concrete	1/8/2002	X		0.016		
GIPI-RD-I3	Concrete	1/9/2002	X		U		
GIPI-RD-I4	Concrete	1/9/2002	X		U		
GIPI-RD-I5	Concrete	1/9/2002	X		U		
GIPI-RD-I43	Concrete	2/6/2002		X	U		
GIPI-RD-J1	Concrete	2/7/2002		X	U		
GIPI-RD-J2	Concrete	1/8/2002	X		U		
GIPI-RD-J3	Concrete	1/8/2002	X		U		
GIPI-RD-J4	Concrete	1/8/2002	X		U		

TABLE C-1
GOULD ISLAND PCB REMEDIATION
PHASE 1 CONCRETE SAMPLE ANALYSIS

Sample I.D	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Results (ppm)	Comment	
GIPI-RD-J5	Concrete	1/8/2002	X		U		
GIPI-RD-J43	Concrete	2/6/2002		X	U		
GIPI-RD-K1	Concrete	1/4/2002	X		U		
GIPI-RD-K2	Concrete	1/4/2002	X		U		
GIPI-RD-K3	Concrete	1/4/2002	X		U		
GIPI-RD-K4	Concrete	1/4/2002	X		U		
GIPI-RD-K5	Concrete	1/4/2002	X		U		
GIPI-RD-K6	Concrete	1/4/2002	X		U		
GIPI-RD-K7	Concrete	1/15/2002	X		U		
GIPI-RD-K8	Concrete	1/15/2002	X		U		
GIPI-RD-K9	Concrete	1/15/2002	X		U		
GIPI-RD-K43	Concrete	2/6/2002		X	U		
GIPI-RD-L1	Concrete	1/17/2002	X		U		
GIPI-RD-L2	Concrete	1/17/2002	X		U		
GIPI-RD-L3	Concrete	1/16/2002	X		U		
GIPI-RD-L4	Concrete	1/16/2002	X		U		
GIPI-RD-L5	Concrete	1/16/2002	X		U		
GIPI-RD-L6	Concrete	1/16/2002	X		U		
GIPI-RD-L7	Concrete	1/16/2002	X		U		
GIPI-RD-L8	Concrete	1/16/2002	X		U		
GIPI-RD-L9	Concrete	1/16/2002	X		U		
GIPI-RD-L10	Concrete	1/15/2002	X		U		
GIPI-RD-L43	Concrete	2/6/2002		X	U		
GIPI-RD-M4	Concrete	1/23/2002	X		U		
GIPI-RD-M5	Concrete	1/23/2002	X		U		
GIPI-RD-M6	Concrete	1/17/2002	X		U		
GIPI-RD-M7	Concrete	1/17/2002	X		U		
GIPI-RD-M8	Concrete	1/17/2002	X		U		
GIPI-RD-M9	Concrete	1/17/2002	X		U		
GIPI-RD-M10	Concrete	1/22/2002	X		U		
GIPI-RD-M43	Concrete	2/6/2002		X	U		
GIPI-RD-N7	Concrete	1/23/2002	X		U		
GIPI-RD-N8	Concrete	1/22/2002	X		U		
GIPI-RD-N9	Concrete	1/22/2002	X		U		
GIPI-RD-N10	Concrete	1/22/2002	X		U		
GIPI-RD-N43	Concrete	2/6/2002		X	0.019		
GIPI-RD-O9	Concrete	1/23/2002	X		U		
GIPI-RD-O10	Concrete	1/22/2002	X		U		
GIPI-RD-O43	Concrete	2/6/2002		X	U		
GIPI-RD-P10	Concrete	1/30/2002		X	U		
GIPI-RD-P35-TOP	Concrete	1/2/2002	X		U		
GIPI-RD-P35-BOT	Concrete	1/2/2002	X		U		
GIPI-RD-P43	Concrete	2/6/2002		X	U		
GIPI-RD-Q11	Concrete	1/23/2002	X		U		
GIPI-RD-Q12	Concrete	1/24/2002	X		U		
GIPI-RD-Q13	Concrete	1/24/2002	X		U		
GIPI-RD-Q14	Concrete	1/25/2002	X		U		
GIPI-RD-Q15	Concrete	1/25/2002	X		U		
GIPI-RD-Q16-TOP	Concrete	1/2/2002	X		U		
GIPI-RD-Q16-BOT	Concrete	1/2/2002	X		U		
GIPI-RD-Q16B11-TOP	Concrete	1/3/2002	X		0.036		
GIPI-RD-Q16B11-BOT	Concrete	1/3/2002	X		0.018		
GIPI-RD-Q17-TOP	Concrete	1/3/2002	X		U		
GIPI-RD-Q17-BOT	Concrete	1/3/2002	X		U		
GIPI-RD-Q17B7-TOP	Concrete	1/3/2002	X		0.018	duplicate of	GIPI-RD-Q17B7-TOPD
GIPI-RD-Q17B7-TOPD	Concrete	1/3/2002	X		0.042	duplicate of	GIPI-RD-Q17B7-TOP
GIPI-RD-Q17B7-BOT	Concrete	1/3/2002	X		0.058		
GIPI-RD-Q17B8-TOP	Concrete	1/3/2002	X		0.07		
GIPI-RD-Q17B8-BOT	Concrete	1/3/2002	X		0.034		
GIPI-RD-Q17B9-TOP	Concrete	1/2/2002	X		U		
GIPI-RD-Q17B9-BOT	Concrete	1/2/2002	X		0.165		
GIPI-RD-Q18-TOP	Concrete	1/2/2002	X		U		

TABLE C-1
GOULD ISLAND PCB REMEDIATION
PHASE 1 CONCRETE SAMPLE ANALYSIS

Sample I.D	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Results (ppm)	Comment	
GIPI-RD-Q18-BOT	Concrete	1/2/2002	X		U		
GIPI-RD-Q18B2-TOP	Concrete	1/3/2002	X		0.038		
GIPI-RD-Q18B2-BOT	Concrete	1/3/2002	X		U		
GIPI-RD-Q18B3-TOP	Concrete	1/2/2002	X		U		
GIPI-RD-Q18B3-BOT	Concrete	1/2/2002	X		U		
GIPI-RD-Q18B5-TOP	Concrete	1/2/2002	X		0.045		
GIPI-RD-Q18B5-BOT	Concrete	1/3/2002	X		U		
GIPI-RD-Q19	Concrete	1/25/2002	X		U		
GIPI-RD-Q20	Concrete	1/28/2002	X		U		
GIPI-RD-Q21	Concrete	1/28/2002	X		U		
GIPI-RD-Q22	Concrete	1/25/2002	X		U	duplicate of	
GIPI-RD-Q22D	Concrete	1/25/2002	X		U	duplicate of	
GIPI-RD-Q23	Concrete	1/25/2002	X		U		
GIPI-RD-Q24	Concrete	1/25/2002	X		U		
GIPI-RD-Q25-TOP	Concrete	1/4/2002	X		U		
GIPI-RD-Q25-BOT	Concrete	1/4/2002	X		U		
GIPI-RD-Q25B14-TOP	Concrete	1/3/2002	X		0.325		
GIPI-RD-Q25B14-BOT	Concrete	1/3/2002	X		U		
GIPI-RD-Q26-TOP	Concrete	1/4/2002	X		U		
GIPI-RD-Q26-BOT	Concrete	1/4/2002	X		0.047		
GIPI-RD-Q26A-TOP	Concrete	1/3/2002	X		0.125		
GIPI-RD-Q26A-BOT	Concrete	1/3/2002	X		0.021		
GIPI-RD-Q26B-TOP	Concrete	1/3/2002	X		**1.36**	duplicate of	GIPI-RD-Q26B-TOPD
GIPI-RD-Q26B-TOPD	Concrete	1/3/2002	X		**1.66**	duplicate of	GIPI-RD-Q26B-TOP
GIPI-RD-Q26B-BOT	Concrete	1/3/2002	X		0.094		
GIPI-RD-Q26B12-TOP	Concrete	1/4/2002	X		0.04		
GIPI-RD-Q26B12-BOT	Concrete	1/4/2002	X		U		
GIPI-RD-Q27	Concrete	1/28/2002	X		U	duplicate of	GIPI-RD-Q27D
GIPI-RD-Q27D	Concrete	1/28/2002	X		U	duplicate of	GIPI-RD-Q27
GIPI-RD-Q27A-TOP	Concrete	1/3/2002	X		U		
GIPI-RD-Q27A-BOT	Concrete	1/3/2002	X		U		
GIPI-RD-Q27B7-TOP	Concrete	1/3/2002	X		U		
GIPI-RD-Q27B7-BOT	Concrete	1/3/2002	X		U		
GIPI-RD-Q28	Concrete	1/28/2002	X		U		
GIPI-RD-Q29	Concrete	1/28/2002	X		U		
GIPI-RD-Q30	Concrete	1/29/2002	X		U		
GIPI-RD-Q31	Concrete	1/29/2002	X		U		
GIPI-RD-Q32	Concrete	1/29/2002	X		U		
GIPI-RD-Q33	Concrete	1/28/2002	X		U		
GIPI-RD-Q34-TOP	Concrete	1/2/2002	X		0.085		
GIPI-RD-Q34-BOT	Concrete	1/2/2002	X		0.343		
GIPI-RD-Q35B4-TOP	Concrete	12/28/2001	X		0.017		
GIPI-RD-Q35B4-BOT	Concrete	12/28/2002	X		0.017		
GIPI-RD-Q35B6-TOP	Concrete	12/28/2001	X		0.039		
GIPI-RD-Q35B6-BOT	Concrete	1/2/2002	X		U		
GIPI-RD-Q35B8-TOP	Concrete	12/28/2001	X		0.153		
GIPI-RD-Q35B8-BOT	Concrete	12/28/2001	X		0.212		
GIPI-RD-Q35B9-TOP	Concrete	12/28/2001	X		**4.71**	duplicate of	GIPI-RD-Q35B9-TOPD
GIPI-RD-Q35B9-TOPD	Concrete	12/28/2001	X		**2.29**	duplicate of	GIPI-RD-Q35B9-TOP
GIPI-RD-Q35B9-BOT	Concrete	12/28/2001	X		0.153		
GIPI-RD-Q35B9-N-TOP	Concrete	2/11/2002		X	0.059		
GIPI-RD-Q35B9-E-TOP	Concrete	2/11/2002		X	U		
GIPI-RD-Q36-TOP	Concrete	1/2/2002	X		U		
GIPI-RD-Q36-BOT	Concrete	1/2/2002	X		U		
GIPI-RD-R11	Concrete	1/30/2002		X	U		
GIPI-RD-R12	Concrete	1/30/2002		X	U	duplicate of	GIPI-RD-R12D
GIPI-RD-R12D	Concrete	1/30/2002		X	U	duplicate of	GIPI-RD-R12
GIPI-RD-R30	Concrete	1/29/2002	X		U		
GIPI-RD-S13	Concrete	1/30/2002		X	U		
GIPI-RD-S17	Concrete	1/31/2002		X	U		
GIPI-RD-S18	Concrete	1/31/2002		X	U		
GIPI-RD-S30	Concrete	1/29/2002	X		U		

TABLE C-1
GOULD ISLAND PCB REMEDIATION
PHASE 1 CONCRETE SAMPLE ANALYSIS

Sample I.D	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Results (ppm)	Comment	
GIPI-RD-T14	Concrete	1/30/2002		X	U		
GIPI-RD-T18	Concrete	2/4/2002		X	U		
GIPI-RD-T30	Concrete	1/29/2002	X		U		
GIPI-RD-U14	Concrete	1/31/2002		X	U		
GIPI-RD-U15	Concrete	1/31/2002		X	U		
GIPI-RD-U16	Concrete	1/31/2002		X	U		
GIPI-RD-U17	Concrete	2/4/2002		X	U		
GIPI-RD-U18	Concrete	2/4/2002		X	U		
GIPI-RD-U30	Concrete	1/29/2002	X		U		
GIPI-RD-V16	Concrete	2/7/2002		X	U		
GIPI-RD-V17	Concrete	2/4/2002		X	U		
GIPI-RD-V18	Concrete	2/4/2002		X	U		
GIPI-RD-V30	Concrete	1/29/2002	X		U		
GIPI-RD-W17	Concrete	1/31/2002		X	U		
GIPI-RD-W18	Concrete	2/4/2002		X	U		
GIPI-RD-W24	Concrete	1/30/2002		X	U		
GIPI-RD-W30	Concrete	1/29/2002	X		U		
GIPI-RD-X17D	Concrete	1/31/2002		X	U	duplicate of	GIPI-RD-X17
GIPI-RD-X17	Concrete	1/31/2002		X	U	duplicate of	GIPI-RD-X17D
GIPI-RD-X18	Concrete	1/31/2002		X	U		
GIPI-RD-X19	Concrete	1/31/2002		X	U		
GIPI-RD-X24	Concrete	1/30/2002		X	U		
GIPI-RD-X30	Concrete	1/29/2002	X		U		
GIPI-RD-Y20	Concrete	1/31/2002		X	U		
GIPI-RD-Y21	Concrete	1/30/2002		X	U		
GIPI-RD-Y24	Concrete	1/30/2002		X	U		
GIPI-RD-Y30	Concrete	1/28/2002	X		U		
GIPI-RD-Z22	Concrete	1/30/2002		X	U		
GIPI-RD-Z23	Concrete	1/30/2002		X	U		
GIPI-RD-Z24	Concrete	1/29/2002		X	U		
GIPI-RD-Z30	Concrete	1/28/2002	X		U		

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
VAULT 53						
GIPI-53-B1-NW	Soil	1/10/2002	X		2.45	
GIPI-53-B1-7	Soil	1/10/2002	X		2.12	
GIPI-53-B1-8	Soil	1/10/2002	X		1.24	
GIPI-53-B1-9	Soil	1/10/2002	X		**11.6**	
GIPI-53-B1-10	Soil	1/10/2002	X		0.092	2' below bottom of vault
GIPI-53-B1-11	Soil	1/16/2002		X	0.036	
GIPI-53-B2-1	Soil	1/9/2002	X		6.71	
GIPI-53-B2-2	Soil	1/9/2002	X		0.779	
GIPI-53-B2-8	Soil	1/9/2002		X	U	
GIPI-53-B2-9	Soil	1/9/2002		X	U	
GIPI-53-B2-10	Soil	1/9/2002		X	U	2' below bottom of vault
GIPI-53-B3-1	Soil	1/9/2002	X		0.018	
GIPI-53-B3-2	Soil	1/9/2002	X		U	
GIPI-53-B3-8	Soil	1/9/2002		X	U	
GIPI-53-B3-9	Soil	1/9/2002		X	U	
GIPI-53-B3-10	Soil	1/9/2002		X	U	2' below bottom of vault
GIPI-53-B4-1	Soil	1/17/2002	X		1.46	
GIPI-53-B4-2	Soil	1/17/2002	X		0.111	
GIPI-53-B4-8	Soil	1/17/2002		X	U	
GIPI-53-B4-9	Soil	1/17/2002		X	U	
GIPI-53-B4-10	Soil	1/17/2002		X	U	2' below bottom of vault
GIPI-53-B5-1	Soil	1/16/2002	X		0.018	
GIPI-53-B5-2	Soil	1/16/2002	X		U	
GIPI-53-B5-8	Soil	1/16/2002		X	U	
GIPI-53-B5-9	Soil	1/16/2002		X	U	
GIPI-53-B5-10	Soil	1/16/2002		X	U	2' below bottom of vault
GIPI-53-B6-1	Soil	1/16/2002	X		U	
GIPI-53-B6-2	Soil	1/16/2002	X		U	
GIPI-53-B6-8	Soil	1/16/2002		X	U	
GIPI-53-B6-9	Soil	1/16/2002		X	U	
GIPI-53-B6-10	Soil	1/16/2002		X	U	2' below bottom of vault
GIPI-53-B7-1	Soil	1/16/2002	X		U	
GIPI-53-B7-2	Soil	1/16/2002	X		U	
GIPI-53-B9-1	Soil	1/16/2002	X		U	
GIPI-53-B9-2	Soil	1/16/2002	X		U	
GIPI-53-B9-8	Soil	1/16/2002		X	U	
GIPI-53-B9-9	Soil	1/16/2002		X	U	
GIPI-53-B9-10	Soil	1/16/2002		X	U	2' below bottom of vault
GIPI-53-B10-1	Soil	1/16/2002	X		U	
GIPI-53-B10-2	Soil	1/16/2002	X		U	Duplicate of GIPI-53-SS-8
GIPI-53-SS-8	Soil	1/16/2002	X		U	Duplicate of GIPI-53-B10-2
GIPI-53-B10-8	Soil	1/16/2002		X	U	
GIPI-53-B10-9	Soil	1/16/2002		X	U	Duplicate of GIPI-53-SS-9
GIPI-53-SS-9	Soil	1/16/2002		X	U	Duplicate of GIPI-53-B10-9
GIPI-53-B10-10	Soil	1/16/2002		X	U	2' below bottom of vault
GIPI-53-B11-1	Soil	1/9/2002	X		0.118	
GIPI-53-B11-2	Soil	1/9/2002	X		U	
GIPI-53-B11-8	Soil	1/9/2002		X	U	
GIPI-53-B11-9	Soil	1/9/2002		X	U	
GIPI-53-B11-10	Soil	1/9/2002		X	U	2' below bottom of vault
GIPI-53-B12-1	Soil	1/15/2002	X		U	
GIPI-53-B12-2	Soil	1/15/2002	X		U	
GIPI-53-B12-8	Soil	1/15/2002		X	U	
GIPI-53-B12-9	Soil	1/15/2002		X	U	
GIPI-53-B12-10	Soil	1/15/2002		X	U	2' below bottom of vault
GIPI-53-B13-1	Soil	1/15/2002	X		U	
GIPI-53-B13-2	Soil	1/15/2002	X		U	
GIPI-53-B13-8	Soil	1/15/2002		X	U	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-53-B13-9	Soil	1/15/2002		X	U	
GIPI-53-B13-10	Soil	1/15/2002		X	U	2' below bottom of vault
GIPI-53-B14-1	Soil	1/17/2002	X		0.364	
GIPI-53-B14-2	Soil	1/17/2002	X		U	
GIPI-53-B14-8	Soil	1/17/2002		X	U	
GIPI-53-B14-9	Soil	1/17/2002		X	U	
GIPI-53-B14-10	Soil	1/17/2002		X	U	2' below bottom of vault
GIPI-53-B15-1	Soil	1/15/2002	X		1.12	
GIPI-53-B15-2	Soil	1/15/2002	X		U	
GIPI-53-B15-8	Soil	1/15/2002		X	U	
GIPI-53-B15-9	Soil	1/15/2002		X	U	
GIPI-53-B15-10	Soil	1/15/2002		X	U	2' below bottom of vault
GIPI-53-B16-1	Soil	1/15/2002	X		0.505	
GIPI-53-B16-2	Soil	1/15/2002	X		U	
GIPI-53-B17-1	Soil	1/9/2002	X		0.252	
GIPI-53-B17-2	Soil	1/9/2002	X		U	
GIPI-53-B17-8	Soil	1/9/2002		X	U	
GIPI-53-B17-9	Soil	1/9/2002		X	U	
GIPI-53-B17-10	Soil	1/9/2002		X	U	2' below bottom of vault
GIPI-53-B18-1	Soil	1/17/2002	X		0.239	
GIPI-53-B18-2	Soil	1/17/2002	X		U	
GIPI-53-B18-8	Soil	1/17/2002		X	U	
GIPI-53-B18-9	Soil	1/17/2002		X	U	
GIPI-53-B18-10	Soil	1/17/2002		X	U	2' below bottom of vault
GIPI-53-B19-1	Soil	1/9/2002	X		**15.8**	
GIPI-53-B19-2	Soil	1/9/2002	X		U	
GIPI-53-B19-3	Soil	1/28/2002	X		U	
GIPI-53-B19-8	Soil	1/9/2002		X	1.19	
GIPI-53-B19-9	Soil	1/9/2002		X	0.294	
GIPI-53-B19-10	Soil	1/9/2002		X	U	2' below bottom of vault
GIPI-53-B20-1	Soil	1/15/2002	X		0.482	
GIPI-53-B20-2	Soil	1/15/2002	X		U	
GIPI-53-B21-1	Soil	1/14/2002	X		0.366	
GIPI-53-B21-2	Soil	1/14/2002	X		U	
GIPI-53-B21-8	Soil	1/14/2002		X	U	
GIPI-53-B21-9	Soil	1/14/2002		X	U	
GIPI-53-B21-10	Soil	1/14/2002		X	U	2' below bottom of vault
GIPI-53-B22-1	Soil	1/8/2002	X		3.06	
GIPI-53-B22-2	Soil	1/8/2002	X		0.029	
GIPI-53-B22-8	Soil	1/8/2002		X	U	
GIPI-53-B22-9	Soil	1/8/2002		X	U	
GIPI-53-B22-10	Soil	1/8/2002		X	U	2' below bottom of vault
GIPI-53-B23-1	Soil	1/14/2002	X		U	
GIPI-53-B23-2	Soil	1/14/2002	X		U	
GIPI-53-B23-8	Soil	1/14/2002		X	U	
GIPI-53-B23-9	Soil	1/14/2002		X	U	
GIPI-53-B23-10	Soil	1/14/2002		X	U	2' below bottom of vault
GIPI-53-B24-1	Soil	1/14/2002	X		U	
GIPI-53-B24-2	Soil	1/14/2002	X		U	
GIPI-53-B24-8	Soil	1/14/2002		X	U	
GIPI-53-B24-9	Soil	1/14/2002		X	U	
GIPI-53-B24-10	Soil	1/14/2002		X	0.034	2' below bottom of vault
GIPI-53-B25-1	Soil	1/9/2002	X		0.165	
GIPI-53-B25-2	Soil	1/9/2002	X		U	
GIPI-53-B25-8	Soil	1/9/2002		X	U	
GIPI-53-B25-9	Soil	1/9/2002		X	U	
GIPI-53-B25-10	Soil	1/9/2002		X	U	2' below bottom of vault

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
VAULT 54						
GIPI-54-B1-SW	Soil	1/10/2002	X		**4020**	Groundwater @ 7'
GIPI-54-B1-SW-8	Soil	1/10/2002	X		**2810**	
GIPI-54-B1-SW-9	Soil	1/10/2002	X		**7660**	
GIPI-54-B1-SW-10	Soil	1/10/2002	X		**124**	2' below bottom of vault
GIPI-54-B1-SW-11	Soil	1/17/2002		X	**22.9**	
GIPI-54-B1-SW-12	Soil	1/17/2002		X	0.712	
GIPI-54-B1-SW-13	Soil	1/17/2002		X	6.28	
GIPI-54-B1-1	Soil	2/4/2002		X	U	duplicate of GIPI-54-SS-29
GIPI-54-SS-29	Soil	2/4/2002		X	U	duplicate of GIPI-54-B1-1
GIPI-54-B1-2	Soil	2/4/2002		X	U	
GIPI-54-B1-6	Soil	2/4/2002		X	U	
GIPI-54-B1-7	Soil	2/4/2002		X	U	
GIPI-54-B1-8	Soil	2/4/2002		X	U	
GIPI-54-B1-9	Soil	2/4/2002		X	U	2' below bottom of vault
GIPI-54-B1-10	Soil	2/4/2002		X	U	
GIPI-54-B1-11	Soil	2/4/2002		X	U	
GIPI-54-B1-12	Soil	2/4/2002		X	U	
GIPI-54-B2-1	Soil	2/4/2002		X	U	
GIPI-54-B2-2	Soil	2/4/2002		X	U	
GIPI-54-B2-6	Soil	2/4/2002		X	U	
GIPI-54-B2-7	Soil	2/4/2002		X	U	
GIPI-54-B2-8	Soil	2/4/2002		X	U	
GIPI-54-B2-9	Soil	2/4/2002		X	U	2' below bottom of vault
GIPI-54-B2-10	Soil	2/4/2002		X	U	
GIPI-54-B2-11	Soil	2/4/2002		X	U	
GIPI-54-B2-12	Soil	2/4/2002		X	U	
GIPI-54-B3-1	Soil	2/7/2002		X	U	
GIPI-54-B3-2	Soil	2/7/2002		X	U	
GIPI-54-B3-5	Soil	2/7/2002		X	U	
GIPI-54-B3-6	Soil	2/7/2002		X	U	
GIPI-54-B3-7	Soil	2/7/2002		X	U	
GIPI-54-B3-8	Soil	2/7/2002		X	U	
GIPI-54-B3-9	Soil	2/7/2002		X	U	2' below bottom of vault
GIPI-54-B4-1	Soil	2/7/2002		X	0.209	
GIPI-54-B4-2	Soil	2/7/2002		X	U	
GIPI-54-B4-5	Soil	2/7/2002		X	U	
GIPI-54-B4-6	Soil	2/7/2002		X	U	
GIPI-54-B4-7	Soil	2/7/2002		X	U	
GIPI-54-B4-8	Soil	2/7/2002		X	U	duplicate of GIPI-54-SS-32
GIPI-54-SS-32	Soil	2/7/2002		X	U	duplicate of GIPI-54-B4-8
GIPI-54-B4-9	Soil	2/7/2002		X	U	2' below bottom of vault
GIPI-54-B5-1	Soil	2/6/2002		X	0.045	
GIPI-54-B5-2	Soil	2/6/2002		X	U	
GIPI-54-B5-5	Soil	2/6/2002		X	U	
GIPI-54-B5-6	Soil	2/6/2002		X	U	
GIPI-54-B5-7	Soil	2/6/2002		X	U	
GIPI-54-B5-8	Soil	2/6/2002		X	U	
GIPI-54-B5-9	Soil	2/6/2002		X	U	2' below bottom of vault
GIPI-54-B6-1	Soil	2/6/2002		X	U	duplicate of GIPI-54-SS-31
GIPI-54-SS-31	Soil	2/6/2002		X	U	duplicate of GIPI-54-B6-1
GIPI-54-B6-2	Soil	2/6/2002		X	U	
GIPI-54-B6-5	Soil	2/6/2002		X	U	
GIPI-54-B6-6	Soil	2/6/2002		X	U	
GIPI-54-B6-7	Soil	2/6/2002		X	0.031	
GIPI-54-B6-8	Soil	2/6/2002		X	U	
GIPI-54-B6-9	Soil	2/6/2002		X	U	2' below bottom of vault
GIPI-54-B7-1	Soil	1/29/2002		X	0.089	
GIPI-54-B7-2	Soil	1/29/2002		X	U	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-54-B7-5	Soil	1/29/2002		X	0.167	
GIPI-54-B7-6	Soil	1/29/2002		X	U	
GIPI-54-B7-7	Soil	1/29/2002		X	U	
GIPI-54-B7-8	Soil	1/29/2002		X	0.033	
GIPI-54-B7-9	Soil	1/29/2002		X	0.041	2' below bottom of vault
GIPI-54-B7-10	Soil	1/29/2002		X	U	
GIPI-54-B7-11	Soil	1/29/2002		X	U	
GIPI-54-B7-12	Soil	1/29/2002		X	U	
GIPI-54-B8-1	Soil	1/28/2002		X	U	
GIPI-54-B8-2	Soil	1/28/2002		X	U	Duplicate of GIPI-54-SS-19
GIPI-54-SS-19	Soil	1/28/2002		X	U	Duplicate of GIPI-54-B8-2
GIPI-54-B8-5	Soil	1/28/2002		X	0.232	
GIPI-54-B8-6	Soil	1/28/2002		X	U	
GIPI-54-B8-7	Soil	1/28/2002		X	0.061	
GIPI-54-B8-8	Soil	1/28/2002		X	0.02	
GIPI-54-B8-9	Soil	1/28/2002		X	U	2' below bottom of vault
GIPI-54-B8-10	Soil	1/28/2002		X	U	
GIPI-54-B8-11	Soil	1/28/2002		X	U	
GIPI-54-B8-12	Soil	1/28/2002		X	U	
GIPI-54-B9-1	Soil	1/30/2002		X	U	
GIPI-54-B9-2	Soil	1/30/2002		X	U	
GIPI-54-B9-5	Soil	1/30/2002		X	U	
GIPI-54-B9-6	Soil	1/30/2002		X	U	
GIPI-54-B9-7	Soil	1/30/2002		X	U	
GIPI-54-B9-8	Soil	1/30/2002		X	U	
GIPI-54-B9-9	Soil	1/30/2002		X	U	2' below bottom of vault
GIPI-54-B9-10	Soil	1/30/2002		X	U	
GIPI-54-B9-11	Soil	1/30/2002		X	U	
GIPI-54-B9-12	Soil	1/30/2002		X	U	
GIPI-54-B10-1	Soil	1/30/2002		X	0.028	
GIPI-54-B10-2	Soil	1/30/2002		X	U	
GIPI-54-B10-5	Soil	1/30/2002		X	U	
GIPI-54-B10-6	Soil	1/30/2002		X	U	
GIPI-54-B10-7	Soil	1/30/2002		X	U	
GIPI-54-B10-8	Soil	1/30/2002		X	U	duplicate of GIPI-54-SS-23
GIPI-54-SS-23	Soil	1/30/2002		X	U	duplicate of GIPI-54-B10-8
GIPI-54-B10-9	Soil	1/30/2002		X	U	2' below bottom of vault
GIPI-54-B10-10	Soil	1/30/2002		X	U	
GIPI-54-B10-11	Soil	1/30/2002		X	U	
GIPI-54-B10-12	Soil	1/30/2002		X	U	
GIPI-54-B11-1	Soil	1/30/2002		X	U	
GIPI-54-B11-2	Soil	1/30/2002		X	U	
GIPI-54-B11-5	Soil	1/30/2002		X	U	
GIPI-54-B11-6	Soil	1/30/2002		X	U	
GIPI-54-B11-7	Soil	1/30/2002		X	U	
GIPI-54-B11-8	Soil	1/30/2002		X	U	
GIPI-54-B11-9	Soil	1/30/2002		X	U	2' below bottom of vault
GIPI-54-B11-10	Soil	1/30/2002		X	U	
GIPI-54-B11-11	Soil	1/30/2002		X	U	
GIPI-54-B11-12	Soil	1/30/2002		X	U	
GIPI-54-B12-1	Soil	1/31/2002		X	0.081	
GIPI-54-B12-2	Soil	1/31/2002		X	U	
GIPI-54-B12-5	Soil	1/31/2002		X	0.025	
GIPI-54-B12-6	Soil	1/31/2002		X	U	
GIPI-54-B12-7	Soil	1/31/2002		X	U	
GIPI-54-B12-8	Soil	1/31/2002		X	U	
GIPI-54-B12-9	Soil	1/31/2002		X	U	2' below bottom of vault
GIPI-54-B12-10	Soil	1/31/2002		X	U	
GIPI-54-B12-11	Soil	1/31/2002		X	U	Duplicate of GIPI-54-SS-25

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-54-SS-25	Soil	1/31/2002		X	U	Duplicate of GIPI-54-B12-11
GIPI-54-B12-12	Soil	1/31/2002		X	U	
GIPI-54-B13-1	Soil	1/31/2002		X	U	
GIPI-54-B13-2	Soil	1/31/2002		X	U	Duplicate of GIPI-54-SS-26
GIPI-54-SS-26	Soil	1/31/2002		X	U	Duplicate of GIPI-54-B13-2
GIPI-54-B13-5	Soil	1/31/2002		X	U	
GIPI-54-B13-6	Soil	1/31/2002		X	0.161	
GIPI-54-B13-7	Soil	1/31/2002		X	U	
GIPI-54-B13-8	Soil	1/31/2002		X	U	
GIPI-54-B13-9	Soil	1/31/2002		X	U	2' below bottom of vault
GIPI-54-B13-10	Soil	1/31/2002		X	U	
GIPI-54-B13-11	Soil	1/31/2002		X	U	
GIPI-54-B13-12	Soil	1/31/2002		X	U	
GIPI-54-B14-1	Soil	1/31/2002		X	U	
GIPI-54-B14-2	Soil	1/31/2002		X	U	
GIPI-54-B14-5	Soil	1/31/2002		X	U	
GIPI-54-B14-6	Soil	1/31/2002		X	U	
GIPI-54-B14-7	Soil	1/31/2002		X	U	
GIPI-54-B14-8	Soil	1/31/2002		X	U	
GIPI-54-B14-9	Soil	1/31/2002		X	U	2' below bottom of vault
GIPI-54-B14-10	Soil	1/31/2002		X	U	
GIPI-54-B14-11	Soil	1/31/2002		X	U	
GIPI-54-B14-12	Soil	1/31/2002		X	U	
GIPI-54-B15-1	Soil	1/25/2002		X	0.172	Duplicate of GIPI-54-SS-17
GIPI-54-SS-17	Soil	1/25/2002		X	0.342	Duplicate of GIPI-54-B15-1
GIPI-54-B15-2	Soil	1/25/2002		X	U	
GIPI-54-B15-6	Soil	1/25/2002		X	U	
GIPI-54-B15-7	Soil	1/25/2002		X	0.024	
GIPI-54-B15-8	Soil	1/25/2002		X	U	Duplicate of GIPI-54-SS-18
GIPI-54-SS-18	Soil	1/25/2002		X	U	Duplicate of GIPI-54-B15-8
GIPI-54-B15-9	Soil	1/25/2002		X	U	
GIPI-54-B15-10	Soil	1/25/2002		X	U	2' below bottom of vault
GIPI-54-B15-11	Soil	1/25/2002		X	0.042	
GIPI-54-B15-12	Soil	1/25/2002		X	U	
GIPI-54-B15-13	Soil	1/25/2002		X	U	
GIPI-54-B16-1	Soil	1/22/2002		X	0.175	
GIPI-54-B16-2	Soil	1/22/2002		X	U	
GIPI-54-B16-6	Soil	1/22/2002		X	U	
GIPI-54-B16-7	Soil	1/22/2002		X	U	
GIPI-54-B16-8	Soil	1/22/2002		X	U	
GIPI-54-B16-9	Soil	1/22/2002		X	U	
GIPI-54-B16-10	Soil	1/22/2002		X	U	2' below bottom of vault
GIPI-54-B16-11	Soil	1/24/2002		X	0.216	
GIPI-54-B16-12	Soil	1/24/2002		X	0.138	
GIPI-54-B16-13	Soil	1/24/2002		X	U	
GIPI-54-B17-1	Soil	1/28/2002		X	U	
GIPI-54-B17-2	Soil	1/28/2002		X	U	
GIPI-54-B17-7	Soil	1/28/2002		X	0.207	
GIPI-54-B17-8	Soil	1/28/2002		X	U	
GIPI-54-B17-9	Soil	1/28/2002		X	U	
GIPI-54-B17-10	Soil	1/28/2002		X	U	
GIPI-54-B17-11	Soil	1/28/2002		X	U	sal, 2' below bottom of vault
GIPI-54-B18-1	Soil	1/22/2002		X	0.141	
GIPI-54-B18-2	Soil	1/22/2002		X	U	Duplicate of GIPI-54-SS-14
GIPI-54-SS-14	Soil	1/22/2002		X	U	Duplicate of GIPI-54-B18-2
GIPI-54-B18-7	Soil	1/22/2002		X	2.18	
GIPI-54-B18-8	Soil	1/22/2002		X	U	
GIPI-54-B18-9	Soil	1/22/2002		X	0.063	
GIPI-54-B18-10	Soil	1/22/2002		X	U	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-54-B18-11	Soil	1/22/2002		X	U	2' below bottom of vault
GIPI-54-B18-12	Soil	1/24/2002		X	0.048	
GIPI-54-B18-13	Soil	1/24/2002		X	U	
GIPI-54-B18-14	Soil	1/24/2002		X	U	
GIPI-54-B19-1	Soil	2/4/2002		X	0.028	
GIPI-54-B19-2	Soil	2/4/2002		X	U	
GIPI-54-B19-3	Soil	2/4/2002		X	U	
GIPI-54-B19-4	Soil	2/4/2002		X	U	
GIPI-54-B19-5	Soil	2/4/2002		X	U	
GIPI-54-B19-6	Soil	2/4/2002		X	U	2' below bottom of vault
GIPI-54-B19-7	Soil	2/4/2002		X	U	
GIPI-54-B19-8	Soil	2/4/2002		X	U	
GIPI-54-B19-9	Soil	2/4/2002		X	U	
GIPI-54-B20-1	Soil	1/25/2002		X	0.037	
GIPI-54-B20-2	Soil	1/25/2002		X	0.077	
GIPI-54-B20-3	Soil	1/25/2002		X	0.876	
GIPI-54-B20-4	Soil	1/25/2002		X	U	
GIPI-54-B20-5	Soil	1/25/2002		X	1.77	
GIPI-54-B20-6	Soil	1/25/2002		X	U	2' below bottom of vault
GIPI-54-B20-7	Soil	1/25/2002		X	3.68	
GIPI-54-B20-8	Soil	1/25/2002		X	U	
GIPI-54-B20-9	Soil	1/25/2002		X	U	
GIPI-54-B21-1	Soil	2/4/2002		X	U	
GIPI-54-B21-2	Soil	2/4/2002		X	U	
GIPI-54-B21-3	Soil	2/4/2002		X	U	
GIPI-54-B21-4	Soil	2/4/2002		X	U	duplicate of GIPI-54-SS-28
GIPI-54-SS-28	Soil	2/4/2002		X	U	duplicate of GIPI-54-B21-4
GIPI-54-B21-5	Soil	2/4/2002		X	U	2' below bottom of vault
GIPI-54-B21-6	Soil	2/4/2002		X	U	
GIPI-54-B21-7	Soil	2/4/2002		X	U	
GIPI-54-B21-8	Soil	2/4/2002		X	U	
GIPI-54-B22-1	Soil	2/4/2002		X	0.086	
GIPI-54-B22-2	Soil	2/4/2002		X	U	
GIPI-54-B22-3	Soil	2/4/2002		X	0.033	2' below bottom of vault
GIPI-54-B22-4	Soil	2/4/2002		X	U	
GIPI-54-B22-5	Soil	2/4/2002		X	U	
GIPI-54-B22-6	Soil	2/4/2002		X	U	
GIPI-54-B22-7	Soil	2/4/2002		X	U	
GIPI-54-B23-1	Soil	2/4/2002		X	U	
GIPI-54-B23-2	Soil	2/4/2002		X	U	
GIPI-54-B23-3	Soil	2/4/2002		X	U	2' below bottom of vault
GIPI-54-B23-4	Soil	2/4/2002		X	U	
GIPI-54-B23-5	Soil	2/4/2002		X	U	
GIPI-54-B23-6	Soil	2/4/2002		X	U	
GIPI-54-B23-7	Soil	2/4/2002		X	U	
GIPI-54-B24-1	Soil	2/6/2002		X	1.25	
GIPI-54-B24-2	Soil	2/6/2002		X	U	
GIPI-54-B24-3	Soil	2/6/2002		X	0.112	
GIPI-54-B24-4	Soil	2/6/2002		X	U	2' below bottom of vault
GIPI-54-B25-1	Soil	1/25/2002		X	0.089	
GIPI-54-B25-2	Soil	1/25/2002		X	U	
GIPI-54-B25-3	Soil	1/25/2002		X	0.549	
GIPI-54-B25-4	Soil	1/25/2002		X	0.048	
GIPI-54-B25-5	Soil	1/25/2002		X	0.111	
GIPI-54-B25-6	Soil	1/25/2002		X	U	2' below bottom of vault
GIPI-54-B25-7	Soil	1/25/2002		X	0.4	
GIPI-54-B25-8	Soil	1/25/2002		X	U	
GIPI-54-B25-9	Soil	1/25/2002		X	U	
GIPI-54-B26-1	Soil	1/25/2002		X	4.32	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-54-B26-2	Soil	1/25/2002		X	4.41	
GIPI-54-B26-3	Soil	1/25/2002		X	3.96	
GIPI-54-B26-4	Soil	1/25/2002		X	1.87	
GIPI-54-B26-5	Soil	1/25/2002		X	**12.2**	2' below bottom of vault
GIPI-54-B26-6	Soil	1/25/2002		X	0.359	
GIPI-54-B26-7	Soil	1/25/2002		X	0.023	
GIPI-54-B26-8	Soil	1/25/2002		X	0.118	Duplicate of GIPI-54-SS-16
GIPI-54-SS-16	Soil	1/25/2002		X	U	Duplicate of GIPI-54-B26-8
GIPI-54-B27-1	Soil	2/6/2002		X	0.027	
GIPI-54-B27-2	Soil	2/6/2002		X	U	
GIPI-54-B27-3	Soil	2/6/2002		X	U	
GIPI-54-B27-4	Soil	2/6/2002		X	U	2' below bottom of vault
GIPI-54-B27-5	Soil	2/6/2002		X	U	
GIPI-54-B27-6	Soil	2/6/2002		X	U	
GIPI-54-B27-7	Soil	2/6/2002		X	U	duplicate of GIPI-54-SS-30
GIPI-54-SS-30	Soil	2/6/2002		X	U	duplicate of GIPI-54-B27-7
GIPI-54-B28-1	Soil	2/6/2002		X	U	
GIPI-54-B28-2	Soil	2/6/2002		X	U	
GIPI-54-B28-3	Soil	2/6/2002		X	U	2' below bottom of vault
GIPI-54-B28-4	Soil	2/6/2002		X	U	
GIPI-54-B29-1	Soil	1/30/2002		X	1.39	
GIPI-54-B29-2	Soil	1/30/2002		X	U	
GIPI-54-B29-3	Soil	1/30/2002		X	0.261	2' below bottom of vault
GIPI-54-B29-4	Soil	1/30/2002		X	0.954	
GIPI-54-B29-5	Soil	1/30/2002		X	U	
GIPI-54-B29-6	Soil	1/30/2002		X	0.02	
GIPI-54-B29-7	Soil	1/30/2002		X	U	
GIPI-54-B30-1	Soil	2/6/2002		X	U	
GIPI-54-B30-2	Soil	2/6/2002		X	U	
GIPI-54-B30-3	Soil	2/6/2002		X	U	
GIPI-54-B30-4	Soil	2/6/2002		X	U	2' below bottom of vault
GIPI-54-B30-5	Soil	2/6/2002		X	U	
GIPI-54-B30-6	Soil	2/6/2002		X	U	
GIPI-54-B30-7	Soil	2/6/2002		X	U	
GIPI-54-B31-1	Soil	1/22/2002		X	0.128	
GIPI-54-B31-2	Soil	1/22/2002		X	0.018	
GIPI-54-B31-3	Soil	1/22/2002		X	4.82	
GIPI-54-B31-4	Soil	1/22/2002		X	0.059	
GIPI-54-B31-5	Soil	1/22/2002		X	**161**	2' below bottom of vault
GIPI-54-B31-6	Soil	1/22/2002		X	**23600**	
GIPI-54-B31-7	Soil	1/24/2002		X	**7540**	
GIPI-54-B31-8	Soil	1/24/2002		X	**163**	
GIPI-54-B31-9	Soil	1/24/2002		X	**17.7**	
GIPI-54-B31-10	Soil	1/25/2002		X	**11.7**	
GIPI-54-B31-11	Soil	1/25/2002		X	1.11	Refusal @ 10.8'
GIPI-54-B32-1	Soil	1/30/2002		X	0.336	
GIPI-54-B32-2	Soil	1/30/2002		X	U	
GIPI-54-B32-3	Soil	1/30/2002		X	U	Duplicate of GIPI-54-SS-24
GIPI-54-SS-24	Soil	1/30/2002		X	U	Duplicate of GIPI-54-B32-3
GIPI-54-B32-4	Soil	1/30/2002		X	U	2' below bottom of vault
GIPI-54-B32-5	Soil	1/30/2002		X	U	
GIPI-54-B32-6	Soil	1/30/2002		X	U	
GIPI-54-B32-7	Soil	1/30/2002		X	U	
GIPI-54-B33-1	Soil	1/31/2002		X	U	
GIPI-54-B33-2	Soil	1/31/2002		X	U	
GIPI-54-B33-3	Soil	1/31/2002		X	0.379	
GIPI-54-B33-4	Soil	1/31/2002		X	U	
GIPI-54-B33-5	Soil	1/31/2002		X	U	2' below bottom of vault
GIPI-54-B33-6	Soil	1/31/2002		X	U	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-54-B33-7	Soil	1/31/2002		X	U	
GIPI-54-B33-8	Soil	1/31/2002		X	U	
GIPI-54-B34-1	Soil	1/22/2002		X	2.03	
GIPI-54-B34-2	Soil	1/22/2002		X	U	
GIPI-54-B34-3	Soil	1/22/2002		X	0.074	
GIPI-54-B34-4	Soil	1/22/2002		X	0.034	
GIPI-54-B34-5	Soil	1/22/2002		X	1.02	
GIPI-54-B34-6	Soil	1/22/2002		X	U	2' below bottom of vault
GIPI-54-B34-7	Soil	1/24/2002		X	0.291	
GIPI-54-B34-8	Soil	1/24/2002		X	0.382	
GIPI-54-B34-9	Soil	1/24/2002		X	0.275	Refusal @ 9'
GIPI-54-B35-1	Soil	1/29/2002		X	U	
GIPI-54-B35-2	Soil	1/29/2002		X	5.45	
GIPI-54-B35-3	Soil	1/29/2002		X	0.024	
GIPI-54-B35-4	Soil	1/29/2002		X	U	
GIPI-54-B35-5	Soil	1/29/2002		X	0.083	
GIPI-54-B35-6	Soil	1/29/2002		X	U	
GIPI-54-B35-7	Soil	1/29/2002		X	U	2' below bottom of vault
GIPI-54-B35-8	Soil	1/29/2002		X	U	
GIPI-54-B35-9	Soil	1/29/2002		X	U	
GIPI-54-B35-10	Soil	1/29/2002		X	U	
GIPI-54-B36-1	Soil	1/17/2002		X	1.54	
GIPI-54-B36-2	Soil	1/17/2002		X	1.01	
GIPI-54-B36-4	Soil	1/17/2002		X	0.275	
GIPI-54-B36-5	Soil	1/17/2002		X	0.071	
GIPI-54-B36-6	Soil	1/17/2002		X	0.6	
GIPI-54-B36-7	Soil	1/17/2002		X	U	
GIPI-54-B36-8	Soil	1/17/2002		X	U	2' below bottom of vault
GIPI-54-B36-9	Soil	1/24/2002		X	0.061	
GIPI-54-B36-10	Soil	1/24/2002		X	0.224	
GIPI-54-B36-11	Soil	1/24/2002		X	6.07	
GIPI-54-B37-1	Soil	1/28/2001		X	0.275	
GIPI-54-B37-2	Soil	1/28/2001		X	U	
GIPI-54-B37-5	Soil	1/28/2001		X	U	
GIPI-54-B37-6	Soil	1/28/2001		X	U	
GIPI-54-B37-7	Soil	1/28/2001		X	0.049	
GIPI-54-B37-8	Soil	1/28/2001		X	U	
GIPI-54-B37-9	Soil	1/28/2001		X	U	2' below bottom of vault
GIPI-54-B37-10	Soil	1/28/2001		X	U	
GIPI-54-B37-11	Soil	1/28/2001		X	U	
GIPI-54-B37-12	Soil	1/28/2001		X	U	
GIPI-54-B38-1	Soil	1/22/2002		X	0.14	
GIPI-54-B38-2	Soil	1/22/2002		X	0.163	
GIPI-54-B38-6	Soil	1/22/2002		X	0.078	
GIPI-54-B38-7	Soil	1/22/2002		X	0.21	
GIPI-54-B38-8	Soil	1/22/2002		X	0.249	
GIPI-54-B38-9	Soil	1/22/2002		X	U	
GIPI-54-B38-10	Soil	1/22/2002		X	U	2' below bottom of vault
GIPI-54-B38-11	Soil	1/24/2002		X	0.085	
GIPI-54-B38-12	Soil	1/24/2002		X	1.84	Duplicate of GIPI-54-SS-15
GIPI-54-SS-15	Soil	1/24/2002		X	0.439	Duplicate of GIPI-54-B38-12
GIPI-54-B38-13	Soil	1/24/2002		X	0.081	
GIPI-54-B39-1	Soil	1/28/2002		X	5.99	
GIPI-54-B39-2	Soil	1/28/2002		X	U	
GIPI-54-B39-5	Soil	1/28/2002		X	U	
GIPI-54-B39-6	Soil	1/28/2002		X	U	
GIPI-54-B39-7	Soil	1/28/2002		X	U	Duplicate of GIPI-54-SS-20
GIPI-54-SS-20	Soil	1/28/2002		X	U	Duplicate of GIPI-54-B39-7
GIPI-54-B39-8	Soil	1/28/2002		X	U	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-54-B39-9	Soil	1/28/2002		X	U	2' below bottom of vault
GIPI-54-B39-10	Soil	1/28/2002		X	0.071	
GIPI-54-B39-11	Soil	1/28/2002		X	U	
GIPI-54-B39-12	Soil	1/28/2002		X	0.215	
GIPI-54-B40-1	Sediment	1/14/2002		X	3.04	Duplicate of GIPI-54-SS-5
GIPI-54-SS-5	Sediment	1/14/2002	X		0.676	Duplicate of GIPI-54-B40-1
GIPI-54-B40-2	Sediment	1/14/2002		X	2.79	Refusal @ 2'
GIPI-54-B41-1	Sediment	1/14/2002		X	0.394	
GIPI-54-B41-2	Sediment	1/14/2002		X	0.028	
GIPI-54-B41-3	Sediment	1/14/2002		X	0.104	
GIPI-54-B41-4	Sediment	1/14/2002		X	0.03	
GIPI-54-B42-1	Sediment	1/14/2002		X	1.61	
GIPI-54-B42-2	Sediment	1/14/2002		X	0.35	
GIPI-54-B42-3	Sediment	1/14/2002		X	U	
GIPI-54-B42-4	Sediment	1/14/2002		X	0.023	
GIPI-54-B45-1	Sediment	1/31/2002		X	3.45	
GIPI-54-B45-2	Sediment	1/31/2002		X	U	
GIPI-54-B45-3	Sediment	1/31/2002		X	8.88	Duplicate of GIPI-54-SS-27
GIPI-54-SS-27	Sediment	1/31/2002		X	2.31	Duplicate of GIPI-54-B45-3
GIPI-54-B45-4	Sediment	1/31/2002		X	U	
GIPI-54-B45-5	Sediment	1/31/2002		X	U	2' below bottom of vault
GIPI-54-B45-6	Sediment	1/31/2002		X	U	
GIPI-54-B45-7	Sediment	1/31/2002		X	0.021	
GIPI-54-B45-8	Sediment	1/31/2002		X	0.096	
GIPI-54-B46-1	Sediment	1/31/2002		X	U	
GIPI-54-B46-2	Sediment	1/31/2002		X	U	
GIPI-54-B46-3	Sediment	1/31/2002		X	U	
GIPI-54-B46-4	Sediment	1/31/2002		X	U	2' below bottom of vault
GIPI-54-B46-5	Sediment	1/31/2002		X	U	
GIPI-54-B46-6	Sediment	1/31/2002		X	U	
GIPI-54-B46-7	Sediment	1/31/2002		X	U	
GIPI-54-B47-1	Sediment	1/29/2002		X	U	Duplicate of GIPI-54-SS-21
GIPI-54-SS-21	Sediment	1/29/2002		X	U	Duplicate of GIPI-54-B47-1
GIPI-54-B47-2	Sediment	1/29/2002		X	U	
GIPI-54-B47-3	Sediment	1/29/2002		X	U	
GIPI-54-B47-4	Sediment	1/29/2002		X	U	2' below bottom of vault
GIPI-54-B47-5	Sediment	1/29/2002		X	U	
GIPI-54-B47-6	Sediment	1/29/2002		X	U	
GIPI-54-B47-7	Sediment	1/29/2002		X	U	
GIPI-54-B48-1	Sediment	1/29/2002		X	1.48	Duplicate of GIPI-54-SS-22
GIPI-54-SS-22	Sediment	1/29/2002		X	0.212	Duplicate of GIPI-54-B48-1
GIPI-54-B48-2	Sediment	1/29/2002		X	U	
GIPI-54-B48-3	Sediment	1/29/2002		X	U	2' below bottom of vault
GIPI-54-B48-4	Sediment	1/29/2002		X	U	
GIPI-54-B48-5	Sediment	1/29/2002		X	U	
GIPI-54-B48-6	Sediment	1/29/2002		X	U	
GIPI-54-B48-7	Sediment	1/29/2002		X	U	
GIPI-54-B49-1	Sediment	1/29/2002		X	0.139	
GIPI-54-B49-2	Sediment	1/29/2002		X	U	
GIPI-54-B49-3	Sediment	1/29/2002		X	0.072	2' below bottom of vault
GIPI-54-B49-4	Sediment	1/29/2002		X	U	
GIPI-54-B49-5	Sediment	1/29/2002		X	U	
GIPI-54-B49-6	Sediment	1/29/2002		X	U	
GIPI-54-B49-7	Sediment	1/29/2002		X	U	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
VAULT 56						
GIPI-56-B1-CTR.	Soil	1/10/2002	X		7	
GIPI-56-B1-7	Soil	1/10/2002	X		0.158	
GIPI-56-B1-8	Soil	1/10/2002	X		**15.6**	
GIPI-56-B1-9	Soil	2/7/2002		X	0.053	
GIPI-56-B1-10	Soil	2/7/2002		X	U	
GIPI-56-B2-6	Soil	2/7/2002		X	U	
GIPI-56-B2-7	Soil	2/7/2002		X	U	
GIPI-56-B2-8	Soil	2/7/2002		X	U	
GIPI-56-B2-9	Soil	2/7/2002		X	0.026	
GIPI-56-B3-4	Soil	2/7/2002		X	U	
GIPI-56-B3-5	Soil	2/7/2002		X	U	
GIPI-56-B3-6	Soil	2/7/2002		X	U	
GIPI-56-B3-7	Soil	2/7/2002		X	U	
GIPI-56-B3-8	Soil	2/7/2002		X	U	
GIPI-56-B4-1	Soil	2/13/2002		X	U	
GIPI-56-B4-2	Soil	2/13/2002		X	U	
GIPI-56-B4-6	Soil	2/13/2002		X	U	
GIPI-56-B4-7	Soil	2/13/2002		X	U	
GIPI-56-B4-8	Soil	2/13/2002		X	U	Refusal @ 7.78'
GIPI-56-B5-1	Soil	2/12/2002		X	U	
GIPI-56-B5-2	Soil	2/12/2002		X	U	
GIPI-56-B5-6	Soil	2/12/2002		X	U	
GIPI-56-B5-7	Soil	2/12/2002		X	U	
GIPI-56-B5-8	Soil	2/12/2002		X	U	
GIPI-56-B6-1	Soil	2/13/2002		X	U	
GIPI-56-B6-2	Soil	2/13/2002		X	U	
GIPI-56-B6-6	Soil	2/13/2002		X	U	
GIPI-56-B6-7	Soil	2/13/2002		X	U	
GIPI-56-B6-8	Soil	2/13/2002		X	U	
GIPI-56-B7-1	Soil	2/13/2002		X	U	
GIPI-56-B7-2	Soil	2/13/2002		X	U	
GIPI-56-B7-6	Soil	2/13/2002		X	U	
GIPI-56-B7-7	Soil	2/13/2002		X	U	
GIPI-56-B7-8	Soil	2/13/2002		X	U	
GIPI-56-B8-1	Soil	2/11/2002		X	U	
GIPI-56-B8-2	Soil	2/11/2002		X	U	
GIPI-56-B8-6	Soil	2/11/2002		X	U	
GIPI-56-B8-7	Soil	2/11/2002		X	U	
GIPI-56-B8-8	Soil	2/11/2002		X	U	
GIPI-56-B9-1	Soil	2/11/2002		X	1.84	
GIPI-56-B9-2	Soil	2/11/2002		X	U	
GIPI-56-B9-6	Soil	2/11/2002		X	U	
GIPI-56-B9-7	Soil	2/11/2002		X	U	
GIPI-56-B9-8	Soil	2/11/2002		X	U	
GIPI-56-B10-1	Soil	2/13/2002		X	U	Duplicate of GIPI-56-SS-40
GIPI-56-SS-40	Soil	2/13/2002		X	U	Duplicate of GIPI-56-B10-1
GIPI-56-B10-2	Soil	2/13/2002		X	U	
GIPI-56-B10-6	Soil	2/13/2002		X	U	
GIPI-56-B10-7	Soil	2/13/2002		X	U	
GIPI-56-B10-8	Soil	2/13/2002		X	U	
GIPI-56-B11-1	Soil	2/12/2002		X	0.227	
GIPI-56-B11-2	Soil	2/12/2002		X	U	
GIPI-56-B11-6	Soil	2/12/2002		X	U	
GIPI-56-B11-7	Soil	2/12/2002		X	U	
GIPI-56-B11-8	Soil	2/12/2002		X	U	Duplicate of GIPI-56-SS-36
GIPI-56-SS-36	Soil	2/12/2002		X	U	Duplicate of GIPI-56-B11-8
GIPI-56-B12-1	Soil	2/14/2002		X	0.147	
GIPI-56-B12-2	Soil	2/14/2002		X	U	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-56-B12-7	Soil	2/14/2002		X	U	
GIPI-56-B12-8	Soil	2/14/2002		X	U	
GIPI-56-B12-9	Soil	2/14/2002		X	U	
GIPI-56-B13-1	Soil	2/14/2002		X	1.76	
GIPI-56-B13-2	Soil	2/14/2002		X	0.023	
GIPI-56-B13-6	Soil	2/14/2002		X	U	
GIPI-56-B13-7	Soil	2/14/2002		X	U	
GIPI-56-B13-8	Soil	2/14/2002		X	U	
GIPI-56-B14-1	Soil	2/12/2002		X	2.84	
GIPI-56-B14-2	Soil	2/12/2002		X	U	
GIPI-56-B14-9	Soil	2/12/2002		X	U	
GIPI-56-B14-10	Soil	2/12/2002		X	U	
GIPI-56-B14-11	Soil	2/12/2002		X	U	
GIPI-56-B16-1	Soil	2/8/2002		X	3.06	
GIPI-56-B16-2	Soil	2/8/2002		X	U	Duplicate of GIPI-56-SS-34
GIPI-56-SS-34	Soil	2/8/2002		X	0.062	Duplicate of GIPI-56-B16-2
GIPI-56-B16-8	Soil	2/8/2002		X	U	
GIPI-56-B16-9	Soil	2/8/2002		X	U	
GIPI-56-B16-10	Soil	2/8/2002		X	U	
GIPI-56-B17-1	Soil	2/13/2002		X	0.19	Duplicate of GIPI-56-SS-42
GIPI-56-SS-42	Soil	2/13/2002		X	0.032	Duplicate of GIPI-56-B17-1
GIPI-56-B17-2	Soil	2/13/2002		X	U	
GIPI-56-B17-10	Soil	2/13/2002		X	U	
GIPI-56-B17-11	Soil	2/13/2002		X	U	
GIPI-56-B17-12	Soil	2/13/2002		X	U	
GIPI-56-B18-1	Soil	2/12/2002		X	U	
GIPI-56-B18-2	Soil	2/12/2002		X	U	
GIPI-56-B18-10	Soil	2/12/2002		X	U	Duplicate of GIPI-56-SS-38
GIPI-56-SS-38	Soil	2/12/2002		X	U	Duplicate of GIPI-56-B18-10
GIPI-56-B18-11	Soil	2/12/2002		X	U	
GIPI-56-B18-12	Soil	2/12/2002		X	U	
GIPI-56-B19-1	Soil	2/13/2002		X	0.133	
GIPI-56-B19-2	Soil	2/13/2002		X	0.166	
GIPI-56-B19-10	Soil	2/13/2002		X	U	
GIPI-56-B19-11	Soil	2/13/2002		X	U	
GIPI-56-B19-12	Soil	2/13/2002		X	U	
GIPI-56-B20-1	Soil	2/13/2002		X	0.247	
GIPI-56-B20-2	Soil	2/13/2002		X	0.286	
GIPI-56-B20-11	Soil	2/13/2002		X	U	
GIPI-56-B20-12	Soil	2/13/2002		X	U	Duplicate of GIPI-56-SS-41
GIPI-56-SS-41	Soil	2/13/2002		X	U	Duplicate of GIPI-56-B20-12
GIPI-56-B20-13	Soil	2/13/2002		X	U	
GIPI-56-B21-1	Soil	2/12/2002		X	0.113	Duplicate of GIPI-56-SS-37
GIPI-56-SS-37	Soil	2/12/2002		X	0.08	Duplicate of GIPI-56-B21-1
GIPI-56-B21-2	Soil	2/12/2002		X	0.054	
GIPI-56-B21-9	Soil	2/12/2002		X	U	
GIPI-56-B21-10	Soil	2/12/2002		X	U	
GIPI-56-B21-11	Soil	2/12/2002		X	U	
GIPI-56-B22-1	Soil	2/8/2002		X	2.16	
GIPI-56-B22-2	Soil	2/8/2002		X	0.555	
GIPI-56-B22-8	Soil	2/8/2002		X	U	Duplicate of GIPI-56-SS-33
GIPI-56-SS-33	Soil	2/8/2002		X	U	Duplicate of GIPI-56-B22-8
GIPI-56-B22-9	Soil	2/8/2002		X	U	
GIPI-56-B22-10	Soil	2/8/2002		X	U	
GIPI-56-B23-1	Soil	2/12/2002		X	0.374	
GIPI-56-B23-2	Soil	2/12/2002		X	0.053	
GIPI-56-B23-10	Soil	2/12/2002		X	U	
GIPI-56-B23-11	Soil	2/12/2002		X	U	
GIPI-56-B23-12	Soil	2/12/2002		X	U	

TABLE C-2
GOULD ISLAND PCB REMEDIATION
PHASE 1 SOIL SAMPLE ANALYSIS

Sample I.D.	Matrix	Date Collected	PCB 3550/8082	PCB 3545/8082	Lab Results (ppm)	Comment
GIPI-56-B24-1	Soil	2/12/2002		X	0.207	
GIPI-56-B24-2	Soil	2/12/2002		X	0.227	Duplicate of GIPI-56-SS-39
GIPI-56-SS-39	Soil	2/12/2002		X	0.328	Duplicate of GIPI-56-B24-2
GIPI-56-B24-10	Soil	2/12/2002		X	U	
GIPI-56-B24-11	Soil	2/12/2002		X	U	
GIPI-56-B24-12	Soil	2/12/2002		X	U	
GIPI-56-B25-1	Soil	2/11/2002		X	0.089	
GIPI-56-B25-2	Soil	2/11/2002		X	0.051	
GIPI-56-B25-9	Soil	2/11/2002		X	U	
GIPI-56-B25-10	Soil	2/11/2002		X	U	
GIPI-56-B25-11	Soil	2/11/2002		X	U	
GIPI-56-B26-1	Soil	2/8/2002		X	7.84	
GIPI-56-B26-2	Soil	2/8/2002		X	U	
GIPI-56-B26-7	Soil	2/8/2002		X	U	
GIPI-56-B26-8	Soil	2/8/2002		X	U	
GIPI-56-B26-9	Soil	2/8/2002		X	U	
GIPI-56-B27-1	Soil	2/11/2002		X	0.079	
GIPI-56-B27-2	Soil	2/11/2002		X	U	
GIPI-56-B27-9	Soil	2/11/2002		X	U	Duplicate of GIPI-56-SS-35
GIPI-56-SS-35	Soil	2/11/2002		X	U	Duplicate of GIPI-56-B27-9
GIPI-56-B27-10	Soil	2/11/2002		X	U	
GIPI-56-B27-11	Soil	2/11/2002		X	U	
GIPI-56-B28-1	Soil	2/13/2002		X	0.26	
GIPI-56-B28-2	Soil	2/13/2002		X	U	
GIPI-56-B28-8	Soil	2/13/2002		X	U	
GIPI-56-B28-9	Soil	2/13/2002		X	U	
GIPI-56-B28-10	Soil	2/13/2002		X	U	
GIPI-56-B29-4	Soil	2/8/2002		X	U	
GIPI-56-B29-5	Soil	2/8/2002		X	U	
GIPI-56-B29-7	Soil	2/8/2002		X	U	
GIPI-56-B29-8	Soil	2/8/2002		X	U	Refusal @ 7.5'
GIPI-56-B30-1	Soil	2/11/2002		X	0.411	
GIPI-56-B30-2	Soil	2/11/2002		X	U	
GIPI-56-B30-7	Soil	2/11/2002		X	U	
GIPI-56-B30-8	Soil	2/11/2002		X	U	
GIPI-56-B30-9	Soil	2/11/2002		X	U	
VAULT 59						
GIPI-59-B1-NW	Soil	1/10/2002	X		0.093	Duplicate of GIPI-59-SS-4
GIPI-59-SS-4	Soil	1/10/2002	X		3	Duplicate of GIPI-59-B1-NW
GIPI-59-B1-8	Soil	1/10/2002	X		0.032	
GIPI-59-B1-9	Soil	1/10/2002	X		0.057	2' below bottom of vault
GIPI-59-B1-10	Soil	1/10/2002	X		0.031	
GIPI-59-B1-11	Soil	1/10/2002	X		0.02	
GIPI-59-B1-12	Soil	1/10/2002	X		0.021	
GIPI-59-B1-13	Soil	1/10/2002	X		U	
GIPI-59-B1-14	Soil	1/10/2002	X		0.075	

TABLE C-3
GOULD ISLAND PCB REMEDIATION
CONFIRMATORY SAMPLING

Sample I.D	Matrix	Date Collected	Time Collected	Date to Lab	Analysis Received	Lab ID#	PCB 3545/8082	Results (ppm)	Action Level (ppm)	Comment
FIELD IMMUNOASSAY LOCATION FS3										
GIPII-FS3-SWN-CS1	Soil	8/8/2002	1255	8/8/2002	8/10/2002	48040-1	X	U	10	Arochlor 1260
GIPII-FS3-SWE-CS1	Soil	8/8/2002	1252	8/8/2002	8/10/2002	48040-2	X	U	10	Arochlor 1260
GIPII-FS3-SWS-CS1	Soil	8/8/2002	1304	8/8/2002	8/10/2002	48040-3	X	U	10	Arochlor 1260
GIPII-FS3-SWW-CS1	Soil	8/8/2002	1300	8/8/2002	8/10/2002	48040-4	X	U	10	Arochlor 1260
GIPII-FS3-BOT-CS1	Soil	8/8/2002	1310	8/8/2002	8/9/2002	48040-11	X	U	10	Arochlor 1260
FIELD IMMUNOASSAY LOCATION FS5										
GIPII-FS5-SWN-CS1	Soil	8/8/2002	1332	8/8/2002	8/10/2002	48040-5	X	U	10	Arochlor 1260
GIPII-FS5-SWE-CS1	Soil	8/8/2002	1330	8/8/2002	8/10/2002	48040-6	X	U	10	Arochlor 1260
GIPII-FS5-SWS-CS1	Soil	8/8/2002	1336	8/8/2002	8/10/2002	48040-7	X	U	10	Arochlor 1260
GIPII-FS5-SWW-CS1	Soil	8/8/2002	1334	8/8/2002	8/10/2002	48040-8	X	U	10	Arochlor 1260
GIPII-FS5-BOT-CS1	Soil	8/8/2002	1338	8/8/2002	8/9/2002	48040-12	X	U	10	Arochlor 1260
FIELD IMMUNOASSAY LOCATION FS6										
GIPII-FS6-SWN-CS1	Soil	8/8/2002	1355	8/8/2002	8/10/2002	48040-9	X	U	10	Arochlor 1260
GIPII-FS6-SWE-CS1	Soil	8/8/2002	1353	8/8/2002	8/13/2002	48040-10	X	0.059	10	Arochlor 1254
GIPII-FS6-SWS-CS1	Soil	8/8/2002	1357	8/8/2002	8/13/2002	48040-11	X	U	10	Arochlor 1260
GIPII-FS6-SWW-CS1	Soil	8/8/2002	1356	8/8/2002	8/13/2002	48040-12	X	U	10	Arochlor 1260
GIPII-FS6-BOT-CS1	Soil	8/8/2002	1400	8/8/2002	8/9/2002	48040-13	X	U	10	Arochlor 1260
BORING LOCATION F2										
GIPII-F2-SWN-CS1	**Soil**	**9/6/2002**	**1450**	**9/6/2002**	**9/10/2002**	**48208-17**	**X**	**50.2**	**10**	**Arochlor 1260**
GIPII-F2-SWN-CS1A	All soil removed along north side of excavation (against seawall). No sample collected.									
GIPII-F2-SWN-CS2	**Soil**	**9/6/2002**	**1452**	**9/6/2002**	**9/10/2002**	**48208-18**	**X**	**117.0**	**10**	**Arochlor 1260**
GIPII-F2-SWN-CS2A	All soil removed along north side of excavation (against seawall). No sample collected.									
GIPII-F2-SWN-CS3	Soil	9/6/2002	1508	9/6/2002	9/10/2002	48208-19	X	5.72	10	Arochlor 1260
GIPII-F2-SWN-CS4	**Soil**	**9/6/2002**	**1514**	**9/6/2002**	**9/10/2002**	**48208-20**	**X**	**11.1**	**10**	**Arochlor 1260**
GIPII-F2-SWN-CS4A	All soil removed along north side of excavation (against seawall). No sample collected.									
GIPII-F2-SWE-CS1	Soil	9/6/2002	1517	9/6/2002	9/9/2002	48208-9	X	0.024	10	Arochlor 1260
GIPII-F2-SWE-CS2	Soil	9/6/2002	1516	9/6/2002	9/9/2002	48208-10	X	0.054	10	Arochlor 1260
GIPII-F2-SWE-CS3	Soil	9/6/2002	1535	9/6/2002	9/9/2002	48208-11	X	0.253	10	Arochlor 1260
GIPII-F2-SWE-CS4	Soil	9/6/2002	1703	9/6/2002	9/9/2002	48208-12	X	U	10	Arochlor 1260
GIPII-F2-SWS-CS1	Soil	9/6/2002	1707	9/6/2002	9/9/2002	48208-21	X	0.042	10	Arochlor 1260
GIPII-F2-SWS-CS2	Soil	9/6/2002	1706	9/6/2002	9/9/2002	48208-22	X	U	10	Arochlor 1260
GIPII-F2-SWS-CS3	Soil	9/6/2002	1705	9/6/2002	9/9/2002	48208-23	X	U	10	Arochlor 1260
GIPII-F2-SWS-CS4	Soil	9/6/2002	1704	9/6/2002	9/9/2002	48208-24	X	U	10	Arochlor 1260
GIPII-F2-SWW-CS1	**Soil**	**9/6/2002**	**1534**	**9/6/2002**	**9/10/2002**	**48208-13**	**X**	**51.5**	**10**	**Arochlor 1260**
GIPII-F2-SWW-CS1A	Soil	9/13/2002	1121	9/13/2002	6/14/2002	48257-1	X	U	10	Arochlor 1260
GIPII-F2-SWW-CS2	**Soil**	**9/6/2002**	**1537**	**9/6/2002**	**9/10/2002**	**48208-14**	**X**	**8400**	**10**	**Arochlor 1260**
GIPII-F2-SWW-CS2A	Soil	9/13/2002	1124	9/13/2002	9/14/2002	48257-2	X	U	10	Arochlor 1260
GIPII-F2-SWW-CS3	**Soil**	**9/6/2002**	**1538**	**9/6/2002**	**9/10/2002**	**48208-15**	**X**	**23.7**	**10**	**Arochlor 1260**
GIPII-F2-SWW-CS3A	Soil	9/13/2002	1126	9/13/2002	9/14/2002	48257-3	X	U	10	Arochlor 1260
GIPII-F2-SWW-CS4	Soil	9/6/2002	1708	9/6/2002	9/10/2002	48208-16	X	0.105	10	Arochlor 1260
GIPII-F2-BOT-CS1	**Soil**	**9/6/2002**	**1453**	**9/6/2002**	**9/10/2002**	**48208-27**	**X**	**57.4**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS1A	**Soil**	**9/13/2002**	**1008**	**9/13/2002**	**9/16/2002**	**48257-4**	**X**	**11.0**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS1B	**Soil**	**9/17/2002**	**1305**	**9/18/2002**	**9/19/2002**	**48294-1**	**X**	**28.5**	**10**	**Arochlor 1260**

TABLE C-3
GOULD ISLAND PCB REMEDIATION
CONFIRMATORY SAMPLING

Sample I.D	Matrix	Date Collected	Time Collected	Date to Lab	Analysis Received	Lab ID#	PCB 3545/8082	Results (ppm)	Action Level (ppm)	Comment
GIPII-F2-BOT-CS1C	**Soil**	**9/19/2002**	**1505**	**9/19/2002**	**9/20/2002**	**48306-1**	**X**	**12.3**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS1D	**Soil**	**9/24/2002**	**1600**	**9/24/2002**	**9/25/2002**	**48338-1**	**X**	**30.4**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS1E	Soil	9/26/2002	0950	9/26/2002	9/27/2002	48362-1	X	0.457	10	Arochlor 1260
GIPII-F2-BOT-CS2	**Soil**	**9/6/2002**	**1458**	**9/6/2002**	**9/10/2002**	**48208-28**	**X**	**34.3**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS2A	Soil	9/13/2002	0952	9/13/2002	9/16/2002	48257-5	X	0.871	10	Arochlor 1260
GIPII-F2-BOT-CS3	**Soil**	**9/6/2002**	**1505**	**9/6/2002**	**9/11/2002**	**48208-29**	**X**	**15.4**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS3A	Soil	9/13/2002	0935	9/13/2002	9/16/2002	48257-6	X	3.54	10	Arochlor 1260
GIPII-F2-BOT-CS4	**Soil**	**9/6/2002**	**1510**	**9/6/2002**	**9/10/2002**	**48208-30**	**X**	**23.0**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS4A	Soil	9/13/2002	0930	9/13/2002	9/14/2002	48257-7	X	0.021	10	Arochlor 1260
GIPII-F2-BOT-CS5	**Soil**	**9/6/2002**	**1533**	**9/6/2002**	**9/10/2002**	**48208-31**	**X**	**185.0**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS5A	**Soil**	**9/13/2002**	**1020**	**9/13/2002**	**9/16/2002**	**48257-8**	**X**	**21.2**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS5B	**Soil**	**9/17/2002**	**1312**	**9/18/2002**	**9/19/2002**	**48294-2**	**X**	**14.8**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS5C	Soil	9/19/2002	1515	9/19/2002	9/20/2002	48306-2	X	5.96	10	Arochlor 1260
GIPII-F2-BOT-CS6	**Soil**	**9/6/2002**	**1532**	**9/6/2002**	**9/10/2002**	**48208-32**	**X**	**49.4**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS6A	**Soil**	**9/13/2002**	**0945**	**9/13/2002**	**9/16/2002**	**48257-9**	**X**	**12.5**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS6B	Soil	9/17/2002	1355	9/18/2002	9/19/2002	48294-3	X	3.36	10	Arochlor 1260
GIPII-F2-BOT-CS7	Soil	9/6/2002	1530	9/6/2002	9/10/2002	48208-33	X	4.14	10	Arochlor 1260
GIPII-F2-BOT-CS8	Soil	9/6/2002	1520	9/6/2002	9/10/2002	48208-34	X	0.362	10	Arochlor 1260
GIPII-F2-BOT-CS9	**Soil**	**9/6/2002**	**1542**	**9/6/2002**	**9/10/2002**	**48208-35**	**X**	**10.7**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS9A	**Soil**	**9/13/2002**	**1045**	**9/13/2002**	**9/16/2002**	**48257-10**	**X**	**11.2**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS9B	**Soil**	**9/17/2002**	**1317**	**9/18/2002**	**9/19/2002**	**48294-4**	**X**	**10.3**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS9C	Soil	9/19/2002	1520	9/19/2002	9/20/2002	48306-3	X	4.26	10	Arochlor 1260
GIPII-F2-BOT-CS10	Soil	9/6/2002	1550	9/6/2002	9/10/2002	48208-36	X	2.54	10	Arochlor 1260
GIPII-F2-BOT-CS11	Soil	9/6/2002	1550	9/6/2002	9/10/2002	48208-37	X	0.378	10	Arochlor 1260
GIPII-F2-BOT-CS12	Soil	9/6/2002	1555	9/6/2002	9/10/2002	48208-38	X	1.13	10	Arochlor 1260
GIPII-F2-BOT-CS13	**Soil**	**9/6/2002**	**1650**	**9/6/2002**	**9/10/2002**	**48208-39**	**X**	**9.65**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS13A	Soil	9/13/2002	1055	9/13/2002	9/16/2002	48257-11	X	0.230	10	Arochlor 1260
GIPII-F2-BOT-CS14	Soil	9/6/2002	1652	9/6/2002	9/10/2002	48208-40	X	1.42	10	Arochlor 1260
GIPII-F2-BOT-CS15	Soil	9/6/2002	1655	9/6/2002	9/10/2002	48208-41	X	0.130	10	Arochlor 1260
GIPII-F2-BOT-CS16	Soil	9/6/2002	1659	9/6/2002	9/10/2002	48208-42	X	0.043	10	Arochlor 1260
GIPII-F2-BOT-CS17	Soil	9/13/2002	1102	9/13/2002	9/16/2002	48257-12	X	4.10	10	Arochlor 1260
GIPII-F2-BOT-CS18	Soil	9/13/2002	1110	9/13/2002	9/14/2002	48257-13	X	0.045	10	Arochlor 1260
GIPII-F2-BOT-CS19	**Soil**	**9/13/2002**	**1115**	**9/13/2002**	**9/16/2002**	**48257-14**	**X**	**21.8**	**10**	**Arochlor 1260**
GIPII-F2-BOT-CS19A	Soil	9/17/2002	1324	9/18/2002	9/19/2002	48294-5	X	4.0	10	Arochlor 1260
TRANSFORMER VAULT 53										
GIPII-B53-SWN-CS1	Soil	8/14/2002	1405	8/14/2002	8/16/2002	48088-1	X	1.15	10	Arochlor 1260
GIPII-B53-SWN-CS2	Soil	8/14/2002	1400	8/14/2002	8/15/2002	48088-2	X	U	10	Arochlor 1260
GIPII-B53-SWE-CS1	Soil	8/14/2002	1423	8/14/2002	8/15/2002	48088-3	X	U	10	Arochlor 1260
GIPII-B53-SWE-CS2	Soil	8/14/2002	1420	8/14/2002	8/15/2002	48088-4	X	0.120	10	Arochlor 1260
GIPII-B53-SWS-CS1	Soil	8/14/2002	1415	8/14/2002	8/15/2002	48088-5	X	U	10	Arochlor 1260
GIPII-B53-SWS-CS2	Soil	8/14/2002	1417	8/14/2002	8/15/2002	48088-6	X	U	10	Arochlor 1260
GIPII-B53-SWW-CS1	Soil	8/14/2002	1410	8/14/2002	8/15/2002	48088-7	X	U	10	Arochlor 1260
GIPII-B53-SWW-CS2	Soil	8/14/2002	1413	8/14/2002	8/15/2002	48088-8	X	0.128	10	Arochlor 1260

TABLE C-3
GOULD ISLAND PCB REMEDIATION
CONFIRMATORY SAMPLING

Sample I.D	Matrix	Date Collected	Time Collected	Date to Lab	Analysis Received	Lab ID#	PCB 3545/8082	Results (ppm)	Action Level (ppm)	Comment
GIPII-B53-BOT-CS1	Soil	8/14/2002	1330	8/14/2002	8/16/2002	48088-14	X	0.187	10	Arochlor 1260
GIPII-B53-BOT-CS2	Soil	8/14/2002	1345	8/14/2002	8/15/2002	48088-15	X	U	10	Arochlor 1260
GIPII-B53-BOT-CS3	Soil	8/14/2002	1343	8/14/2002	8/15/2002	48088-16	X	U	10	Arochlor 1260
GIPII-B53-BOT-CS4	Soil	8/14/2002	1340	8/14/2002	8/15/2002	48088-17	X	0.176	10	Arochlor 1260
TRANSFORMER VAULT 53 - BORING LOCATION B19										
GIPII-53B19-SWN-CS1	Soil	8/14/2002	1348	8/14/2002	8/15/2002	48088-9	X	0.140	10	Arochlor 1260
GIPII-53B19-SWE-CS1	Soil	8/14/2002	1354	8/14/2002	8/15/2002	48088-10	X	0.105	10	Arochlor 1260
GIPII-53B19-SWS-CS1	Soil	8/14/2002	1358	8/14/2002	8/15/2002	48088-11	X	0.017	10	Arochlor 1260
GIPII-53B19-SWW-CS1	**Soil**	**8/14/2002**	**1401**	**8/14/2002**	**8/16/2002**	**48088-12**	**X**	**67.2**	**10**	**Arochlor 1260. Additional material excavated.**
GIPII-53B19-SWW-CS1A	Soil	8/21/2002	1112	8/21/2002	8/23/2002	48123-1	X	U	10	Arochlor 1260
GIPII-53B19-BOT-CS1	Soil	8/14/2002	1340	8/14/2002	8/15/2002	48088-18	X	0.146	10	Arochlor 1260
TRANSFORMER VAULT 54 - BORING LOCATION B29										
GIPII-54B29-SWN-CS1	SED	9/5/2002	1549	9/5/2002	9/6/2002	48202-7	X	U	1	Arochlor 1260
GIPII-54B29-SWE-CS1	SED	9/5/2002	1552	9/5/2002	9/6/2002	48202-8	X	U	1	Arochlor 1260
GIPII-54B29-SWS-CS1	**SED**	**9/5/2002**	**1551**	**9/5/2002**	**9/6/2002**	**48202-9**	**X**	**1.01**	**1**	**Arochlor 1260**
GIPII-54B29-SWS-CS1A	**SED**	**9/9/2002**	**0740**	**9/10/2002**	**9/11/2002**	**48223-1**	**X**	**9.64**	**1**	**Arochlor 1260**
GIPII-54B29-SWS-CS1B	All soil removed along south end between 54B29 and 54B45. No sample collected.									
GIPII-54B29-SWW-CS1	SED	9/5/2002	1554	9/5/2002	9/6/2002	48202-10	X	0.044	1	Arochlor 1260
GIPII-54B29-BOT-CS1	SED	9/5/2002	1545	9/5/2002	9/6/2002	48202-13	X	U	1	Arochlor 1260
TRANSFORMER VAULT 54 - BORING LOCATION B40										
GIPII-54B40-SWN-CS1	SED	9/5/2002	1441	9/5/2002	9/6/2002	48202-4	X	0.109	1	Arochlor 1260
GIPII-54B40-SWE-CS1	SED	9/5/2002	1448	9/5/2002	9/6/2002	48202-5	X	U	1	Arochlor 1260
GIPII-54B40-SWS-CS1	SED	9/5/2002	1445	9/5/2002	9/6/2002	48202-6	X	0.016	1	Arochlor 1260
GIPII-54B40-SWW-CS1	No sample collected due to sheet pile wall on west side of excavation									
GIPII-54B40-BOT-CS1	SED	9/5/2002	1431	9/5/2002	9/6/2002	48202-12	X	0.119	1	Arochlor 1260
TRANSFORMER VAULT 54 - BORING LOCATION B42										
GIPII-54B42-SWN-CS1	SED	9/5/2002	1324	9/5/2002	9/6/2002	48202-1	X	U	1	Arochlor 1260
GIPII-54B42-SWE-CS1	SED	9/5/2002	1327	9/5/2002	9/6/2002	48202-2	X	U	1	Arochlor 1260
GIPII-54B42-SWS-CS1	SED	9/5/2002	1320	9/5/2002	9/6/2002	48202-3	X	0.188	1	Arochlor 1260
GIPII-54B42-SWW-CS1	No sample collected due to sheet pile wall on west side of excavation									
GIPII-54B42-BOT-CS1	SED	9/5/2002	1315	9/5/2002	9/6/2002	48202-11	X	0.072	1	Arochlor 1260
TRANSFORMER VAULT 54 - BORING LOCATION B45										
GIPII-54B45-SWN-CS1	SED	9/6/2002	1228	9/6/2002	9/9/2002	48208-1	X	0.289	1	Arochlor 1260
GIPII-54B45-SWE-CS1	SED	9/6/2002	1233	9/6/2002	9/9/2002	48208-2	X	0.059	1	Arochlor 1260
GIPII-54B45-SWS-CS1	**SED**	**9/6/2002**	**1232**	**9/6/2002**	**9/9/2002**	**48208-3**	**X**	**4.34**	**1**	**Arochlor 1260**
GIPII-54B45-SWS-CS1A	SED	9/10/2002	1245	9/10/2002	9/11/2002	48223-2	X	0.231	1	Arochlor 1260
GIPII-54B45-SWW-CS1	SED	9/6/2002	1230	9/6/2002	9/9/2002	48208-4	X	0.389	1	Arochlor 1260
GIPII-54B45-BOT-CS1	SED	9/6/2002	1223	9/6/2002	9/9/2002	48208-25	X	U	1	Arochlor 1260
TRANSFORMER VAULT 54 - BORING LOCATION B48										
GIPII-54B48-SWN-CS1	SED	9/6/2002	1140	9/6/2002	9/9/2002	48208-5	X	U	1	Arochlor 1260
GIPII-54B48-SWE-CS1	SED	9/6/2002	1141	9/6/2002	9/9/2002	48208-6	X	U	1	Arochlor 1260
GIPII-54B48-SWS-CS1	SED	9/6/2002	1142	9/6/2002	9/9/2002	48208-7	X	0.022	1	Arochlor 1260
GIPII-54B48-SWW-CS1	SED	9/6/2002	1143	9/6/2002	9/9/2002	48208-8	X	0.116	1	Arochlor 1260

TABLE C-3
GOULD ISLAND PCB REMEDIATION
CONFIRMATORY SAMPLING

Sample I.D	Matrix	Date Collected	Time Collected	Date to Lab	Analysis Received	Lab ID#	PCB 3545/8082	Results (ppm)	Action Level (ppm)	Comment
GIPII-54B48-BOT-CS1	SED	9/6/2002	1135	9/6/2002	9/9/2002	48208-26	X	U	1	Arochlor 1260
TRANSFORMER VAULT 54										
GIPII-B54-SWN-CS1	Soil	10/1/2002	1506	10/1/2002	10/2/2002	48391-18	X	U	10	
GIPII-B54-SWN-CS2	Soil	10/1/2002	1508	10/1/2002	10/2/2002	48391-19	X	U	10	
GIPII-B54-SWN-CS3	Soil	10/1/2002	1509	10/1/2002	10/2/2002	48391-20	X	U	10	
GIPII-B54-SWN-CS4	Soil	10/1/2002	1510	10/1/2002	10/2/2002	48391-21	X	1.43	10	
GIPII-B54-SWE-CS1	Soil	10/1/2002	1512	10/1/2002	10/2/2002	48391-30	X	U	10	
GIPII-B54-SWE-CS2	Soil	10/1/2002	1423	10/1/2002	10/2/2002	48391-31	X	U	10	
GIPII-B54-SWE-CS3	Soil	10/1/2002	1426	10/1/2002	10/2/2002	48391-32	X	0.489	10	
GIPII-B54-SWE-CS4	Soil	10/1/2002	1428	10/1/2002	10/2/2002	48391-33	X	0.115	10	
GIPII-B54-SWE-CS5	**Soil**	**10/1/2002**	**1430**	**10/1/2002**	**10/2/2002**	**48391-34**	**X**	**35.7**	**10**	
GIPII-B54-SWS-CS1	Soil	10/1/2002	1433	10/1/2002	10/2/2002	48391-26	X	0.314	10	
GIPII-B54-SWS-CS2	Soil	10/1/2002	1432	10/1/2002	10/2/2002	48391-27	X	U	10	
GIPII-B54-SWS-CS3	Soil	10/1/2002	1431	10/1/2002	10/2/2002	48391-28	X	U	10	
GIPII-B54-SWS-CS4	Soil	10/1/2002	1429	10/1/2002	10/2/2002	48391-29	X	U	10	
GIPII-B54-SWW-CS1	Soil	10/1/2002	1456	10/1/2002	10/2/2002	48391-22	X	U	10	
GIPII-B54-SWW-CS2	Soil	10/1/2002	1458	10/1/2002	10/2/2002	48391-23	X	U	10	
GIPII-B54-SWW-CS3	Soil	10/1/2002	1500	10/1/2002	10/2/2002	48391-24	X	0.109	10	
GIPII-B54-SWW-CS4	Soil	10/1/2002	1502	10/1/2002	10/2/2002	48391-25	X	0.030	10	
GIPII-B54-BOT-CS1	Soil	10/1/2002	1450	10/1/2002	10/2/2002	48391-1	X	0.389	10	
GIPII-B54-BOT-CS2	Soil	10/1/2002	1444	10/1/2002	10/2/2002	48391-2	X	3.72	10	
GIPII-B54-BOT-CS3	Soil	10/1/2002	1437	10/1/2002	10/2/2002	48391-3	X	3.99	10	
GIPII-B54-BOT-CS4	Soil	10/1/2002	1415	10/1/2002	10/2/2002	48391-4	X	6.33	10	
GIPII-B54-BOT-CS5	Soil	10/1/2002	1521	10/1/2002	10/2/2002	48391-5	X	1.82	10	
GIPII-B54-BOT-CS6	**Soil**	**10/1/2002**	**1514**	**10/1/2002**	**10/2/2002**	**48391-6**	**X**	**17.8**	**10**	
GIPII-B54-BOT-CS7	**Soil**	**10/1/2002**	**1410**	**10/1/2002**	**10/2/2002**	**48391-7**	**X**	**26.7**	**10**	
GIPII-B54-BOT-CS8	**Soil**	**10/1/2002**	**1405**	**10/1/2002**	**10/2/2002**	**48391-8**	**X**	**22.5**	**10**	
GIPII-B54-BOT-CS9	Soil	10/1/2002	1400	10/1/2002	10/2/2002	48391-9	X	0.157	10	
GIPII-B54-BOT-CS10	Soil	10/1/2002	1528	10/1/2002	10/2/2002	48391-10	X	3.81	10	
GIPII-B54-BOT-CS11	**Soil**	**10/1/2002**	**1538**	**10/1/2002**	**10/2/2002**	**48391-11**	**X**	**24.4**	**10**	
GIPII-B54-BOT-CS12	**Soil**	**10/1/2002**	**1355**	**10/1/2002**	**10/2/2002**	**48391-12**	**X**	**12.7**	**10**	
GIPII-B54-BOT-CS13	**Soil**	**10/1/2002**	**1348**	**10/1/2002**	**10/2/2002**	**48391-13**	**X**	**18.8**	**10**	
GIPII-B54-BOT-CS14	Soil	10/1/2002	1342	10/1/2002	10/2/2002	48391-14	X	0.656	10	
GIPII-B54-BOT-CS15	Soil	10/1/2002	1333	10/1/2002	10/2/2002	48391-15	X	3.87	10	
GIPII-B54-BOT-CS16	**Soil**	**10/1/2002**	**1330**	**10/1/2002**	**10/2/2002**	**48391-16**	**X**	**370**	**10**	
GIPII-B54-BOT-CS17	Soil	10/1/2002	1314	10/1/2002	10/2/2002	48391-17	X	2.43	10	
TRANSFORMER VAULT 56										
GIPII-B56-SWN-CS1	Soil	8/21/2002	1315	8/21/2002	8/23/2002	48123-3	X	0.053	10	Arochlor 1260
GIPII-B56-SWN-CS2	Soil	8/21/2002	1318	8/21/2002	8/23/2002	48123-4	X	U	10	Arochlor 1260
GIPII-B56-SWE-CS1	Soil	8/21/2002	1403	8/21/2002	8/23/2002	48123-5	X	U	10	Arochlor 1260
GIPII-B56-SWE-CS2	Soil	8/21/2002	1400	8/21/2002	8/23/2002	48123-6	X	U	10	Arochlor 1260
GIPII-B56-SWS-CS1	Soil	8/21/2002	1406	8/21/2002	8/23/2002	48123-7	X	U	10	Arochlor 1260
GIPII-B56-SWS-CS2	Soil	8/21/2002	1408	8/21/2002	8/23/2002	48123-8	X	0.065	10	Arochlor 1260

TABLE C-3
GOULD ISLAND PCB REMEDIATION
CONFIRMATORY SAMPLING

Sample I.D	Matrix	Date Collected	Time Collected	Date to Lab	Analysis Received	Lab ID#	PCB 3545/8082	Results (ppm)	Action Level (ppm)	Comment
GIPII-B56-SWW-CS1	Soil	8/21/2002	1411	8/21/2002	8/23/2002	48123-9	X	U	10	Arochlor 1260
GIPII-B56-SWW-CS2	Soil	8/21/2002	1415	8/21/2002	8/23/2002	48123-10	X	U	10	Arochlor 1260
GIPII-B56-BOT-CS1	Soil	8/21/2002	1330	8/21/2002	8/23/2002	48123-12	X	0.094	10	Arochlor 1260
GIPII-B56-BOT-CS2	Soil	8/21/2002	1340	8/21/2002	8/23/2002	48123-13	X	0.066	10	Arochlor 1260
GIPII-B56-BOT-CS3	Soil	8/21/2002	1345	8/21/2002	8/23/2002	48123-14	X	U	10	Arochlor 1260
GIPII-B56-BOT-CS4	Soil	8/21/2002	1349	8/21/2002	8/23/2002	48123-15	X	0.040	10	Arochlor 1260
GIPII-B56-BOT-CS5	Soil	8/21/2002	1351	8/21/2002	8/23/2002	48123-16	X	U	10	Arochlor 1260
GIPII-B56-CTR-CS1	Soil	8/21/2002	1355	8/21/2002	8/23/2002	48123-11	N/A	N/A	N/A	No PCB analysis (TPH, VOC, SVOC)
TRANSFORMER VAULT 59										
GIPII-B59-SWN-CS1	Soil	9/17/2002	1130	9/18/2002	9/19/2002	48293-1	X	U	10	Arochlor 1260
GIPII-B59-SWN-CS2	Soil	9/19/2002	1205	9/19/2002	9/21/2002	48307-1	X	U	10	Arochlor 1260
GIPII-B59-SWE-CS1	Soil	9/17/2002	1132	9/18/2002	9/19/2002	48293-2	X	7.22	10	Arochlor 1260
GIPII-B59-SWE-CS2	Soil	9/19/2002	1207	9/19/2002	9/21/2002	48307-2	X	0.225	10	Arochlor 1260
GIPII-B59-SWS-CS1	Soil	9/17/2002	1135	9/18/2002	9/19/2002	48293-3	X	0.014	10	Arochlor 1260
GIPII-B59-SWS-CS2	Soil	9/19/2002	1213	9/19/2002	9/21/2002	48307-3	X	0.205	10	Arochlor 1260
GIPII-B59-SWW-CS1	Soil	9/19/2002	1211	9/19/2002	9/21/2002	48307-4	X	0.016	10	Arochlor 1260
GIPII-B59-SWW-CS2	Soil	9/19/2002	1209	9/19/2002	9/21/2002	48307-5	X	0.033	10	Arochlor 1260
GIPII-B59-BOT-CS1	Soil	9/17/2002	1152	9/18/2002	9/19/2002	48293-13	X	4.93	10	Arochlor 1260
GIPII-B59-BOT-CS2	Soil	9/17/2002	1235	9/18/2002	9/19/2002	48293-14	X	6.81	10	Arochlor 1260
GIPII-B59-BOT-CS3	Soil	9/19/2002	1214	9/19/2002	9/21/2002	48307-9	X	2.17	10	Arochlor 1260
GIPII-B59-BOT-CS4	Soil	9/19/2002	1216	9/19/2002	9/21/2002	48307-10	X	1.21	10	Arochlor 1260
TRANSFORMER VAULT 59 SUMP										
GIPII-B59-SUMP-SWN	Soil	9/17/2002	1305	9/17/2002	9/19/2002	48288-1	X	6.04	10	Arochlor 1260
GIPII-B59-SUMP-SWE	Soil	9/17/2002	1315	9/17/2002	9/19/2002	48288-2	X	0.029	10	Arochlor 1260
GIPII-B59-SUMP-SWS	Soil	9/17/2002	1320	9/17/2002	9/19/2002	48288-3	X	0.03	10	Arochlor 1260
GIPII-B59-SUMP-SWW	Soil	9/17/2002	1325	9/17/2002	9/19/2002	48288-4	X	0.541	10	Arochlor 1260
GIPII-B59-SUMP-BOT	Soil	9/17/2002	1335	9/17/2002	9/19/2002	48288-5	X	0.037	10	Arochlor 1260
TRANSFORMER VAULT 59 - BORING LOCATION B10										
GIPII-59B10-SWE-CS1	Soil	9/17/2002	1140	9/18/2002	9/19/2002	48293-4	X	0.928	10	Arochlor 1260
GIPII-59B10-SWS-CS1	Soil	9/17/2002	1141	9/18/2002	9/19/2002	48293-5	X	0.451	10	Arochlor 1260
GIPII-59B10-BOT-CS1	**Soil**	**9/17/2002**	**1148**	**9/18/2002**	**9/19/2002**	**48293-15**	**X**	**10.4**	**10**	**Arochlor 1260**
GIPII-59B10-BOT-CS1A	Soil	9/24/2002	1315	9/24/2002	9/24/2002	48338-2	X	0.132	10	Arochlor 1260
TRANSFORMER VAULT 59 - BORING LOCATION B11										
GIPII-59B11-SWN-CS1	Soil	9/17/2002	1138	9/18/2002	9/19/2002	48293-6	X	0.843	10	Arochlor 1260
GIPII-59B11-SWE-CS1	**Soil**	**9/17/2002**	**1139**	**9/18/2002**	**9/19/2002**	**48293-7**	**X**	**80.5**	**10**	**Arochlor 1260**
GIPII-59B11-SWE-CS1A	All soil removed along East side of excavation up to existing curbing. No sample collected.									
GIPII-59B11-BOT-CS1	**Soil**	**9/17/2002**	**1145**	**9/18/2002**	**9/19/2002**	**48293-16**	**X**	**61.3**	**10**	**Arochlor 1260**
GIPII-59B11-BOT-CS1A	Soil	9/24/2002	1320	9/24/2002	9/24/2002	48338-3	X	0.39	10	Arochlor 1260
TRANSFORMER VAULT 59 - BORING LOCATION B11										
GIPII-59B25-SWN-CS1	Soil	9/19/2002	1221	9/19/2002	9/21/2002	48307-6	X	0.082	10	Arochlor 1260
GIPII-59B25-SWS-CS1	Soil	9/19/2002	1222	9/19/2002	9/21/2002	48307-6	X	U	10	Arochlor 1260
GIPII-59B25-SWW-CS1	Soil	9/19/2002	1223	9/19/2002	9/21/2002	48307-6	X	0.031	10	Arochlor 1260
GIPII-59B25-BOT-CS1	Soil	9/19/2002	1225	9/19/2002	9/21/2002	48307-6	X	0.11	10	Arochlor 1254

TABLE C-3
GOULD ISLAND PCB REMEDIATION
CONFIRMATORY SAMPLING

Sample I.D	Matrix	Date Collected	Time Collected	Date to Lab	Analysis Received	Lab ID#	PCB 3545/8082	Results (ppm)	Action Level (ppm)	Comment
TRANSFORMER VAULT 59 - SAMPLE LOCATION Q26B										
GIPII-Q26B-SWN-CS1	Soil	9/17/2002	1114	9/18/2002	9/19/2002	48293-8	X	1.78	10	Arochlor 1260
GIPII-Q26B-SWE-CS1	Soil	9/17/2002	1116	9/18/2002	9/19/2002	48293-9	X	U	10	Arochlor 1260
GIPII-Q26B-SWE-CS2	Soil	9/17/2002	1117	9/18/2002	9/19/2002	48293-10	X	0.043	10	Arochlor 1260
GIPII-Q26B-SWE-CS3	Soil	9/17/2002	1120	9/18/2002	9/19/2002	48293-11	X	0.088	10	Arochlor 1260
GIPII-Q26B-SWS-CS1	Soil	9/17/2002	1118	9/18/2002	9/19/2002	48293-12	X	0.421	10	Arochlor 1260
GIPII-Q26B-BOT-CS1	Soil	9/17/2002	1124	9/18/2002	9/19/2002	48293-17	X	0.279	10	Arochlor 1260
GIPII-Q26B-BOT-CS2	Soil	9/17/2002	1127	9/18/2002	9/19/2002	48293-18	X	0.173	10	Arochlor 1260
GIPII-Q26B-BOT-CS3	Soil	9/17/2002	1230	9/18/2002	9/19/2002	48293-19	X	0.400	10	Arochlor 1260
TRANSFORMER VAULT 60										
GIPII-B60-SWN-CS1	Soil	8/8/2002	1448	8/8/2002	8/9/2002	48041-9	X	0.220	10	Arochlor 1260
GIPII-B60-SWE-CS1	Soil	8/8/2002	1440	8/8/2002	8/9/2002	48041-2	X	U	10	Arochlor 1260
GIPII-B60-SWE-CS2	Soil	8/8/2002	1437	8/8/2002	8/9/2002	48041-3	X	0.214	10	Arochlor 1260
GIPII-B60-SWS-CS1	Soil	8/8/2002	1453	8/8/2002	8/9/2002	48041-4	X	0.085	10	Arochlor 1260
GIPII-B60-SWW-CS1	Soil	8/8/2002	1458	8/8/2002	8/13/2002	48041-1	X	2.4	10	Arochlor 1260
GIPII-B60-SWW-CS2	Soil	8/8/2002	1459	8/8/2002	8/9/2002	48041-10	X	0.117	10	Arochlor 1260
GIPII-B60-BOT-CS1	Soil	8/8/2002	1545	8/8/2002	8/9/2002	48041-14	X	0.468	10	Arochlor 1260
GIPII-B60-BOT-CS2	Soil	8/8/2002	1550	8/8/2002	8/9/2002	48041-15	X	0.052	10	Arochlor 1260
TRANSFORMER VAULT 60 - BORING LOCATION B14										
GIPII-60B14-SWN-CS1	Soil	8/8/2002	1555	8/8/2002	8/9/2002	48041-7	X	0.019	10	Arochlor 1260
GIPII-60B14-SWW-CS1	Soil	8/8/2002	1510	8/8/2002	8/9/2002	48041-8	X	0.098	10	Arochlor 1260
GIPII-60B14-BOT-CS1	Soil	8/8/2002	1537	8/8/2002	8/9/2002	48041-17	X	U	10	Arochlor 1260
TRANSFORMER VAULT 60 - BORING LOCATION B15										
GIPII-60B15-SWS-CS1	Soil	8/8/2002	1504	8/8/2002	8/13/2002	48041-5	X	5.16	10	Arochlor 1260. Additional material excavated at Navy request
GIPII-60B15-SWS-CS1A	Soil	8/21/2002	1119	8/21/2002	8/26/2002	48123-2	X	6.12	10	Arochlor 1260
GIPII-60B15-SWW-CS1	Soil	8/8/2002	1506	8/8/2002	8/9/2002	48041-6	X	U	10	Arochlor 1260
GIPII-60B15-BOT-CS1	Soil	8/8/2002	1553	8/8/2002	8/9/2002	48041-16	X	0.421	10	Arochlor 1260
TRANSFORMER VAULT 61										
GIPII-B61-SWN-CS1	Soil	8/14/2002	1115	8/14/2002	8/20/2002	48089-1	X	**19.9**	10	Arochlor 1248
GIPII-B61-SWN-CS1A	Soil	9/10/2002		9/10/2002	9/11/2002	48223-3	X	5.76	10	Arochlor 1248
GIPII-B61-SWE-CS1	Soil	8/14/2002	1117	8/14/2002	8/19/2002	48089-2	X	0.160	10	Arochlor 1260
GIPII-B61-SWS-CS1	Soil	8/14/2002	1119	8/14/2002	8/19/2002	48089-3	X	0.363/0.121	10	Arochlor 1248/1260
GIPII-B61-SWW-CS1	Soil	8/14/2002	1120	8/14/2002	8/19/2002	48089-4	X	0.334/0.200	10	Arochlor 1248/1260
GIPII-B61-BOT-CS1	Soil	8/14/2002	1125	8/14/2002	8/19/2002	48089-8	X	0.273/0.065	10	Arochlor 1248/1260
GIPII-B61-BOT-CS2	Soil	8/14/2002	1128	8/14/2002	8/19/2002	48089-9	X	0.068/0.025D	10	Arochlor 1248/1260
GIPII-B61-CTR-CS1	Soil	8/14/2002	1130	8/14/2002	8/16/2002	48089-5	N/A	N/A	N/A	No PCB analysis (TPH, VOC, SVOC)
MISCELLANEOUS										
GIPII-DEBRIS-WC1	**Soil**	**8/14/2002**		**8/14/2002**	**8/20/2002**	**48089-6**	**X**	**19.1**	**10**	**Arochlor 1260**
GIPII-ASB-TRENCH	Soil	8/14/2002		8/14/2002	8/19/2002	48089-7	X	U	10	Arochlor 1260

TABLE 3-2
COMPARISON OF AUGUST 2002 GROUNDWATER ELEVATIONS TO HISTORIC DATA
DRAFT SEMI-ANNUAL MONITORING REPORT - AUGUST 2002
NWIRP BEDFORD

Location	n[a]	Groundwater Elevations			
		January-96 to February-02			August-02
		Average	Maximum	Minimum	
ELM-1R	15	115.18	116.25	114.08	114.70
ELM-1S	15	114.50	115.88	113.51	114.01
ELM-2	15	114.68	116.03	113.26	113.21
MP-2	11	114.29	115.58	113.67	113.86
MP-3	11	112.64	114.47	111.73	111.56
MW-1R	15	125.02	152.69	120.31	121.29
MW-1S	14	162.09	166.39	159.93	158.42
MW-2R	12	116.82	119.24	115.01	115.68
MW-2S	14	145.85	149.49	141.85	144.71
MW-3B	14	118.87	121.33	116.49	117.45
MW-3S	15	134.45	136.79	123.76	**134.86**[b]
MW-10B	5	142.05	142.13	141.97	141.83
MW-10S	5	152.39	152.81	152.71	**152.49**[b]
MW-11B	14	126.64	128.68	123.32	**145.76**[b]
MW-11S	13	154.22	154.57	153.62	154.35
MW-12I	7	162.78	163.62	162.31	162.57
MW-12R	15	128.33	158.79	122.94	**133.68**[b]
MW-12S	15	165.00	166.24	163.25	164.93
MW-13R	14	134.23	137.88	130.43	134.12
MW-13S	15	172.58	176.13	168.86	171.06
MW-14R	14	130.37	134.62	126.76	128.06
MW-14S	13	149.99	152.56	148.31	**150.50**[b]
MW-16R	15	120.61	128.48	117.71	*
MW-17S	14	135.46	137.50	127.28	129.29
MW-18S	12	151.45	153.51	149.84	150.17
MW-20I	13	182.20	187.99	175.15	178.56
MW-20R	13	152.42	157.58	145.45	**154.06**[b]
MW-20S	12	184.09	189.33	179.81	179.58
MW-21R	14	140.87	144.20	132.82	140.57
MW-21S	15	178.66	183.89	172.91	176.70
MW-31S	10	129.82	130.95	128.94	128.60
MW-32I	10	121.91	123.03	120.75	119.73
MW-32S	10	122.56	124.00	121.45	120.26
MW-33I	7	121.33	123.00	119.07	118.23
MW-33S	10	121.19	123.23	118.68	118.09
MW-34S	10	118.83	120.93	115.79	115.71
OW-1	12	122.09	124.43	118.31	119.04
OW-2	13	122.83	125.92	120.20	<121.66
OW-3	14	124.85	128.55	122.68	120.62
OW-4	15	143.91	146.33	142.53	**145.18**[b]
STM-1R	15	114.95	116.24	110.06	**115.51**[b]
STM-1S	15	115.29	116.26	114.38	**115.69**[b]
STM-2	15	114.31	115.68	113.28	113.52
STM-4	14	115.54	116.33	114.46	115.77
STM-5I	15	127.34	129.59	118.78	126.56
STM-5R	14	123.93	126.30	121.25	122.15
STM-5S	15	147.87	148.71	146.50	147.14
STM-6I	7	147.18	148.25	145.39	146.41
STM-6S	12	152.69	154.19	151.06	151.40

[a] n is the number of water level measurements from January 1996 to February 2002

[b] Bold values exceed historic average

TABLE 3-2
COMPARISON OF AUGUST 2002 GROUNDWATER ELEVATIONS TO HISTORIC DATA
DRAFT SEMI-ANNUAL MONITORING REPORT - AUGUST 2002
NWIRP BEDFORD

* No water level measurement taken.

LEGEND:

MW-02 MONITORING WELL
CASING ELEV. – 9.63
PVC ELEV. – 9.47
GROUND ELEV. – 7.6

MW-206 MONITORING WELL
CASING ELEV. – 7.25
PVC ELEV. – 6.96
GROUND ELEV. – 7.2

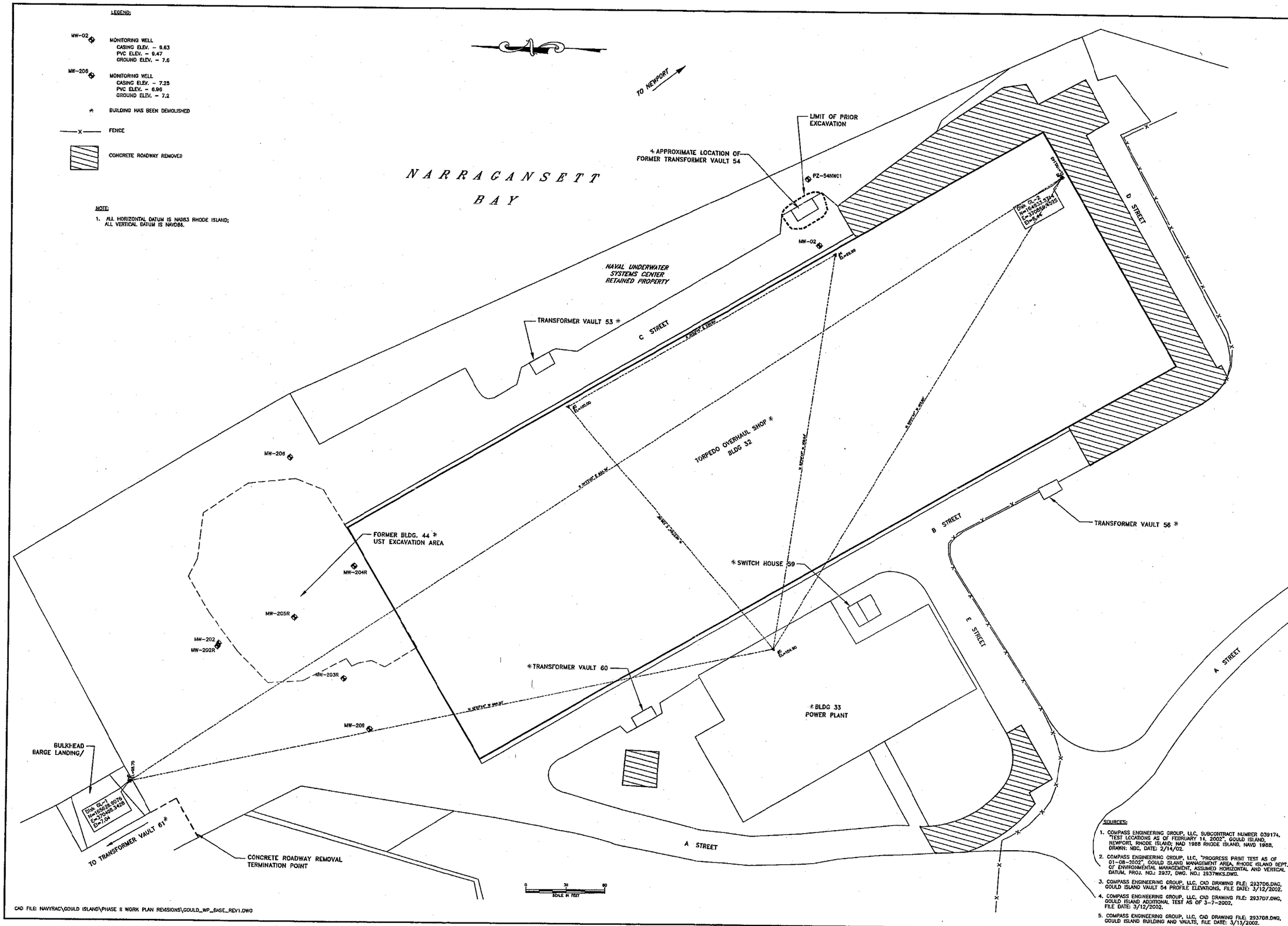
* BUILDING HAS BEEN DEMOLISHED

—X— FENCE

CONCRETE ROADWAY REMOVED

NOTE:

1. ALL HORIZONTAL DATUM IS NAD83 RHODE ISLAND; ALL VERTICAL DATUM IS NAVD88.



SOURCES:

1. COMPASS ENGINEERING GROUP, LLC, SUBCONTRACT NUMBER 039174, "TEST LOCATIONS AS OF FEBRUARY 14, 2002", GOULD ISLAND, NEWPORT, RHODE ISLAND; NAD 1988 RHODE ISLAND, NAVD 1988, DRAWN: NBC, DATE: 2/14/02.
2. COMPASS ENGINEERING GROUP, LLC, "PROGRESS PRINT TEST AS OF 01-08-2002", GOULD ISLAND MANAGEMENT AREA, RHODE ISLAND DEPT. OF ENVIRONMENTAL MANAGEMENT, ASSUMED HORIZONTAL AND VERTICAL DATUM, PROJ. NO.: 2937, DWG. NO.: 2937WKS.DWG.
3. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D6.DWG, GOULD ISLAND VAULT 54 PROFILE ELEVATIONS, FILE DATE: 3/12/2002.
4. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D7.DWG, GOULD ISLAND ADDITIONAL TEST AS OF 3-7-2002, FILE DATE: 3/12/2002.
5. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND BUILDING AND VAULTS, FILE DATE: 3/13/2002.

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN REVISIONS\GOULD_WP_BASE_REV1.DWG

REV.	DESCRIPTION	PREP BY	DATE	APPRVD

FOSTER WHEELER ENVIRONMENTAL CORPORATION

DRN. CHK. CH ENG. (ONLY) DATE
SUBMITTED BY: (PWD WEBBER)
INITIATOR: ENG. PRC. CONT. DES. IN CHARGE
APPROVED DATE

NAVAL FACILITIES ENGINEERING COMMAND PENNSYLVANIA

DEPARTMENT OF THE NAVY
ENGINEERING FIELD ACTIVITY – NORTHEAST
LESTER

GOULD ISLAND, NEWPORT, RHODE ISLAND
SITE PLAN

SEAL AREA

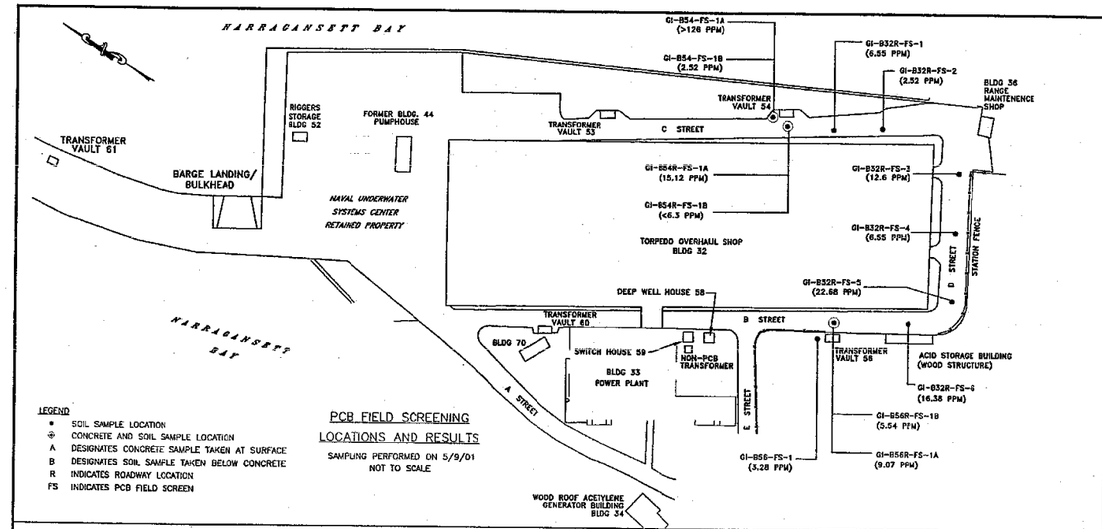
APPROVED DATE

EFANE FOR COMMANDER, NAVFAC

SAT TO	DATE 6/28/02
CODE I.D. NO.	80091
SCALE :	AS SHOWN
SPEC. NO.	
CONSTRN. CONTR. NO.	N62472-99-D-0032
NAVFAC DRAWING NO.	
SHEET 1 OF 10	
SIZE: D	DS. SH. NO. FIGURE 1

DATE CREATED
LATEST CHANGE

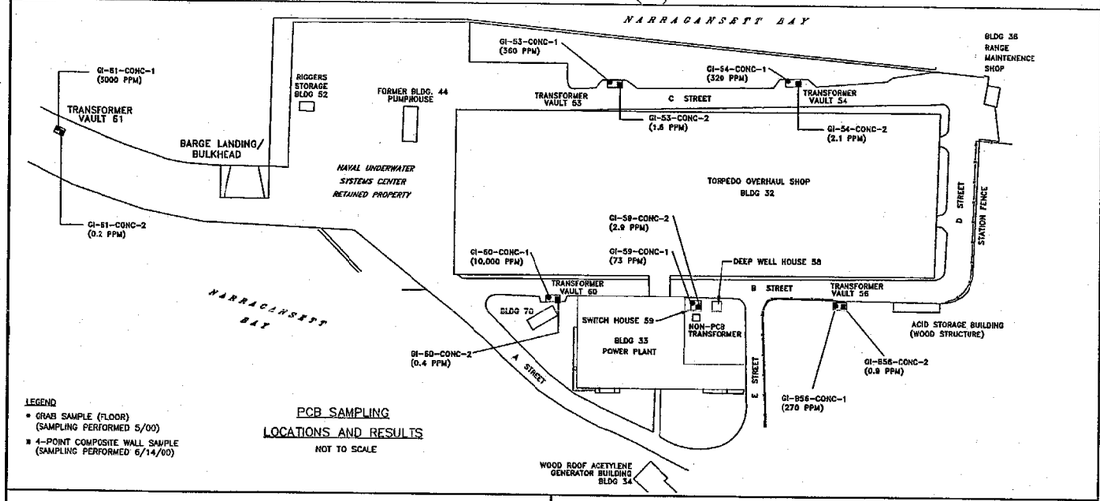
03/FAB/33



LEGEND
- • SOIL SAMPLE LOCATION
- ⊕ CONCRETE AND SOIL SAMPLE LOCATION
- A DESIGNATES CONCRETE SAMPLE TAKEN AT SURFACE
- B DESIGNATES SOIL SAMPLE TAKEN BELOW CONCRETE
- R INDICATES ROADWAY LOCATION
- FS INDICATES PCB FIELD SCREEN

PCB FIELD SCREENING LOCATIONS AND RESULTS

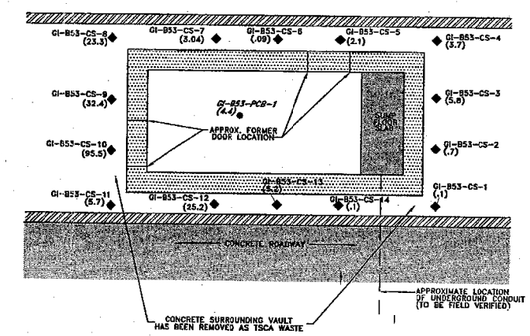
SAMPLING PERFORMED ON 5/9/01
NOT TO SCALE



LEGEND
- • GRAB SAMPLE (FLOOR) (SAMPLING PERFORMED 5/00)
- ■ 4-POINT COMPOSITE WALL SAMPLE (SAMPLING PERFORMED 6/14/00)

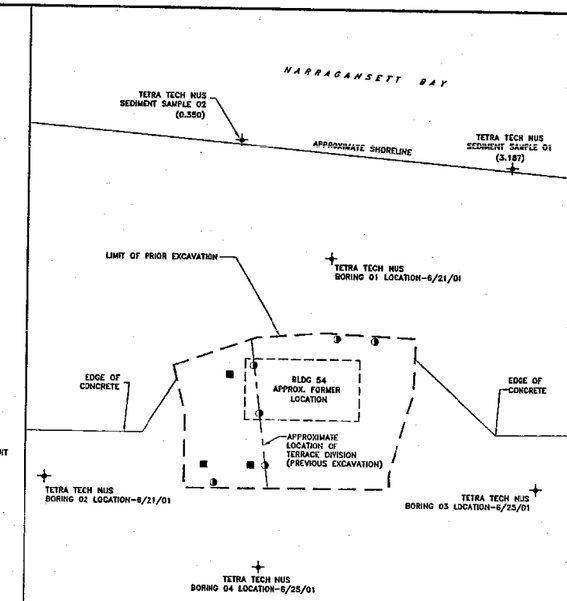
PCB SAMPLING LOCATIONS AND RESULTS

NOT TO SCALE



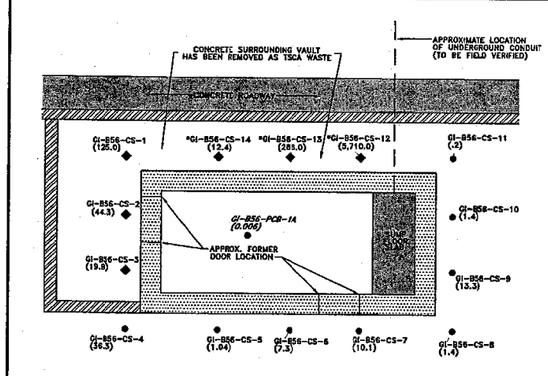
TRANSFORMER VAULT – BUILDING 53

PERIMETER SAMPLED ON 4/12/01
NOT TO SCALE



TRANSFORMER VAULT – BUILDING 54

NOT TO SCALE

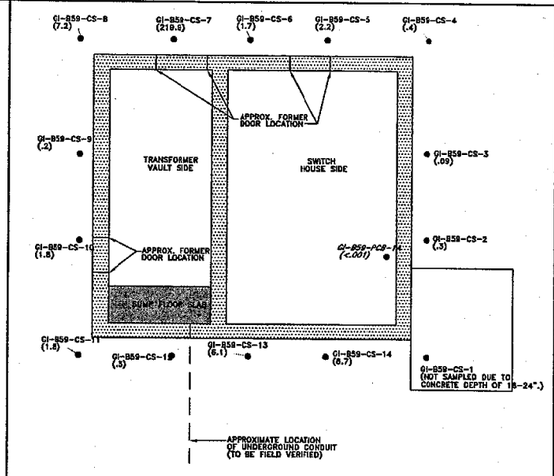


TRANSFORMER VAULT – BUILDING 56 SAMPLING GRID

APPROXIMATE INTERIOR SLAB SIZE = 6' x 15'
PERIMETER SAMPLED ON 4/12/01
NOT TO SCALE

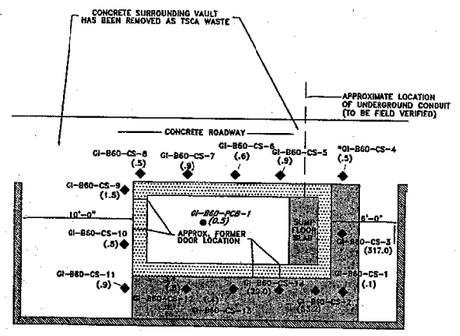
* SAMPLED ON 4/18/01

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN REVISIONS\GOULD_WP_HISTORICAL.DWG



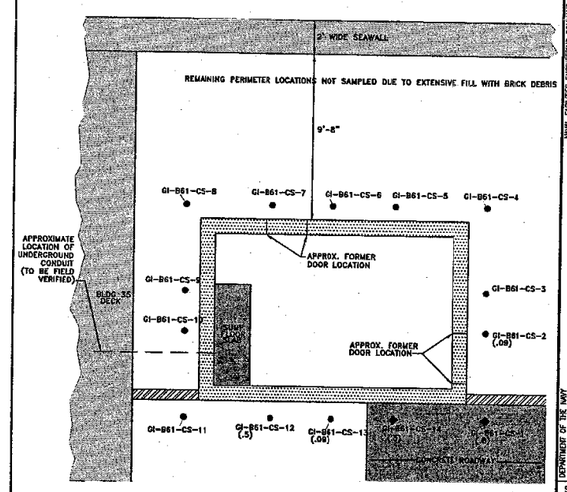
SWITCH HOUSE – BUILDING 59

PERIMETER SAMPLED ON 4/12/01
NOT TO SCALE



TRANSFORMER VAULT – BUILDING 60

PERIMETER SAMPLED ON 4/12/01
NOT TO SCALE



TRANSFORMER VAULT– BUILDING 61

PERIMETER SAMPLED ON 4/16/01
NOT TO SCALE

NOTE: SAMPLE LOCATIONS SHOWN ARE APPROXIMATE ONLY AND ARE BASED ON FIELD MEASUREMENTS.

LEGEND
- CONCRETE SLAB
- CONCRETE FOUNDATION
- 8"HIGH CONCRETE CURB
- 8 FT. HIGH CONCRETE RETAINING WALL
- • PREVIOUS SOIL SAMPLE LOCATION (0"-6")
- ◆ PREVIOUS CONCRETE SURFACE SAMPLE (0"-1")
- ■ BOTTOM SAMPLE WITH 5/21/01 FIELD SCREEN RESULT >126 ppm
- ◑ SIDEWALL SAMPLE WITH 5/21/01 FIELD SCREEN RESULT >126 ppm
- (23.5) SOIL SAMPLE ANALYTICAL LAB PCB RESULTS IN ppm
- (95.5) WATER SAMPLE ANALYTICAL LAB PCB RESULTS IN ppm

REV.	DESCRIPTION	PREP BY	DATE	APPRVD

FOSTER WHEELER ENVIRONMENTAL CORPORATION

DRN. CH CHK. (DATE) QA(T) ISS. SUBMITTED BY (TYPE & SIGN) DATE ENG. DR. PRC. DR. OFFICER IN CHARGE APPROVED

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND — PENNSYLVANIA

ENGINEERING FIELD ACTIVITY – NORTHEAST

GOULD ISLAND, NEWPORT, RHODE ISLAND

HISTORICAL SAMPLE RESULTS AND LOCATIONS

LESTER — SEAL AREA — DATE — APPROVED — ENAC FOR COMMANDER, NAVFAC

SAT TO	DATE 6/28/02
CODE I.D. NO.	80091
SCALE :	AS SHOWN
SPEC. NO.	
CONSTRN. CONTR. NO.	N62472-99-D-0032
NAVFAC DRAWING NO.	
SHEET 2 OF 10	
SIZE: D	DIS. SH. NO. FIGURE 2

DATE CREATED
LATEST CHANGE

LEGEND:

MW-02 — MONITORING WELL
CASING ELEV. – 9.63
PVC ELEV. – 9.47
GROUND ELEV. – 7.5

MW-206 — MONITORING WELL
CASING ELEV. – 7.25
PVC ELEV. – 6.96
GROUND ELEV. – 7.2

* BUILDING HAS BEEN DEMOLISHED

—x— FENCE

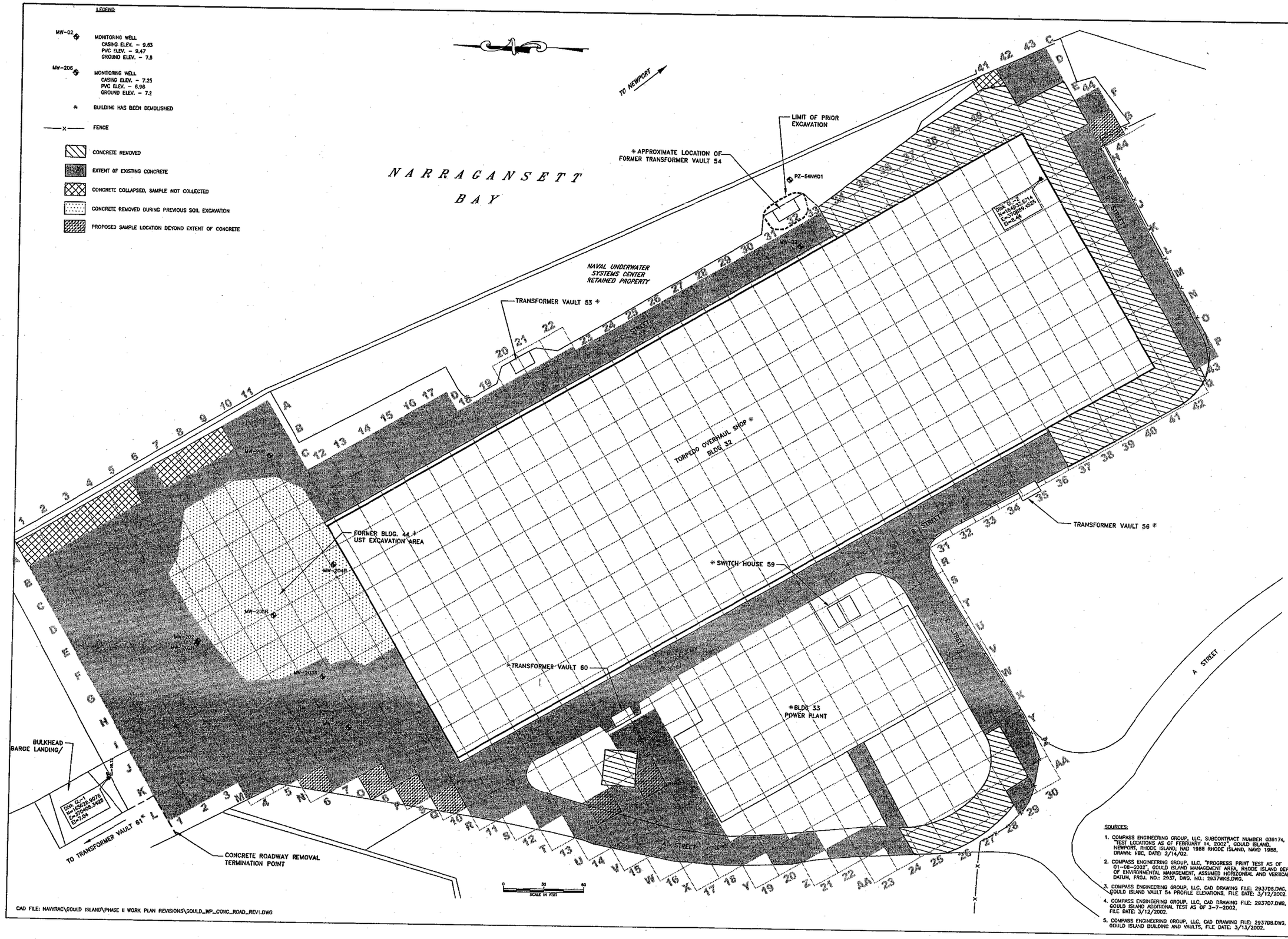
CONCRETE REMOVED

EXTENT OF EXISTING CONCRETE

CONCRETE COLLAPSED, SAMPLE NOT COLLECTED

CONCRETE REMOVED DURING PREVIOUS SOIL EXCAVATION

PROPOSED SAMPLE LOCATION BEYOND EXTENT OF CONCRETE



SOURCES:

1. COMPASS ENGINEERING GROUP, LLC, SUBCONTRACT NUMBER 039174, "TEST LOCATIONS AS OF FEBRUARY 14, 2002", GOULD ISLAND, NEWPORT, RHODE ISLAND, NAD 1988 RHODE ISLAND, NAVD 1988, DRAWN: NBC, DATE: 2/14/02.
2. COMPASS ENGINEERING GROUP, LLC, "PROGRESS PRINT TEST AS OF 01-08-2002", GOULD ISLAND MANAGEMENT AREA, RHODE ISLAND DEPT. OF ENVIRONMENTAL MANAGEMENT, ASSUMED HORIZONTAL AND VERTICAL DATUM, PROJ. NO.: 2937, DWG. NO.: 2937WKS.DWG.
3. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND VAULT 54 PROFILE ELEVATIONS, FILE DATE: 3/12/2002.
4. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D7.DWG, GOULD ISLAND ADDITIONAL TEST AS OF 3-7-2002, FILE DATE: 3/12/2002.
5. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND BUILDING AND VAULTS, FILE DATE: 3/13/2002.

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN REVISIONS\GOULD_WP_CONC_ROAD_REV1.DWG

REV.	DESCRIPTION	PREP BY	DATE	APPRV'D

FOSTER WHEELER ENVIRONMENTAL CORPORATION

DSN. DR. CHK. CH. ENG. DATE
SUBMITTED BY: SUPV. (TYPE BADGES)
NORFOLK Div. Vol. No. Sec. No. Dwg. No.
FPC: OFFICER IN CHARGE
APPROVED DATE

NAVAL FACILITIES ENGINEERING COMMAND
PENNSYLVANIA

DEPARTMENT OF THE NAVY
ENGINEERING FIELD ACTIVITY – NORTHEAST
LESTER

GOULD ISLAND, NEWPORT, RHODE ISLAND
EXISTING CONCRETE ROADWAY CONDITIONS

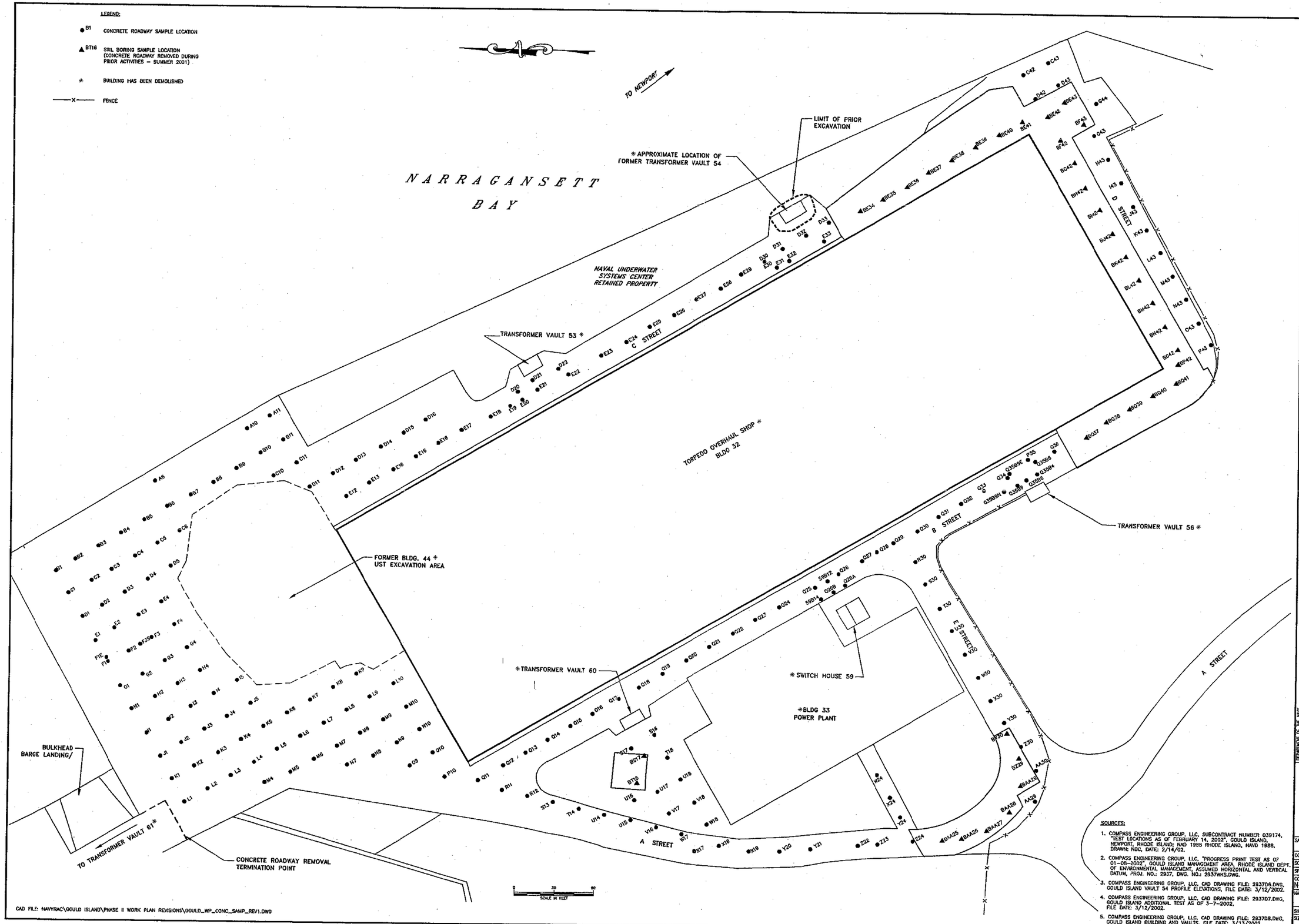
DATE
ETAME FOR COMMANDER, NAVFAC
APPROVED

SEAL AREA

SAT TO	DATE 6/28/02
CODE I.D. NO.	80091
SCALE : AS SHOWN	
SPEC. NO.	
CONSTRN. CONTR. NO.	N62472-99-D-0032
NAVFAC DRAWING NO.	
SHEET 3 OF 10	
SIZE: D	DIS. SH. NO. FIGURE 3

LEGEND:

- ● B1 — CONCRETE ROADWAY SAMPLE LOCATION
- ▲ BT16 — SOIL BORING SAMPLE LOCATION (CONCRETE ROADWAY REMOVED DURING PRIOR ACTIVITIES – SUMMER 2001)
- * — BUILDING HAS BEEN DEMOLISHED
- —X— FENCE



SOURCES:

1. COMPASS ENGINEERING GROUP, LLC. SUBCONTRACT NUMBER 039174, "TEST LOCATIONS AS OF FEBRUARY 14, 2002", GOULD ISLAND, NEWPORT, RHODE ISLAND; NAD 1988 RHODE ISLAND, NAVD 1988, DRAWN: NBC, DATE: 2/14/02.
2. COMPASS ENGINEERING GROUP, LLC. "PROGRESS PRINT TEST AS OF 01-08-2002", GOULD ISLAND MANAGEMENT AREA, RHODE ISLAND DEPT. OF ENVIRONMENTAL MANAGEMENT, ASSUMED HORIZONTAL AND VERTICAL DATUM, PROJ. NO.: 2937, DWG. NO.: 2937WKS.DWG.
3. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D6.DWG, GOULD ISLAND VAULT 54 PROFILE ELEVATIONS, FILE DATE: 3/12/2002.
4. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D7.DWG, GOULD ISLAND ADDITIONAL TEST AS OF 3-7-2002, FILE DATE: 3/12/2002.
5. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND BUILDING AND VAULTS, FILE DATE: 3/13/2002.

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN REVISIONS\GOULD_WP_CONC_SAMP_REV1.DWG

DATE CREATED
LATEST CHANGE

REV.	DESCRIPTION	PREP BY	DATE	APPRVD

FOSTER WHEELER ENVIRONMENTAL CORPORATION

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND — PENSCOLA/NAVA.

ENGINEERING FIELD ACTIVITY – NORTHEAST

GOULD ISLAND, NEWPORT, RHODE ISLAND

CONCRETE ROADWAY SAMPLE LOCATIONS

SEAL AREA

SAT TO — DATE 6/28/02

CODE I.D. NO. 80091

SCALE : AS SHOWN

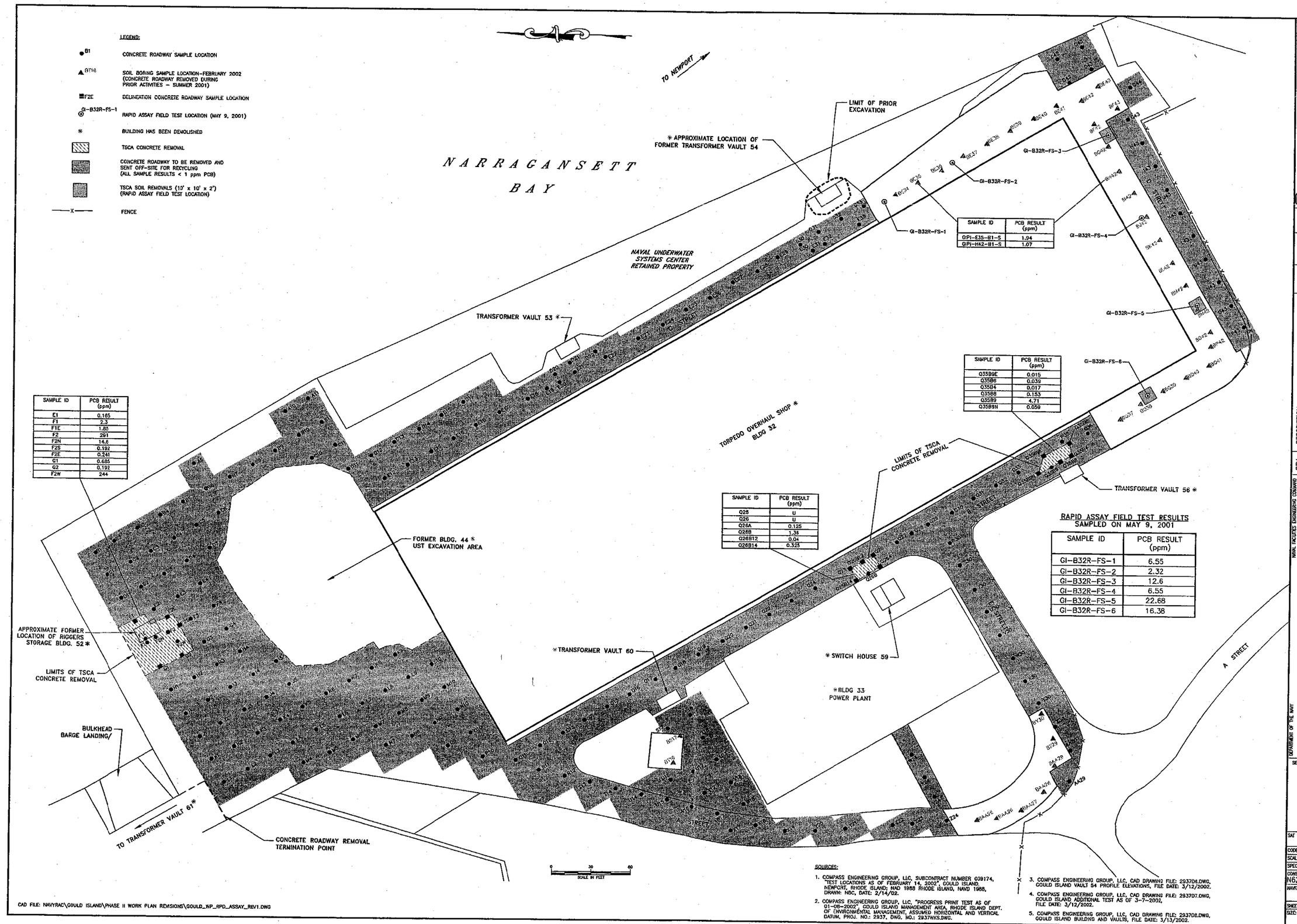
SPEC. NO.

CONSTRN. CONTR. NO. N62472-99-D-0032

NAVFAC DRAWING NO.

SHEET 4 OF 10

SIZE: D — DS. SH. NO. FIGURE 4



SAMPLE ID	PCB RESULT (ppm)
E1	0.165
F1	2.3
F1E	1.85
F2	291
F2N	14.6
F2S	0.192
F2E	0.241
G1	0.685
G2	0.192
F2W	244

SAMPLE ID	PCB RESULT (ppm)
Q25	U
Q26	U
Q26A	0.125
Q26B	1.35
Q26B12	0.04
Q26B14	0.325

SAMPLE ID	PCB RESULT (ppm)
GIPI-E35-B1-S	1.94
GIPI-H42-B1-S	1.07

SAMPLE ID	PCB RESULT (ppm)
Q35B9E	0.015
Q35B6	0.039
Q35B4	0.017
Q35B8	0.153
Q35B9	4.71
Q35B9N	0.059

RAPID ASSAY FIELD TEST RESULTS
SAMPLED ON MAY 9, 2001

SAMPLE ID	PCB RESULT (ppm)
GI-B32R-FS-1	6.55
GI-B32R-FS-2	2.32
GI-B32R-FS-3	12.6
GI-B32R-FS-4	6.55
GI-B32R-FS-5	22.68
GI-B32R-FS-6	16.38

SOURCES:

1. COMPASS ENGINEERING GROUP, LLC, SUBCONTRACT NUMBER 039174, "TEST LOCATIONS AS OF FEBRUARY 14, 2002", GOULD ISLAND, NEWPORT, RHODE ISLAND; NAD 1983 RHODE ISLAND, NAVD 1988, DRAWN: NBC, DATE: 2/14/02.
2. COMPASS ENGINEERING GROUP, LLC, "PROGRESS PRINT TEST AS OF 01-08-2002", GOULD ISLAND MANAGEMENT AREA, RHODE ISLAND DEPT. OF ENVIRONMENTAL MANAGEMENT, ASSUMED HORIZONTAL AND VERTICAL DATUM, PROJ. NO.: 2937, DWG. NO.: 2937WKS.DWG.
3. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D6.DWG, GOULD ISLAND VAULT 54 PROFILE ELEVATIONS, FILE DATE: 3/12/2002.
4. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D7.DWG, GOULD ISLAND ADDITIONAL TEST AS OF 3-7-2002, FILE DATE: 3/12/2002.
5. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND BUILDING AND VAULTS, FILE DATE: 3/13/2002.

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN REVISIONS\GOULD_WP_RPD_ASSAY_REV1.DWG

DATE CREATED
LATEST CHANGE

REV.	DESCRIPTION	PREP BY	DATE	APPRVD

FOSTER WHEELER ENVIRONMENTAL CORPORATION

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ENGINEERING FIELD ACTIVITY – NORTHEAST
PENNSYLVANIA

GOULD ISLAND, NEWPORT, RHODE ISLAND

TSCA CONCRETE ROADWAY REMOVALS/RAPID ASSAY SOIL EXCAVATIONS

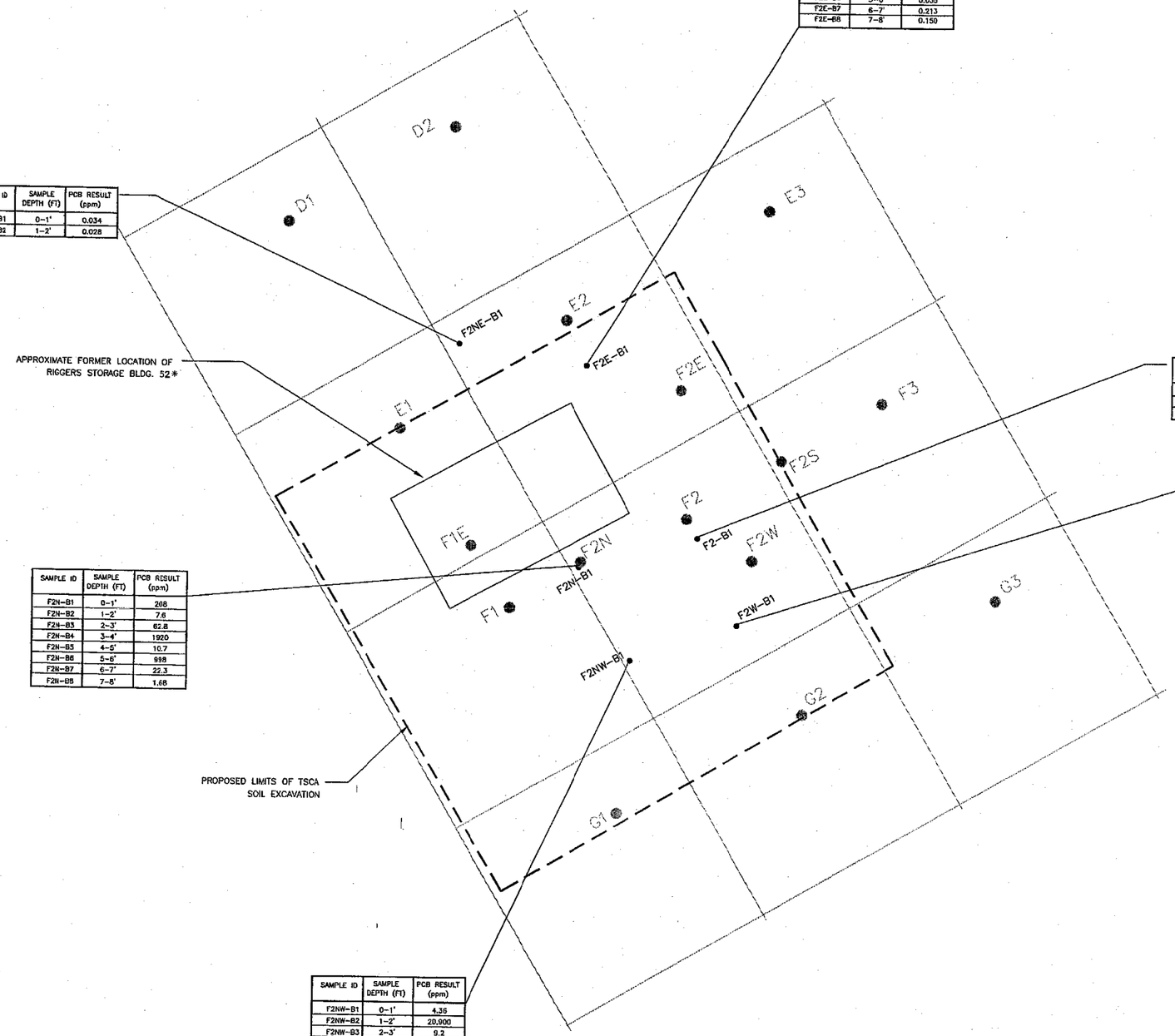
ESTATE FOR COMMANDER, NAVFAC

SEAL AREA

SAF TO DATE 6/28/02
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO.
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET 5 OF 10
SIZE: D
DWG. SH. NO. FIGURE 5

SAMPLE ID	SAMPLE DEPTH (FT)	PCB RESULT (ppm)
F2E-B1	0-1'	0.455
F2E-B2	1-2'	30.8
F2E-B3	2-3'	0.038
F2E-B4	3-4'	1.7
F2E-B5	4-5'	0.07
F2E-B6	5-6'	0.035
F2E-B7	6-7'	0.213
F2E-B8	7-8'	0.150

SAMPLE ID	SAMPLE DEPTH (FT)	PCB RESULT (ppm)
F2NE-B1	0-1'	0.034
F2NE-B2	1-2'	0.028



SAMPLE ID	SAMPLE DEPTH (FT)	PCB RESULT (ppm)
F2-B1	0-1'	4.83
F2-B2	1-2'	0.057
F2-B3	2-3'	U

SAMPLE ID	SAMPLE DEPTH (FT)	PCB RESULT (ppm)
F2W-B1	0-1'	858
F2W-B2	1-2'	1.64
F2W-B3	2-3'	0.434

SAMPLE ID	SAMPLE DEPTH (FT)	PCB RESULT (ppm)
F2N-B1	0-1'	208
F2N-B2	1-2'	7.6
F2N-B3	2-3'	62.8
F2N-B4	3-4'	1920
F2N-B5	4-5'	10.7
F2N-B6	5-6'	998
F2N-B7	6-7'	22.3
F2N-B8	7-8'	1.68

SAMPLE ID	SAMPLE DEPTH (FT)	PCB RESULT (ppm)
F2NW-B1	0-1'	4.36
F2NW-B2	1-2'	20,900
F2NW-B3	2-3'	9.2
F2NW-B4	3-4'	0.599
F2NW-B5	4-5'	424
F2NW-B6	5-6'	8
F2NW-B7	6-7'	116
F2NW-B8	7-8'	0.463

CONCRETE ROADWAY SAMPLE RESULTS

CONCRETE SAMPLE ID	PCB RESULT (ppm)
D1	U
D2	0.115
E1	0.165
E2	0.056
E3	0.083
F1	2.3
F1E	1.85
F2	291
F2N	14.6
F2S	0.192
F2E	0.241
F2W	244
F3	0.12
G1	0.685
G2	0.192
G3	0.132

0 5 10
SCALE IN FEET

LEGEND

- F1 CONCRETE SAMPLE LOCATION
- SOIL BORINGS BENEATH CONCRETE ROADWAY
- * BUILDING HAS BEEN DEMOLISHED

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN REVISIONS\GOULD_WP_F2_D.DWG

DATE CREATED
LATEST CHANGE

FOSTER WHEELER ENVIRONMENTAL CORPORATION

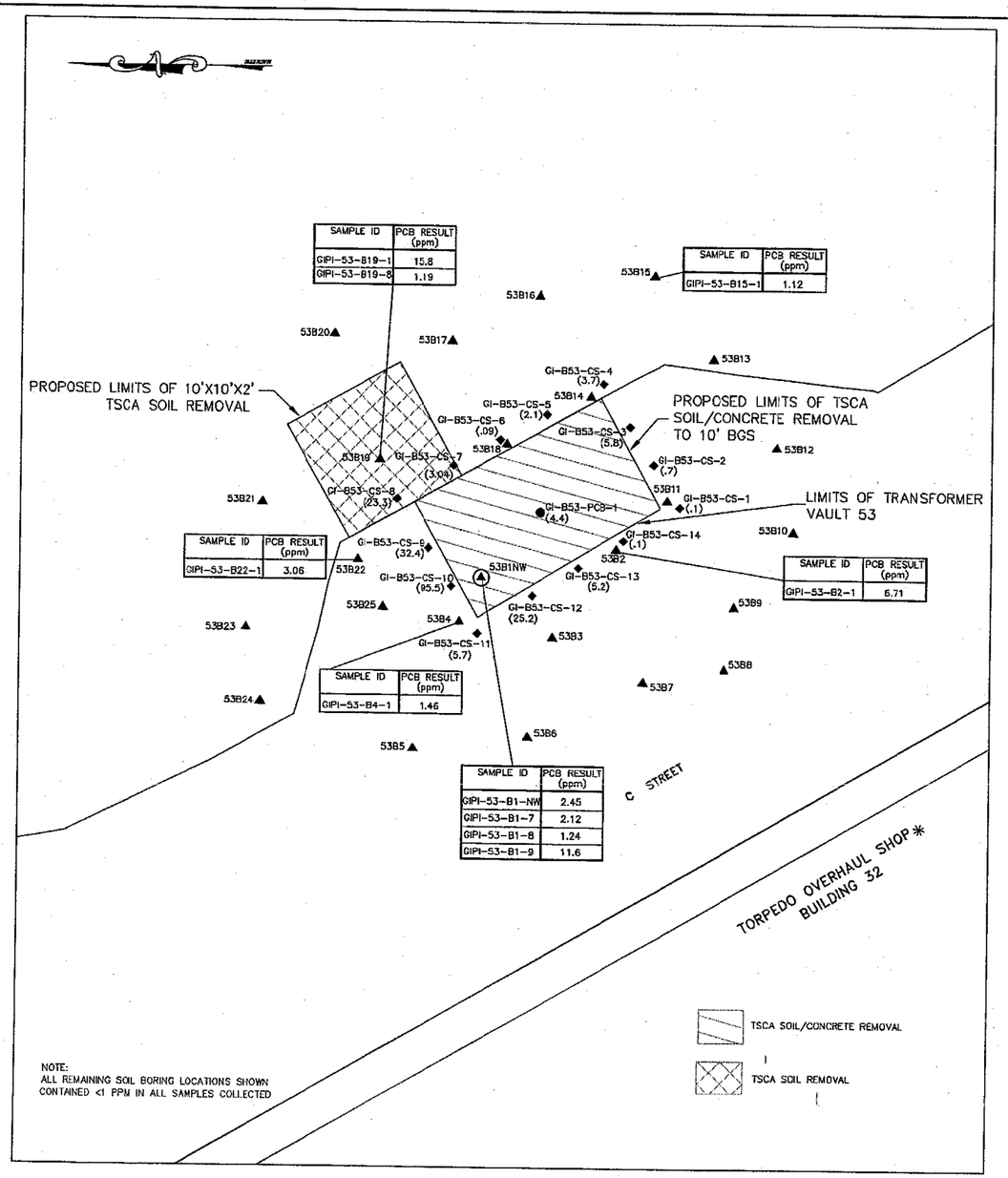
REV.	DESCRIPTION	PREP BY	DATE	APPRVD

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ENGINEERING FIELD ACTIVITY - NORTHEAST
LESTER PENNSYLVANIA

GOULD ISLAND, NEWPORT, RHODE ISLAND
TSCA SOIL BENEATH GRID F2

SEAL AREA

SAT TO
DATE 6/28/02
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO.
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET 6 OF 10
SIZE: D
DIS. SH. NO. FIGURE 6



SAMPLE ID	PCB RESULT (ppm)
GIPI-53-B19-1	15.8
GIPI-53-B19-8	1.19

SAMPLE ID	PCB RESULT (ppm)
GIPI-53-B15-1	1.12

SAMPLE ID	PCB RESULT (ppm)
GIPI-53-B22-1	3.06

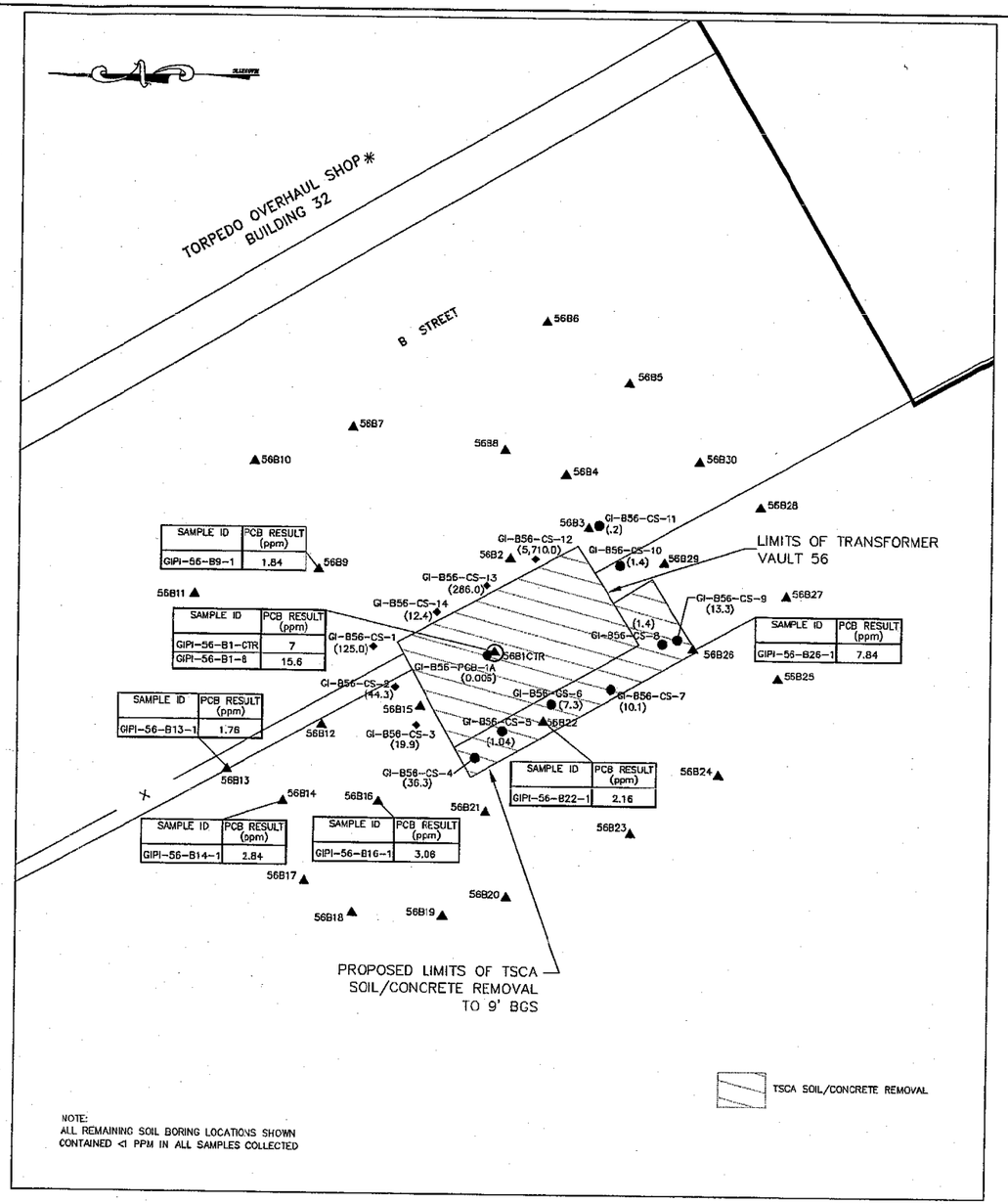
SAMPLE ID	PCB RESULT (ppm)
GIPI-53-B2-1	6.71

SAMPLE ID	PCB RESULT (ppm)
GIPI-53-B4-1	1.46

SAMPLE ID	PCB RESULT (ppm)
GIPI-53-B1-NW	2.45
GIPI-53-B1-7	2.12
GIPI-53-B1-8	1.24
GIPI-53-B1-9	11.6

TRANSFORMER VAULT 53 *

0 5 10
SCALE IN FEET



SAMPLE ID	PCB RESULT (ppm)
GIPI-56-B9-1	1.84

SAMPLE ID	PCB RESULT (ppm)
GIPI-56-B1-CTR	7
GIPI-56-B1-8	15.6

SAMPLE ID	PCB RESULT (ppm)
GIPI-56-B26-1	7.84

SAMPLE ID	PCB RESULT (ppm)
GIPI-56-B13-1	1.76

SAMPLE ID	PCB RESULT (ppm)
GIPI-56-B22-1	2.16

SAMPLE ID	PCB RESULT (ppm)
GIPI-56-B14-1	2.84

SAMPLE ID	PCB RESULT (ppm)
GIPI-56-B16-1	3.06

TRANSFORMER VAULT 56 *

0 5 10
SCALE IN FEET

LEGEND:

- ▲ SOIL BORING SAMPLE LOCATION
- ⊛ SOIL BORING SAMPLE LOCATION (ADDITIONAL ANALYSIS FOR TPH, VOCs AND SVOCs)
- * BUILDING HAS BEEN DEMOLISHED
- —X— FENCE
- BGS BELOW GROUND SURFACE
- GI-B53-PCB-1 (4.4) ● APPROXIMATE LOCATION OF PREVIOUS SOIL SAMPLE (0"-6") WITH SAMPLE ID AND ANALYTICAL RESULT IN PARENTHESES
- GI-B53-CS-1 (.1) ◆ APPROXIMATE LOCATION OF PREVIOUS CONCRETE SURFACE SAMPLE (0"-1") WITH SAMPLE ID AND ANALYTICAL RESULT IN PARENTHESES. CONCRETE HAS BEEN DISPOSED OF AS TSCA WASTE.

SOURCES:

1. COMPASS ENGINEERING GROUP, LLC, SUBCONTRACT NUMBER 039174, "TEST LOCATIONS AS OF FEBRUARY 14, 2002", GOULD ISLAND, NEWPORT, RHODE ISLAND; NAD 1988 RHODE ISLAND, NAVD 1988, DRAWN: NBC, DATE: 2/14/02.
2. COMPASS ENGINEERING GROUP, LLC, "PROGRESS PRINT TEST AS OF 01-08-2002", GOULD ISLAND MANAGEMENT AREA, RHODE ISLAND DEPT. OF ENVIRONMENTAL MANAGEMENT, ASSUMED HORIZONTAL AND VERTICAL DATUM, PROJ. NO.: 2937, DWG. NO.: 2937WKS.DWG.
3. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D6.DWG, GOULD ISLAND VAULT 54 PROFILE ELEVATIONS, FILE DATE: 3/12/2002.
4. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D7.DWG, GOULD ISLAND ADDITIONAL TEST AS OF 3-7-2002, FILE DATE: 3/12/2002.
5. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND BUILDING AND VAULTS, FILE DATE: 3/13/2002.

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN REVISIONS\GOULD_WP_VAULT_53_56_REV1.DWG

REV.	DESCRIPTION	PREP BY	DATE	APPRV'D
1	ADDITION OF SAMPLE RESULTS > 1 PPM PCBs			

FOSTER WHEELER ENVIRONMENTAL CORPORATION

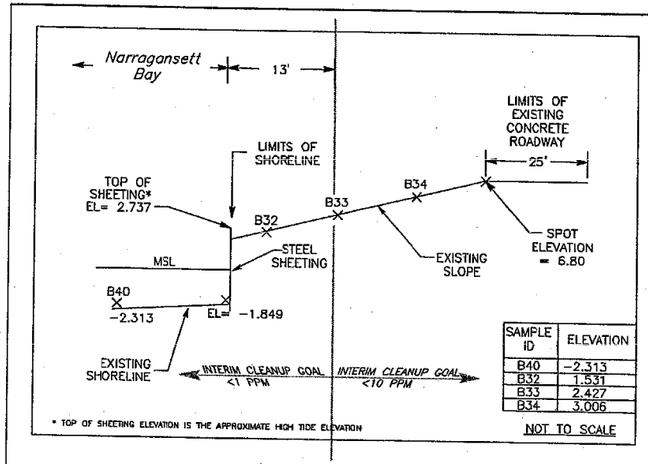
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ENGINEERING FIELD ACTIVITY - NORTHEAST
PENNSYLVANIA

GOULD ISLAND, NEWPORT, RHODE ISLAND

SOIL SAMPLE RESULTS - TRANSFORMER VAULT NOS. 53 AND 56

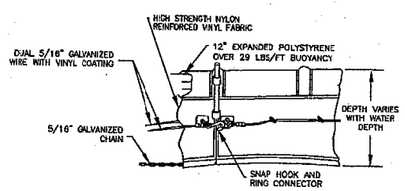
SEAL AREA

SAT TO	DATE 6/28/02
CODE I.D. NO.	80091
SCALE :	AS SHOWN
SPEC. NO.	
CONSTRN. CONTR. NO.	N62472-99-D-0032
NAVFAC DRAWING NO.	
SHEET	7 OF 10
SIZE: D	DIS. SH. NO. FIGURE 7



SAMPLE ID	ELEVATION
B40	-2.313
B32	1.531
B33	2.427
B34	3.006

NOT TO SCALE



TURBIDITY BARRIER
NOT TO SCALE

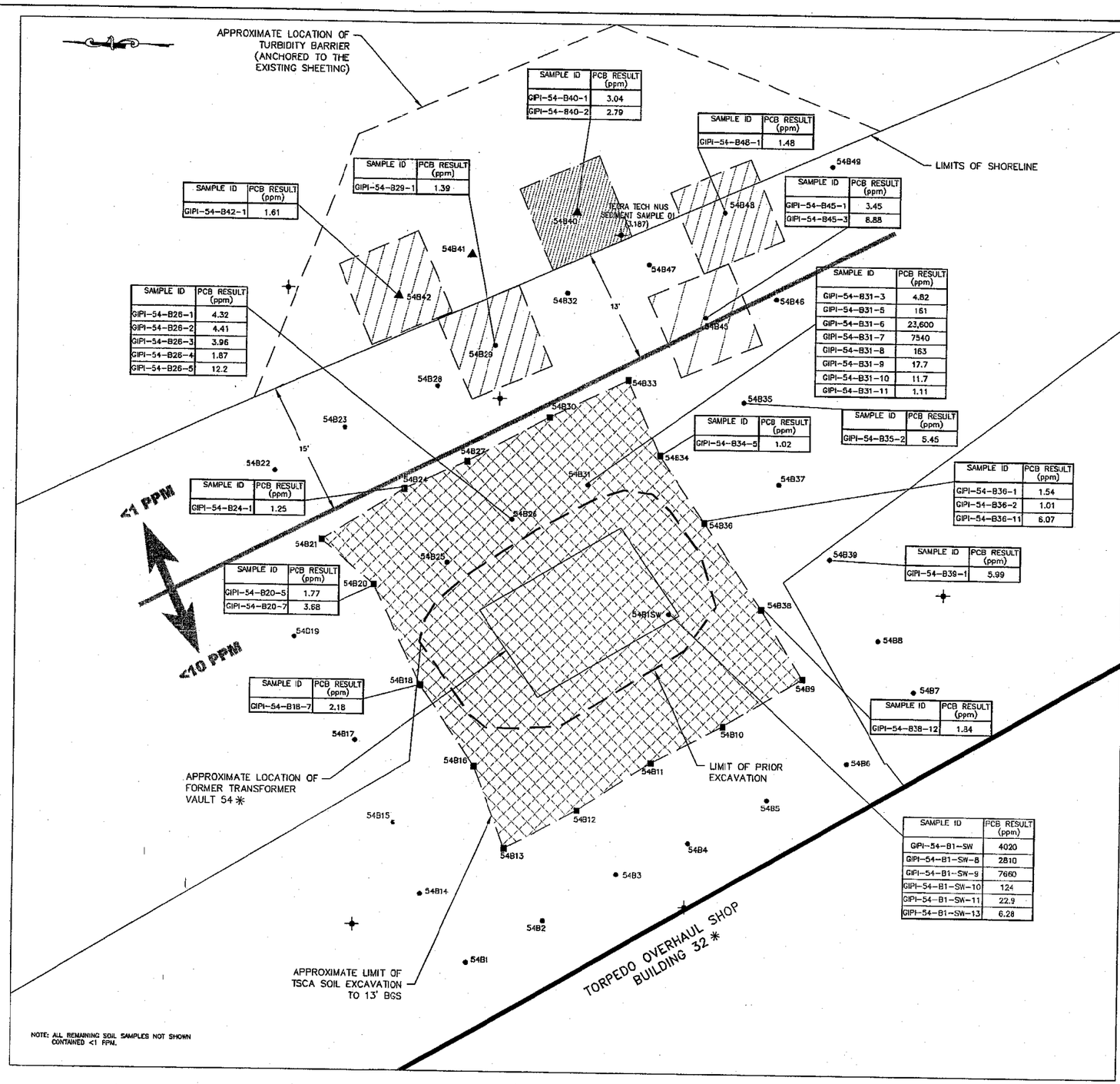
NOTES:
1. SHALL BE CONSTRUCTED OF HIGH VISBILITY MATERIAL.
2. BARRIER SHALL BE SIZED TO EXTEND TO THE WATER BODY BOTTOM.

LEGEND

- SOIL BORING LOCATION
- SEDIMENT SAMPLE LOCATION
- DELINEATION SOIL BORING – ALL SAMPLE RESULTS <10 PPM
- APPROXIMATE LOCATION OF PREVIOUS SAMPLE PERFORMED BY TETRA-TECH NUS
- TSCA SOIL EXCAVATION
- TSCA SOIL/SEDIMENT EXCAVATION TO 2' BGS
- TSCA SOIL/SEDIMENT EXCAVATION TO 3' BGS
- TSCA SOIL/SEDIMENT EXCAVATION TO 4' BGS
- BUILDING HAS BEEN DEMOLISHED
- PROPOSED LIMIT OF 10 PPM/1 PPM INTERIM CLEAN-UP GOAL
- BGS — BELOW GROUND SURFACE

SOURCES:
1. COMPASS ENGINEERING GROUP, LLC, SUBCONTRACT NUMBER 039174, "TEST LOCATIONS AS OF FEBRUARY 14, 2002", GOULD ISLAND, NEWPORT, RHODE ISLAND; NAD 1988 RHODE ISLAND, NAVD 1988. DRAWN: NBC. DATE: 2/14/02.
2. COMPASS ENGINEERING GROUP, LLC, "PROGRESS PRINT TEST AS OF 01-08-2002", GOULD ISLAND MANAGEMENT AREA, RHODE ISLAND DEPT. OF ENVIRONMENTAL MANAGEMENT, ASSUMED HORIZONTAL AND VERTICAL DATUM. PROJ. NO.: 2937. DWG. NO.: 2937WKS.DWG.
3. COMPASS ENGINEERING GROUP, LLC. CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND VAULT 54 PROFILE ELEVATIONS. FILE DATE: 3/12/2002.
4. COMPASS ENGINEERING GROUP, LLC. CAD DRAWING FILE: 2937D7.DWG, GOULD ISLAND ADDITIONAL TEST AS OF 3-7-2002. FILE DATE: 3/12/2002.
5. COMPASS ENGINEERING GROUP, LLC. CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND BUILDING AND VAULTS. FILE DATE: 3/13/2002.

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN_REVISIONS\GOULD_WP_VAULT_54_REV1.DWG



SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B40-1	3.04
GIPI-54-B40-2	2.79

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B48-1	1.48

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B29-1	1.39

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B45-1	3.45
GIPI-54-B45-3	8.88

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B42-1	1.61

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B26-1	4.32
GIPI-54-B26-2	4.41
GIPI-54-B26-3	3.96
GIPI-54-B26-4	1.87
GIPI-54-B26-5	12.2

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B31-3	4.82
GIPI-54-B31-5	161
GIPI-54-B31-6	23,600
GIPI-54-B31-7	7540
GIPI-54-B31-8	163
GIPI-54-B31-9	17.7
GIPI-54-B31-10	11.7
GIPI-54-B31-11	1.11

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B34-5	1.02

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B35-2	5.45

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B24-1	1.25

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B36-1	1.54
GIPI-54-B36-2	1.01
GIPI-54-B36-11	6.07

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B39-1	5.99

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B20-5	1.77
GIPI-54-B20-7	3.68

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B18-7	2.18

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B38-12	1.84

SAMPLE ID	PCB RESULT (ppm)
GIPI-54-B1-SW	4020
GIPI-54-B1-SW-8	2810
GIPI-54-B1-SW-9	7660
GIPI-54-B1-SW-10	124
GIPI-54-B1-SW-11	22.9
GIPI-54-B1-SW-13	6.28

NOTE: ALL REMAINING SOIL SAMPLES NOT SHOWN CONTAINED <1 PPM.

TRANSFORMER VAULT 54 *

0 6 12
SCALE IN FEET

REV.	DESCRIPTION	PREP BY	DATE	APPRV'D
1	ADDITION OF SAMPLE RESULTS > 1 PPM PCBs			

FOSTER WHEELER ENVIRONMENTAL CORPORATION

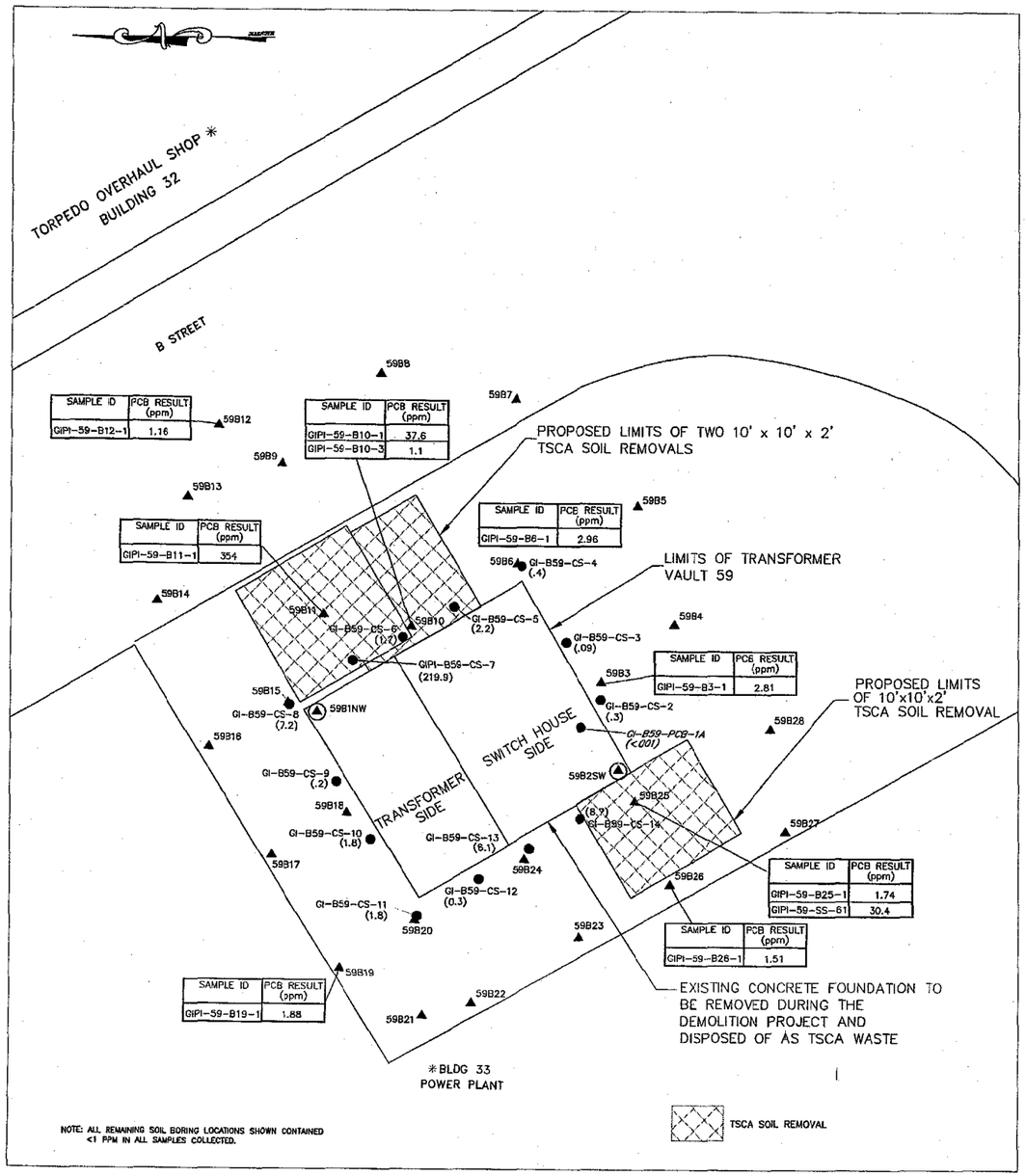
DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ENGINEERING FIELD ACTIVITY – NORTHEAST
LOCATION: PENNSYLVANIA

GOULD ISLAND, NEWPORT, RHODE ISLAND
SAMPLE RESULTS – TRANSFORMER VAULT NO. 54

SEAL AREA

APPROVED — DATE — ENGR FOR COMMANDER, NAVFAC

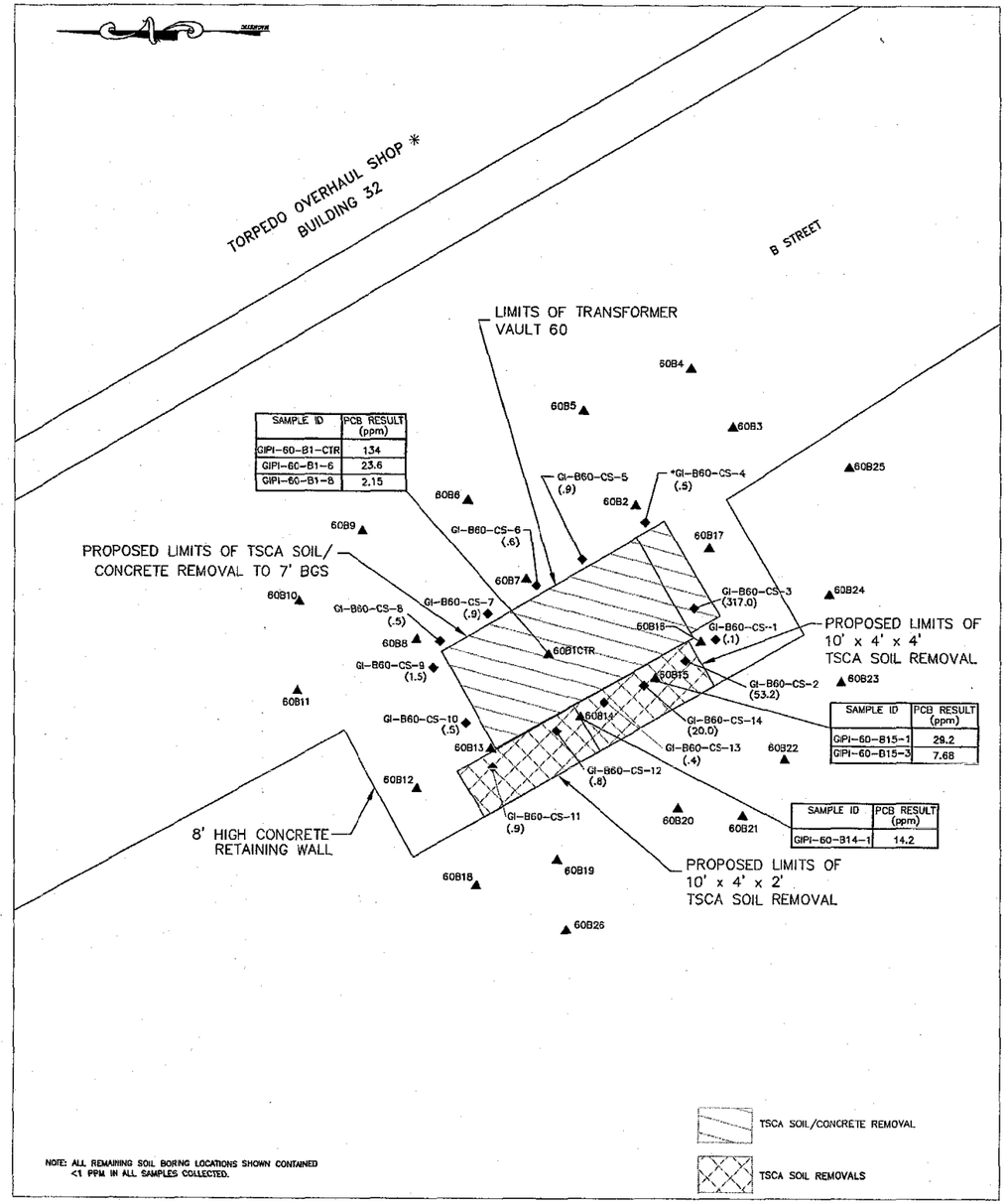
SAT TO — DATE 6/28/02
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO. 04--
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET 8 OF 10
SIZE: D
DWG. SIZ. NO. FIGURE 8



NOTE: ALL REMAINING SOIL BORING LOCATIONS SHOWN CONTAINED <1 PPM IN ALL SAMPLES COLLECTED.

SWITCH HOUSE 59*

0 5 10
SCALE IN FEET



NOTE: ALL REMAINING SOIL BORING LOCATIONS SHOWN CONTAINED <1 PPM IN ALL SAMPLES COLLECTED.

TRANSFORMER VAULT 60 *

0 5 10
SCALE IN FEET

LEGEND:

- ▲ SOIL BORING SAMPLE LOCATION
- Ⓐ SOIL BORING SAMPLE LOCATION (ADDITIONAL ANALYSIS FOR TPH, VOCs AND SVOCs)
- * BUILDING HAS BEEN DEMOLISHED
- ● APPROXIMATE LOCATION OF PREVIOUS SOIL SAMPLE (0"-6") WITH RESULT (10.1)
- ◆ PREVIOUS CONCRETE SURFACE SAMPLE (0"-1") WITH RESULT (317.0)

SOURCES:

1. COMPASS ENGINEERING GROUP, LLC, SUBCONTRACT NUMBER 039174, "TEST LOCATIONS AS OF FEBRUARY 14, 2002", GOULD ISLAND, NEWPORT, RHODE ISLAND; NAD 1988 RHODE ISLAND, NAVD 1988, DRAWN: NBC, DATE: 2/14/02.
2. COMPASS ENGINEERING GROUP, LLC, "PROGRESS PRINT TEST AS OF 01-08-2002", GOULD ISLAND MANAGEMENT AREA, RHODE ISLAND DEPT. OF ENVIRONMENTAL MANAGEMENT, ASSUMED HORIZONTAL AND VERTICAL DATUM, PROJ. NO.: 2937, DWG. NO.: 2937WKS.DWG.
3. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D6.DWG, GOULD ISLAND VAULT 54 PROFILE ELEVATIONS, FILE DATE: 3/12/2002.
4. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D7.DWG, GOULD ISLAND ADDITIONAL TEST AS OF 3-7-2002, FILE DATE: 3/12/2002.
5. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 2937D8.DWG, GOULD ISLAND BUILDING AND VAULTS, FILE DATE: 3/13/2002.

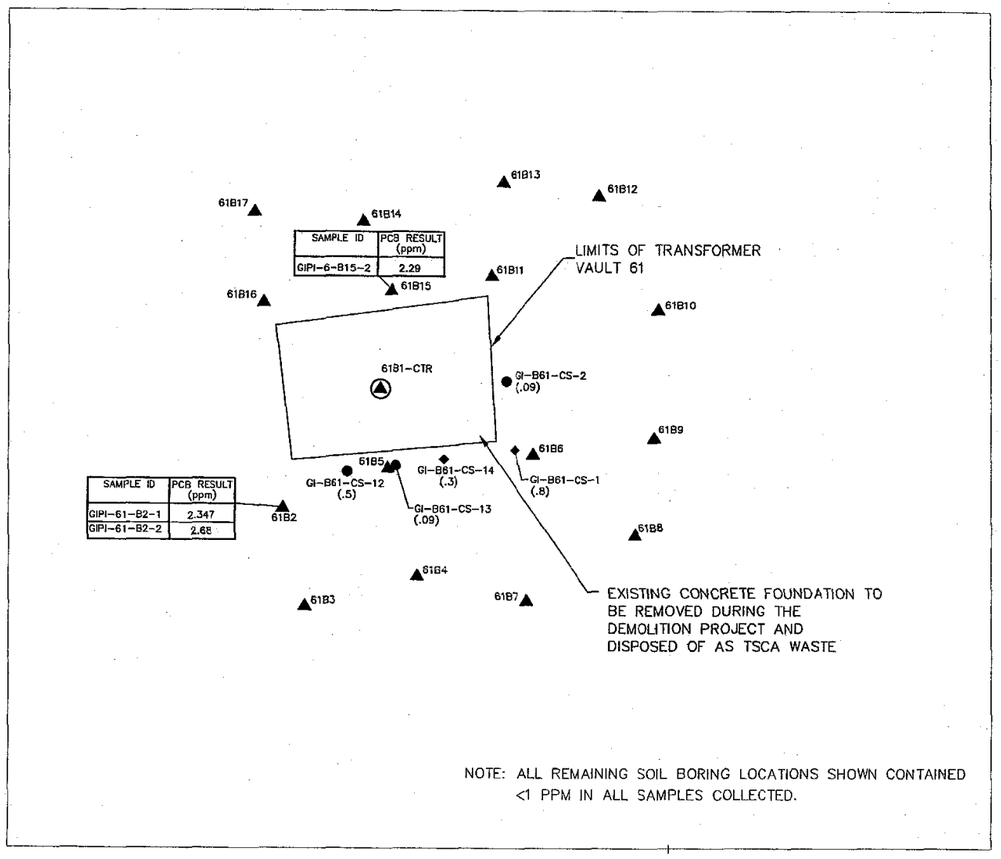
CAD FILE: NAVFAC\GOULD ISLAND\PHASE II WORK PLAN_REVISIONS\GOULD_WP_VAULT_59_60_REV1.DWG

REV.	DESCRIPTION	PREP BY	DATE	APPRVD
1	ADDITION OF SAMPLE RESULTS > 1 PPM PCBs			

FOSTER WHEELER ENVIRONMENTAL CORPORATION

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
PENNSYLVANIA
ENGINEERING FIELD ACTIVITY - NORTHEAST
LESTER
GOULD ISLAND, NEWPORT, RHODE ISLAND
SOIL SAMPLE RESULTS - TRANSFORMER VAULT NOS. 59 AND 60
SEAL AREA
APPROVED
DATE
ENAE FOR COMMANDER, NAVFAC

SAT TO	DATE 6/28/02
CODE I.D. NO.	80091
SCALE : AS SHOWN	
SPEC. NO.	
CONSTRN. CONTR. NO.	N62472-99-D-0032
NAVFAC DRAWING NO.	
SHEET 9 OF 10	
SIZE: D	DWG. SH. NO. FIGURE 9

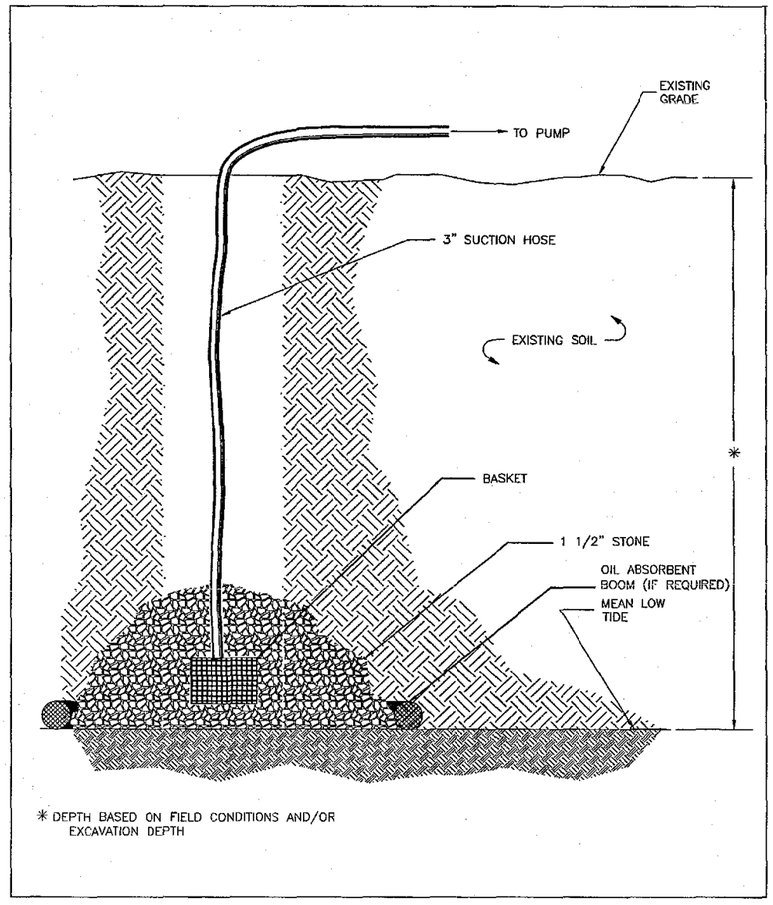


SAMPLE ID	PCB RESULT (ppm)
GIPI-6-B15-2	2.29

SAMPLE ID	PCB RESULT (ppm)
GIPI-61-B2-1	2.347
GIPI-61-B2-2	2.68

TRANSFORMER VAULT 61*

SCALE IN FEET



DEWATERING DETAIL

NOT TO SCALE

LEGEND:

- ▲ SOIL BORING SAMPLE LOCATION
- ⊙ SOIL BORING SAMPLE LOCATION (ADDITIONAL ANALYSIS FOR TPH, VOCs AND SVOCs)
- * BUILDING HAS BEEN DEMOLISHED
- ● APPROXIMATE LOCATION OF PREVIOUS SOIL SAMPLE (0"–6") WITH RESULT (10.1)
- ◆ PREVIOUS CONCRETE SURFACE SAMPLE (0"–1") WITH RESULT (317.0)

SOURCES:

1. COMPASS ENGINEERING GROUP, LLC, SUBCONTRACT NUMBER 039174, "TEST LOCATIONS AS OF FEBRUARY 14, 2002", GOULD ISLAND, NEWPORT, RHODE ISLAND; NAD 1988 RHODE ISLAND, NAVD 1988, DRAWN: NBG. DATE: 2/14/02.
2. COMPASS ENGINEERING GROUP, LLC, "PROGRESS PRINT TEST AS OF 01-08-2002", GOULD ISLAND MANAGEMENT AREA, RHODE ISLAND DEPT. OF ENVIRONMENTAL MANAGEMENT, ASSUMED HORIZONTAL AND VERTICAL DATUM, PROJ. NO.: 2937, DWG. NO.: 2937WKS.DWG.
3. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 293706.DWG, GOULD ISLAND VAULT 54 PROFILE ELEVATIONS, FILE DATE: 3/12/2002.
4. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 293707.DWG, GOULD ISLAND ADDITIONAL TEST AS OF 3-7-2002, FILE DATE: 3/12/2002.
5. COMPASS ENGINEERING GROUP, LLC, CAD DRAWING FILE: 293708.DWG, GOULD ISLAND BUILDING AND VAULTS, FILE DATE: 3/13/2002.

CAD FILE: NAVYRAC\GOULD ISLAND\PHASE II WORK PLAN_REVISIONS\GOULD_WP_VAULT_61_REV1.DWG

DATE CREATED
LATEST CHANGE

FOSTER WHEELER ENVIRONMENTAL CORPORATION

REV.	DESCRIPTION	PREP BY	DATE	APPR'VD
1	ADDITION OF SAMPLE RESULTS > 1 PPM PCBs			

NAVAL FACILITIES ENGINEERING COMMAND
DEPARTMENT OF THE NAVY
LESTER PENNSYLVANIA

ENGINEERING FIELD ACTIVITY - NORTHEAST

GOULD ISLAND, NEWPORT, RHODE ISLAND

TRANSFORMER VAULT NO. 61/DEWATERING DETAIL

ESTIMATE FOR COMMANDER, NAVFAC

SEAL AREA

SAT TO	DATE 6/28/02
CODE I.D. NO.	80091
SCALE :	AS SHOWN
SPEC. NO.	
CONSTRN. CONTR. NO.	N62472-99-D-0032
NAVFAC DRAWING NO.	
SHEET 10 OF 10	
SIZE: D	DWG. SH. NO. FIGURE 10

APPENDIX B

HEALTH AND SAFETY PLAN
FOR SITE INVESTIGATIONS, BUILDING 32
TtNUS, MAY 2000

HEALTH AND SAFETY PLAN
for
SITE INVESTIGATIONS

BUILDING 32

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CONTRACT NO. N62472-90-D-1298
CONTRACT TASK ORDER 0286

MAY 2000

TETRA TECH NUS, INC.

W5200226

HEALTH AND SAFETY PLAN
FOR
SITE INVESTIGATIONS

BUILDING 32

NAVAL STATION NEWPORT
NEWPORT, RHODE ISLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION - NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch, Code 1812
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop No. 82
Lester, Pennsylvania 19113-2090

Submitted by:
Tetra Tech NUS, Inc.
600 Clark Avenue, Suite 3
King of Prussia, Pennsylvania 19406-1433

CONTRACT NO. N62472-90-D-1298
CONTRACT TASK ORDER 0286

MAY 2000

PREPARED UNDER THE SUPERVISION OF:

STEVEN S. PARKER
PROJECT MANAGER
TETRA TECH NUS, INC.
WILMINGTON, MASSACHUSETTS

APPROVED FOR SUBMITTAL BY:

MATTHEW M. SOLTIS, CIH, CSP
CLEAN H & S MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

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ATTACHMENT III Tick Control and Lyme Disease
ATTACHMENT IV NETC Utility Clearance Form
ATTACHMENT V Equipment Inspection
ATTACHMENT VI TtNUS Respiratory Protection SOP Site Respiratory Protection Program

1.0 INTRODUCTION

This Health and Safety Plan (HASP) is designed to provide practices and procedures for Tetra Tech NUS Inc. (TtNUS) personnel and subcontract personnel engaged in the Remedial Investigation of the Electroplating Shop located on Gould Island, Newport, Rhode Island. This HASP must be used in conjunction with the TtNUS Health and Safety Guidance Manual. Both of these documents must be present at the site during the performance of all site activities. The TtNUS Guidance Manual provides detailed information pertaining to the HASP as well as applicable TtNUS Standard Operating Procedures (SOPs). This HASP and the contents of the Guidance Manual were developed to comply with the requirements stipulated in 29 CFR 1910.120 (OSHA's Hazardous Waste Operations and Emergency Response Standard), OSHA's Construction Industry Standards, 29 CFR 1926.

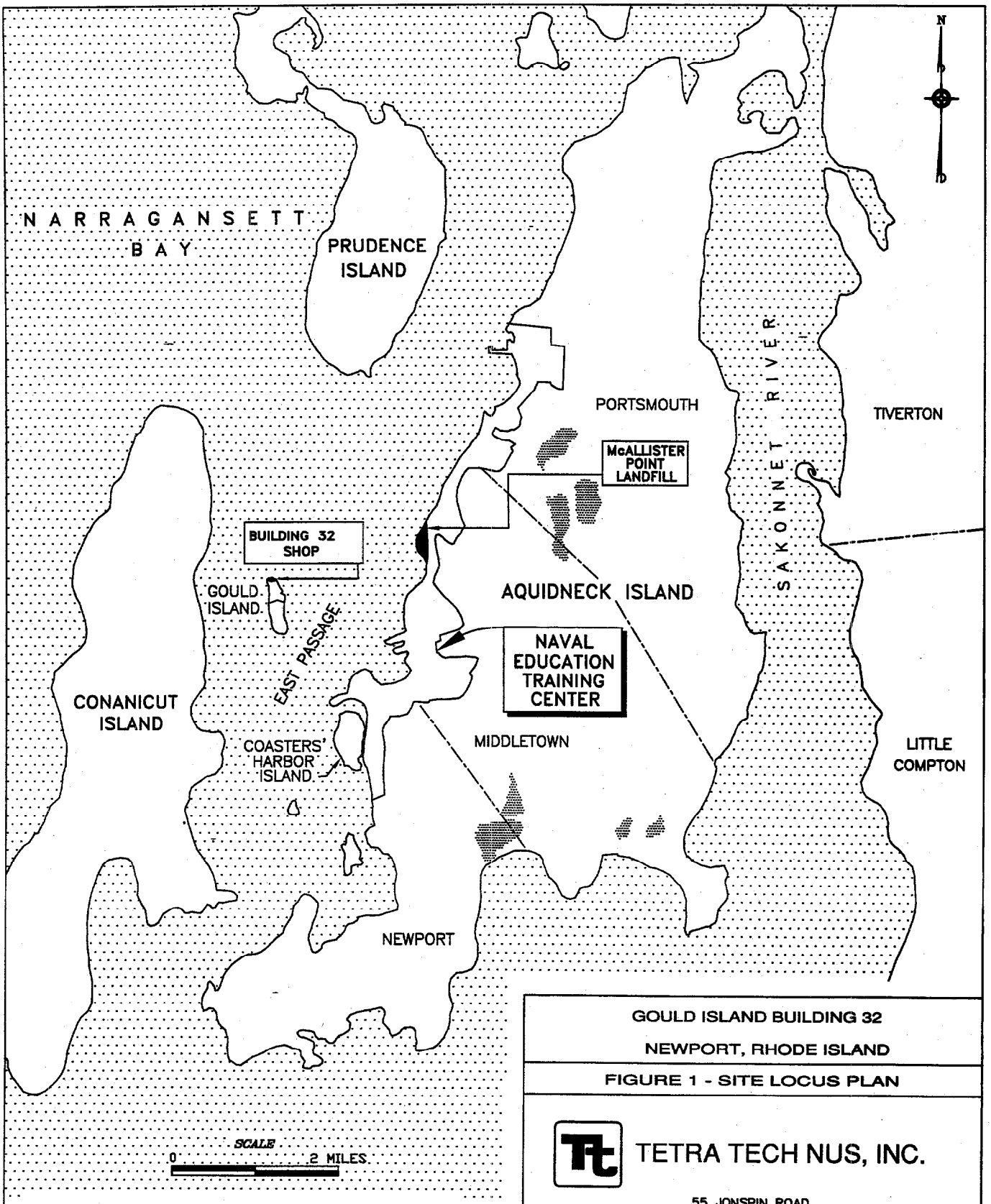
TtNUS will be operating on site concurrently with other Navy contractors performing construction and demolition tasks. This HASP will address Tetra Tech NUS, Inc. personnel and contractors performing assigned tasks, but the Foster Wheeler Environmental Corporation Site-Specific Health and Safety Plan will direct emergency response procedures and site control procedures.

This HASP supports the principal activities for conducting a Site Investigation at Building 32 located on Gould Island. Figure 1 depicts the location of Gould Island. Figure 1-2 depicts one feature of Building 32.

This HASP was developed using the most current information regarding known or suspected chemical contaminants and potential physical hazards associated with the proposed work and the history of the site. This HASP will be modified as necessary, if new information becomes available. All changes to the HASP will be made with the approval of the TtNUS Project Health and Safety Officer (PHSO) and the TtNUS Health and Safety Manager (HSM). Requests for modifications to the HASP will be directed to the PHSO, who will determine whether or not to make changes. The PHSO will notify the Project Manager (PM), who will then notify all affected personnel of the changes.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for TtNUS Team and subcontractor employees engaged in on-site activities. The specific project personnel (Project Manager, Field Operations Leader) assigned to these positions have primary responsibility for implementing on-site health and safety requirements and the HSM and the SSO will be the primary points of contact for any questions regarding the safety and health procedures and the selected control measures that are to be implemented for on-site activities:



GOULD ISLAND BUILDING 32

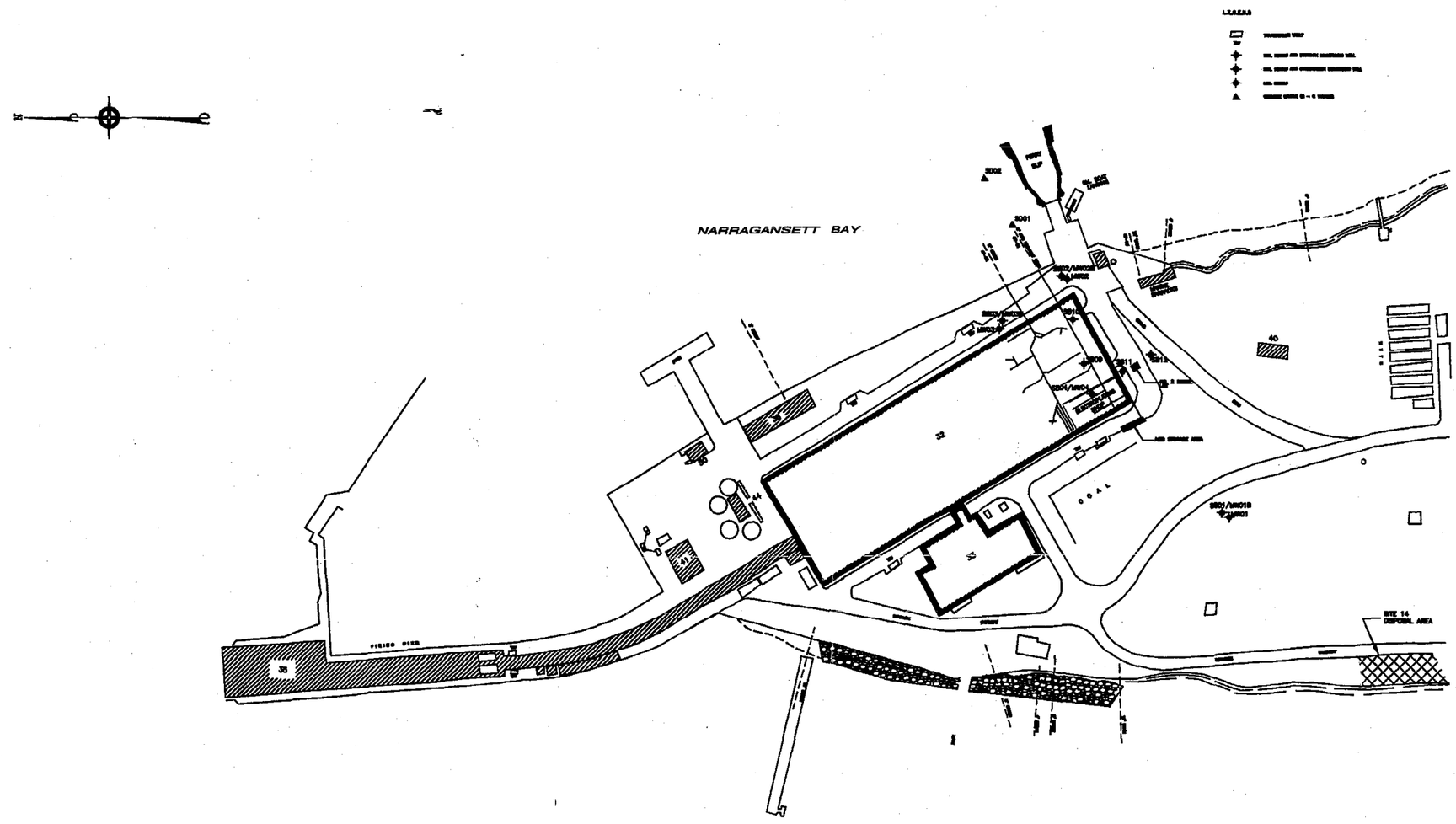
NEWPORT, RHODE ISLAND

FIGURE 1 - SITE LOCUS PLAN

TETRA TECH NUS, INC.

55 JONSPIN ROAD
WILMINGTON, MASSACHUSETTS 01887
(978)658-7899

ACAD NAME: D:\DWG\NAVY\GOULD\FIG_2-1AA.DWG



NOTES:
1. PLAN NOT TO BE USED FOR DESIGN.
2. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
3. PHYSICAL FEATURES SHOWN MAY NOT DEPICT CURRENT CONDITIONS

GRAPHIC SCALE
0' 200' 400'
1 INCH = 200 FEET

HEALTH AND SAFETY PLAN			
GOULD ISLAND BUILDING 32			
NEWPORT, RI			
DRAWN BY:	R.C. DEWSNAP	REV.:	0
CHECKED BY:	DAM	DATE:	29 MARCH 00
SCALE:	1" = 200'	FILE NO.:	D:\DWG\NAVY\GOULD\BASE_MAPAA

FIGURE 1-2

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658-7899

031 5 2 4 1 7

The TtNUS Project Manager (PM) is responsible for the overall direction and implementation of health and safety for this project.

- The TtNUS HSM is responsible for developing this HASP in accordance with applicable OSHA regulations. Specific responsibilities include:

  - providing information regarding site contaminants and physical hazards associated with the site
  - establishing air monitoring and decontamination procedures
  - assigning personal protective equipment
  - determining emergency response procedures and emergency contacts
  - stipulating training requirements and reviewing appropriate training and medical surveillance certificates
  - providing standard work practices to minimize potential injuries and exposures associated with hazardous work
  - modifying this HASP, as it becomes necessary

- The Tetra Tech NUS Inc. Field Operations Leader (FOL) is responsible for implementation of this HASP with the assistance of an appointed SSO. The FOL manages all field activities, executes elements of the work plan and field sampling plan and enforces safety procedures, as applicable to the site work.

- The SSO supports site activities by advising the FOL on all aspects of health and safety on-site. These duties may include:

  - coordinating all health and safety activities with the FOL
  - selecting, applying, inspecting and maintaining personal protective equipment
  - establishing work zones and control points
  - implementing air monitoring procedures for on-site activities
  - verifying training and medical status of on-site personnel
  - implementing hazard communication, respiratory protection and other associated safety and health programs
  - coordinating emergency services
  - providing site specific training to all on-site personnel
  - investigating all accidents and injuries (See Attachment I - Illness/Injury Reporting Procedure and Form)

- providing input to the HSM regarding the need to modify this HASP or applicable health and safety associated documents as per site-specific requirements

Compliance to the requirements established in this HASP is monitored by the SSO and coordinated through the TtNUS HSM.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: US Naval Station Building 32 **Client Contact:**

Address: Gould Island **Phone Number**

Jamestown, Rhode Island

Date of Scheduled Activities: February 2000 through October 2000

Scheduled Activities: The objective of the field work is to locate and characterize chemical contamination in soil and groundwater through limited sampling. This work involves the following tasks:

- Task 1: Electroplating Shop Survey, and Inspection
- Task 2: Concrete Slab Floor Sampling
- Task 3: Underground Drainage System Clearing and Tracking (Test Pit Excavation)
- Task 4: Sediment and Drainage Line Residue Sampling
- Task 5: Surficial Soil Sampling

Proposed Dates of Work: April 11, 2000 Through May 30, 2000

Project Team:

TtNUS TEAM Personnel:	**Discipline/Tasks Assigned:**
Stephen S. Parker	Project Manager (PM)
Dave Masse	Field Operations Leader (FOL)
TBD	Field Team Personnel
Matthew Soltis	Clean Health and Safety Manager (HSM)

Non-TtNUS Personnel:	
TBD	Surveying Subcontractor
TBD	IDW Subcontractor

Hazard Assessments (for purposes of 29 CFR 1910.132) and HASP preparation conducted by:

Clyde Snyder

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a preplanning effort to direct and guide field personnel in the event of an emergency. All site activities will be coordinated with local Emergency Services prior to commencement.

Because the remote location of the site, and because Foster Wheeler Environmental Corporation is currently operating on site and maintaining site control, Tetra Tech NUS, Inc. personnel will coordinate all emergency response activities through the Foster Wheeler on-site representative.

Tetra Tech NUS, Inc. is not to operate on the site without access coordinated with and emergency transportation provided by Foster-Wheeler Environmental Corporation or the Navy.

In the event of on-site emergencies, site personnel will be evacuated to a safe place of refuge and the appropriate emergency response agencies will be notified. Since a majority of foreseeable emergency situations will require assistance from outside emergency responders, TtNUS Team and subcontractor personnel will not provide emergency response support beyond the capabilities of on-site response. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. This Emergency Action Plan, therefore, conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), as designated in OSHA 29 CFR 1910.120(l)(1)(ii).

TtNUS Team will, through necessary services, provide the following response measures:

- Incipient stage fire fighting support and prevention
- Incipient spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Initial medical support for injuries or illnesses requiring only first-aid level support
- Site control and security measures, as necessary

2.2 PRE-EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, injuries or illnesses resulting from exposure to physical hazards (slip/trip/fall or from operating/working around equipment) are the most probable emergencies that could be encountered during site activities. It is less likely but possible that a chemical exposure from contaminated groundwater (and subsurface soils) may exist.

To minimize and eliminate these potential emergency situations, pre-emergency planning activities associated with this project include the following (which are the responsibility of the SSO and/or the FOL):

- Coordinating with the Naval Base and local Emergency Response personnel in order to ensure that TtNUS Team emergency action activities are compatible with existing emergency response procedures.

- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:

  - Chemical Inventory (used on-site), with Material Safety Data Sheets.
  - On-site personnel medical records (Medical Data Sheets).
  - A log book or sign in logsheet identifying personnel on site each day.
  - Hospital route maps with directions (these should also be placed in each vehicle).
  - Emergency Notification - phone numbers.

It will be the responsibility of the TtNUS Team FOL to ensure specific information is available and present at the site, including:

- Identifying a chain of command for emergency action.

- Educating site workers as to the hazards and control measures associated with planned activities at the site and providing early recognition and prevention where possible.

- Periodically performing practice drills to ensure site workers are familiar with incidental response measures.

- Providing the necessary equipment to safely accomplish identified tasks.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 <u>Recognition</u>

Foreseeable emergency situations that may be encountered during site activities will generally be recognizable by visual observation. Visual observation is primarily relevant for physical hazards that may be associated with the proposed scope of work. Visual observation will also play a role in detecting some chemical exposures. To adequately recognize exposures to site contaminants, site personnel must have

a clear knowledge of the signs and symptoms of exposure associated with the site contaminants. This information is provided in Table 6-1 of this HASP. Potential site hazards, the activities that they have been associated with, and the recommended control methods are discussed in detail in Section 5.0 and 6.0 of this HASP. Additionally, early recognition of emergency situations will be supported by daily site surveys to eliminate any situation considered predisposed to an emergency. The FOL and the SSO will be responsible for performing daily site surveys during the initiation of this effort and will be documented in the Health and Safety Logbook. The above actions provide early recognition for potential emergency situations. However, should an incident occur, TtNUS Team will take measures to control these situations. If the FOL and the SSO determine that an incident has progressed to a serious emergency situation, TtNUS Team will withdraw and notify the appropriate response agencies listed in Table 2-1.

2.3.2 Prevention

TtNUS Team and subcontractor personnel will minimize the potential for emergencies by following the Health and Safety Guidance Manual and complying with the HASP and applicable OSHA regulations. Daily site surveys of work areas, prior to the commencement of that day's activities, by the FOL and/or the SSO will also assist in prevention of illness/injuries when hazards are recognized early and control measures initiated.

2.4 EVACUATION ROUTES, PROCEDURES, AND PLACES OF REFUGE

An evacuation will be initiated whenever recommended hazard controls are insufficient to protect the health, safety or welfare of site workers. Specific examples of conditions that may initiate an evacuation include, but are not limited to the following: severe weather conditions; fire or explosion; monitoring instrumentation readings which indicate levels of contamination are greater than instituted action levels; and evidence of personnel overexposure to potential site contaminants.

In the event of an emergency requiring evacuation, all personnel will immediately stop activities and report to the designated safe place of refuge unless doing so would pose additional risks. When evacuation to the primary place of refuge is not possible, personnel will proceed to a designated alternate location and remain until further notification from the TtNUS FOL. Safe places of refuge will be identified prior to the commencement of site activities by the SSO and will be conveyed to personnel as part of the pre-activities training session. This information will be reiterated during daily safety meetings. Whenever possible, the safe place of refuge will also serve as the telephone communications point for that area. During an evacuation, personnel will remain at the refuge location until directed otherwise by the TtNUS FOL or the on-site Incident Commander of the Emergency Response Team. The FOL or the SSO will

perform a head count at this location to account for and to confirm the location of all site personnel. Emergency response personnel will be immediately notified of any unaccounted personnel. The SSO will document the names of all personnel onsite (on a daily basis) in the site Health and Safety Logbook. This information will be utilized to perform the head count in the event of an emergency.

Evacuation procedures will be discussed during the pre-activities training session, prior to the initiation of project tasks. Evacuation routes from the site and safe places of refuge are dependent upon the location at which work is being performed and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) may dictate evacuation routes. As a result, assembly points will be selected and communicated to the workers relative to the site location where work is being performed. Evacuation should always take place in an upwind direction from the site.

2.5 DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT

During an evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. Decontamination will not be performed if the incident warrants immediate evacuation. However, it is unlikely that an evacuation would occur which would require workers to evacuate the site without first performing decontamination procedures.

TtNUS personnel will perform removal of personnel from emergency situations and may provide initial medical support for injury/illnesses requiring only first-aid level support. Medical attention above that level will require assistance and support from the designated emergency response agencies. Attachment I provides the procedure to follow when reporting an injury/illness, and the form to be used for this purpose. **If the emergency involves personnel exposures to chemicals, follow the steps provided in Figure 2-1.**

2.6 EMERGENCY CONTACTS

Prior to initiating field activities, all personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an accident. Table 2-1 provides a list of emergency contacts and their associated telephone numbers. This table must be posted where it is readily available to all site personnel. Facility maps should also be posted showing potential evacuation routes and designated meeting areas.

2.7 EMERGENCY ROUTE TO HOSPITAL

Newport Hospital

Friendship Street

(401) 846-6400

Directions:

From the Dock and landing at Pier 1 turn right (North) on DEFENSE HIGHWAY to WEST MAIN ROAD (Route 114)

Turn Right (South) onto WEST MAIN ROAD. Stay on this road through the junction with ROUTE 138 until WEST MAIN ROAD becomes BROADWAY.

The Hospital is 0.8 miles on the left at the intersection of BROADWAY and FRIENDSHIP STREET.

Driving Time from Landing: Approximately 7 minutes.

Boat time from site to landing is approximately 18 minutes.

Refer to hospital route map on Figure 2-2.

FIGURE 2-1
EMERGENCY RESPONSE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of injury situations. In the event of a personnel injury or accident:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the injured person is a Tetra Tech NUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing which may be appropriate. WorkCare physicians will monitor the care of the victim. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call WorkCare at 1-800-455-6155 and enter Extension 109 or follow the voice prompt for after hours and weekend notification and being prepared to provide:
  - Any known information about the nature of the injury.
  - As much of the exposure history as was feasible to determine in the time allowed.
  - Name and phone number of the medical facility to which the victim(s) has/have been taken.
  - Name(s) of the involved Tetra Tech NUS, Inc. employee(s).
  - Name and phone number of an informed site officer who will be responsible for further investigations.
  - Fax appropriate information to WorkCare at (714) 456-2154.
- Contact Corporate Health and Safety Department (Matt Soltis) at 1-800-245-2730.

As data is gathered and the scenario becomes more clearly defined, this information should be forwarded to WorkCare.

WorkCare will compile the results of all data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. A personalized letter describing the individual findings/results will accompany this generalized summary. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

FIGURE 2-1 (continued)
WORKCARE
POTENTIAL EXPOSURE REPORT

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

Client Contact: _____ Phone No.: _____

Company Name: _____

I. Exposing Agent

Name of Product or Chemicals (if known): _____

_____

Characteristics (if the name is not known)
Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing? _____
How long did individual work in area before signs/symptoms developed? _____
Was protective gear being used? If yes, what was the PPE? _____
Was their skin contact? _____
Was the exposing agent inhaled? _____
Were other persons exposed? If yes, did they experience symptoms? _____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Dizziness
Chest Tightness / Pressure
Nausea / Vomiting
Weakness

Delayed Symptoms:

Weakness
Nausea / Vomiting
Shortness of Breath
Cough
Loss of Appetite
Abdominal Pain
Headache
Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Cyanosis
Nausea / Vomiting
Dizziness
Weakness
Loss of Appetite
Abdominal Pain
Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)
Improved: _____ Worsened: _____ Remained Unchanged: _____

V. Treatment of Symptoms (check off appropriate response)

None: _____ Self-Medicated: _____ Physician Treated: _____

TABLE 2-1
EMERGENCY REFERENCE TABLE
BUILDING 32
U.S. NAVAL STATION - NEWPORT
NEWPORT, RHODE ISLAND

CONTACT	PHONE NUMBER
EMERGENCY (Fire & Rescue) OR Police Emergency Number Police Non-Emergency Number	911 OR (401) 846-7888 (Fire Dept.) (401) 846-1144
Newport Hospital Friendship Street Newport, Rhode Island	(401) 846-6400
Chemtrec National Response Center	(800) 424-9300 (800) 424-8802
Naval Station Newport Facility Contact: Shannon Behr	(401) 841-6377
Project Manager: Stephen Parker	(978) 658-7899
Clean Health and Safety Manager: Matt Soltis	(412) 921-7090
Project Health and Safety Officer: Janet Pillion	(978) 658-7899

2.8 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

TtNUS personnel will be working on multiple sites and may not be in close proximity to each other at MCCDC. As a result, two-way radio communications will be required. Radios must be intrinsically safe and be carried by all field crews. In a case of site emergencies the FOL or SSO will communicate emergency instructions to field teams. In areas where personnel will be working in close proximity to each other hand signals, voice commands, and line of site communication will be sufficient to alert site personnel of an emergency. When project tasks are performed simultaneously on different sites and radio communications are inadequate, vehicle horns will be used to communicate emergency situations. If an emergency warranting evacuation occurs, the following procedures are to be initiated:

- Initiate the evacuation via radio, hand signals, voice commands, line of site communication, or vehicle horns. The following signals shall be utilized when communication via vehicle horn is necessary:

HELP	three short blasts	(. . .)
EVACUATION	three long blasts	(- - -)

- Report to the designated refuge point.

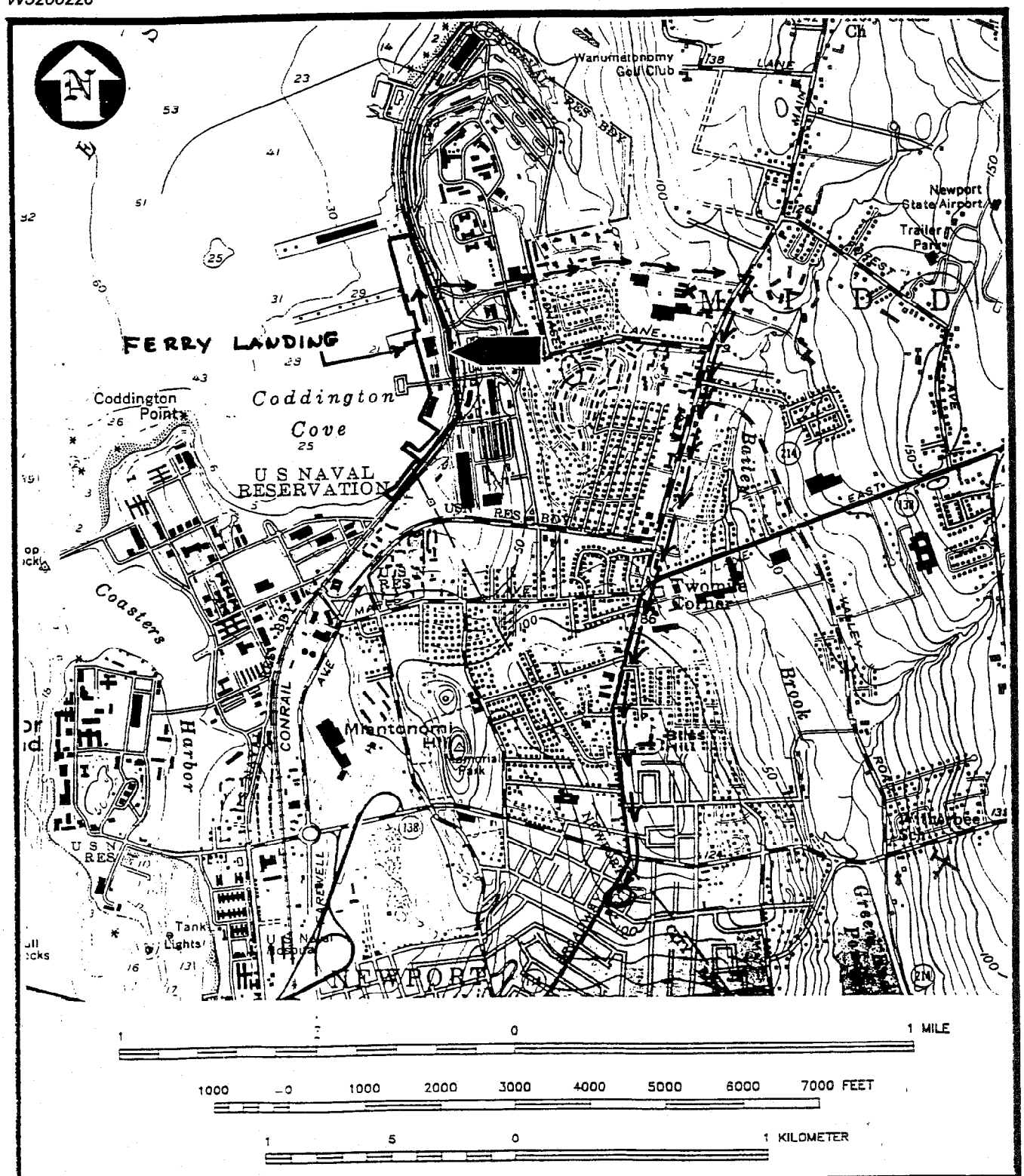
- Once all non-essential personnel are evacuated, appropriate response procedures will be enacted to control the situation.
- Describe to the FOL (FOL will serve as the Incident Coordinator) pertinent incident details.

In the event that site personnel cannot mitigate the hazardous situation, the FOL and SSO will enact emergency notification procedures to secure additional assistance in the following manner:

- Dial 911 (emergency services) and call other pertinent emergency contacts listed in Table 2-1 and report the incident. Give the emergency operator the location of the emergency, the type of emergency, the number of injured, and a brief description of the incident. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

2.9 PPE AND EMERGENCY EQUIPMENT

A first-aid kit, eye wash units (or bottles of disposable eyewash solution) and/or fire extinguishers (strategically placed) will be maintained onsite and shall be immediately available for use in the event of an emergency. When available, this equipment will be located in the field office as well as in each site vehicle. At least one first aid kit supplied with equipment to protect against bloodborne pathogens will also be available on site. Personnel identified within the field crew with bloodborne pathogen and first-aid training will be the only personnel permitted to offer first-aid assistance.



HOSPITAL ROUTE MAP
ROUTE FROM FERRY LANDING
GOULD ISLAND BUILDING 32

TETRA TECH NUS, INC.

FIGURE 2-2

3.0 SITE BACKGROUND

Gould Island is located in the East Passage of Narragansett Bay in Rhode Island, approximately 1.5 miles from the Naval Station Newport (NSN) shoreline. Gould Island is located between Aquidneck and Conanicut Islands, and occupies approximately 52 acres (Figure 3-1). The Gould Island Electroplating Shop consists of three small rooms located in Building 32 on the northeast end of Gould Island (Figure 3-2).

Gould Island was purchased by the Navy in the early 1940s to construct a weapons support center for naval vessels. Photos taken during construction show the island was redeveloped with housing, a water tower, and a seaplane base at the south end of the island; and the power plant, an overhaul shop, a covered tramway, and a torpedo test firing pier at the north end. In addition, fueling docks, two large coal piles, ammunition bunkers, and a number of other unidentifiable structures were present.

A large portion of the island that contains known potential release sites has been transferred from the Navy to the State of Rhode Island. However, a complete inventory of these sites has not been performed. NSN retains ownership of the northern end of the island, and is conducting investigations at known former UST locations and at the Electroplating Shop.

Building 32, where the electroplating rooms are housed, is planned for demolition, although no date has been set. The building and the adjacent coal-fueled power plant (Building 33) are in disrepair, and the other structures on this portion of the island have given way to opportunistic vegetation and animals. This portion of the island is off limits to the public although trespass by recreational boaters is possible. Buildings 32 and 33 have been surrounded recently with a nine-foot chain-link and barbed-wire fence, which is secured at all times.

The Gould Island Electroplating Shop occupies a room with approximate dimensions of 95 feet by 45 feet (4,275 square feet) in the southwestern portion of Building 32, which is known as the Torpedo Overhaul Shop. The location of the electroplating shop within Building 32 is shown on Figure 3-2. Two doorways on the east wall of the plating shop provide access from the main portion of the building. The plating shop room consists of numerous square metal open top vats ("baths"), two concrete open top round tanks ("pits"), several wooden benches, a small sandblasting room, a motor generator room, a small "acid dipping room" with additional baths, a small office, and floor trenches and drains.

The electroplating shop floor is constructed of concrete, with a series of open top floor trenches and connecting floor drains. Floor trenches are between 0.5 and 3 feet in depth and are located along the

eastern and western walls of the room and in the center portion of the shop. The open top trenches are partially covered with metal grates.

Significant observations from a site walkover in March 1997 included the following:

- Numerous metal vats were present in the plating room.
- A series of three trench drains were present running along the floor of the room. These trench drains were partially covered with metal grates.
- Several floor drains were present in the concrete floor of the plating shop.
- Overhead signs were observed above several tanks. Individual signs read "Chromic Acid", "Muriatic Acid", "Sulfuric and Nitric Acid", and "Caustic Soda".

NOTE: Building 32 is brick and steel construction with overhead piping that is covered with insulation containing asbestos. Due to the condition of the building some of the insulation is in poor condition and is falling off onto the floor below.

4.0 SCOPE OF WORK

This section discusses the activities that are to be performed at the site. Table 5-1 of this HASP provides information related to the tasks that are to be performed as part of the scope of work. The planned activities are presented in detail in the Sampling and Analysis Plan developed for this project. If new tasks are to be performed at the site, Table 5-1 will be modified accordingly. If tasks other than those described below are performed at the site, this section will be modified accordingly.

4.1 TASK 1 - SURVEY OF BUILDING 32

Under Task 1, the interior components of Building 32 will be land-surveyed to create a floor plan of the existing condition. This task will not require any intrusive work, but will require entry into Building 32.

4.2 TASK 2 - CONCRETE AND SUB SLAB SOIL SAMPLING

Under Task 2, concrete samples will be acquired by drilling into the floor of the building at specific locations. The concrete dust and chips will be collected into sample containers. A hand-held rotary drill hammer will be used for this purpose. If flooring is found to be less than 6 inches thick, cores may be advanced into the ground to collect soil samples.

4.3 TASK 3 - UNDERGROUND DRAINAGE SYSTEM SAMPLING

Under Task 3, floor drains and cleanouts to drain systems will be sampled. Floor drain systems will be accessed by opening clean-outs or removing drain covers. If necessary, outfall pipes on the east side of Building 32 will also be accessed to remove debris or reside for sampling.

4.4 TASK 6 - SOIL GAS SAMPLING

Under Task 6, a passive soil gas survey will be performed around and under Building 32. To sample under the floor of Building 32, a series of holes 3/4 inches in diameter will be drilled through the slab and 18 inches below the bottom of the slab. The modules will be installed into these holes and left for a period of 14 to 21 days.

4.5 TASK 7 - SURFACE SOIL SAMPLING

Under this task, soil samples will be collected from the surface soils outside the building. These samples will be collected using hand augers or shovels as appropriate for the location.

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

Table 5-1 of this section serves as the primary portion of the site specific HASP and discusses the contaminants and physical hazards that are associated with each of the proposed tasks that are to be performed at the site. A new Table 5-1 must be developed and incorporated into this document should additional tasks occur at the site. Table 5-1 details the anticipated hazards, recommended control measures, air monitoring recommendations, required Personal Protective Equipment (PPE), and decontamination measures for each site task. This table and the associated control measures will be changed if the scope of work, contaminants of concern, or other conditions change.

By using the table, site personnel can determine the hazards associated with each task, the hazards present at each site, and the associated control measures necessary to minimize potential exposure or injuries related to those hazards. The table also assists field team members in determining which PPE and decontamination procedures to use, based on proper air monitoring techniques and site-specific conditions.

As discussed earlier, this table and HASP are accompanied by a Health and Safety Guidance Manual. This manual is designed to further explain supporting elements for any site specific operations as required by 29 CFR 1910.120. This Guidance Manual will be available at the site and should be referenced, as necessary, for additional information regarding air monitoring instrumentation, decontamination activities, emergency response, hazard assessments, hazard communication and hearing conservation programs, medical surveillance, PPE, respiratory protection, site control measures, standard work practices, and training requirements. Many of TtNUS's SOPs are also provided in this Guidance Manual.

Safe Work Permits issued for all exclusion zone activities (See Section 10.10) will use elements defined in Table 5-1 as it's primary reference. The FOL or the SSO completing the Safe Work Permit will add additional site-specific information. In situations where the Safe Work Permit is more conservative than the direction provided in Table 5-1 due to the incorporation of site-specific elements, the Safe Work Permit will be followed.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
BUILDING 32 INVESTIGATIONS
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Mobilization/ Demobilization and Location Survey	***Chemical hazards:*** Chemicals brought on site in support of field activities are to be identified, logged, accompanied by an appropriate MSDS, properly stored, and evaluated for purposes of hazard communication. Survey work will require entry into Building 32 prior to asbestos removal activities. Friable asbestos pipe lagging is present in Building 32 in poor condition and asbestos fibers may become airborne if disturbed by direct physical contact, vibration or airflow. ***Physical hazards:*** Potential physical hazards associated with this task may include: 1) Strain/muscle pulls from heavy lifting 2) Pinch/compression points 3) Uneven or unstable terrain (slip, trip, and fall hazards) 4) Contact/entanglement with rotating equipment or machinery 5) Natural hazards (insect/animal bites and stings, poisonous plants) 6) Other physical hazards associated with ongoing operations (foot and vehicular traffic)	***Chemical Hazards:*** To eliminate potential chemical hazards associated with this task ensure the following: - A chemical inventory list is generated and MSDSs are available for all chemicals brought on-site (Complete Section 5.0 of the Health and Safety Guidance Manual). - Materials are stored in accordance with recommended practices and according to compatibility (See MSDS for storage and compatibility recommendations). An exclusion zone shall be established to consist of all of Building 32. All work performed inside building 32 prior to removal of asbestos-containing building material (ACBM) will require level C PPE with full-face air purifying respirators equipped with HEPA cartridges and disposable whole body coveralls (Tyvek) to reduce the potential for exposure to asbestos fibers that may become airborne during work within the building. ACBM must not be disturbed. Workers should avoid working in and around fallen ACBM debris or disturbing ACBM in the work areas. Additional precautions may include wetting the damaged, fallen material and covering with polyethylene sheeting to minimize disturbance and airborne release of asbestos fibers. This must be performed by a properly trained and qualified asbestos abatement contractor or other equivalently qualified person (in-house personnel). All site work will stop if ACBM is disturbed/damaged during the site operations. Consult with the HSM for further instructions. ***Physical hazards:*** 1) Use machinery or multiple personnel for heavy lifts. - Use proper lifting techniques. 2) Use pinch bars or other equipment to keep hands from the point of operation. 3) Preview and prepare work locations where unstable/uneven terrain exists. 4) All equipment to be used will be - Inspected in accordance with OSHA, and manufacturers design. The inspection will include the review of the Equipment Inspection Checklist provided as Attachment V. - Operated by knowledgeable operators, and knowledgeable ground crew, as applicable. - Establish safe zones of approach (i.e. Boom + 3 feet). - Secure all loose articles to avoid possible entanglement. 5) Avoid insect/animal areas, use commercially available insect repellants. Report potential hazards to the SSO. Frequently inspect clothing and persons during and after activities in wooded areas for ticks and other vectors.(See Tick Control SOP provided in Attachment III) 6) Identify all access/egress routes and locations within established areas of operation. - All equipment capable of self propelled movement will be equipped with movement alarms as applicable.	Air monitoring for VOCs will not be performed during this task given the low probability of airborne concentrations of site contaminants being present. Real time air monitoring for asbestos is not feasible, and concentrations of airborne asbestos are anticipated to be lower than 0.01 fibers per cc of air. Use of APRs for work in Building 32 is precautionary only. Generation of dusts should be minimized to the greatest extent possible due to insulation containing asbestos. If asbestos insulation is encountered or suspected, area wetting and /wetting methods are not feasible , termination of site activities will be used to minimize exposure to any airborne dusts	Mobilization/demobilization activities is intended to initiate in Level D protection. Work performed inside Building 32 shall be performed in Level C which will include a Full-face air purifying respirator equipped with HEPA filter cartridges and disposable whole body coveralls (Tyvek). (See TtNUS Respiratory Protection Program and the Site Respiratory Protection Program in Attachment VI) Level D - (Minimum Requirements) - Standard field attire (Work shirt; long pants; or coveralls) - Safety shoes (Boots with steel toe/shank) - Safety glasses - Hardhat (when overhead hazards exists, or identified as an operation requirement) - Hearing protection for high noise areas, or as directed on an operation by operation scenario. As a general rule of thumb, if you need to raise your voice to be heard while engaged in conversation with someone who is within 2 feet of your position, you may be exposed to excessive noise levels. If this occurs, use hearing protection until the SSO can quantify the potential hazard through sound level measurements or noise dosimetry. **Note:** Additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task. Level C - (Minimum Requirements) - Standard field attire (Work shirt; long pants; or coveralls) - Safety shoes (Boots with steel toe/shank) - Rubber overboots - Latex or Nitrile Gloves - Tyvek Coveralls - Half Face Air Purifying Respirator fitted with magenta cartridges (HEPA Cartridge for dusts, mists and fumes) - Safety glasses - Hardhat (when overhead hazards exists, or identified as an operation requirement)	As potential site contaminants are not anticipated as part of this task, personal decontamination is not required. All equipment arriving/leaving the site will be inspected prior to permitting this equipment to enter or exit the site. The SSO will inspect the equipment and give the clearance to allow the equipment to pass. Failure to pass inspection will prohibit entering or exiting the site as applicable. All equipment which fails the inspection will have to be decontaminated again to a level acceptable to the SSO prior to passage on or off site. While leaving Building 32, the following decontamination procedures shall be required: 1. Wash, remove gloves 2. Wash, remove overboots 3. Remove coverall and dispose in appropriately labeled container. 4. Wash hands. 5. Remove APR. Discard filter cartridges or seal for future use.

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TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
BUILDING 32 INVESTIGATIONS
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND
PAGE 2 0F 2

Tasks/ Operation Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Concrete, Soil, Surface Soil and Soil Gas Sampling	***Chemical hazards*** 1)..The potential health hazards include various contaminants in subsurface soils and groundwater. Soils and groundwater may contain VOCs, SVOCs, metals and TPH. -Sampling will be performed inside Building 32 prior to asbestos removal activities. Friable asbestos pipe lagging is present in Building 32 in poor condition. 2) Transfer of contamination into clean areas or onto persons ***Physical hazards*** 3) Contact/entanglement with rotating/vibrating equipment or machinery 4) Damage to eyes during drilling and sampling concrete 5) Noise in excess of 85 dBA 6) Contact with underground or overhead utilities (electric lines, gas lines, water lines, etc.) 7) Strain/muscle pulls from heavy lifting 8) Uneven or unstable terrain (slip, trip, and fall hazards) 9) Pinch/compression points 10) Other physical hazards associated with ongoing operations (foot and vehicular traffic) 11) Natural hazards (insect/animal bites or stings, poisonous plants, etc.) 12) Ambient temperature extremes	***Chemical hazards*** 1) Use real-time monitoring instrumentation, action levels, personal sampling, and identified PPE to control exposures to potentially contaminated media (e.g., water and soils) during intrusive work. Generation of dusts should be minimized to the greatest extent possible due insulation containing asbestos. If asbestos insulation is encountered or suspected, area wetting and or covering the material with plastic will be used. If area wetting methods are not feasible , termination of site activities will be used to minimize exposure to any airborne dusts -All work performed inside building 32 prior to removal of asbestos containing building material will require level C PPE with full-face air purifying respirators fitted with magenta filters (HEPA filter for dusts mists and fumes) to reduce the potential for exposure to asbestos fibers that may become airborne during sampling operations. An exclusion zone shall be established to consist of all of Building 32. All work performed inside building 32 prior to removal of asbestos-containing building material (ACBM) will require level C PPE with full-face air purifying respirators equipped with HEPA cartridges and disposable whole body coveralls (Tyvek)to reduce the potential for exposure to asbestos fibers that may become airborne during work within the building. ACBM must not be disturbed. Workers should avoid working in and around fallen ACBM debris or disturbing ACBM in the work areas. Additional precautions may include wetting the damaged, fallen material and covering with polyethylene sheeting to minimize disturbance and airborne release of asbestos fibers. This must be performed by a properly trained and qualified asbestos abatement contractor or other equivalently qualified person (in-house personnel). All site work will stop if ACBM is disturbed/damaged during the site operations. Consult with the HSM for further instructions. (See TtNUS Respiratory Protection Program and the Site Respiratory Protection Program in Attachment VI) 2) Decontaminate all equipment and supplies between sampling events as well as prior to leaving the site. ***Physical hazards*** 3) All equipment used will be: Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturer's design, and documented as such using Equipment Inspection Checklist provided as Attachment V Complete the Equipment Inspection Checklist for each piece of equipment used at the site. Equipment operation will be performed as follows: - Only manufacturer approved equipment may be used in conjunction with equipment repair procedures (e.g., pins for auger flights). In addition to the equipment considerations, the following standard operating procedures will be used: - All personnel not directly supporting the sampling operation will remain at least 25 feet from the point of operation. - All loose clothing/protective equipment will be secured to avoid possible entanglement. - A remote sampling device must be used to sample drill cuttings near rotating tools. - Work areas will be kept clear of clutter. - All personnel will be instructed in the location and operations of the emergency shut off device(s). This device will be tested initially (and then periodically) to ensure its operational status. 4) Eye protection will be worn at all times while working on site. 5) Excessive noise levels will be mitigated through the use of hearing protection. Any piece of equipment or operation that has the potential to generate excessive noise levels (i.e., you must raise your voice to speak to someone within two feet of where you are standing) will require hearing protection until sound level measurements and/or noise dosimetry may be conducted to quantify the associated noise levels. 6) All utility clearances shall be obtained through DIGSAFE prior to subsurface activities. The locations of all underground utilities will be identified and marked prior to all subsurface investigations. (See Attachment II TtNUS Utility Clearance SOP) - Drill masts, backhoe booms or other projecting devices shall be at least 20 feet from overhead power lines and a minimum of 3 feet from identified underground locations. 7) Use machinery or multiple personnel for heavy lifts. - Use proper lifting techniques. 8)Preview work location for uneven/unstable terrain. 9)Use pinch bars or other equipment to remove hands from the point of operation, when acquiring samples. 10) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 3 feet). - All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility. 11) Wear appropriate clothing and PPE. Avoid insect/animal areas, use commercially available insect repellants.(See Attachment III TtNUS Tick Control SOP) 12) Wear appropriate clothing for the anticipated weather conditions while maintaining the required level of protection. If necessary, perform biological monitoring.	*Continuous monitoring of VOCs will be performed during operations to ensure safe work conditions do not change as a result of work being performed or other external factors. Monitoring of each activity in particular, will be performed in an attempt to anticipate and characterize site contaminants.* A direct reading Photoionization Detector (PID) with a lamp strength of 10.6 eV or higher, or Flame Ionization Detector (FID), will be used to screen samples and to detect the presence of VOCs, SVOCs, and any other detectable contaminants. Source monitoring of the sample stations will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location which may impact the field crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. Any sustained readings (greater than 1 minute in duration) above 5 PPM in the breathing zone of the at-risk employees requires site activities to be suspended and site personnel to report to an unaffected area. - Work may only resume if airborne readings in worker breathing zone return to background levels. If elevated readings in the worker's breathing zone persist, the PHSO and HSM will be contacted to determine necessary actions and levels of protection. Site contaminants may adhere to or be part of airborne dusts or particulates generated during site activities. Generation of dusts should be controlled to minimize the potential for inhalation of contaminated dusts and particulates. Evaluation of dust concentrations, EXCEPT FOR ASBESTOS MATERIALS will be performed by observing work conditions for "visible" emissions of dust. Such a condition will require evacuation of the work area until water can be used to control dust.	Outside activities are to be initiated in Level D protection. Activities inside Building 32 will be conducted in Level C. Level D protection constitutes the following minimum protection: - Standard field dress (Long pants and long or short sleeve shirts) - Steel toe/shank safety shoes These following items will be incorporated during sampling operations: - Nitrile gloves - Hardhat, safety glasses, and earplugs or muffs. - Tyvek coveralls - *Chemical resistant boot covers* - *PVC or PE coated Tyvek will be incorporated if there is a potential for saturation of work attire.* *(The italicized items are optional as conditions dictate)* - If liquid contamination is encountered, or if the potential for saturation of the work clothes exists, the use of a PVC or PE splash suit, chemical resistant boots (covers), and Nitrile gloves are required. Level C protection constitutes the following minimum protection: - Standard field dress (Long pants and long or short sleeve shirts) - Steel toe/shank safety shoes - Nitrile gloves - Hardhat, safety glasses, and earplugs or muffs. - Tyvek coveralls - Full-face APR with magenta filters (for dusts mists and fumes) - *Chemical resistant boot covers* - *PVC or PE coated Tyvek will be incorporated if there is a potential for saturation of work attire.* *(The italicized items are optional as conditions dictate)*	**Personnel Decontamination** - Will consist of a soap/water wash and rinse for outer protective equipment (e.g., boots, gloves, PVC coveralls, etc.). This function will take place adjacent to the sampling or drilling operations. As potential site contaminants are not anticipated as part of this task, personal decontamination is not required. All equipment arriving/leaving the site will be inspected prior to permitting this equipment to enter or exit the site. The SSO will inspect the equipment and give the clearance to allow the equipment to pass. Failure to pass inspection will prohibit entering or exiting the site as applicable. All equipment which fails the inspection will have to be decontaminated again to a level acceptable to the SSO prior to passage on or off site. While leaving Building 32, the following decontamination procedures shall be required: 1. Wash, remove gloves 2. Wash, remove overboots 3. Remove coverall and dispose in appropriately labeled container. 4. Wash hands. Remove APR. Discard filter cartridges or seal for future use. This decontamination procedure for Level D protection will consist of - Equipment drop - Soap/water wash and rinse of outer gloves and outer boots, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Wash hands and face, leave contamination reduction zone While leaving Building 32, the following decontamination procedures shall be required: 5. Wash, remove gloves 6. Wash, remove overboots 7. Remove coverall and dispose in appropriately labeled container. 8. Wash hands. Remove APR. Discard filter cartridges or seal for future use. **Equipment Decontamination** - All equipment decontamination will take place at a centralized decontamination pad utilizing steam or pressure washers. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving on site and that which is to leave the site. No equipment will be allowed access or exit without this authorization.

6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical and physical hazards associated with the Building 32 site and the activities that are to be conducted as part of the scope of work. Table 6-1 provides information on the most common and significant substances likely to be encountered during site investigations, whereas, Table 6-2 provides information of substances that are likely to be encountered during sampling and based on review of available data. Specifically, toxicological information, exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data are discussed in the table. Section 6.1 provides a general list of the contaminants that may be present at the site. Section 6.2 lists the physical hazards that may be present at the site or associated with site activities.

6.1 CHEMICAL HAZARDS

The potential health hazards associated with the site include inhalation, ingestion, and dermal contact of various contaminants that may be present at the site in surface and subsurface soils. Contamination identified on the site is generally associated with degreasing and electroplating activities. Based on previous investigations, trace concentrations of chlorinated solvents including Trichloroethene, and trace concentrations of metals and petroleum are present in the soils at the site. In addition, other fuel components may be present including BTEX compounds, diesel range organic compounds, and semivolatile organic compounds (SVOCs).

In addition, asbestos-containing building materials are present in poor condition in the building, and these materials will likely be undisturbed and avoided during investigation work at Building 32.

It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (drilling and chipping concrete samples and sampling into subsurface soil). VOCs, SVOCs and TPH are known or suspected contaminants onsite, predominantly in subsurface soil. Exposure to soil is most likely to occur through inhalation of airborne particulates or through ingestion of contaminated soil or water through hand-to-mouth contact during soil disturbance activities or during sampling.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
1,1,1- Trichloroethane	71-55-6	PID: I.P. 11.0 eV, relative response ratio unknown. FID: 85% response with FID.	Air sample using charcoal sorbent tube and carbon disulfide desorption with gas chromatography-flame ionization detector; Sampling and analytical protocol in accordance with OSHA Method #07, or NIOSH Method #1003 Halogenated Hydrocarbons.	OSHA, ACGIH: 350 ppm NIOSH; 350 ppm (C) IDLH: 700 ppm	No information was found concerning odor threshold limits. The use of air-purifying respirator with organic vapor cartridge for <100 ppm for escape purposes is permitted. Exceedances above 100 ppm will require the use of airline or SCBA combination units. **Recommended glove:** Butyl rubber,solvent dipped, unsupported - >5.78 hrs; PV alcohol - >8.00 hrs; Teflon - >24.00 hrs; Viton - <24.00 hrs	**Boiling Pt:** 165°F **Melting Pt:** -23°F **Solubility:** 0.4% **Flash Pt:** Not available **LEL/LFL:** 7.5% **UEL/UFL:** 12.5% **Vapor Density:** Not available **Vapor Pressure:** 19 mmHg @ 68°F; 20° C **Specific Gravity:** 1.34 **Incompatibilities:** Acids, acid fumes, oxidizers, caustics, and chemically active metals such as aluminum, magnesium, sodium, potassium, etc. **Appearance and Odor:** Colorless liquid with a mild chloroform-like odor.	Overexposure to this substance may cause irritation to the eyes, skin, and mucous membranes of the respiratory and gastrointestinal tract. CNS effects may include sleepiness, incoordination, depression similar to a narcotic. Chronic exposure may cause liver, kidney and lung damage. This substance has demonstrated carcinogenic potential in laboratory animals. Repeated or prolonged exposure may cause dermatitis.
1,1,2- Trichloroethane	79-00-5	PID: I.P. 11.0 eV, relative response ratio unknown. FID: 85% response with FID.	Air sample using charcoal sorbent tube and carbon disulfide desorption with gas chromatography-flame ionization detector; Sampling and analytical protocol in accordance with OSHA Method #07, or NIOSH Method #1003 Halogenated Hydrocarbons.	OSHA; NIOSH; ACGIH: 10 ppm (skin) IDLH: 100 ppm	No information was found concerning odor threshold limits. The use of air-purifying respirator with organic vapor cartridge for <100 ppm for escape purposes is permitted. Exceedances above 100 ppm will require the use of airline or SCBA combination units. **Recommended glove:** Butyl rubber,solvent dipped, unsupported - >5.78 hrs; PV alcohol - >8.00 hrs; Teflon - >24.00 hrs; Viton - <24.00 hrs	**Boiling Pt:** 237°F; 114°C **Melting Pt:** -31°F-35°C **Solubility:** 0.6% **Flash Pt:** Not available **LEL/LFL:** 6% **UEL/UFL:** 15.5% **Vapor Density:** Not available **Vapor Pressure:** 19 mmHg @ 68°F; 20° C **Specific Gravity:** 1.44 **Incompatibilities:** Acids, acid fumes, oxidizers, caustics, and chemically active metals such as aluminum, magnesium, sodium, potassium, etc. **Appearance and Odor:** Colorless liquid with a sweet chloroform-like odor.	Overexposure to this substance may cause irritation to the eyes, skin, and mucous membranes of the respiratory and gastrointestinal tract. CNS effects may include sleepiness, incoordination, depression similar to a narcotic. Chronic exposure may cause liver, kidney and lung damage. This substance has demonstrated carcinogenic potential in laboratory animals. Repeated or prolonged exposure may cause dermatitis.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
SITE INVESTIGATIONS, BUILDING 32
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
1,1,2,2-Tetrachloroethane	79-34-5	PID: I.P. 11.1 eV, relative response ratio unknown. FID: 100% response with FID.	Air sample using charcoal tube; carbon disulfide desorption, GC/FID detection. Sampling and analytical protocol in accordance with OSHA Method #07, or NIOSH Method #1003.	OSHA: 5 ppm (skin) ACGIH; NIOSH: 1 ppm (skin) IDLH: 100 ppm	Odor threshold for this substance is 7.3 ppm. This level in comparison to the TLV is considered poor. Air purifying elements (organic vapor/acid gas) are recommended for escape purposes only. Combination units (APR/airline respirator) are recommended for working in concentrations in excess of the TLV. **Recommended glove:** Butyl rubber 4.6 hrs; solvent dipped, unsupported. PV alcohol >8.00 hrs; Teflon >15.20 hrs; Viton >8.00 hrs	**Boiling Pt:** 296°F; 147°C **Melting Pt:** -33 to -47°F; -36 to -43.8°C **Solubility:** 0.3% **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 9 mmHg @ 86°F; 30°C **Specific Gravity:** 1.59 @ 77°F; 25°C **Incompatibilities:** Strong oxidizers, alkalis, fuming sulfuric acid, and chemically active metals. When heated to decomposition temperatures will emit toxic fumes of chlorine. **Appearance and Odor:** Colorless to pale yellow liquid with a pungent chloroform like odor.	Overexposure may result in CNS effects including depression, sleepiness, hallucinations, distorted perceptions, tremors(fingers), and stupor (narcosis). Systemically, symptoms may result in nausea, vomiting, abdominal pains, and cramps. May also irritate the eyes, skin, and mucous membranes. Chronic exposures may result in dermatitis, enlarged tender liver, jaundice, hepatitis, kidney, and lung damage.
1,1-Dichloroethane	75-34-3	PID: I.P. 11.06 eV, relative response ratio unknown. FID: 80% relative response ratio with FID.	Air sample using charcoal tube; carbon disulfide desorption. Sampling and analytical protocol shall proceed in accordance with OSHA Method #07-B or NIOSH Method #1003	OSHA; NIOSH; ACGIH: 100 ppm IDLH: 4000 ppm	Questionable warning properties - Odor threshold 49 - 1359 ppm. APRs may be employed for escape only. Exceedances over the exposure limits are recommended to use airline or airline/APR combination type respirator. **Recommended glove:** Butyl; Polyvinyl alcohol; Viton	**Boiling Pt:** 135°F; 57°C **Melting Pt:** -143°F;-97°C **Solubility:** 0.6% **Flash Pt:** 2°F; -17°C **LEL/LFL:** 5.6% **UEL/UFL:** 11.4% Vapor Density: 3.42 **Vapor Pressure:** 182 mmHg **Specific Gravity:** 1.18 **Incompatibilities:** Strong oxidizers, strong caustics **Appearance and odor:** Colorless, oily liquid with a chloroform-like odor.	Overexposure may result in CNS depression, skin and eye irritation, and damage to the liver, kidneys, and lungs.
1,2-dibromo-3-chloropropane (DBCP), trade name Nemagon™	96-12-8	Substance is not volatile, I.P. is unknown, and detection by PID is unknown. FID: Relative response ratio unknown, however, this substance is considered detectable.	There are no NIOSH validated sampling and analytical methods for DBCP	OSHA; 1 ppb as 8-hr TWA; no eye or skin contact NIOSH: 10 ppb as 10-hr TWA (superceded by OSHA PEL)	Poor warning properties: odor threshold well below PEL. If exposures approaching PEL are suspected, a SCBA or supplied air respirator is required. **Recommended Gloves:** Skin contact with DBCP must be avoided. Standard rubber and neoprene gloves do not offer adequate protection. Nitrile gloves are recommended.	**Boiling Pt:** 383°F; 195°C **Melting Pt:** 43°F; 6°C **Solubility:** 0.1% **Flash Pt:** 170°F; 77°C **LEL/LFL:** Unknown **UEL/UFL:** Unknown **Vapor Density:** Unknown **Vapor Pressure:** 0.1 mmHg @ 68°F; 20°C **Specific Gravity:** 2.093 **Incompatibilities:** DBCP reacts with chemically active metals such as aluminum, magnesium, and tin alloys. **Appearance and odor:** Dense yellow or amber liquid or granular solid with a pungent odor. Any detectable odor of DBCP indicates overexposure.	DBCP may cause drowsiness, irritation of the eyes, nose, throat and skin, nausea and vomiting. In addition, overexposure may cause damage to the lungs, liver, or kidneys. Prolonged or repeated exposure to DBCP has been shown to cause sterility in humans. It also has been shown to produce cancer and sterility in laboratory animals, and has been determined to constitute an increased risk of cancer in man. DBCP is an OSHA regulated carcinogen (1910.1044).

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CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Acenaphthalene	83-32-9 208-96-8	No information found concerning ionization potentials or relative response ratios for PID or FID detection.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection; Sampling and analytical protocol in accordance with OSHA 07 or NIOSH Method #1501	None established for this compound. However, it is recommended that 0.2 mg/m³ for coal tar pitch volatiles be employed where excessive concentrations may exist. This is more relevant for those PAHs considered carcinogenic.	Information regarding this substance was limited. This material is a natural constituent of coal tar. Adequate - Odor threshold 0.08-0.22 ppm. OSHA accepts the use of air-purifying respirators with organic vapor cartridge up to 10 mg/m³, providing cartridges are changed at the beginning of each shift. **Recommended gloves:** Butyl - >8.00 hrs; are recommended for other coal tar pitch associated substances; Neoprene >4.00 hrs; Nitrile >1.00 hrs	**Boiling Pt:** 534°F; 279°C **Melting Pt:** 203°F; 95°C **Solubility:** Insoluble **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Density:** 1.189 **Vapor density:** 5.32 **Vapor Pressure:** 10 mmHg **Specific Gravity:** 1.189 **Incompatibilities:** Strong oxidizers, caustics, and acids **Appearance and Odor:** Colorless needles with an aromatic odor at concentrations of 0.08-0.22 ppm	Overexposure may result in irritation to the eyes, nose, throat, and respiratory system.
Acetone	67-64-1	PID: I.P. 9.69 eV, high response with PID and 10.2 eV lamp. FID: 60 % relative response ratio with FID.	Air sample using a charcoal tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with OSHA Method #69, 07 or NIOSH Method #1300.	OSHA: 1000 ppm ACGIH: 750 ppm, 1000 ppm STEL NIOSH: 250 ppm IDLH: 2500 ppm	Adequate - Can use air purifying respirator with organic vapor cartridge up to 2500 ppm. **Recommended glove:** Natural rubber	**Boiling Pt:** 133°F; 56°C **Melting Pt:** -139°F; -95°C **Solubility:** Miscible **Flash Pt:** 0°F; -18°C **LEL/LFL:** 2.5% **UEL/UFL:** 13% **Vapor Density:** Not available **Vapor Pressure:** 180 mmHg **Specific Gravity:** 0.79 **Incompatibilities:** Oxidizers, acids **Appearance and odor:** Colorless liquid with a fragrant mint-like odor.	Exposure to this chemical may result in irritation to the eyes, nose, throat. Overexposure may cause headache, dizziness. Contact with the skin may cause dermatitis. Target organs are listed as the respiratory system (lungs) and skin.
Aroclor-1260 (Polychlorinated Biphenyl, PCB) It should be noted that this substance is representative of the more common isomers Aroclor – 1242, 1254, which may be encountered.	11096-82-5 53469-21-9 (42%) 11097-69-1 (54%)	Substance is not volatile (VP=0.00006 mmHg), I.P. is unknown however is anticipated to be elevated, therefore, PID is not anticipated to detect substance. Substance is non combustible and as a result will not be detected by FID.	Air sample using a particulate filter, Florisil sorbent tube with glass fiber filter; hexane desorption; gas chromatography-electron capture detector. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #5503 (PCBs).	OSHA; ACGIH: 0.5 mg/m³ (skin) NIOSH: 0.001 mg/m³ IDLH: 5 mg/m³	Inadequate - However due to the low volatility it is assumed unless agitated this substance does not present a volatile vapor or gas respiratory threat. For dusty conditions where this material may cling to particulates, use a HEPA filter. APRs are approved for escape only when concentrations exceed the exposure limits. Concentrations greater than the exposure limits require PAPR or supplied air respirators. **Recommended glove:** Butyl rubber >24 hrs; Neoprene rubber >24.00 hrs; Silver shield or Viton (for pure product).	**Boiling Pt:** distillation range 689- 734°F; 365-390°C **Melting Pt:** -2 to 50°F; -19 to 10°C **Solubility:** Insoluble **Flash Pt:** Not applicable **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable Nonflammable liquid, however, exposure to fire results in black soot containing PCBs, dibenzofurans, & chlorinated dibenzo-p-dioxins **Vapor Density:** Not available **Vapor Pressure:** 0.00006 - 0.001 mmHg **Specific Gravity:** 1.566 @ 60°F; 15.5°C **Incompatibilities:** Strong oxidizers **Appearance and Odor:** Colorless to pale yellow, viscous liquid or solid (Aroclor 54 below 50°F) with a mild, hydrocarbon odor	This substance is irritating to the eyes and skin. Chronic effects of overexposure may include potential to cause liver damage, chloracne, and reproductive effects. Recognized as possessing carcinogenic properties by NIOSH, and NTP.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Arsenic	7440-38-2	Particulate form - This substance is not detectable using a PID or FID.	Sample with a Mixed-cellulose ester (MCE) filter and analyze using Inductively coupled plasma / atomic emission spectroscopy in accordance with NIOSH Method 7300.	OSHA: 0.010 mg/m³ (1910.1018) NIOSH: 0.002 mg/m³ (Ceiling) ACGIH: 0.010 mg/m³	The substance will generally be present in a particulate form or bound to particulates. As a result, air purifying respirators equipped with High Efficiency Particulate Air (HEPA) filters are suitable for use. **Recommended glove:** Given this chemicals particulate form, any glove material is suitable for protection. Nitrile is the most common glove material.	**Boiling Pt:** Sublimes **Melting Pt:** 1135°F; 613°C **Solubility:** Insoluble **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg (approx.) **Specific Gravity:** 5.73 (metal) **Incompatibilities:** Strong oxidizers, bromine azide. Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine. **Appearance and Odor:** Metal - Silver-gray or tin-white, brittle, odorless solid.	Exposure to arsenic may cause ulceration of the nasal septum, dermatitis, gastrointestinal disturbances, respiratory irritation, hyperpigmentation of the skin, and peripheral neuropathy. Arsenic is recognized as a carcinogen by IARC, NTP, OSHA, and ACGIH. Target organs include the liver, kidneys, skin, lungs, and lymphatic system (lung and lymphatic cancer).
Asbestos	1332-21-4	Particulate / fibrous form - unable to be detected by PID/FID.	Air sample using particulate filter; analyze using Phase Contrast Microscopy (PCM). Sampling and analytical protocol in accordance with NIOSH Method #7400.	OSHA; NIOSH: 0.1 fiber per cubic centimeter ACGIH: Exposure limits are dependant upon the type of asbestos; range from 0.2 to 2.0 fiber/cc	Unable to be perceived by senses. Requires use of full face air purifying respirator with dual High Efficiency Air Particulate (HEPA) filter in accordance with OSHA standards 29 CFR 1910.1001 and 1926.58.	**Boiling Pt:** Decomposes **Melting Pt:** 1112°F; 600°C **Solubility:** Insoluble **Flash Pt:** Not applicable **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** Not available **Specific Gravity:** Not available **Incompatibilities:** None Reported **Appearance and odor:** White or greenish (chrysotile), blue (crocidoite), or gray-green (amosite) fibrous, odorless, solids	Exposure may result in difficulty breathing, scaring of the lungs, restricted pulmonary function, and finger clubbing. Asbestos is listed as a carcinogen. Target organ is listed as the lungs.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Benzo(a)pyrene	50-32-8	Particulate form - This substance is not detectable using a PID or FID.	Air sample using a glass fiber or silver membrane filter; analysis by gas chromatography/infra red or other spectrophotometric method or colorimeter. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #1(186).	OSHA: 0.2 mg/m³ NIOSH: 0.1 mg/m³	Adequate - use a full-face air-purifying respirator with dust/mist cartridge up to 10 mg/m³. **Recommended glove:** Nitrile	**Boiling Pt:** 594°F; 312°C **Melting Pt:** 354°F; 179°C **Solubility:** Insoluble **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 10 mmHg @ 594°F; 312°C **Specific Gravity:** Not available **Incompatibilities:** Not available **Appearance and Odor:** Yellow odorless crystals.	Regulated primarily as a result of potential carcinogenic properties. Listed by NTP, IARC, and ACGIH as carcinogenic.
Cadmium	7440-43-9	Particulate Form - Unable to be easily detected by PID or FID.	Air sample using a mixed cellulose-ester filter / acid desorption and analysis by atomic absorption-flame. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7300 or #7048.	OSHA: 2 µg/m³ (0.002 mg/m³) ACGIH: 0.01 mg/m³ (total particulate) 0.002 mg/m³ (respirable particulate) IDLH: 9 mg/m3 (as cd)	The use of an air purifying, full face-piece respirator with a high efficiency particulate air filter for concentrations up to 0.25 mg/m³. **Recommended Gloves:** This is in particulate form. Therefore any glove suitable to prevent skin contact.	**Boiling Pt:** 1412°F; 767°C **Melting Pt:** 610°F; 321°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 1 mmHg @ 741°F; 394°C **Specific Gravity:** 8.65 @ 90°F; 32°C **Incompatibilities:** Strong oxidizers, elemental sulfur, selenium, tellurium, zinc, nitric acid, and hydrazoic acid **Appearance and Odor:** Metal: Silver-white, blue-tinged lustrous, odorless solid. Fume: yellow-brown, finely divided particulate dispersed in air.	Overexposure to this substance may result in irritation to the respiratory tract, dyspnea, tightness in the chest, coughing, possibly pulmonary edema. Overexposure to fumes causes symptoms characteristic of the flu (headaches, chills, muscle aches, nausea, vomiting, diarrhea). Chronic exposure may result in damage to the lungs, kidneys and liver. This substance has been identified as a confirmed animal; potential human carcinogen by IARC and NTP.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Chlorobenzene	108-90-7	PID: I.P. 9.07 eV, High response with PID and 10.2 eV lamp. FID: Relative response ratio for FID detection is unknown, however, is considered to be detectable as this substance will burn.	Air sample using charcoal sorbent tube; carbon disulfide desorption with gas chromatography-flame ionization detector. Sampling and analytical protocol in accordance with NIOSH Method #1003	OSHA: 75 ppm NIOSH: ACGIH: 10 ppm IDLH: 1000 pp	Adequate - Odor threshold 1.3 ppm. Can use air-purifying respirator with organic vapor cartridge up to 500 ppm. **Recommended glove:** Viton - >8.00 hrs PV Alcohol >8.00 hrs	**Boiling Pt:** 268°F; 131°C **Melting Pt:** -49°F; -45°C **Solubility:** 0.05% **Flash Pt:** 82°F; 28°C **LEL/LFL:** 1.3% **UEL/UFL:** 9.6% **Vapor Density:** 3.88 **Vapor Pressure:** 10 mmHg @ 72°F; 22° C **Specific Gravity:** 1.11 **Incompatibilities:** Strong oxidizers **Appearance and Odor:** Colorless liquid with an almond-like odor.	Regulated primarily because of it potential to cause sleepiness and incoordination. Irritating to the eyes, nose, and skin. Chronic exposure may cause liver, kidney, and lung damage.
Chromium Compounds	7440-47-3 (Element)	Not detectable by PID. Not detectable by FID.	Air sample using mixed cellulose - ester filter; acid desorption and analysis by atomic absorption. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7024.	OSHA & NIOSH: (Chromium II, III) 0.5 mg/m^3 (Chromium VI) 0.1 mg/m^3 (Ceiling) ACGIH: 0.5 mg/m^3 (Chromium II, III compounds), 0.05 mg/m^3 (Chromium VI compounds) IDLH: 30 mg/m^3 (Chromium VI compounds)	The use of a air purifying, full face-piece respirator with a high efficiency particulate filter for concentrations up to 0.1 mg/m^3. **Recommended Gloves:** This is in particulate form. Therefore any glove suitable to prevent skin contact.	**Boiling Pt:** 4788°F; 2642°C **Melting Pt:** 3452°F; 1900°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 7.14 **Incompatibilities:** Strong oxidizers, peroxides, and alkalis **Appearance and Odor:** Appearance and odor vary depending upon the specific compound.	Health hazards are characterized normally through chronic exposure manifesting as histologic fibrosis of the lungs and ulceration of the nasal septum and skin. IARC, NTP and ACGIH list various chromium compounds as possessing carcinogenic properties.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Copper	7440-50-8 (Cu) 1317-38-0 (CuO)	Substance is not volatile. Unable to be detected by PID or FID.	Air sample using a mixed cellulose ester filter; inductively coupled plasma/atomic emission spectroscopy. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7300.	NIOSH; OSHA: 0.10 mg/m³ ACGIH: 0.2 mg/m³	The use of an air-purifying full-face respirator with a high efficiency particulate air filter. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 4215°F; 2324°C **Melting Pt:** 1981°F; 1083°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 1 mmHg @ 2962°F 1628°C **Specific Gravity:** 8.94 **Incompatibilities:** Oxidizers, alkalis, sodium azide, acetylene, bromates, chlorates, iodates, and acids. **Appearance and Odor:** Metal: Reddish, lustrous malleable, odorless solid. Fume: Finely divided black particulate dispersed in air.	Irritation to the nose, throat, and respiratory tract. Metallic taste Discoloration of skin (potential dermatitis) and hair. Chronic exposure may result in dermatitis and damage to the liver and kidneys. Overexposure to fumes causes symptoms characteristic of the flu (headaches, chills, muscle aches, nausea, vomiting, diarrhea). Ingestion may cause burning in the mouth, throat, and stomach. Metallic taste with colicky abdominal pain. Individuals with Wilson's disease are at greater risk of chronic exposure as a result of the bodies tendency to absorb and retain copper.
Cyanides (as CN)	varies depending of compound	No information found.	Air sample using filter; analyze using specific ion electrode. Sampling and analytical protocol in accordance with established methodology.	OSHA; ACGIH; NIOSH: 5 mg/m³ (ceiling) IDLH: 50 mg/m³	Inadequate warning properties; recommend the use of supplied air respirators. **Recommended Gloves:** Butyl 1.00 hr.	**Boiling Pt:** 2725°F; 1496°C **Melting Pt:** 1047°F; 564°C **Solubility:** 58% **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 1.6 **Incompatibilities:** Strong oxidizers, acids, acid salts, chlorates, and nitrates **Appearance and odor:** KCN and NaCN are white granular or crystalline solids with a faint almond-like odor	Overexposure may result in chemical asphyxiation and death. Symptoms of exposure include weakness, headache, confusion, nausea, vomiting, increased respiratory rate, slow gasping respirations, irritation of the eyes and skin. Target organs are listed as Cardiovascular system, Central nervous system, liver, kidneys, and skin.
Diesel Fuel No.2-D	Mixture	Components of this substance will be detected readily however no documentation exists as to the relative response ratio of either PID or FID.	Air sampling use charcoal tube as a collection media; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol in accordance with NIOSH Method #1550.	OSHA/NIOSH/ ACGIH: 5 mg/m³ as mineral oil mist. In addition NIOSH and ACGIH establish 10 mg/m³ as a STEL.	Kerosene odor **Recommended Air Purifying cartridges:** Organic vapor **Recommended gloves:** Nitrile	**Boiling Pt:** <170-400°F; 77-204°C **Melting Pt:** Not available **Solubility:** Negligible **Flash Pt:** 125°F; 52°C **LEL/LFL:** 0.6% **UEL/UFL:** 7.5% **Vapor Density:** >5 **Vapor Pressure:** <1 mmHg @ 70°F; 21°C **Specific Gravity:** 0.86 **Incompatibilities:** strong oxidizers, halogens, and hypochlorites **Appearance and odor:** Colorless to amber with a kerosene odor	Prolonged or repeated exposures to this product may cause skin and eye irritation. Due to the defatting capabilities this exposure may lead to a dermatitis condition. High vapor concentrations are irritating to the eyes and respiratory tract. Exposure to high airborne concentrations may result in narcotic effects including dizziness, headaches, and anesthetic to unconsciousness. High concentrations in a confined space may adequately displace oxygen thereby resulting in suffocation.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
General PAHs / Coal Tar Pitch Volatiles / Creosote / cresol (Fluoranthene, pyrene, benzo(a) anthracene, benzo(a) pyrene, benzo(f)fluoranthene, benzo(k)fluoranthene), etc.)	(CAS Numbers vary depending on specific compound)	PID: I.P. of 8.97 eV, relative response ratio unknown. FID: Response factor unknown but given the substances flammability, detection by FID can be anticipated.	Refer to NIOSH methods for each specific compound for appropriate air sampling protocols. Many PAHs can be sampled using NIOSH Method 5506 or 5515 - Teflon filter with support ring - High pressure liquid chromatography with UV detector. For cresol (a major constituent of creosote) by silica gel or xad-7 sorbent tube; Acetone desorption and analysis by gas chromatography - flame ionization detector or high-pressure liquid chromatography. (NIOSH Method #2001, or OSHA Method #32)	**General PAHs:** Most PAHs have no established exposure limits. Other Coal Tar Pitch Volatiles / PAHs such as chrysene and benzo(a)pyrene have an exposure limit of 0.2 mg/m^3 (OSHA and ACGIH). 0.1 mg/m^3 - (NIOSH) **Creosote / Cresol:** OSHA; ACGIH: 5 ppm NIOSH: 2.3 ppm IDLH: 80 mg/m^3	Adequate - use a full-face air-purifying respirator with organic vapor / dust/mist cartridge up to 250 ppm. Cresol has an Odor Threshold of 0.00005-0.0079 ppm. **Recommended gloves:** Viton >96.00 hrs; butyl rubber >90.00 hrs; neoprene >4.50 hrs	Properties of various PAHs/Coal Tar Pitch Volatiles vary depending upon the specific compound. *For Creosote/Cresol:* **Boiling Pt:** 376-397°F; 191-203°C **Melting Pt:** 52-96°F; 10.9-35.5°C **Solubility:** Insoluble **Flash Pt:** 178°F; 81°C **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** 3.72 **Vapor Pressure:** 1 mmHg @ 100-127° F; 38-53°C **Specific Gravity:** 1.030-1.038 **Incompatibilities:** Nitric acid, oleum, chlorosulfonic acid, oxidizers **Appearance and Odor:** Yellowish or colorless, flammable, oily liquid (often brownish because of impurities or oxidation)	Regulated based on effects on respiratory tract and skin irritation Other effects may include eye irritation and central nervous system, disturbances. Acute exposures may result in difficulty breathing, respiratory failure and skin and eye irritation and burns. Chronic exposure may damage the liver, kidneys, lungs and skin and cause photosensitivity. IARC, NTP, NIOSH, ACGIH, and the EPA list some PAHs such as benzo(a)pyrene as a potential carcinogen (ARC 2A, NTP-2, ACGIH TLV-A2, NIOSH-X, EPA-B2).
Methyl ethyl ketone (2-Butanone)	78-93-3	PID: I.P. 9.54 eV high response with PID and 10.2 eV lamp. FID: 80% relative response ratio with FID.	Air sample using Ambersorb tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with OSHA Method #16, 84 or NIOSH Method #2500.	OSHA; NIOSH; ACGIH: 200 ppm NIOSH; ACGIH: have established STEL of 300 ppm IDLH: 3000 PPM	Adequate - Can use air purifying respirator with organic vapor cartridges up to 2000 ppm. **Recommended glove:** Poly vinyl alcohol or natural rubber	**Boiling Pt:** 175°F; 79°C **Melting Pt:** -124°F; -86.4°C **Solubility:** 28% **Flash Pt:** 16°F; 9°C **LEL/LFL:** 1.4% **UEL/UFL:** 11.4% **Vapor Density:** 2.41 **Vapor Pressure:** 71 mmHg **Specific Gravity:** 0.81 **Incompatibilities:** Strong oxidizers, amines, ammonia, inorganic acids, caustics, copper, isocyanates, pyridines **Appearance and odor:** Colorless liquid with a moderately sharp, fragrant mint- or acetone like odor	Exposure may result in irritation to the eyes and nose. Overexposure may cause headache, dizziness, and vomiting. Target organs are the Central Nervous System and lungs.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Nickel	7440-02-0	Particulate form - This substance is unable to be detected by PID/FID.	Air sample using particulate filter; acid desorption; ICP detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7300.	OSHA: as Ni metal and insoluble compounds 1 mg/m³ NIOSH: 0.015 mg/m³ ACGIH: 0.05 mg/m³ IDLH: 10 mg/m³	No identifiable warning properties to indicate presence and thereby detection. **Recommended APR Cartridge:** Suitable for dust and fume. Organic vapor acid gases with HEPA filter. **Recommended gloves:** This material is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 4946°F; 2730°C **Melting Pt:** 2651°F; 1455°C **Solubility:** Insoluble acid **Flash Pt:** Not available(Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 1 mmHg @ 3290°F; 1810°C **Specific Gravity:** 8.90 **Incompatibilities:** Strong acids, halogens, sulfur, wood and other combustibles, nickel nitrate, and oxidizers **Appearance and odor:** Silvery white, hard, malleable ductile metal, odorless	Symptoms of overexposure to this product may include headaches, vertigo, delirium, extreme weakness, GI disturbance and pain including nausea vomiting and diarrhea, coughing, hyperpnea, cyanosis, weakness, allergic dermatitis, nickel itch, pulmonary asthma, chest pains tightness, dyspnea, dry cough, and conjunctivitis. This substances has been identified as a Human carcinogen by NTP and IARC.
Silver	7440-22-4	Particulate form - Unable to be detected by PID or FID.	Air sample using a mixed cellulose ester filter; acid desorption; Atomic absorption or plasma emission spectroscopy detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #5(s182), or OSHA Method #ID121.	NIOSH; OSHA; ACGIH: 0.01 mg/m³	No identifiable warning properties to indicate presence and thereby detection. The use of a air purifying, full-face respirator with a high efficiency particulate air filter. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 4014°F; 2212°C **Melting Pt:** 1764°F; 962°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 10.49 **Incompatibilities:** Acetylene, acetylene compounds, ammonia, peroxides, bromoazide, chlorine, trifluoride, ethylene imine, oxalic acid, nitric acid, and tartaric acid **Appearance and Odor:** Metal: white lustrous solid.	Overexposure to this substance may result in gastrointestinal, upper respiratory, and skin irritation. Discoloration of the eyes, skin and hair.

TABLE 6-1
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Sulfuric Acid	7664-93-9	This substance is unable to be detected by PID/FID.	Sampling and analytical protocol shall be in accordance with NIOSH Method #7903.	OSHA; NIOSH: 1 mg/m³ ACGIH: 1 mg/m³, 3 mg/m³ (Ceiling) NIOSH: 1 mg/m³ IDLH: 15 mg/m³	Adequate - Irritating, tingling sensation. Odor threshold 0.15 ppm. Suitable for acid gases and dusts and mists for concentrations less than 15 mg/m³. **Recommended gloves:** Nitrile 6.00 hrs has been the one most widely used for the other substances and is acceptable for this substance. Other options include butyl rubber >8.00 hrs; silver shield 6.00 hrs; neoprene 1-3 hrs; and Viton >8.00 hrs.	**Boiling Pt:** 554°F; 290°C **Melting Pt:** 51°F; 10°C **Solubility:** Miscible **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 1 mmHg @ 295°F; 146°C **Specific Gravity:** 1.84 **Incompatibilities:** Organic materials, chlorates, carbides, fulminates, water, and powdered metals. Liberates excessive heat when mixed with water. **Appearance and odor:** Colorless, oily liquid, odorless	This substance is corrosive at all points of contact. Severe exposure may result in burns, chemical pneumonitis, conjunctivitis, stomatitis, and erosion of the teeth. Depending on the severity, shock and collapse may result.
Tetrachloroethylene See also Perchloroethylene PERK PCE	127-18-4	PID: I.P. 9.32 eV, relative response ratio 200% with 10.6 eV lamp. FID: 70% relative response ratio with a FID.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1003.	ACGIH: 25 ppm 100 ppm STEL OSHA: 100 ppm 200 ppm Ceiling; 300 ppm 5-minute max peak in any 3-hr period. IDLH: 150 ppm	Odor threshold for this substance has been determined to be at airborne concentrations of approximately 47 ppm, which is considered adequate. APR with organic vapor/acid gas cartridges should be used for escape purposes only. Exceedances over the recommended exposure limits requires the use of airline or airline/APR combination units. **Recommended glove:** Viton, PV alcohol 5-16 hrs; silver shield >6.00 hrs; teflon 10-24 hrs; and Nitrile in that order. The breakthrough time for the nitrile glove ranges between 1.5 - 5.5 hrs. during complete immersion.	**Boiling Pt:** 250°F; 121°C **Melting Pt:** -2°F; 19°C **Solubility:** 0.02% **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** 5.83 **Vapor Pressure:** 14 mmHg @ 77°F; 25°C **Specific Gravity:** 1.62 @ 77°F; 25°C **Incompatibilities:** Strong oxidizers, alkalis, fuming sulfuric acid, and chemically active metals. When heated to decomposition temperatures will emit toxic fumes of chlorine. **Appearance and Odor:** Colorless liquid with a mild chloroform like odor.	Overexposure may result in irritation to eyes, nose, throat, and skin. Potential CNS effects including sleepiness, incoordination, headaches, hallucinations, distorted perceptions, and stupor (narcosis). Systemically, symptoms may result in nausea, vomiting, weakness, tremors, and cramps. Chronic exposures may result in dermatitis, enlarged tender liver, kidney, and lung damage. This material is considered a animal carcinogen (liver tumors), however, inadequate evidence exists concerning carcinogenic potential in humans.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Trichloroethylene	79-01-6	PID: I.P. 9.45 eV, High response with PID and 10.2 eV lamp. FID: 70% Response with FID.	Air sample using charcoal tube; carbon disulfide desorption; Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1022 or #1003.	OSHA: 50 ppm 200 ppm (Ceiling) ACGIH: 50 ppm 100 ppm STEL NIOSH: 25 ppm IDLH: 1000 ppm	Inadequate - Odor threshold 82 ppm. APRs with organic vapor/acid gas cartridges may be used for escape purposes. Exceedances over the exposure limits require the use of positive pressure-demand supplied air respirator. **Recommended gloves:** PV Alcohol unsupported >16.00 hrs; Silver shield >6.00 hrs; Teflon >24.00 hrs; or Viton >24.00 hrs; Nitrile (Useable time limit 0.5 hr, complete submersion for the nitrile selection)	**Boiling Pt:** 188°F; 86.7°C **Melting Pt:** -99°F; -73°C **Solubility:** 0.1% @ 77°F; 25°C **Flash Pt:** 90°F; 32°C **LEL/LFL:** 8% @ 77°F; 25°C **UEL/UFL:** 10.5 @ 77°F; 25°C **Vapor Density:** 4.53 **Vapor Pressure:** 100 mmHg @ 90°F; 32°C **Specific Gravity:** 1.46 **Incompatibilities:** Strong caustics and alkalis, chemically active metals (barium, lithium, sodium, magnesium, titanium, and beryllium) **Appearance and Odor:** Colorless liquid with a chloroform type odor. Combustible liquid, however, burns with difficulty.	Central nervous system effects including euphoria, analgesia, anesthesia, paresthesia, headaches, tremors, vertigo, and somnolence. Damage to the liver, kidneys, heart, lungs, and skin have also been reported. Contact may result in irritation to the eyes, skin, and mucous membranes. Ingestion may result in GI disturbances including nausea, and vomiting NIOSH lists this substance a potential human carcinogen.
Zinc	7440-66-6	Particulate form - This substance is not detectable using a PID or FID.	Air sample using a particulate filter; acid desorption; AAS detection. Sampling and analytical protocol will proceed in accordance with NIOSH Method #7300.	OSHA: 10 mg/m³ Total dust, 5 mg/m³ Respirable fraction NIOSH: 5 mg/m³, 15 mg/m³ (Ceiling) ACGIH: 10 mg/m³	No identifiable warning properties to indicate presence and thereby detection. **Recommended APR Cartridge:** Suitable for dust and fume. Organic vapor acid gases with HEPA filter. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 1666°F; 908°C **Melting Pt:** 788°F; 419.8°C **Solubility:** Insoluble **Flash Pt:** Not available (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 7.14 **Incompatibilities:** Strong acids, halogens, catalytic metals, combustibles, oxidizers, nitryl fluoride **Appearance and odor:** Bluish-white, lustrous metal, odorless	Inhalation of fumes may result in metal fume fever. This condition is characterized by metallic taste, dryness of the throat, coughing with generalized aching and flu-like symptoms. Effects through ingestion may include coughing, difficulty in breathing, and sweating. A human skin irritant. Irritation to the eyes may result from mechanical action.

6.2 PHYSICAL HAZARDS

The physical hazards are a concern during the performance of site activities due to the nature of the planned work. The following general concerns are summarized below:

- Slip, trip, and fall hazards from uneven or unstable terrain;
- Contact/entanglement with rotating equipment or machinery;
- Strain/muscle pulls from heavy lifting;
- Pinch/compression points;
- Noise in excess of 85 decibels (dBA);
- Inclement weather;
- Ambient temperature extremes (heat or cold stress);
- Natural hazards (insect/animal bites or stings, poisonous plants, particularly poison ivy)See Attachment III TtNUS Tick Illness SOP;
- Other physical hazards associated with ongoing operations (proximity to heavy equipment and machinery, vehicular traffic, etc.).

The Navy has performed a digsafe clearance, and found no overhead or underground utilities active in the work area (See Attachments II TtNUS Utility Clearance SOP and Attachment !V NETC Utility Clearance Form).

These physical hazards are discussed in Table 5-1 as applicable to each site task. Furthermore, many of these hazards are discussed in detail in Section 4.0 of the Health and Safety Guidance Manual. Specific discussion on some of these hazards is presented below.

6.2.1 Contact with Underground or Overhead Utilities

Underground utilities such as pressurized fuel lines, water lines, telephone lines, buried utility lines, and high voltage power lines may be present throughout the facility although Navy records state they are not. Clearance of underground and overhead utilities for each sample location must be coordinated by the subcontractors through both the NSN base DIGSAFE and commercial utility DIGSAFE. DIGSAFE clearance permit numbers must be obtained prior to any subsurface activity onsite. A form for initiating the NSN DIGSAFE is provided in Attachment V. Additionally, sampling operations will be conducted at a safe distance (>20 feet) from overhead power lines. Whenever underground utilities are suspected to be close to subsurface sampling locations, the borehole will be advanced to a minimum of 5.0 feet with a hand auger

prior to sampling. As built drawings may also be utilized for additional clarification. The Standard operating Procedure for Utility Clearance is contained in Attachment II.

6.2.2 Ambient Temperature Extremes

Ambient temperature extremes (heat or cold stress) may exist during performance of this work depending on the project schedule. Work performed when temperatures are below 50°F may result in varying levels of cold stress (frost nip, frost bite, etc.) depending on environmental factors such as temperature, wind speed, and humidity; psychological factors such as metabolic rate and moisture content of the skin; and other factors such as the protective clothing being worn. Work performed when ambient temperatures exceed 70 °F can result in varying levels of heat stress (heat rash, heat cramps, heat exhaustion, and/or heat stroke) depending on factors similar to those presented for cold stress.

For more information concerning the effect and controls for cold and heat stress, see Section 4.0 of the Health and Safety Guidance Manual.

6.2.3 Natural Hazards

During warm months (spring through early fall), tick-borne Lyme Disease may pose a potential health hazard, especially in coastal Rhode Island which is an endemic area for Lyme Disease. The site is located in a developed area but is partially overgrown with vegetation. The Site's partially overgrown condition indicates the potential presence of ticks, including deer ticks *(Ixodes dammini)* that are known to carry Lyme disease. The longer a disease carrying tick remains attached to the body, the greater the potential for contracting the disease. Wearing long sleeved shirts and long pants (tucked into boots). As well as performing frequent body checks will prevent long term attachment. Site first aid kits should be equipped with medical forceps and rubbing alcohol to assist in tick removal. For information regarding tick removal procedures, and symptoms of exposure consult Attachment III of this HASP or Section 4.0 of the Health and Safety Guidance Manual.

Poison ivy may also present on the site. In general, avoidance of areas of known insect infestation or poisonous plant growth will be the preferred exposure control. However, this avoidance practice may not be feasible. Wearing of insect repellent and protective clothing is the best protective measure when working in these areas. In addition, individuals with known allergic reactions to insect bites and poisonous plants should notify SSO prior to engaging in activities where these hazards may be encountered.

7.0 AIR MONITORING

Monitoring devices such as Direct Reading Instruments (DRIs) will be used at the site to detect and evaluate the presence of site contaminants and other potentially harmful agents. The specific type of monitoring and the associated instruments, frequency of use, and applicable action levels are dependent upon the specific scope of work and the contaminants of concern. As a result, specific air monitoring measures and requirements will be established in Table 5-1 of this site specific HASP. Section 1.0 of the Health and Safety Guidance Manual contains detailed information regarding direct reading instrumentation, personal and area air sampling procedures, and general calibration procedures of various instruments.

7.1 PHOTOIONIZATION DETECTOR (PID)

A photoionization detector (PID) with a 10.6 eV (or equivalent) lamp will be used to screen source areas and the worker's breathing zone during sampling and other intrusive activities. Prior to the commencement of any field activities, the background level of the site must be determined and noted. Daily background readings must be taken away from areas of potential contamination to obtain accurate results. These readings, any influencing conditions (i.e., weather, temperature, and humidity) and the location will also be documented in the Health and Safety Logbook as a matter of reference

7.2 FLAME IONIZATION DETECTOR (FID)

A flame ionization detector (FID) may also be used to monitor potential sources areas and to screen collected samples and breathing zones of employees during sampling and other intrusive activities.

The FID has been included as a backup instrument due to the different principle of operation relative to the PID.

7.3 PARTICULATES

The potential for contaminant-laden dusts to be generated as a result of site activities is possible. Asbestos containing materials are present in the building, and disturbance of these materials may result in a release of airborne fibers. Unfortunately, real- time monitoring of asbestos is not technologically available, and particulate monitoring is not appropriate for asbestos exposure. Therefore, all work performed inside building 32 will be performed in Level C respiratory protection, using full-face air purifying respirators as described in Table 5-1. In addition, if the possibility of generating airborne dusts can occur during sampling activities exposure to these dusts will be minimized by the use of wetting

methods and covering the material with plastic, or if that fails suspension of the dust generating activity until an appropriate control method can be developed.

7.3.1 Air Sampling for Airborne Asbestos

In order to document that no exposure to asbestos has occurred. A Certified Industrial Hygienist will be retained to perform appropriate air sampling with quick turn around results, thus supporting the level of protection being used. The sampling results will be forwarded to the Clean Health and Safety Manager for review.

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section is included to specify health and safety training and medical surveillance requirements for both TtNUS Team and subcontractor personnel participating in site activities.

8.1.1 Requirements for TtNUS Team Personnel

All TtNUS Team personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at the site. Additionally, TtNUS Team personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before they can be cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of TtNUS introductory, supervisory and refresher training as well as site-specific training will be maintained at the TtNUS Wilmington office. Copies of certificates or other official documentation will be used to fulfill this requirement.

The TtNUS Team will also conduct a brief meeting daily to discuss operations and safety objectives planned for that day. At the end of the workday, a short meeting will be held to discuss the operations completed and any problems encountered.

8.1.2 Requirements for Subcontractors

All TtNUS subcontractor personnel must have completed the 40-Hour introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) and 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing field work at the site. TtNUS subcontractors must certify that each employee has had such training by sending TtNUS a letter, on company letterhead, containing the information in the example letter shown in Figure 8-1 and by providing copies of certificates for all subcontractor personnel participating in site activities.

8.2 SITE-SPECIFIC TRAINING

TtNUS Team will provide approximately a three one-hour (maximum) mandatory site-specific training to all TtNUS Team employees and subcontractor personnel who will perform intrusive work on this project. Site-specific training will also be provided to all personnel (EPA, etc.) who may enter the site to perform functions that may be directly related to site operations. Site-specific training will include:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of the contents of relevant Material Safety Data Sheets

Site-specific documentation will be verified through the use of Figure 8-2. All site personnel and visitors must sign this document upon receiving site-specific training.

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements for TtNUS Team Personnel

All TtNUS Team personnel participating in project field activities will have had a physical examination meeting the requirements of TtNUS's medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained in the TtNUS Wilmington office and made available, as necessary.

FIGURE 8-1
TRAINING LETTER

The following statements must be typed on company letterhead and signed by an officer of the company and accompanied by copies of personnel training certificates:

LOGO
XYZ CORPORATION
555 E. 5th Street
Town, State 55555

Month, day, year

Mr. Stephen Parker
Project Manager
Tetra Tech NUS, Inc.
55 Jonspin Road
Wilmington, MA 01887-1020

Subject: HAZWOPER Training

Dear Mr. Parker

As an officer of XYZ Corporation, I hereby state that I am aware of the potentially hazardous nature of the subject project. I also understand that it is our responsibility to comply with all applicable occupational safety and health regulations, including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1910 and Part 1926.

I also understand that Title 29 CFR 1910.120, entitled "Hazardous Waste Operations and Emergency Response," requires an appropriate level of training for certain employees engaged in hazardous waste operations. In this regard, I hereby state that the following employees have had 40 hours of introductory hazardous waste site training or equivalent work experience as requested by 29 CFR 1910.120(e) and have had 8 hours of refresher training as applicable and as required by 29 CFR 1910.120(e)(8). I further state that site supervisory personnel have had training in accordance with 29 CFR 1910.120(e)(4).

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

FIGURE 8-2
SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potentially hazardous nature of performing site activities at the Electroplating shop in Building 32 on Gould Island, Newport, Rhode Island, and that I have received site-specific training which included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on-site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of contents of relevant Material Safety Data Sheets

My signature below indicates that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction, and that the dates of my training and medical surveillance indicated below are accurate.

Name (Printed and Signature)	Site-Specific Training Date	Site Asbestos Training	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

8.3.2 Medical Surveillance Requirements for Subcontractors

Subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" provided in Figure 8-3 shall be used to satisfy this requirement, provided it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute the "Subcontractor Medical Approval Form" with a letter, on company letterhead, containing all of the information in the example letter presented in Figure 8-4 of this HASP.

8.3.3 Requirements for All Field Personnel

Each field team member entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet presented in Section 7 of the Health and Safety Guidance Manual. This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTIONS

Subcontractors who will not enter the contamination reduction and exclusion zone during operation and whose activities involve no potential for exposure to site contaminants will not be required to meet the requirements for training/medical surveillance other than site-specific training as stipulated in Section 8.2.

FIGURE 8-3
SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of _____
Company Name

Participant Name: _____ Date of Exam: _____

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f), and was found to be medically -

   ( ) qualified to perform work at the site
   ( ) not qualified to perform work at the site
   and,

2. Undergone a physical examination in accordance with OSHA 29 CFR 1910.134(b)(10) and was found to be medically -

   ( ) qualified to wear respiratory protection
   ( ) not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.

( ) A description of the employee's duties as they relate to the employee's exposures.

( ) A list of known/suspected contaminants and their concentrations (if known).

( ) A description of any personal protective equipment used or to be used.

( ) Information from previous medical examinations of the employee that is not readily available to the examining physician.

Part B

I, _____, have examined _____
Physician's Name (print) Participant's Name (print)

and have determined the following information:

FIGURE 8-3
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

   _____
   _____
   _____

2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

   _____
   _____
   _____

3. Recommended limitations upon the employee's assigned work:

   _____
   _____
   _____

I have informed this participant of the results of this medical examination and any medical conditions which require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the site, this participant

( ) may
( ) may not

perform his/her assigned task.

Physician's Signature _____

Address _____

Phone Number _____

NOTE: Copies of test results are maintained and available at:

_____

_____
Address

FIGURE 8-4
MEDICAL SURVEILLANCE LETTER

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
XYZ CORPORATION
555 E. 5th Street
Town, State 55555

Month, day, year

Mr. Stephen Parker
Project Manager
Tetra Tech NUS, Inc.
55 Jonspin Road
Wilmington, MA 01887-1020

Subject: Medical Surveillance

Dear Mr. Parker:

As an officer of XYZ Corporation, I hereby state that the persons listed below have participated in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response: Final Rule." I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive- and negative-pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at the Roto-Print Site.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,
(Name and Title of Company Officer)

9.0 SPILL CONTAINMENT PROGRAM

9.1 SCOPE AND APPLICATION

It is not anticipated that quantities of bulk potentially hazardous materials (greater than 55-gallons) will be handled during some of the site activities conducted as part of the scope of work. Small quantities of waste water (decontamination, purge and development) and Investigative-Derived Wastes (IDW) may be generated as part of site activities. It is not anticipated, however, that spillage of these materials would constitute a significant danger to human health or the environment. Furthermore, it is possible that as the job progresses, that disposable PPE and other non-reusable items may be generated. IDW will be generally be discharged onsite, however, if needed, 55 -gallon drums will be used to contain waste waters, IDW, and other unwanted items generated during investigation activities. These drums will be labeled with the site name, source, description of contents and the date the container was filled. If needed, samples will be collected and analyzed to characterize the material and determine appropriate disposal measures. Once characterized, the waste can be removed from the staging area and disposed of in accordance with Federal, State and local regulations.

9.2 POTENTIAL SPILL AREAS

Potential spill areas will be monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, there are various areas vulnerable to this hazard including the areas used for central staging and decontamination activities. Additionally, areas designated for handling, loading, and unloading of potentially contaminated soils, waters, and debris present limited potential for leaks or spills.

9.2.1 <u>Site Drums/Containers</u>

All drums/containers used for containing soils and liquids will be sealed, labeled, and staged within a centralized area awaiting shipment or disposal.

9.3 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic walk around by the SSO will be conducted during working hours to visually determine that containers are not leaking. If a leak is detected, the first approach will be to transfer the container contents (using a hand pump) into a new container. Other provisions for the transfer of container contents will be made and the appropriate emergency contacts will be notified, if necessary. In most instances, leaks will be collected and contained using absorbents such as Oil-dry, vermiculite, or sand, which will be stored at the staging area in a conspicuously marked drum. This material will also be containerized for disposal pending analyses. All inspections will be documented in the Project Logbook.

9.4 PERSONNEL TRAINING AND SPILL PREVENTION

All personnel will be instructed on the procedures for spill prevention, containment and collection of hazardous materials in the site-specific training. The FOL and/or the SSO will serve as the Spill Response Coordinator for this operation should the need arise.

9.5 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment that will be maintained at the staging area at all times for the purpose of supporting this Spill Prevention/Containment Program.

- Sand, clean fill, vermiculite, or other non-combustible absorbent (oil-dry);
- Drums (55-gallon U.S. DOT 17-E or 17-H)
- Portable storage tanks (if necessary)
- Shovels, rakes, and brooms
- Hand operated drum pump with hose
- Labels

9.6 SPILL CONTROL PLAN

This section describes the procedures the TtNUS Team field crew members will employ upon the detection of a spill or leak.

1) Notify the SSO or FOL immediately upon the detection of a leak or spill.

2) Employ personal protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the drum or raising the leak to the highest point. Spread the absorbent material in the area of the spill covering completely.

3) Transfer the material to a new container, collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment or disposal options.

4) Solid spills will be re-containerized with 2-inches of top cover and will await test results for treatment or disposal options.

It is not anticipated that a spill will occur in which the field crews cannot handle. Should this occur notification of appropriate the naval base emergency response team will be carried out by the FOL or SSO.

10.0 SITE CONTROL

This section outlines the means by which the TtNUS Team will delineate work zones and use these work zones in conjunction with decontamination procedures in order to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site. This three-zone approach will utilize an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants and protect individuals who are not cleared to enter work areas.

10.1 EXCLUSION ZONE

The exclusion zone will be considered the fenced area around and the interior of Building 32. The southern, eastern and northern site boundaries are delineated and enclosed with a fence that thereby limits access.

10.1.1 Exclusion Zone Clearance

Prior to the initiation of site activities, utility locations will be identified by utility companies contacted through DIGSAFE or through review of Naval base records. The positions of identified utilities will be field located and staked to minimize the potential for damage during intrusive activities. Sample locations can be located to avoid buried utilities. In the unlikely event that a utility is struck during a subsurface investigative activity, the emergency numbers provided in Table 2-1 will be notified. This effort shall be performed by Foster Wheeler Environmental Corporation.

Access to work areas will be controlled by Foster Wheeler Environmental Corporation.

10.2 CONTAMINATION REDUCTION ZONE

The contamination reduction zone (CRZ) will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. The personnel and equipment decontamination will take place in this area at a central location to facilitate and support field activities. When applicable. this area will be delineated using barrier tape, cones and/or drive poles, and postings to inform and direct facility personnel.

10.3 SUPPORT ZONE

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

10.4 SITE VISITORS

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by TtNUS Team
- Naval Base Personnel;
- Regulatory personnel (RIDEM, OSHA, etc.)
- Other authorized visitors

All personnel working on this project will be required to gain initial access to the site by coordinating with Naval Station Newport and Foster Wheeler Environmental Corporation, and the TtNUS Team FOL or designee and following established site access procedures.

Once access to the site is obtained all personnel who require site access into areas of ongoing operations will be required to obtain permission from the FOL and SSO. Upon gaining access to the site, all site visitors interested in observing operations in progress will be escorted by a TtNUS Team representative (arranged for by the FOL) and shall be required to meet the following minimum requirements:

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity which they represent, and the purpose of the visit.

- All site visitors will be required to produce the necessary information supporting clearance to the site. This shall include information attesting to applicable training (40-hours of HAZWOPER training) and medical surveillance as stipulated in Section 8.0 of this document. In addition, to enter the site operational zones during planned activities, all visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items, they will be permitted to enter the operational zone. All visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit. Any and all visitors not meeting the requirements stipulated in this plan will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause the termination of all on-site activities until the unauthorized visitor is removed from the premises. Removal of unauthorized visitors will be accomplished with support from the FOL or SSO.

10.5 SITE SECURITY

Site security will be the responsibilities of Naval Station Newport. TtNUS Team will retain control over active sampling locations. The first line of security consists of the waters of Narragansett Bay - the only way to access Gould Island is by boat and the dock at the North Firing Pier. All persons accessing the site will be required to report in to Foster Wheeler Environmental Corporation. Sign in logs will be maintained in their work trailer at the site.

10.6 SITE MAP

Once the areas of contamination, access routes, utilities, topography, and evacuation routes are determined, a site map will be generated and adjusted as site conditions change. These maps will show utility locations, potential points of contact with the public, roadways, and other significant characteristics that may impact site operations and safety. A site map to the hospital will also be provided.

10.7 BUDDY SYSTEM

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

10.8 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

The TtNUS Team and subcontractor personnel will provide MSDSs for all chemicals brought on-site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of all chemicals used on site will be developed using Figure 1 (Section 5) of the Health and Safety Guidance Manual. The MSDSs will then be maintained in a central location and will be available for anyone to review upon request.

10.9 COMMUNICATION

If personnel are not working in proximity to one another during field activities, a supported means of communication between field crews may be necessary. As a result, two-way radio communication devices may be used by field personnel while at the site.

External communication will be accomplished by using provided cellular telephones.

10.10 SAFE WORK PERMITS

All exclusion zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task by task basis. An example of the Safe Work Permit to be used is illustrated in Figure 10-1. The daily meetings conducted during their generation will further support these work permits. This effort will ensure all site-specific considerations and changing conditions are incorporated into the planning effort.

Use of these permits will provide the communication line for reviewing protective measures and hazards associated with each operation. This HASP will be used as the primary reference for selecting levels of protection and control measures. The work permit will take precedence over the HASP when more conservative measures are required based on specific site conditions.

The FOL and/or the SSO will be responsible for completing the safe work permit and issuing them to the appropriate parties. Site personnel at the end of each day's activity will turn in the permit(s) used for that day to the SSO. All permits will be maintained as part of the permanent project files attesting to safety and health measures employed for a given task at a given time and place. Any problems encountered with the protective measures required should be documented on the permit and brought to the attention of the SSO. Examples of safe work permits for soil borings and well installation soil sampling, and excavation operations are contained in Attachment IV.

FIGURE 10-1
SAFE WORK PERMIT

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): _____

II. Names: _____

III. Onsite Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ TtNUS _____ NSB-NLON

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. 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	☐

Modifications/Exceptions: _____

V. Chemicals of Concern | Action Level(s) | Response Measures

_____ _____ _____

VI. Additional Safety Equipment/Procedures

Hardhat	☐ Yes	☐ No	Hearing Protection	☐ 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/shank	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Workboots	☐ Yes	☐ No			

Modifications/Exceptions: _____

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment inspected	☐	☐	Assembly points	☐	☐

VIII. Equipment Preparation

	Yes	NA
Equipment drained/depressured	☐	☐
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	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No

If yes, contact Health Science, Pittsburgh, PA Office

X. Special instructions, precautions: _____

Permit Issued by: _____ Permit Accepted by: _____
Job Completed by: _____ Date: _____

11.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that confined space and permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces**. A confined space is defined as an area which has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section.
- Contains any other recognized and serious safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the SSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed.

12.0 MATERIALS AND DOCUMENTATION

The TtNUS Team FOL shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for all chemicals brought on-site, including decon solutions, fuels, lime, sample preservatives, calibration gases, etc.
- Follow-up Reports
- A full-size OSHA Job Safety and Health Poster (posted in the site trailers)
- Training/Medical Surveillance Documentation Form (Blank)
- First-Aid Supply Usage Form
- Emergency Reference Form (TtNUS H & S Guidance Manual, Section 2.0, extra copy for posting)

12.1 MATERIALS TO BE POSTED AT THE SITE

The following documentation is to be posted at the site for quick reference purposes. In situations where posting of these documents is not feasible, these documents should be separated and immediately accessible. Postings will be provided to and maintained by Foster Wheeler Environmental corporation in the administration office at the site.

Material Safety Data Sheets (MSDSs) - The MSDSs should also be in a central area accessible to all site personnel. These documents should match all the listings on the chemical inventory list for all

substances employed on site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster - This poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

Site Clearance Posting - This list is found within the training section of the HASP (See Figure 8-1). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. This list indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) - This list of numbers and the directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards - Medical Data Sheets will be filled out by all on-site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. A copy of this sheet or a wallet card will be given to all personnel to be carried on their person.

Placards and Labels - Chemical inventories that have been separated, because of quantities and incompatibilities, will be conspicuously marked using Department of Transportation (DOT) placards and acceptable [Hazard Communication 29 CFR 1910.1200 (f)] labels.

13.0 GLOSSARY

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air Purifying Respirators
AOC	Area of Concern
CFR	Code of Federal Regulations
CNS	Central Nervous System
CRZ	Contamination Reduction Zone
DOD	Department of Defense
DOT	Department of Transportation
EPA	Environmental Protection Agency
eV	electron Volts
FID	Flame Ionization Detector
FOL	Field Operations Leader
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
LEL/O_2	Lower Explosive Limit/Oxygen
N/A	Not Available
NIOSH	National Institute Occupational Safety and Health
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PID	Photo Ionization Detector
PPE	Personal Protective Equipment
PVC	Poly Vinyl Chloride
SAP	Sampling and Analysis Plan
SCBA	Self Contained Breathing Apparatus
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TOM	Task Order Manager
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
VOCs	Volatile Organic Compounds
WP	Work Plan

ATTACHMENT I

INJURY/ILLNESS PROCEDURE AND REPORT FORM

CASE NO. _____

TETRA TECH NUS, INC.

INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

WHAT YOU SHOULD DO IF YOU ARE INJURED OR DEVELOP AN ILLNESS AS A RESULT OF YOUR EMPLOYMENT:

- If injury is minor, obtain appropriate first aid treatment.
- If injury or illness is severe or life threatening, obtain professional medical treatment at the nearest hospital emergency room.
- If incident involves a chemical exposure on a project work site, follow instructions in the Health & Safety Plan.
- Immediately report any injury or illness to your supervisor or office manager. In addition, you must contact your Human Resources representative, Marilyn Diethorn at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours. You will be required to complete an Injury/Illness Report (attached). You may also be required to participate in a more detailed investigation from the Health Sciences Department.
- If further medical treatment is needed, The Hartford Network Referral Unit will furnish a list of network providers customized to the location of the injured employee. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work. Please call Marilyn Diethorn at (412) 921-8475 for the number of the Referral Unit.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local human resources representative, corporate health and safety coordinator, or Corporate Administration in Pasadena, California, at (626) 351-4664.

Worker's compensation is a state-mandated program that provides medical and disability benefits to employees who become disabled due to job related injury or illness. Tetra Tech, Inc. and its subsidiaries (Tetra Tech or Company) pay premiums on behalf of their employees. The type of injuries or illnesses covered and the amount of benefits paid are regulated by the state worker's compensation boards and vary from state to state. Corporate Administration in Pasadena is responsible for administering the Company's worker's compensation program. The following is a general explanation of worker's compensation provided in the event that you become injured or develop an illness as a result of your employment with Tetra Tech or any of its subsidiaries. Please be aware that the term used for worker's compensation varies from state to state.

WHO IS COVERED:

All employees of Tetra Tech, whether they are on a full-time, part-time or temporary status, working in an office or in the field, are entitled to worker's compensation benefits. All employees must follow the above injury/illness reporting procedures. Consultants, independent contractors, and employees of subcontractors are <u>not</u> covered by Tetra Tech's Worker's Compensation plan.

CASE NO. _____

WHAT IS COVERED:

If you are injured or develop an illness caused by your employment, worker's compensation benefits are available to you subject to the laws of the state you work in. Injuries do not have to be serious; even injuries treated by first aid practices are covered and must be reported. Please note that if you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

CASE NO. _____

TETRA TECH NUS, INC.
INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

To: Corporate Health and Safety Manager
Human Resource Administrator

Prepared by: _____

Position: _____

Project Name: _____

Office: _____

Project No. _____

Telephone: _____

Information Regarding Injured or Ill Employee:

Name: _____

Office: _____

Home address: _____

Gender: M ☐ F ☐ No. of dependents: _____

_____

Marital status: _____

Home telephone: _____

Date of birth: _____

Occupation (regular job title): _____

Social Security No.: _____

Department: _____

Date of Accident: _____ **Time of Accident:** _____

Location of Accident Was place of accident or exposure on employer's premises Yes ☐ No ☐

Street address: _____

City, state, and zip code: _____

County: _____

Narrative Description of How Accident Occurred: (Be specific. Explain what the employee was doing and how the accident occurred.)

TETRA TECH, INC.
INJURY/ILLNESS REPORT

Did employee die? Yes ☐ No ☐
Was employee performing regular job duties? Yes ☐ No ☐
Was safety equipment provided? Yes ☐ No ☐
Was safety equipment used? Yes ☐ No ☐
Note: Attach any police reports or related diagrams to this accident report.

Witness(es):

Name:

Address:

Telephone:

Describe the Illness or Injury and Part of Body Affected:

Name the Object or Substance which Directly Injured the Employee:

Medical Treatment Required:

☐ No ☐ Yes ☐ First Aid Only

Physician's Name: _____

Address: _____

Hospital or Office Name: _____

Address: _____

_____

Telephone No.: _____

Lost Work Days:

☐ No. of Lost Work Days _____

Last Date Worked _____

Time Employee Left Work _____

Date Employee Returned to Work _____

☐ No. of Restricted Work Days _____

☐ None

Corrective Action(s) Taken by Unit Reporting the Accident:

Corrective Action Still to be Taken (by whom and when):

Name of Tetra Tech employee the injury or illness was first reported to: _____

Date of Report: _____ Time of Report: _____

	Printed Name	Signature	Telephone No.	Date
Project or Office Manager				
Site Safety Coordinator				
Injured Employee				

To be completed by Human Resources:

Date of hire: Hire date in current job:

Wage information: $ _____ per _____ (hour, day, week, or month)

Position at time of hire:

Shift hours:

State in which employee was hired:

Status: ☐ Full-time ☐ Part-time Hours per week: _____ Days per week: _____

Temporary job end date:

To be completed during report to workers' compensation insurance carrier:

Date reported: Reported by:

TeleClaim phone number:

TeleClaim account number:

Location code:

Confirmation number:

Name of contact:

Field office of claims adjuster:

ATTACHMENT II

STANDARD OPERATING PROCEDURES
FOR
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 service locating and excavation clearance. It is the policy of TtNUS to provide a safe and healthful work environment for the protection of our employees. The purpose of this SOP is to aid in achieving the objectives of the TtNUS Utility Locating and Clearance Policy. The TtNUS Utility Locating and Clearance Policy should be reviewed by anyone 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 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 development of detailed operating procedures. This guidance is not intended to provide a detailed description of methodology and 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 a fixed distance apart. 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 - 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) or 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).

Site Health & Safety Officer (HSO) – Responsible to provide technical assistance and verify full compliance with this SOP and the TtNUS Utility Locating and Clearance Policy. The HSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager and to the Project Manager.

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 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 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.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM is responsible for arranging for the procurement of a qualified, experienced, utility locating contractor 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 site inspection must be performed to compare the site plan information to actual conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation must be marked at the site in white paint or pin flags to notify personnel of the proposed excavation 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, 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.

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 on (and comply with) property owner requirements. It is important to note that private property owners may require from 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 are to mark their respective lines within the specified time frame.

5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other 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 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 auguring. Each method has advantages and disadvantages including complexity, applicability, and price.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment and utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed with a hand augur or pole 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 uncovered utilities must be supported. 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 Health and Safety Manager. 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 electromagnetics, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References in Section 6.0.

Electromagnetics

Electromagnetic (EM) 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 good example of this type of geophysical equipment is an EM-61.

EM 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 EM surveys, simple magnetic locating and traced nonmetallic surveys.

When access can be gained to a conduit, a flexible insulated trace wire can also 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) and steel utility lines. A good 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.

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 is 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. 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. High-quality hand-held thermal imagers are available from $15,000 to $30,000, with prices decreasing as new systems are introduced.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to determine the exact horizontal and vertical location of 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 physical methods, borings must be hand-augured for all locations where there is a potential to impact buried utilities. Hand auguring must be performed to depths of no less than 4 feet. 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 3 presents frost line depths for the regions of the continental 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 auguring, 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 that a post-hole digger is not used in place of a hand augur.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, tile probes may be used instead of or in addition to hand augurs. Tile probes must be performed to the same depth requirements as hand augurs. Depending upon the site conditions and intended probe usage, tile probes should be made of non-conductive material such as fiberglass.

7.0 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
UTILITY CLEARANCE FORM

Project No.: _____ Completed by: _____

Site Location: _____ Work Date: _____

Excavation Method/Overhead Equipment: _____

			Circle One		
1.	Underground Utilities				
	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
	b)	Excavation areas marked in the field?	yes	no	N/A
	e)	Utilities located in the field?	yes	no	N/A
	f)	Located utilities added to site maps?	yes	no	N/A
	g)	State One-Call agency called?	yes	no	N/A
		Caller: _____			
		Ticket Number: _____ Date: _____			
	h)	Geophysical survey performed?	yes	no	N/A
		Survey performed by: _____			
		Method: _____ Date: _____			
	i)	Hand auguring performed?	yes	no	N/A
		Auguring completed by: _____			
		Total depth: _____ feet Date: _____			
	j)	Trench/excavation probed?	yes	no	N/A
		Probing completed by: _____			
		Depth/frequency: _____ Date: _____			
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): _____			

6. Approval:

_____ _____

Site Manager/Field Operations Leader Date

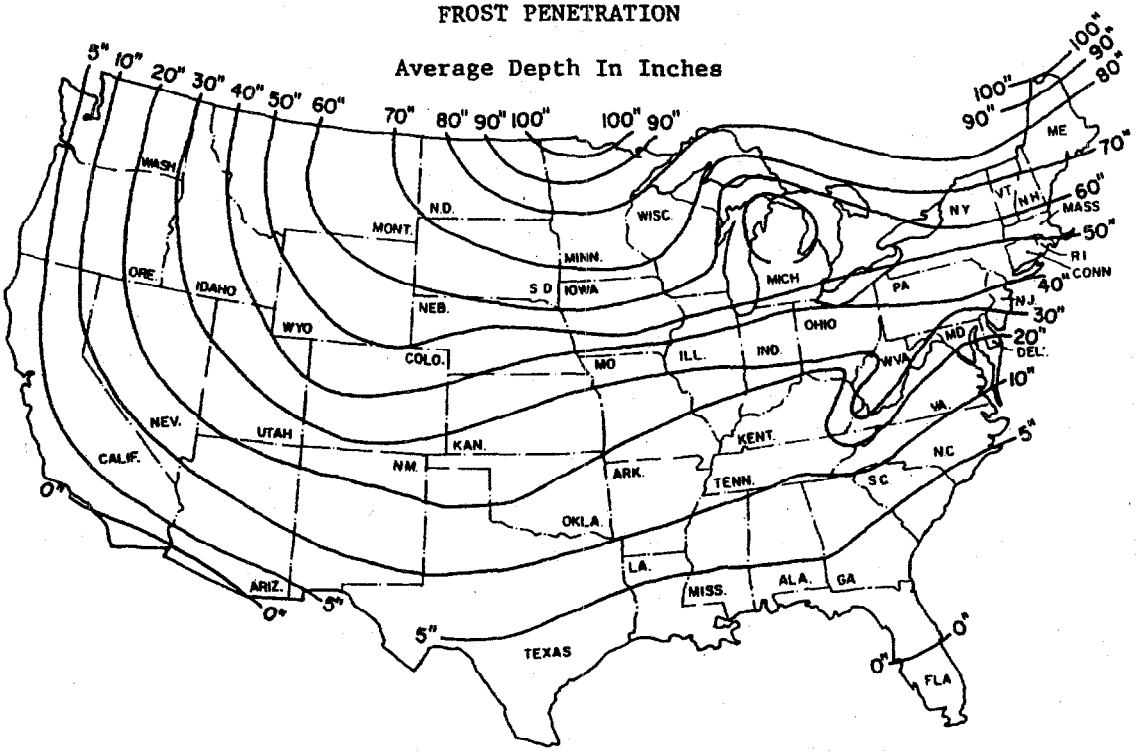
cc: PM/Project File
Program File

ATTACHMENT 3

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION

FROST PENETRATION

Average Depth In Inches



Courtesy U.S. Department Of Commerce

ATTACHMENT III

TICK CONTROL
AND
LYME DISEASE

TICK CONTROL
AND
LYME DISEASE

The occurrence of Lyme disease has become a worldwide problem since its identification in 1976. This disease is characteristically recognized as being transmitted by ticks, which may be encountered by field personnel while working at this site. As a result, this discussion has been included with this Health and Safety Plan to provide for adequate recognition, evaluation, and control efforts to minimize the occurrence and effects of this potential hazard.

The discovery of Lyme disease is credited to Dr. Allen Steere of Yale University Medical School, and is named after the community where it was (reportedly) first encountered, Lyme, Connecticut. This disease can be transmitted to man through the bite of ticks that are infected with a cork screw-shaped microbe (spirochete). The spread of this disease has been so rapid that in 1984 it surpassed Rocky Mountain Spotted fever as the most common tick-borne disease in the United States. In this country, most of the incidents of this disease have been recorded in the Northeast, and the tick species most commonly attributed with its spread is the deer tick.

Recognition

This hazard potential exists primarily in the spring and summer months, as these are the seasons that tick populations and activity flourish. In fact, 90 percent of the reported cases have occurred from early June through September. Also, this concern exists primarily in heavily vegetated areas. Therefore, recognition of these factors can aid in the awareness and control of this threat.

Ticks attach themselves to animals (including man) that pass through the area and rub against them. After finding a host, the tick inserts its mouthparts and sucks blood until it is fully engorged. This requires a time period of three to twelve days, then the tick will drop off. Two species of tick, the American Dog Tick (*Dermacentor variabilis*) and the Deer Tick (*Ixodes dammini*) commonly occur in northeast and typically are present in areas covered with tall grass or dense underbrush.

The most common of these species is the American Dog Tick (*Dermacentor variabilis*). This tick, which is approximately 0.30–inch long, has been identified as a transmitter of Rocky Mountain Spotted Fever, the organisms of tularemia and possibly relapsing fever. Deer Ticks are about 1/3 smaller than dog ticks, reaching a maximum (unengorged) adult size of approximately 0.10-inch. However, their larval and nymphal stages are no bigger than a pinhead. The Deer Tick is primarily responsible for the transmission of Lyme disease. In addition to Lyme disease concerns, the wounds left by tick bites can be painful, and can also have a paralyzing effect commonly referred to as tick paralysis. Illustrations of Deer and Dog Tick I are included in this attachment..

The earliest symptom of the onset of this disease is often the occurrence of an unusual red skin rash. This is commonly the first indication since it has been evidenced that many persons who have contracted this disease were, in fact, unaware that they had been bitten. This rash can appear at the site of the bite anywhere from several days to a few weeks after the bite. It typically starts as a small red spot, and then expands as the spirochetes expand from the bite location. It is important to note that the rash *does not always appear* after receiving a tick bite. Rash sizes can vary, but have been most commonly associated in a 2 to 3 inch diameter size range. This rash will fade (with or without treatment) after a few weeks Close inspection is necessary to detect this symptom as the rashes are easy to miss because they're often very faint. Body sites where rashes frequently occur include the thigh areas, groin, and armpits. Also, it is not uncommon for a rash to develop in more than one place.

Other early symptoms include profound fatigue, a stiff neck, and flu-like symptoms such as headache. chills, fever, and muscle aches. Recognition of the onset of any of these symptoms is important since tick bites do not always produce a rash. If left untreated, the disease will progress to its second stage within weeks or months after the infection. This stage involves affects to the heart and nervous system. A common second stage symptom is a paralysis on one or both sides of the face. Others include severe headache, encephalitis, or meningitis. The third and final stage involves the development of chronic inflammatory arthritis, which can occur up to a year or more after the bite.

Evaluation

Evaluation of this hazard potential principally involves field personnel performing close self-inspections for the presence of ticks each time they leave the site. This should involve careful examination, especially of the individuals' heads. Personnel should be aware that when a tick attaches itself to its host, it inserts its entire head under the surface of the skin.

Control

Control of this threat involves several components. First, field personnel must be aware of the climate and area conditions which are commonly associated with being conducive to tick infestation. Second, when working in or walking through potential infested areas, personnel must ensure that they do not have exposed body parts (i.e. at least long sleeved shirts and long pants, particularly when protective coveralls are not worn). In heavily vegetated areas where infestation is likely, Tyvek coveralls will be required to minimize this hazard potential. Also, several commercial products have been demonstrated as being effective in repelling ticks. Examples include Permanone, Off!, and Cutter. These types of repellents will be used at the direction and discretion of the Tetra Tech NUS Health and Safety Officer, and only in accordance and observation of manufacturer's recommendations. In most instances, however, such repellents are typically applied to the outside surfaces of clothing (and not directly onto the skin), and should be applied also to shoe tops, socks, pants cuffs, and other areas most susceptible to ticks.

Tick Removal

In the event that a tick is discovered to be attached to a member of the field team, timely removal of the insect is critical to reducing the potential for contracting the disease. According to available information and research, there is apparently a grace period of at least a few hours from the time of the bite before the tick transmits the microbe (the spirochetes are not present in the mouth parts of the tick). However, the incident of a tick bite is frequently unnoticed, and the discovery of the tick may not occur until after this suspected grace period has already elapsed. Therefore, timely removal is very important. The preferred method of tick removal is to pull it out using tweezers or small forceps. In this method, the tick should be grasped as close to the mouth as possible, and then pulled steadily upward. Care must be exercised so as not to pull in a jerking motion as this can result in the head becoming detached. After the tick has been removed, disinfect the bite with rubbing alcohol or povidone iodine (Betadine). The tick must not be handled as the microbes can enter the body through any breaks in intact skin. The bite should be checked occasionally for at least a two-week period to see if a rash forms. If it does, medical attention must be promptly sought.

In order to provide for proper and timely response to the occurrence of a tick bite, the SSO will ensure that the site First Aid kit is properly equipped with medical forceps and rubbing alcohol, in addition to the standard kit contents. Also, an adequate supply of commercial insect (tick) repellents will be maintained on-site, and all personnel will be trained in its proper application and will be required to use it, at the direction of FOL.

ATTACHMENT IV

NETC UTILITY CLEARANCE FORM

DIG - SAFE REQUEST

Number given by DIG-SAFE Center : 2000-150 - 8212

Day / Month / Hour safe to dig after : April 10, 2000 11:45 Am

N.E.T.C. Dig - safe Number :

GOVT. Point of Contact:

* NOTE : DO NOT FILL ABOVE THIS LINE *

Person Submitting : Stephen S. Parker Phone # 978-658-7899

TO : Utilities Operation Section, Code 452

1. Name of company doing work : Tetra Tech NUS Inc.
2. Town / City where company is located : 55 Jonspin Rd, Wilmington MA 01887
3. Phone # of company : 978-658-7899
4. Contract or job order number : ~~Contract~~ N62472-90-D-1298/C TO 286
5. Location of dig - safe : Building 32, Gould Island
6. Building or house number : Building 32, All area within fence
7. Street name(s) : NA (GOULD ISLAND)
8. Town / City of dig - safe : Newport / Jamestown
9. Reason for dig - safe : Test holes in Building foundation ~ 24"
10. Anticipated digging depth : 24"
11. Is dig - safe staked : YES : AREA NOTED BY FENCE NO :
12. Map or sketch attached : YES : X NO :
13. Point of contact : Stephen S. Parker / Dave Masse (Site)

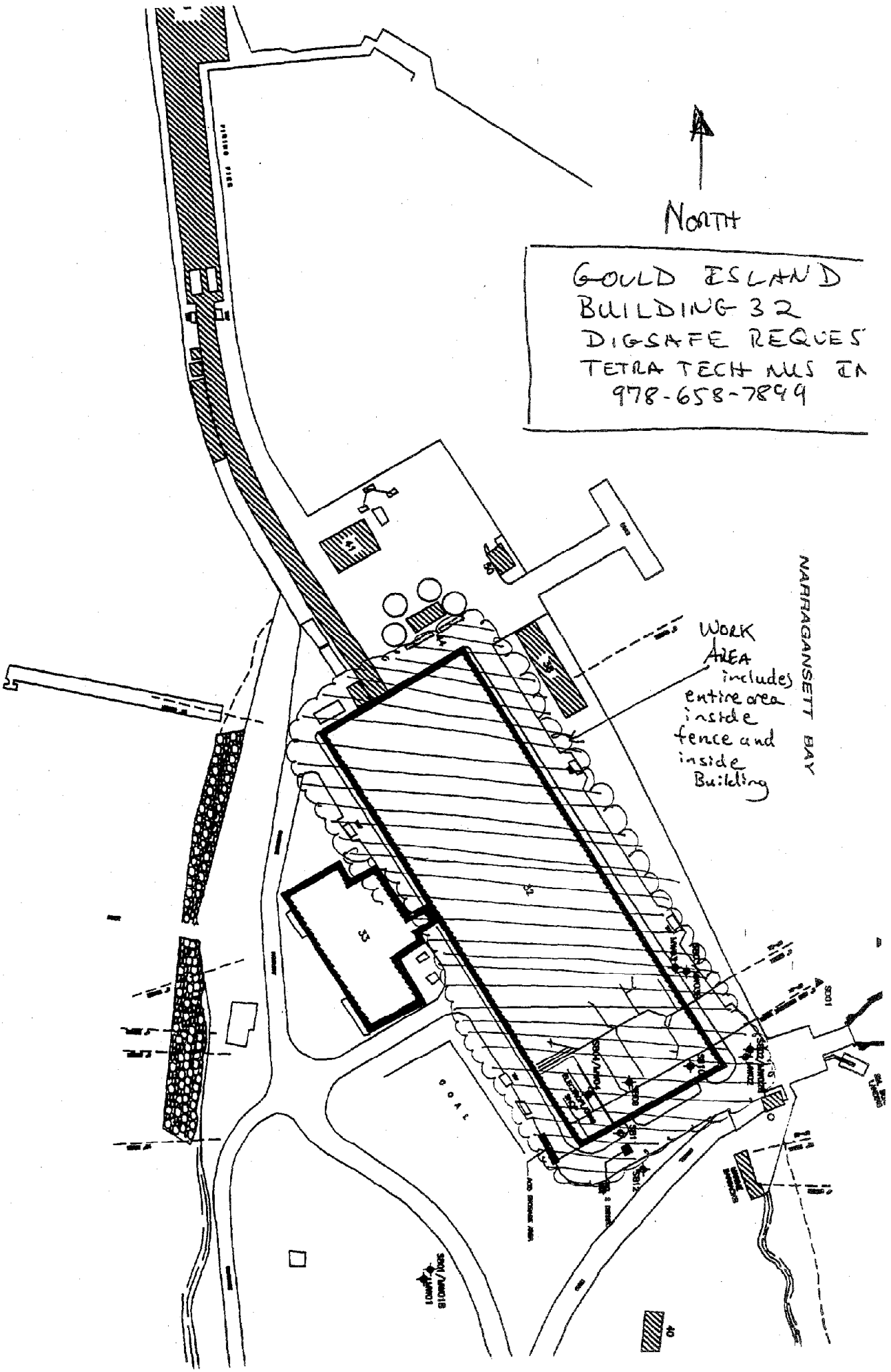
HOURS USED : DIG - SAFE #

DIG - SAFE CLEARED THROUGH : (ELECTRIC) (WATER) (STEAM) (SEWAGE)

CLEARED BY : DATE :

* NOTE : Dig - safes are only good for five (5) days after completion date of this request. *

A DIG - SAFE REQUEST MUST BE SUBMITTED AT LEAST TWO (2) WORKING DAYS PRIOR TO EXCAVATION. EMERGENCIES WILL BE GIVEN SPECIAL CONSIDERATION.


NARRAGANSETT BAY
WORK AREA includes entire area inside fence and inside Building
COAL
NORTH
GOULD ISLAND
BUILDING 32
DIGSAFE REQUES
TETRA TECH NUS IN
978-658-7899

ATTACHMENT V

EQUIPMENT INSPECTION

EQUIPMENT INSPECTION

COMPANY:_____ **UNIT NO.**_____

FREQUENCY: Inspect daily, document prior to use and as repairs are needed.

Inspection Date: ____/____/____ Time: _____ Equipment Type:_____
(e.g., bulldozer)

	Good	Need Repair	N/A
Tires or tracks	❒	❒	❒
Hoses and belts	❒	❒	❒
Cab, mirrors, safety glass	❒	❒	❒
- Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	❒	❒	❒
- Is the equipment equipped with audible back-up alarms and back-up lights?	❒	❒	❒
Horn and gauges	❒	❒	❒
Brake condition (dynamic, park, etc.)	❒	❒	❒
Fire extinguisher (Type/Rating -_____)	❒	❒	❒
Fluid Levels:			
- Engine oil	❒	❒	❒
- Transmission fluid	❒	❒	❒
- Brake fluid	❒	❒	❒
- Cooling system fluid	❒	❒	❒
- Windshield wipers	❒	❒	❒
- Hydraulic oil	❒	❒	❒
Oil leak/lube	❒	❒	❒
Coupling devices and connectors	❒	❒	❒
Exhaust system	❒	❒	❒
Blade/boom/ripper condition	❒	❒	❒
Accessways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	❒	❒	❒
Power cable and/or hoist cable	❒	❒	❒
Steering (standard and emergency)	❒	❒	❒

Safety Guards:

	Yes	No
– Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact?_____	❒	❒
– Hot pipes and surfaces exposed to accidental contact?_____	❒	❒
– All emergency shut offs have been identified and communicated to the field crew?_____	❒	❒
– Have emergency shutoffs been field tested? _____	❒	❒
– Results?_____	❒	❒
– Are any structural members bent, rusted, or otherwise show signs of damage?_____	❒	❒
– Are fueling cans used with this equipment approved type safety cans?_____	❒	❒

- Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use?_____ ❒ ❒

Portable Power Tools:

- Tools and Equipment in Safe Condition?_____ ❒ ❒
- Saw blades, grinding wheels free from recognizable defects (grinding wheels have been sounded)? ❒ ❒
- Portable electric tools properly grounded?_____ ❒ ❒
- Damage to electrical power cords?_____ ❒ ❒
- Blade guards in place?_____ ❒ ❒
- Components adjusted as per manufacturers recommendation?_____ ❒ ❒

Cleanliness:

- Overall condition (is the decontamination performed prior to arrival on-site considered acceptable)?_____
- Where was this equipment used prior to its arrival on site?_____
- Site Contaminants of concern at the previous site?_____
- Inside debris (coffee cups, soda cans, tools and equipment) blocking free access to foot controls?_____

Operator Qualifications (as applicable for all heavy equipment):

- Does the operator have proper licensing where applicable, (e.g., CDL)?_____
- Does the operator, understand the equipments operating instructions?_____
- Is the operator experienced with this equipment? _____
- Does the operator have emotional and/or physical limitations which would prevent him/her from performing this task in a safe manner?_____
- Is the operator 21 years of age or more?_____

Identification:

- Is a tagging system available, for positive identification, for tools removed from service?___

Additional Inspection Required Prior to Use On-Site

	Yes	No
- Does equipment emit noise levels above 90 decibels?	❒	❒
- If so, has an 8-hour noise dosimetry test been performed?	❒	❒

- Results of noise dosimetry:_____
- Defects and repairs needed:_____
- General Safety Condition: _____
- Operator or mechanic signature:_____

Approved for Use: ❒ Yes ❒ No

_____
Site Safety Officer Signature

ATTACHMENT VI
TtNUS RESPIRATORY PROTECTION SOP
SITE RESPIRATORY PROTECTION PROGRAM

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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 service locating and excavation clearance. It is the policy of TtNUS to provide a safe and healthful work environment for the protection of our employees. The purpose of this SOP is to aid in achieving the objectives of the TtNUS Utility Locating and Clearance Policy. The TtNUS Utility Locating and Clearance Policy should be reviewed by anyone 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 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 development of detailed operating procedures. This guidance is not intended to provide a detailed description of methodology and 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 a fixed distance apart. 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 - 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) or 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).

Site Health & Safety Officer (HSO) – Responsible to provide technical assistance and verify full compliance with this SOP and the TtNUS Utility Locating and Clearance Policy. The HSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager and to the Project Manager.

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 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 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.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM is responsible for arranging for the procurement of a qualified, experienced, utility locating contractor 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 site inspection must be performed to compare the site plan information to actual conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation must be marked at the site in white paint or pin flags to notify personnel of the proposed excavation 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, 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.

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 on (and

comply with) property owner requirements. It is important to note that private property owners may require from 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 are to mark their respective lines within the specified time frame.

5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other 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 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 auguring. Each method has advantages and disadvantages including complexity, applicability, and price.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment and utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed with a hand augur or pole 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 uncovered utilities must be supported. 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 Health and Safety Manager. 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 electromagnetics, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References in Section 6.0.

Electromagnetics

Electromagnetic (EM) 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 good example of this type of geophysical equipment is an EM-61.

EM 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 EM surveys, simple magnetic locating and traced nonmetallic surveys.

When access can be gained to a conduit, a flexible insulated trace wire can also 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) and steel utility lines. A good 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.

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 is 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. 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. High-quality hand-held thermal imagers are available from $15,000 to $30,000, with prices decreasing as new systems are introduced.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to determine the exact horizontal and vertical location of 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 physical methods, borings must be hand-augured for all locations where there is a potential to impact buried utilities. Hand auguring must be performed to depths of no less than 4 feet. 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 3 presents frost line depths for the regions of the continental 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 auguring, 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 that a post-hole digger is not used in place of a hand augur.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, tile probes may be used instead of or in addition to hand augurs. Tile probes must be performed to the same depth requirements as hand augurs. Depending upon the site conditions and intended probe usage, tile probes should be made of non-conductive material such as fiberglass.

7.0 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
UTILITY CLEARANCE FORM

Project No.: _____ Completed by: _____

Site Location: _____ Work Date: _____

Excavation Method/Overhead Equipment: _____

			Circle One
1.	Underground Utilities		
	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
	b)	Excavation areas marked in the field?	yes no N/A
	e)	Utilities located in the field?	yes no N/A
	f)	Located utilities added to site maps?	yes no N/A
	g)	State One-Call agency called?	yes no N/A
		Caller: _____	
		Ticket Number: _____ Date: _____	
	h)	Geophysical survey performed?	yes no N/A
		Survey performed by: _____	
		Method: _____ Date: _____	
	i)	Hand auguring performed?	yes no N/A
		Auguring completed by: _____	
		Total depth: _____ feet Date: _____	
	j)	Trench/excavation probed?	yes no N/A
		Probing completed by: _____	
		Depth/frequency: _____ Date: _____	
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): _____	

6. Approval:

_____ _____

Site Manager/Field Operations Leader Date

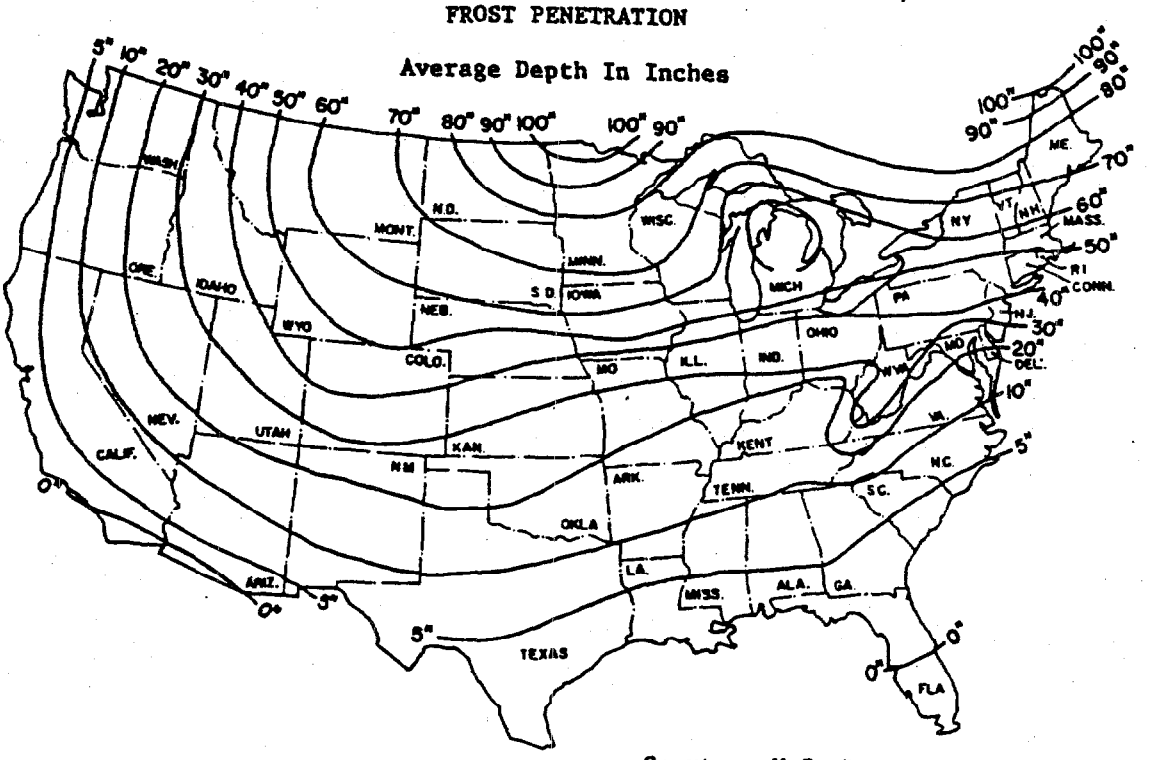
cc: PM/Project File
Program File

ATTACHMENT 3

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION

FROST PENETRATION

Average Depth In Inches



Courtesy U.S. Department Of Commerce

DIG - SAFE REQUEST

Number given by DIG-SAFE Center : 2000-150 - 8212

Day / Month / Hour safe to dig after : April 10, 2000 11:45 AM

N.E.T.C. Dig - safe Number :

GOVT. Point of Contact:

* NOTE : DO NOT FILL ABOVE THIS LINE *

Person Submitting : Stephen S. Parker Phone # 978-658-7899

TO : Utilities Operation Section, Code 452

1. Name of company doing work : Tetra Tech NUS Inc.
2. Town / City where company is located : 55 Jonspin Rd, Wilmington MA 01887
3. Phone # of company : 978-658-7899
4. Contract or job order number : ~~Contract~~ N62472-90-D-1298 TO 286
5. Location of dig - safe : Building 32, Gould Island
6. Building or house number : Building 32, All area within fence
7. Street name(s) : NA (GOULD ISLAND)
8. Town / City of dig - safe : Newport / Jamestown
9. Reason for dig - safe : Test holes in Building foundation ~ 24"
10. Anticipated digging depth : 24"
11. Is dig - safe staked : YES : AREA NOTED BY FENCE NO :
12. Map or sketch attached : YES : X NO :
13. Point of contact : Stephen S. Parker / Dave Masse (Site)

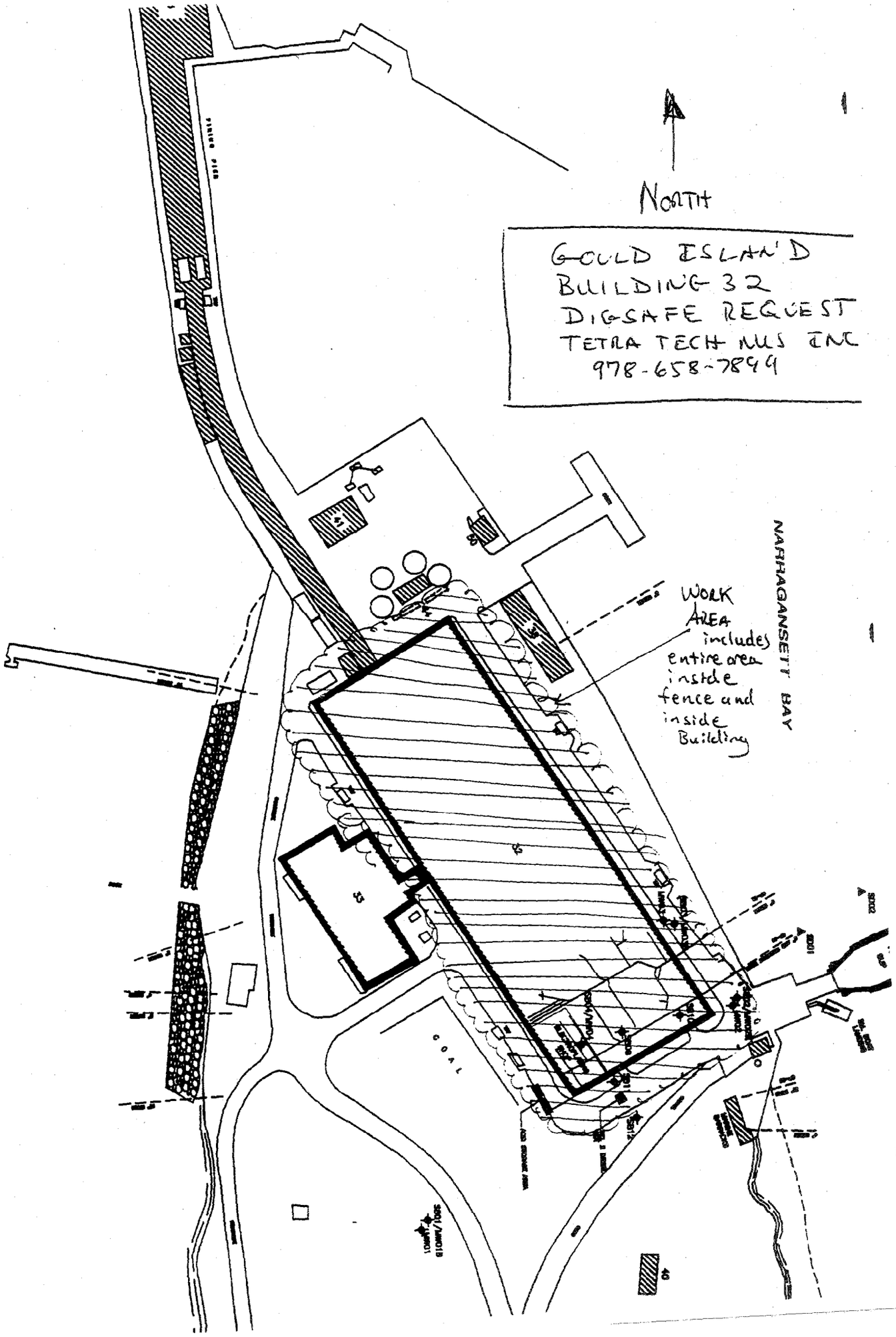
HOURS USED : DIG - SAFE #

DIG - SAFE CLEARED THROUGH : (ELECTRIC) (WATER) (STEAM) (SEWAGE)

CLEARED BY : DATE :

* NOTE : Dig - safes are only good for five (5) days after completion date of this request. *

A DIG - SAFE REQUEST MUST BE SUBMITTED AT LEAST TWO (2) WORKING DAYS PRIOR TO EXCAVATION. EMERGENCIES WILL BE GIVEN SPECIAL CONSIDERATION.


NARRAGANSETT BAY
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DIGSAFE REQUEST
TETRA TECH NUS INC
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TETRA TECH NUS
RESPIRATORY PROTECTION PROGRAM

1.0 PURPOSE

The Respiratory Protection Program (RPP) establishes the uniform procedures and minimum requirements for use of respiratory protection on projects performed by (or managed by) Tetra Tech NUS personnel.

1.1 Scope

This program applies to all Tetra Tech NUS projects with a scope of work that includes the use of respiratory protection as specified in a site-specific health and safety plan (HASP) or specified work plan. This program will be implemented based on directed use or personal preference of Tetra Tech NUS personnel to employ respiratory protection. This program has been developed on the basis of the following requirement:

- That this program will be implemented on a site-specific basis, establishing flexibility to provide for the protection of the health and safety of Tetra Tech NUS personnel, as well as for internal and regulatory compliance. This concept recognizes that Tetra Tech NUS personnel work on many different sites, often with only brief field operations tasks, as opposed to longer term project sites.

This site-specific program includes technical guidelines that are based on sound accepted industrial hygiene and safety and health principles. The guidelines presented in this program are generated and maintained through Tetra Tech NUS corporate safety and health administrative structure and by persons identified as responsible for the execution of the work site elements. This program will be maintained and improved through the participation of all Tetra Tech NUS personnel and through information generated through periodic program evaluations.

2.0 RESPONSIBILITIES

The following Tetra Tech NUS personnel are responsible for the support and implementation of the described program elements.

Tetra Tech NUS President: Has the overall responsibility for the health and safety of all personnel and operations in the Tetra Tech NUS. This responsibility is principally satisfied through delegating the necessary authority and accountability to the Tetra Tech NUS Office Management level. Successful accomplishment and maintenance of this and other health and safety programs will be achieved through such means as ensuring that health and safety is a principal component of personnel annual performance reviews ranging from Tetra Tech NUS top management through to each employee.

Tetra Tech NUS Office Management: Provide labor and equipment resources necessary to comply with the requirements of this program. Other responsibilities include:

- Establishing office policy concerning the use of respiratory protection for all Tetra Tech NUS operations.

- Supporting the office health and safety Point of Contact in the implementation and maintenance of this program for that office.

Tetra Tech NUS Health and Safety Manager (HSM): The HSM will serve as the Program Administrator and provide technical management and oversight of this program, and will aid all Tetra Tech NUS locations in effectively implementing these requirements. The Tetra Tech NUS HSM will also be responsible for monitoring the overall effectiveness of this program. This will be accomplished by:

- Reviewing random completed site-specific programs to ensure compliance. This will be performed on a periodic basis.
- Performing field audits of select project sites where respiratory protection is employed.
- Obtaining feedback from Tetra Tech NUS office health and safety Points of Contact and employees concerning the effectiveness of the program elements.
- Maintaining proficiency in regulatory requirements regarding the use of respiratory protection.
- Modifying elements of this program, when or as appropriate.

Other specific responsibilities of the Tetra Tech NUS HSM include:

- Defining minimum components of respiratory protection training course material, both for in-house and subcontractor-provided training courses
- Maintaining appropriate record-keeping for this program.
- Regularly communicating with Tetra Tech, Inc. Corporate Health and Safety, to satisfy overall company requirements.

Office Health and Safety Points of Contact (POCs): Ensure that the requirements of this program are satisfied for all project operations using respiratory protection. Other responsibilities include ensuring that:

- RP training is provided by subcontractors, that an appropriate organization is selected, and that the training course material satisfies the Tetra Tech NUS requirements.

- No individual is permitted to use respiratory protection in any Tetra Tech NUS operations unless they are fully compliant with all program requirements.

- All avenues to accomplish a specific task in a manner where respiratory protection is not necessary (such as the use of engineering controls) are exhausted, and that respiratory protection is selected as a hazard control approach only as a last resort.

- A properly completed written program is present at every site where respiratory protection is used.

- Appropriate documentation is maintained for that office, and that completed site-specific programs are submitted to the HSM at the conclusion of identified project activities to facilitate the periodic program review requirement.

Site Safety Officers (SSO): Ensure that the requirements of this program are satisfied for all Tetra Tech NUS operations performed or managed at their sites using respiratory protection. Other responsibilities include ensuring that:

- All respiratory equipment to be used at their location is inspected meeting manufacturer's minimum operational readiness requirements. All respiratory equipment to be employed at Tetra Tech NUS project work sites is certified for its intended use. Approved respiratory devices will be identified as such through the use of stickers and/or markers to indicate operational status as well as a log to indicate Tetra Tech NUS numbers inspected and approved. All respiratory devices, prior to being pressed into service will be inspected and this inspection documented. The SSO will not take for granted all equipment released from the equipment warehouse has undergone such scrutiny and is operationally ready.

- All personnel at the Tetra Tech NUS project work site who will employ respiratory protection are trained to the appropriate level for the tasks to be performed and documentation certifying this training

is obtained or generated on site through the incorporation of this program as part of site-specific training.

- All personnel at the Tetra Tech NUS project work site meet the necessary medical qualifications to perform their identified tasks wearing negative or positive pressure respiratory protection.

- Rescue services are readily available during IDLH operations under respiratory protection.

- Intended rescue services receive the necessary information concerning the hazards associated with IDLH operations. Including Material Safety Data Sheets or HASPs, where available, information concerning hazard atmospheres and any associated physical hazards.

Field Operations Leader (FOL): Smaller work site operations and operations with minimal hazards may not be provided the support of an SSO. In such cases the FOL will be responsible for assuming the duties of the SSO.

Note: All operations in respiratory protection Level B and greater will be supported by an SSO as part of standard protocol.

Equipment Manager: The Equipment Manager is the primary point of reference for dispersion of respiratory protective devices to Tetra Tech NUS project work sites. In addition the Equipment Manager is responsible for the following elements:

- Ensuring all respiratory devices to be sent to Tetra Tech NUS project work sites have been inspected and meet the manufacturer's definition for operational readiness. This inspection will take place prior to shipping any respiratory device to a project location. The Equipment Manager shall also mark and label respiratory devices for readiness through the use of stickers, tags, or other labels.

- Repairing respiratory protection (within training and qualification limits). When needed repairs are at a level for which the Equipment Manager is not qualified, he/she shall expedite repairs at an approved location.

3.0 RESPIRATORY PROTECTION PROGRAM ELEMENTS

3.1 Introduction

The following elements represent the minimum RPP requirements. Within these requirements, elements of this program have been subdivided to represent administrative responsibilities and sections to be completed at the work site (Attachment A) by identified personnel. Both sections must be completed by the designated representative for each Tetra Tech NUS project location employing respiratory protection.

The minimum elements to be covered as part of this RPP and the administrative or work site responsibility for their completion is as follows:

1. Procedures for selecting the proper respirators for use - Administrative
2. Medical evaluations of employees - Administrative/Work site
3. Fit testing respiratory protective equipment - Administrative/Work site
4. Procedures for proper use and application of respiratory equipment - Administrative
5. Maintenance procedures (cleaning, inspection, storage, repairs, and replacement) - Administrative/Work site
6. Procedures for atmospheric supplying respirators (air quality, quantity, and delivery) - Administrative/Work site
7. Training in all aspects of this program including respiratory hazards, use/application of respiratory protection in controlling these hazards, and program maintenance elements - Administration/Work site

8. Program evaluation/modification - Administrative/Work site

3.1.1 Administrative Responsibilities of the Above Identified Program Elements

The following elements represent the administrative responsibilities to be carried out under the guidance and direction of the HSM in accordance with corporate policy and regulatory requirements as established in 29 CFR 1910.134.

3.1.1.1 Procedures For Selecting The Proper Respirators For Use

Currently, within Tetra Tech NUS respiratory protection devices for which this program governs use and application fall into four classifications. These are as follows:

- Air Purifying Respirators (APRs) - These include half and full-face mask configurations using filter elements including cartridges and canisters to clean atmospheric air.

- Powered Air Purifying Respirators (PAPRs) - This type of respirator also employs air purifying elements as the APRs above. The primary difference is a power source or battery operated pump establishing positive pressure in an APR.

- Supplied Air Respirators (SARs) - This type of respiratory protection device uses breathing grade quality air (Grade D) supplied via an airline from a source point. This source can be temporary containers (pressurized cylinders) or obtained from an air compressor source. This configuration is always employed with a 5-minute escape cylinder should the source fail or become compromised.

- Self Contained Breathing Apparatus (SCBA) - This is a self contained supply of Grade D breathing air in a portable cylinder attached to a back plate assembly. This configuration provides a portable air source for the user for up to 30 minutes in duration.

Selection

From these four respiratory device categories, selection is made to provide Tetra Tech NUS personnel protection from airborne inhalation hazards. Proper selection of respiratory protection for use in the work place takes place in the following manner:

1. A designated Health and Safety professional is provided or obtains information concerning the work site including:

- Chemical contaminant(s) and concentrations present
- Quantified or estimated concentrations
- Media (soil, groundwater, etc) the chemicals are present.
- Chemical and physical properties of the contaminants.
  - Determine Permissible Exposure Limits and applicable Threshold Limit Values for the chemical(s) in question.
  - Verify routes of exposure to determine if eyes, skin may be effected, or lead to systemic effects.
  - Ascertain information concerning warning properties of the chemical contaminant(s) in question.
  - Determine whether conditions may exist or may result given the chemical contaminants and measured concentrations in an IDLH situation.
- Toxicological profiles
- Potential migration pathways

1. This information (through sound industrial hygiene and safety and health practices) is manipulated for the purpose of estimating potential airborne concentrations given the physical and chemical properties of the contaminant(s).

2. The Health and Safety Profesional then evaluates the tasks to be conducted to determine the opportunity for occupational exposure which exists given the inherent properties of the contaminants under standard temperature and pressure and the task(s) to be conducted. This evaluation includes

   - Intrusive nature of the task

   - Physical properties and hazards conveyed by the contaminants in question (flammable, explosive, corrosive, shock sensitive, etc.).

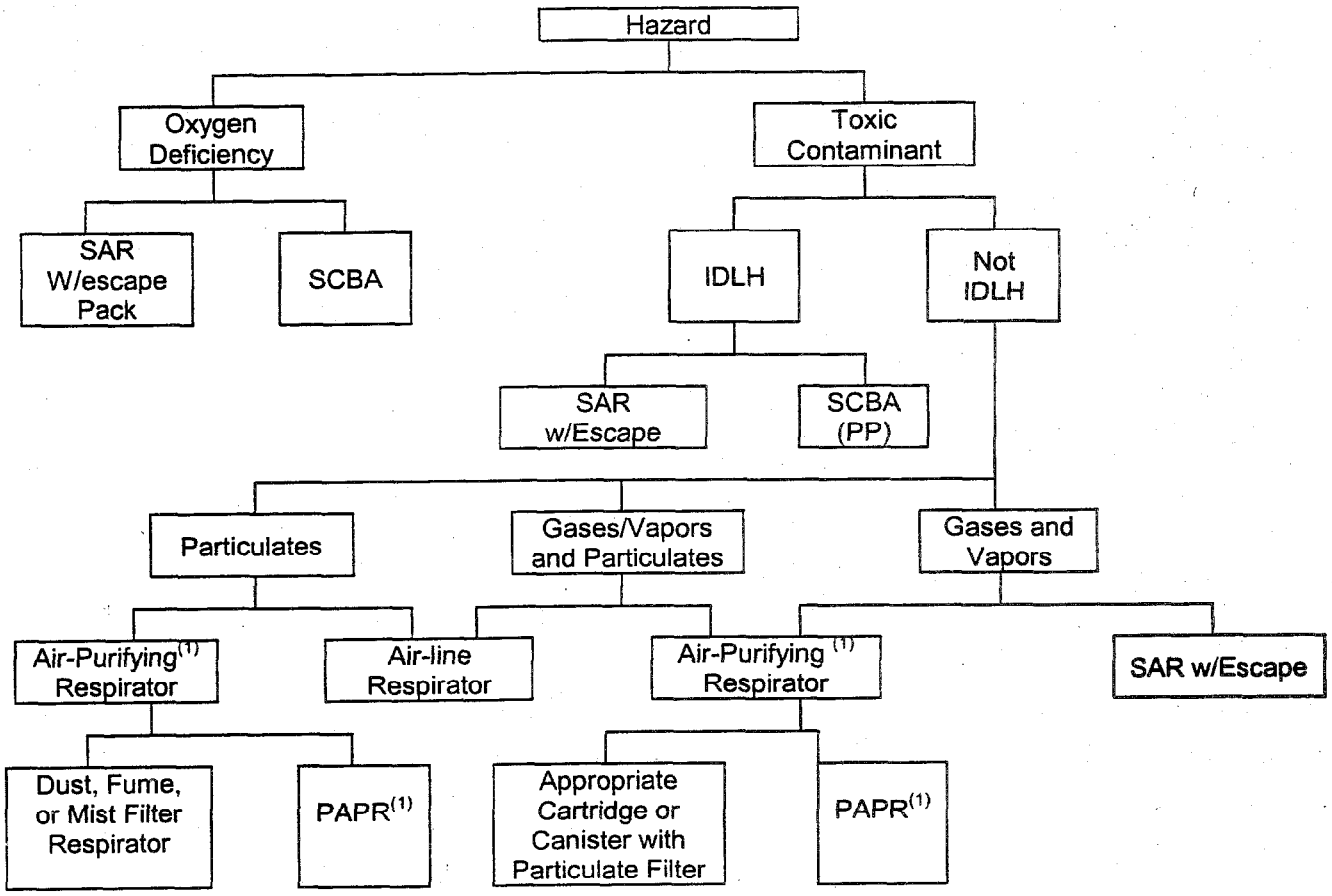
   - Determine whether the conditions which may exist or may result given the nature of the task to be completed. This would includes considerations such as hot work operations which may increase hazard potential of the operation.

   - Determine given the physical properties of the substances a flammable, explosive or other IDLH atmosphere may result.

Given information provided and generated, a logic flow chart and professional judgement is employed to select respiratory protection in support of an identified task (see Figure 1).

FIGURE 1

DECISION LOGIC FLOWCHART FOR THE SELECTION OF RESPIRATORY PROTECTION



(1) Conditions and criteria for using air purifying respirator are considered acceptable. This includes:
- Contaminant(s) are known
- Concentrations are quantifiable
- No chance for fire/explosion
- IDLH concentrations will not be achieved
- Approved cartridge/canister is available
- Adequate warning properties

Note: This decision logic flowchart has been structured based on advantages and limitation of the respiratory protection used by Tetra Tech NUS. This information (along with that derived or provided concerning project work sites or tasks) defines the selection of the appropriate respiratory protection device.

3.1.1.2 Medical Evaluations

Once respiratory protection has been selected, the physiological wellness of the user must be determined. Therefore, all personnel who are required to wear respiratory protection must be medically evaluated prior to being permitted to do so.

The HSM (with the assistance of the Health Care Management Provider) has defined the medical evaluation protocol for all Tetra Tech NUS office locations. The health care provider will determine through a physical wellness profile and medical screening the ability of Tetra Tech NUS personnel to perform their duties using positive and negative-pressure respiratory protection.

Personnel approved by the health care provider will be permitted to employ respiratory protection in field service activities. Under certain conditions during field activities such as temperature extremes or heavy work loads, additional biological monitoring by the SSO and/or the FOL may be conducted to monitor cardiovascular and pulmonary loading under respiratory protection and the influence of these environmental conditions. For more information concerning this biological monitoring see section 4.1.1.4.

Those individuals not approved by the health care provider to wear respiratory protection while performing assigned duties will be assigned supporting functions not requiring respiratory protection.

Information concerning the exact protocol or questions regarding its content should be directed to the HSM.

3.1.1.3 Fit Testing

All Tetra Tech NUS personnel who are required to wear respiratory protection will be required to be fit tested. Fit testing to be performed or coordinated by Tetra Tech NUS Office locations Qualitative Fit Testing (QLFT) will be performed as a minimum protocol. This fit testing will be performed to qualify respiratory protective devices for use in service for concentrations of up to 10 times the PEL or TLV. Estimated or potential concentrations in excess of 10 times the PEL will require Quantitative Fit Testing (QNFT).

- Fit testing will be provided to Tetra Tech NUS personnel on an as-needed basis as determined by project requirements. Fit testing and re-fit testing will be provided under the following conditions:

    1. The scope of work defines activities to be conducted which include working with chemical(s) identified in the OSHA standards (29 CFR 1910.1000 series) that have their own fit testing requirements.

    2. A change in the type(s) of respiratory protection for which the individual had been originally fit tested.

    3. A change involving the individual fit tested which may impact the respiratory protective device fit. This may include significant weight change, changes in facial composition due to scarring, dental changes, or any change which may adversely impact the face-to-seal fit.

The procedures to be followed for QLFT are provided in Attachment B.

1. Procedures for Respirator Use

Under the elements established for this program (and in order to maintain compliance) specified protocol must be maintained. All Tetra Tech NUS earing respiratory protection will ensure the following:

- All facial hair which may impede the face-piece to face seal is removed. Personnel will be clean shaven each day when required to wear respiratory protective devices.

- Inform Office Health and Safety POCs of your necessity to wear corrective lens for vision correction. This will permit the following:

  2. Vision kits for the respiratory device selected may be obtained and corrective lens prescriptions filled.

     - Alternative respiratory protective devices may be permitted under certain conditions such as the use of Half-face masks in lieu of full-face. Modifications of this nature require approval from the SSO and the HSM.

     - Contacts will be permitted with approval of the HSM.

- Tetra Tech NUS personnel shall inspect the respiratory device to be used prior to use in accordance with section 4.1.1.5. The inspections will include an initial thorough inspection and a functional field inspection to be conducted prior to use and after the initial inspection has been completed. All deficient findings will be reported and repaired regardless of the severity prior to permitting the device to be employed in service.

- Each time a respirator is put on a positive and negative pressure check will be performed to ensure respirator to face-piece seal

- All air purifying cartridges/canister removed from their wrappers will be dated and the time of installation recorded on the label. If successive use is approved for these cartridge/canister, each date and time used items will be chronicled on the label.

Note: Reuse of cartridges/canister will be determined and approved as indicated by:

  3. An End-of-Service-Life-Indicator on the cartridges/canister

  4. Guidance documents governing on-site activities (HASP, Safe Work Permit, etc.). The document will approve use based on chemicals of concern, measured concentrations, and warning properties under specified conditions.

- When air purifying cartridges/canisters are used spent, they must be thrown away otherwise made unusable.

- Report to the SSO any time conditions of the task or environmental conditions may be impacting the use of the respirator. This may include temperature extremes, close working quarters, or the prohibitive nature of other PPE ensembles which may impede the respiratory device selected.

- Physiological responses of the user of other wearers – All Tetra Tech NUS personnel shall be made aware of associated physiological stresses brought on by or further compounded by respirator use. Signs and symptoms of physiological stress, increased pulse or respiration should be immediately reported to the SSO. The physiological benchmarks currently in use are as follows:

  Conditions related to heat stress –

  Oral temperature = 100.6°F
  Pulse rate = 110 beats per minute

Conditions related to cold stress –

Oral temperature = 95.0°F Core temperature
Pulse rate = 110 beats per minute

These quantifiable benchmarks (as well as other signs and symptoms of physiological stress) determine the necessity to increase cooling or warming periods given the work climate activity and acclimatization of the work force. Work/rest and work/rest periods should be established in accordance with recommendations established by American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values.

The SSO shall continually monitor the work area for conditions which may negatively impact the effectiveness of respiratory protection, as well as, other PPE devices or that which may invoked increased stress on Tetra Tech NUS personnel.

5. Maintenance Procedures (inspection, cleaning, storage, repairs, and replacement)

Tetra Tech NUS personnel will be responsible for the inspection, cleaning, storage, and minor (manufacturer approved) repairs to the respiratory devices issued.

Inspections – All Tetra Tech NUS personnel will be required to complete an inspection of the respiratory device prior to use. Inspections will occur upon initial receipt and after maintenance procedures have been performed. This will require site personnel to complete a Respirator Inspection Record (See Attachment D). Respirators with identified deficiencies which have been turned in for maintenance will be accompanied by a copy of this inspection record.

Cleaning – Respirators will be cleaned and disinfected after each use. The cleaner and sanitizer used will be a commercially available detergent/disinfectant or when possible those recommended by the manufacturer. Cleaning will proceed as follows:

1. Washing by hand:

Add cleaning solution to wash waters. Optimum temperature of the wash waters should be between 90°F (18°C) and not exceed 110°F (43°C).

Disassemble the respirator mask removing the cartridges/canister or low pressure breathing tube, nose cup, speaking diaphragm, spider wheel assembly and one-way disc valve(s), and protective acetate lens cover.

Using a soft brush or sponge clean all accessible parts of the mask. The mask should be permitted to soak in the solution at a minimum one minute in duration and a maximum one hour. This will permit the removal of associated chemical contaminants, and will permit the disinfectant an opportunity to eradicate the majority of microorganisms which may be derived from the user or biological based organisms associated within limited job scope applications. All other areas of the respirator device such as air cylinder, back-plate assembly, when applicable should have the surfaces washed, rinsed, and permitted to dry.

Note: A variety of chemical solutions are employed to remove chemical contaminants from equipment used in field operations. Should an exotic blend of cleaning solutions, other than the detergent/disinfectant described above, be identified for use, approval for such use on respiratory equipment should be obtained from the Health Sciences Department or Office Health and Safety Point of Contact prior to such use.

2. Rinsing:

Respirators, where possible, should be rinsed under running water. Rinse time should also be sufficient to remove all detergent/disinfectant from the mask. Residual detergent/disinfectant left on the mask may cause irritation, rash, or dermatitis to the area of contact. Optimum temperature of the rinse waters should be between 90°F (18°C) and not exceed 110°F (43°C) to avoid damaging the rubber seals and face-piece components.

3. Air drying:

Disassembled respirator parts, once cleaned and rinsed, should be allowed to air dry in a clean area other than that from which the respiratory device was disassembled to avoid contamination. All parts should laid in such a position to minimize distortion of rubber gaskets, face-to-mask seals, etc.

Reassemble the respiratory device once it is dry. Prior to use, test the respiratory device using positive and negative pressure tests to ensure operating status.

Storage

Follow manufacturer's storage instructions, which are always furnished with new respirators or affixed to the lid of the carrying case. The following general instructions may also be helpful:

1. After respirators have been inspected, cleaned, and repaired, store them so that they are protected against dust, excessive moisture, damaging chemicals, extreme temperatures, direct sunlight, and mechanical damage or distortion.

2. Do not store respirators in clothes lockers, bench drawers, or tool boxes. Place them in a sealed plastic bag, wall compartments at work stations, or in a work area designated for emergency equipment. Respirators should be stored in their original carton or a protective carrying case to prevent mechanical damage.

3. Each Tetra Tech NUS respirator should be sealed in a plastic bag, placed in a separate box, and tagged for immediate use. The tags recommended for use are fluorescent green adhesive stickers which can be dated and initialed indicating approval for use.

Storage of SCBA/SAR . Check to ensure that

a. Cylinder is refilled as necessary and the unit is cleaned and inspected.

b. Cylinder valve is closed.

c. High-pressure hose connector is tight on cylinder.

d. Pressure is bled off high-pressure hose and regulator.

e. Bypass valve, as applicable is closed.

f. Mainline valve is closed.

g. All straps are completely loosened and laid straight.

h. Face-piece is properly stored to protect against dust, sunlight, extreme temperatures, excessive moisture, damaging chemicals, and mechanical damage.

All cartridges/canisters, if they have not exceeded their useful life will be bagged and stored separately (i.e., they will not be stored in the APR). It is important to remember, once cartridges are removed from

their wrapper, they must be dated including the time installed. Thereafter, for each date and time frame, , these air purifying elements are used this information must also be recorded on the cartridge/canister.

Repairs

Only a trained person with proper tools and replacement parts shall be permitted to work on respirators. No one should ever attempt to replace components or to make adjustments or repairs beyond the manufacturer's recommendations.

Repairs should be made as follows:

1. Tetra Tech NUS personnel may assemble and disassemble respiratory components to the level which they been trained and which has been specified through the inspection protocol. Repairs in excess of this level should be routed to the Equipment Manager for repair or to have the respiratory device sent out for repairs by a certified repair service.

2. Once repairs have been completed, re-assemble entire respirator, visually inspect completed assembly, and test completed assembly to ensure proper operation.

3. Insert new filters, cartridges, or canisters, as required. Make sure that gaskets or seals are in place and tightly sealed.

3.1.1.6 Procedures for Supplied Air Respirators (air quality, quantity, and delivery)

In situations where Tetra Tech NUS personnel must use SCBA/SAR, the SSO must insure the following:

Air Quality - Grade D breathing air in accordance with ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989 (or latest edition).

- If the source of breathing air is supplied in pressurized cylinders for use by Tetra Tech NUS personnel, certification of analysis shall be obtained by the SSO from the supplier indicating Grade D quality.

Pressurized cylinders - All cylinders used as a source for breathing air shall meet requirements as specified in 49 CFR 173 and 178. These requirements include specifications for:

- Construction
- Classification
- Marking and labeling
- Storage
- Transportation
- Testing

- If the source of breathing air is supplied through a compressor, air samples will be periodically extracted to ensure Grade D breathing air quality. The SSO shall ensure, based on the type of compressor, it is equipped as necessary with carbon monoxide and high temperature alarms.

Air quantity and delivery -

- SAR delivers air to users through the high pressure lines between 80-120 psi to maintain sufficient pressure on the low pressure side to maintain positive pressure.

- Additionally, all sections of airlines joined together will be combined by locking connections between the user and the source.

- The airline, in order to maintain an average working pressure between 80-120 psi shall not be permitted to exceed 300 feet in total length between the source an individual user.

- A SCBA supplies air through a portable cylinder strapped to the back-plate assembly worn by the user. Again the air source for refilling the portable cylinder will be qualified as Grade D breathing air. Portable cylinders will be fully charged prior to being used for entry in regulated locations. All points of the delivery system between the user and the portable cylinder will have all gaskets and seals in place to minimize inefficient loss of air supplies.

3.1.1.7 Training

The HSM will ensure training will be provided to ensure proficiency and uniformity of approach in the use of respiratory equipment for all Tetra Tech NUS personnel. Respiratory protection training at Tetra Tech NUS will be provided to Tetra Tech NUS personnel as follows:

- Stand alone module during site-specific or job specific training
- Stand alone module upon hire

Modularized Units during:

- 40-Hour General Site Worker Training in accordance with 29 CFR 1910.120
- 8-Hour Refresher Training in accordance with 29 CFR 1910.120 (e)(8)
- 8-Hour Management and Supervisory Training

In addition, the HSM will insure through Office Health and Safety POCs where training is obtained from outside vendors within their location vicinity, that the content meet minimum requirements provided in support of this program.

Training of a minimum content will include:

Respiratory protection -

- Purpose
- Engineering controls
- Selection
- Use - Routine and reasonably foreseeable emergency situations
- Limitations and advantages of the respiratory protection devices provided for use by Tetra Tech NUS personnel
- Physiological stresses of the user. Additionally, environmental and task associated elements which may compound these stresses.
- Elements of this Respiratory Protection program
- Maintenance (Inspection and Care)
- Respiratory program evaluations/findings

Note: In addition to the above elements, which serve as core elements of this program, information will be exchanged as part of the site-specific program. This includes the following:

+ Names of personnel and alternates responsible for the implementation of the site-specific RPP
+ Safety, health and other hazards present on site
+ Selection of respiratory protection

+ Work practices to minimize risks from hazards

+ Safe use of engineering controls and equipment

+ Medical surveillance requirements

+ Procedures for proper use of respiratory equipment to be employed
  - Donning and doffing
  - Routine use and foreseeable emergency situations
  - Action levels for upgrade in protective levels and evacuation procedures
  - IDLH atmosphere rescue support
  - Supplied air respirators (air quality, quantities, and delivery systems)

+ Respiratory protection maintenance procedures including inspection, cleaning, storing and repairing respiratory protection.

+ Where applicable the contents of the health and safety plan including Tables 5-1 and 6-1 regarding health effects and physical properties of the contaminants and associated control measures. In situations where a HASP is not employed Tetra Tech NUS personnel will review contents of relevant Material Safety Data Sheets or other information where physical, chemical, and toxicological information may exist.

+ Fit testing documentation

A refresher training of the above content will be provided to Tetra Tech NUS personnel during normal working hours on a frequency of once a year.

Modifications to this frequency may occur when

- Unacceptable level of deficiencies are noted through work site and program evaluations. These may include
  - Deficiencies in employee comprehension concerning respiratory protection and the elements of this program.
  - Program based deficiencies
  - New or modified respiratory equipment is introduced

All initial, refresher, and retraining will be supported by content examinations and hands on application.

Testing - An examination will be employed to test Tetra Tech NUS personnel's levels of comprehension of the subject matter. A minimum test score of 70% will be required to receive a passing grade. All tests administered will be reviewed with Tetra Tech NUS personnel to provide opportunity for discussion and review of any mistakes made on the tests.

Hands On Application - At a minimum Tetra Tech NUS personnel will be required to disassemble and reassemble respiratory protective devices including APRs and SCBAs to the level identified by the manufacturer. Individuals will also be required to trouble shoot respiratory protective devices again to a level considered acceptable by the manufacturer. Pass or fail in this application is based on a functional respiratory device after the exercise. Failure will require review of the material and the exercise to be re-conducted until successful completion.

Trainer's Qualifications - Training may be conducted by only those individuals specified through job experience or academic credentials regarding respiratory protection. These individuals must also be approved by the HSM.

Training documentation for work site personnel will utilize Attachment D. For record-keeping purposes a copy of Attachment D will be maintained with the work site specific respiratory program.

3.1.1.8 Program Evaluation

In order to ensure effectiveness of this program the HSM or designated representative will evaluate the implementation of this program at various work sites. The evaluation will include pre-, during, and post-activity appraisals. The evaluations will include:

- Employee comprehension of the RPP.
- Employee use and application of respiratory protective devices.
- Employee comment regarding selection and effectiveness of the respiratory devices selected.
- Respirator maintenance including inspection, cleaning, and storage.
- Record Keeping
    - Medical evaluation for each employee who will wear respiratory protection
    - Fit Test results for each employee who will wear respiratory protection
    - Completed Site-Specific Respiratory Protection Program (See Attachment A).

This evaluation will be performed on a periodic basis, but not less than once a year. This minimum frequency may be increased based on the findings generated from the evaluations.

4.0 SITE-SPECIFIC RESPIRATORY PROTECTION PROGRAM

This Site-Specific Respiratory Protection Program (SRPP) responsibilities, administrative procedures, training, and program evaluation. The second segment of the program identifies Tetra Tech NUS project work site function and application of these identified program elements.

4.1 Work Site Responsibilities Of The Identified Program Elements

The following elements represent the work site responsibilities to be carried out under the guidance and direction of the HSM in accordance with corporate policy and regulatory requirements as established in 29 CFR 1910.134. The person(s) responsible for the execution of these elements and record-keeping requirements are the SSO and/or the FOL (when a SSO is not available). The following information provides a summary background of the requirements. Completion of Attachment A for each site will satisfy the work site portion of this program.

1. Medical evaluations of employees
2. Fit testing respiratory protective equipment
3. Maintenance procedures (cleaning, inspection, storage, repairs, and replacement)
4. Procedures for atmospheric supplying respirators (air quality, quantity, and delivery)
5. Training in all aspects of this program including respiratory hazards, use/application of respiratory protection in controlling these hazards, and program maintenance elements
6. Program evaluation/modification

4.1.1 Medical Evaluations

The work site responsibility in this case is primarily record-keeping. It will be the responsibility of the FOL or acting SSO to ensure all Tetra Tech NUS personnel and subcontractor personnel provide documentation regarding medical evaluation and clearance to wear respiratory protection of the type employed on the specific work site. Documentation stipulating medical evaluation and clearance to employ respiratory protection shall be obtained from a licensed health care provider and must be maintained on-site. Under no circumstances will persons be permitted to employ respiratory protection on any Tetra Tech NUS work site (whether it is of their own volition or it is a required use of respiratory protection) unless medical evaluation documentation is available on site for that person(s).

4.1.2 Fit Testing

This work site function may entail two primary functions, which must be carried by the FOL or SSO. These two functions may include record-keeping activities and actual fit testing of on-site personnel. Conditions of these activities are as follows:

- Documentation will be maintained on-site regarding Fit Tests for all Tetra Tech NUS and subcontractor persons who will wear respiratory protection whether voluntarily or as required. The Fit Tests documentation will be for the types of respiratory protection to be worn in support of on-site activities. If multiple types are to be employed, Fit Test records must be available for each type of respiratory protection to be used. This includes both negative and positive pressure masks.

- Fit Tests for each type of mask will be conducted on a project by project basis unless the criteria identified in section 4.1.1.3, regarding modification of this frequency has been determined to take precedent. Given this the FOL or the SSO may be responsible for fit testing persons on longer term jobs where annual fit tests have expired. The SSO and/or the FOL shall perform fit testing in accordance with the fit test protocol established in Attachment B.

- The FOL or the SSO shall employ the fit testing protocol as fit checks in situations determined to be of an elevated hazardous nature to ensure respiratory face-to-mask seals prior to entry into these situations.

4.1.3 Maintenance Procedures

On-site personnel (including Tetra Tech NUS and subcontractor personnel) will be responsible for the maintenance and upkeep of the respiratory protection assigned or temporarily provided. This will include inspection, cleaning, manufacturer approved level repairs, and storage. The FOL and/or the SSO will be responsible for ensuring the completed documentation (Attachment C) is collected, collated, and filed. All maintenance procedures will be performed in accordance with section 3.1.1.5.

4.1.4 Procedures for Atmospheric Supplying Respirators (air quality, quantity, and delivery) - Administrative/Work site

Support of this activity on the work site will primarily serve as a record-keeping function in accordance with the requirements as established in section 4.1.1.5. In situations where Tetra Tech NUS personnel must use SAR/SCBA, the FOL and/or the SSO must insure the following:

- Documentation is obtained from the supplier attesting to the air Quality - Grade D breathing air in accordance with ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.

- All cylinders used as a source for breathing air shall meet requirements as specified in 49 CFR 173 and 178. Work site responsibilities pertaining to these requirements include:

  - Construction - Visual inspection of cylinders - No evidence of leaks, bulges, physical abuse, excessive corrosion, fire/heat damage, defective safety devices.

  - Classification - Nonflammable gas, oxygen compressed, U.N. 2.2. Documentation will also be requested concerning USP Grade D breathing air certification.

  - Marking and labeling - Work site responsibility includes ensuring the cylinders received have the appropriate markings. This would include the DOT or UN classification. Breathing air cylinders employed by Tetra Tech NUS are DOT-3AA2400. This number may be followed sequentially by an Inspectors Identification number XXXX and then a date designation

DOT-3AA2400-1234-8-98 or DOT-3AA2400 (Cylinder type and service pressure)
1234 (Inspector's I.D. Number)
8-98 (Date)

- Storage -

  a) All cylinders will be stored in the vertical upright position.
  b) All cylinders will be stored to prevent physical damage.
  c) All cylinders when in use should be accompanied by a hood to protect the valve stem, as designs permit.
  d) All cylinders when not in use will have their caps replaced, again to protect the valve stem.
  e) All cylinders will be stored separately from flammable and incompatible materials.

  – Transportation

  a) Cylinders transported via site equipment will be done so in the vertical position with protective caps in place.
  b) Work site vehicles will require placarding for the transport of cylinders if the weight of the cylinders cumulatively is in excess of 1,000 pounds.

- Testing - The SSO and/or the FOL will be responsible for ensuring the cylinders received have been hydrostatically tested within the last ten years. This is determined looking at the last test date as indicated under marking and labeling above. Portable cylinders such as the types used on SCBAs and SAR units will require hydrostatic testing of a different frequency. These are as follows:

  – Aluminum wrapped in fiberglass - Hydrostatically tested every 3 years, for a total of 5 test cycles or 15 years.
  – Steel or aluminum - Hydrostatically tested every 5 years for as long as the cylinders pass the testing criteria.

- If the source of breathing air is supplied through a compressor, air samples will be periodically extracted to ensure Grade D breathing air quality. The SSO shall ensure, based on the type of compressor, it is equipped as necessary with carbon monoxide and high temperature alarms.

Air quantity and delivery -

- Air will be delivered to users through the high pressure lines between 80-120 psi, to maintain sufficient pressure on the low pressure side to maintain positive pressure.

- Additionally, all sections of airlines joined together will be combined by locking connections between the user and the source.

- The airline, in order to maintain an average working pressure between 80-120 psi shall not be permitted to exceed 300 feet in total length between the source an individual user.

4.1.5 Training

The work site function in this situation will primarily be one of record-keeping. This function will include securing all the training records for the personnel on-site for the types of respiratory protection to be employed.

In addition to the record-keeping function, the SSO and/or the FOL will be responsible for completing Attachment A which will include the elements of this respiratory protection program. Site-specific training

documentation is provided as part of site-specific training for the HASP or as stand alone provided in Attachment D.

Trainer's Qualifications - Training may only be conducted by those individuals specified through job experience or academic credentials regarding respiratory protection. These individuals must also be approved by the HSM.

4.1.6 Program Evaluation

This activity will be supported by site personnel using the respiratory equipment. This function will entail providing information to the SSO, Tetra Tech NUS Health and Safety POCs and the HSM regarding the performance and the suitability of the respiratory protective devices used. This information may be provided in the following formats:

- Documented on the back of the Safe Work Permit(s) you are operating under, thereby identifying the activity for which the respiratory protection evaluation is pertaining to.
- Written documentation - This format must also identify tasks and activities which were being conducted for which this evaluation pertains to.
- Verbal to the SSO and/or the FOL which are then required to document the evaluation as a logbook entry.

In all cases information pertaining respiratory protection performance and suitability regarding application will be maintained as part of the work site file and copied to the HSM who will determine the need or conditions for modification.

APPENDIX I

DEFINITIONS

Atmosphere-supplying respirator means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) Tetra Tech NUSs.

Canister or cartridge means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Emergency situation means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

Employee exposure means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respirator protection.

End-of-service-life indicator (ESLI) means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

Escape-only respirator means a respirator intended to be used only for emergency exit.

Filter or air purifying element means a component used in respirators to remove solid or liquid aerosols from the inspired air.

Fit test means the use of a protocol to quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

High efficiency particulate air (HEPA) filter means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

Immediately dangerous to life or health (IDLH) means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individuals ability to escape from a dangerous atmosphere.

Maximum use concentration (MUC) means a respiratory protective device may be employed in concentrations of hazardous chemicals up to the protective factor assigned to the mask, times the Permissible Exposure Limit or Threshold Limit Value. It should be noted, that this qualifies the respirator mask capabilities and does not address the full criterion for respirator selection regarding the use of air purifying versus atmosphere supplying.

Negative pressure respirator (tight fitting) means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator

Oxygen deficient atmosphere means an atmosphere with an oxygen content below 19.5% by volume.

Physician or other licensed health care professional (PLHCP) means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

Positive pressure respirator means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

Powered air-purifying respirator (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Pressure demand respirator means a positive pressure atmopshere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

Qualitative fit test (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that resides on the individual's response to the test agent.

Quantitative fit test (QNFT) means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

Self-contained breathing apparatus (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

Service life means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

ATTACHMENT A

WORK SITE
RESPIRATORY PROTECTION PROGRAM

RESPIRATORY PROTECTION PROGRAM

The following information pertaining to the use of respiratory protection is to be completed by the Site Health and Safety Officer (SSO), their duly appointed representative, or the Field Operations Leader (FOL). This work site portion of the respiratory protection program will be completed only if respiratory protection is to be used in the completion of the assigned tasks. The use of respiratory protection will be specified as identified per the HASP or as determined through hazard assessment of the tasks and potential hazards, which may be involved.

Steven Parker

The following persons are available to provide assistance in all elements of this program including question/conflict resolution and modification variances. These persons exercise the primary responsibility for the implementation of this site-specific program.

I) **SSO (On-site Program Administrator):** Dave Masse **Phone #:** 978-658-7899
Field Operations Leader: Dave Masse **Phone #:** 978-658-7899
Project Health and Safety Officer: Janet Pillion **Phone #:** 978-658-7899
Health and Safety Manager: Matthew Soltis **Phone #:** 412-921-8912

Personnel Who by Way of Assignment Will Wear Respiratory Protection

The following lists of personnel represent Tetra Tech NUS, Inc. personnel or subcontractor personnel working under the provision of this respiratory protection program. The persons listed below represent only those who will actively employ respiratory protection by way of assignment or of their own volition.

II)

Personnel	Make/Model of Respiratory Protective Devices to be used	Medical Evaluation(s)(1)	Fit Tested(2)

(1) Medical Qualifications for all personnel who will wear respiratory protection by way of assignment or of their own volition shall be attached.
(2) Fit test records for each type of respiratory protection site personnel will employ shall also be attached to this program.

Inspection Qualification of Respiratory Devices to Be Used

The following information provides a summary sheet of the inspections performed on respiratory devices to be used on-site.

III)

Personnel (Person Issued the Respiratory Device Performing the Inspection)	Make/Model of Respiratory Protective Devices to be used	Deficiencies[3]	Supervisor/Responsible Person Review

(3) Respirator Inspection Checklist shall be attached for each respiratory device listed above. All respirators inspected shall be tagged or stickered to indicate inspection status.

Respiratory Protection Use and Application

The following table represent only tasks to be initiated in Level B or C, or if a task through achieving an elevated level of protection by surpassing established action levels.

IV) Classification of Respiratory hazard

Task(s) to be Completed[7]	Contaminants of Concern and associated PEL or TLV	Estimated Airborne Concentrations and Media[8]	Classification of Respiratory Hazard/Level of Protection[9]	Action Levels for Upgrade/Evacuation([7])
Sampling	Asbestos	<0.1f/cc	C	Visible dust cloud evacuate upwind

(7) Each task which will employ respiratory protection will be listed.
(8) Estimated airborne concentrations may be obtained from the Health Sciences group.
(9) Classification of the type of respiratory hazard:

Oxygen deficiency — Gas/vapor
particulate(dust, fume, smoke, fog, mist) — Immediately Dangerous to Life or Health

RESPIRATORY PROTECTION TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potentially hazardous nature of performing work under respiratory protection at Naval Station,Newport Rhode Island Building 32, and that I have received project-specific respiratory protection training, which included the elements presented below:

- Names of personnel and alternates responsible for the implementation of the site-specific respiratory protection program
- Safety, health and other hazards present on site
- Selection of respiratory protection
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Procedures for proper use of respiratory equipment to be employed
  - Donning and doffing
  - Routine use and foreseeable emergency situations
  - Action levels for upgrade in protective levels and evacuation procedures
  - IDLH atmosphere rescue support
  - Supplied air respirators (air quality, quantities, and delivery systems)
- Respiratory protection maintenance procedures including inspection, cleaning, storing and repairing respiratory protection.
- Where applicable the contents of the health and safety plan including Tables 5-1 and 6-1 regarding health effects and physical properties of the contaminants and associated control measures. In situations where a HASP is not employed Tetra Tech NUS personnel will review contents of relevant Material Safety Data Sheets or other information where physical, chemical, and toxicological information may exist.
- Fit testing documentation

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

NAME(Print)	DATE	SIGNATURE

INSTRUCTOR(S): _____

_____

_____

ATTACHMENT B

RESPIRATOR FIT TESTING

RESPIRATOR FIT-TESTING

There are several manufacturers (Wilson, Norton, MSA, Scott, etc.) who carry respirators approved by NIOSH. Each company manufactures one or more air-purifying cartridge/canister respirator. Each make and model has a slightly different fit. Although each manufacturer designs his facepieces to fit a broad section of the working population as possible, no respirator marketed will fit everyone. Conditions that affect a good facepiece fit include: growth of beard, sideburns, a skull cap that projects under the facepiece. temple pieces on glasses, facial scars, facial injuries, and presence or absence of dentures. Therefore Tetra Tech NUS shall select several manufacturers so that each employee can take advantage of the different fitting characteristics to find a respirator that fits properly. Also, the opportunity to select from various manufacturers allows the wearer to choose a respirator that is reasonably comfortable while providing good protection. It is in the process of matching the respirator to the individual user that a FIT-testing procedure is needed.

OSHA regulations (29 CFR Part 1910.134) requires that each person who wears a respirator shall have it properly fitted, test the facepiece to face seal, and wear it in a test atmosphere. In compliance with this regulation, each respirator user should be given a fit test to determine his/her ability to obtain a satisfactory fit with a "negative-pressure," air-purifying respirator (half or full-face) and positive pressure masks. The results of the fit test will be used to select the specific type, make, and model of the mask which is most comfortable and fits best for use by the wearer.

The following policies shall be adhered to in the fitting and use of the negative and positive pressure respirator masks:

1. An employee must have passed the FIT test in order to use a respirator.

2. If it is found that an employee cannot obtain a good respirator-to-face seal because of facial or medical characteristics, that employee will not use and/or enter an atmosphere that will require the use of a respirator.

3. Facial hair such as beards, sideburns, or certain mustaches that may interfere with the fit test are not allowed.

4. Persons requiring corrective lenses shall be provided with specially mounted lenses inside the full-face mask. Under no circumstances will contact lenses and/or glasses be worn while using respirators.

5. A person may only use the specific make(s) and model(s) of air-purifying respirators for which he has obtained a satisfactory fit via the qualitative FIT-testing procedures. Under no circumstances shall a person be allowed to use any make or model respirator in which he has not passed a FIT-test.

In the fulfillment of the commitment to comply with the FIT-testing requirement, Tetra Tech NUS has selected qualitative FIT -testing for concentrations of up to 10 times the PEL or TLV which ever is more conservative rather than quantitative FIT-testing procedures. Quantitative FIT-testing will be employed when estimated or potential concentrations can exceed 10 times the PEL or TLV.

Qualitative FIT-test procedures involve two stages of testing. Stage I involves a simple respirator positive and negative-pressure seal check for facepiece fit. Stage II involves the exposure of the respirator wearer to a test atmosphere. This will include two separate atmosphere tests to double-check the adequate fit of the respirator.

Stage I

Positive-Pressure Sealing Check for Air-Purifying Respirators

This test is performed after donning an air-purifying respirator that contains an exhalation and inhalation valve. The test is conducted by closing off the exhalation valve and exhaling gently. The fit of a respirator equipped with a facepiece is considered to be satisfactory if a slight positive pressure can be built up inside the facepiece for at least 10 seconds without detecting any outward leakage of air between the sealing surface of the facepiece and the respirator wearer's face.

This test is made as a gross determination of fit prior to the respirator being used in a toxic atmospheres. This test shall be used each time the user must enter a toxic atmosphere.

Negative-Pressure Sealing Check for Air-Purifying Respirators

The wearer can perform this test by himself or herself in the field or office after donning the air-purifying respirator. The test is performed by closing off the inlet opening of the respirator cartridge(s) by covering it with the palm of the hand(s) so that it will not allow the passage of air. Then, by inhaling gently, and holding the breath for at least 10 seconds, the face-piece should collapse slightly and no inward leakage of air into the facepiece should be detected. If no leakage is perceived, it can be reasonably assumed that the fit of the respirator to the wearer is satisfactory.

This test, like the positive-pressure sealing check, is to be used as a gross determination of fit prior to the respirator being used in a toxic/ atmosphere. (Both the positive and negative-pressure sealing checks can be used on the SCBA air mask to determine the gross fit characteristics.) This test shall be used just before entering any toxic atmosphere.

Stage II

A person wearing an air-purifying respirator will be exposed to two test agents: isoamyl acetate--an odorous vapor--and stannic chloride--an irritant smoke. A respirator mask equipped with an air-purifying cartridge/canister, which effectively removes the test agents from respired air. If the respirator wearer is unable to detect penetration of the test agent into the respirator, he has achieved a satisfactory fit. FIT-test results must be documented using a form like that provided in this section.

Procedures for the Isoamyl Acetate Test

Isoamyl acetate is a chemical that produces a pleasant banana-smelling organic vapor. It is an easily detectable odor. The isoamyl acetate FIT-test will be conducted by using a plastic garbage bag as a test hood covering hung from the ceiling over a coat hanger suspended by twine or other suitable enclosure. Inside the enclosure ampoules will be broken to release sufficient concentrations (10-50 ppm) to be detected if a seal is not sufficient. This test is a FIT-check protocol, which will be used to check a respirator face-to-mask seal, prior to exposing the test subject to irritant smoke.

The following isoamyl acetate FIT-check will be performed as follows:

1. The wearer puts on the respirator in a normal manner. If it is an air-purifying device, it must be equipped with a cartridge(s) specifically designed for protection against organic vapors. Positive and negative pressure checks are performed.

2. Upon successful completion of the positive and negative pressure checks, the wearer enters the test enclosure, so that his head and shoulders are well inside the enclosure.

3. The Tester breaks an ampoule containing the isoamyl acetate and allows the test enclosure to capture the vapors generated. If the wearer smells banana oil, he/she returns to clean air until no longer detecting the odor of isoamyl acetate. Upon clearing mask, readjusts the facepiece and/or adjusts the

headstraps without unduly tightening them, and re-tests. The test subject will not submit to the stannic chloride test until successfully passing the isoamyl acetate test.

FIT-TEST RECORD

Name:_____

Location:_____

Signature:_____ Date:_____

Name of FIT-TESTER:_____

Signature:_____ Date:_____

TYPE OF TEST	ISOAMYL ACETATE	IRRITANT SMOKE
Type of Mask: Manufacturer: Model:	Pass/Fail	Pass/Fail
Type of Mask: Manufacturer: Model:	Pass/Fail	Pass/Fail
Type of Mask: Manufacturer: Model:	Pass/Fail	Pass/Fail
Type of Mask: Manufacturer: Model:	Pass/Fail	Pass/Fail
Type of Mask: Manufacturer: Model:	Pass/Fail	Pass/Fail

Comments:_____

4. The wearer repeats the second step. If he/she does not smell banana oil, he/she is assumed to have obtained a satisfactory fit. If he/she smells the vapor, an attempt should be made to find the leakage point. If the leak cannot be located, another respirator of the same type and brand should be tried. If this leaks, another brand of respirator with a facepiece of the same type should be tried.

5. After satisfactory fit is obtained, if the respirator is an air-purifying device, it must be equipped with the correct filter(s), cartridge(s), or canister for the anticipated hazard.

During the test, the subject makes movements that approximate a normal working situation. This may include the following:

1. Normal breathing.
2. Deep breathing, as during heavy exertion.
3. Side-to-side and up-and-down head movements. These movements should be exaggerated.
4. Talking. This is most easily accomplished by reading a prepared text and/or reciting the alphabet loudly enough to be understood by someone standing nearby.
5. Other exercises may be added depending upon the situation. For example, if the wearer is going to spend a significant part of his time bent over at some task, it may be desirable to include an exercise approximating this bending.

The major drawback of the isoamyl acetate test is that the odor threshold varies widely among individuals. Furthermore, the sense of smell is easily dulled and may deteriorate during the test so that the wearer can detect only high vapor concentrations. Another disadvantage is that isoamyl acetate smells pleasant. even in high concentrations. Therefore, a wearer may say that the respirator fits although it has a large leak. Therefore, these test results must be checked carefully and confirmed by the next test atmosphere.

Procedures for the Irritant Smoke (Stannic Chloride) Test

This qualitative test is similar to the isoamyl test in concept. It involves exposing the respirator wearer to an irritating smoke. Sealed glass tubes, approximately 12 cm long by 1 cm in diameter, filled with pumice impregnated with stannic chloride are used to produce the smoke. When the tube ends are broken and air is allowed to enter, the material inside reacts with the moisture in the air to produce a dense, highly-irritating smoke.

As a qualitative means of determining respirator fit, this test has a distinct advantage in that the wearer usually reacts involuntarily to leakage by coughing or sneezing. The likelihood of his/her giving a false indication of proper fit is reduced. However, because this smoke is very irritating, it can cause problems for the test applicators or other persons in the same room. Therefore, it is advisable to have good ventilation in the room in which the testing is to be conducted.

The irritant smoke test will be conducted by using a plastic garbage bag or other suitable enclosure as a test hood. The bag shall be hung from the ceiling over a coat hanger suspended by twine. If a bag is used, a small hole is made in the top portion of the bag so that the irritant smoke can be dispensed into the bag when the test subject has entered the bag.

The air-purifying respirator to be used in this test must be equipped with a high-efficiency particulate filter.

The irritant smoke FIT-test will be performed as follows:

1. The wearer puts on the respirator normally, taking care not to tighten the headstraps uncomfortably. Once the respirator is on, positive and negative pressure checks are performed. Upon successful completion of the positive and negative pressure checks, the subject is to enter the suspended bag so that his head and shoulders are well inside the enclosure.

2. Once the subject is inside the bag, the tester will introduce the smoke, still remaining alert to the wearer's reactions.

3. If the wearer detects no leakage, the tester may increase the smoke density, still remaining alert to the wearer's reaction.

4. At this point, if no leakage has been detected, the wearer may cautiously begin the head movements and exercises mentioned in the isoamyl acetate test. The tester should remain especially alert and be prepared to stop producing smoke immediately and remove the subject from the bag.

5. If a leakage is detected at any time, the tester should stop the smoke and let the wearer out of the bag to readjust the facepiece or headstrap tension. The tester should then start the test over at step 1.

6. If at the end of all the movements and exercises the wearer is unable to detect penetration of the irritant smoke into the respirator, the respirator wearer has a satisfactory fit.

7. After the test is completed, the subject should be removed from the test atmosphere.

ATTACHMENT C

RESPIRATOR INSPECTION CHECKLIST

RESPIRATOR INSPECTION CHECKLIST

Type and Model Number _____ Manufacturer _____
Location of Respirator _____ Inspector _____
Serial Number _____ Date: _____

All Respirators

1. **Storage:**
   (a) Properly Stored ..... ☐ Yes ☐ No
   (b) Sanitized ..... ☐ Yes ☐ No
   (c) Cleaned & Packaged ..... ☐ Yes ☐ No
   (d) Accessible ..... ☐ Yes ☐ No
   (e) Other Comments/Corrective Actions _____

2. **Examine Face-piece for:**
   (a) Clean/Odor Free ..... ☐ Yes ☐ No
   (b) Cracked Lens, Scratches ..... ☐ Yes ☐ No
   (c) Flexibility (flexible) ..... ☐ Yes ☐ No
   (d) Cracks, tears, holes, or distortion ..... ☐ Yes ☐ No
   (e) Connectors, clamps, mounting clips OK ..... ☐ Yes ☐ No
   (f) Other Comments/Corrective Actions _____

3. **Examine Head straps:**
   (a) Loss of elasticity ..... ☐ Yes ☐ No
   (b) Any breaks or fraying ..... ☐ Yes ☐ No
   (c) Buckles or snaps good ..... ☐ Yes ☐ No
   (d) Clean & in good condition ..... ☐ Yes ☐ No
   (e) Other Comments/Corrective Actions _____

4. **Exhalation Valve: (Remove Cover)**
   (a) Any foreign material on seal ..... ☐ Yes ☐ No
   (b) Any cracks, tears, or distortion ..... ☐ Yes ☐ No
   (c) Properly inserted valve & Valve Body ..... ☐ Yes ☐ No
   (d) Valve cover proper ..... ☐ Yes ☐ No
   (e) Other Comments/Corrective Actions _____

AIR PURIFYING RESPIRATORS ONLY

5. **Air Purifying Element Holder:**
   (a) Cracked or broken ..... ☐ Yes ☐ No
   (b) Gasket present and in good condition ..... ☐ Yes ☐ No
   (c) Badly worn threads ..... ☐ Yes ☐ No
   (d) Other Comments/Corrective Actions _____

6. **Air Purifying Element:**
   (a) Correct Cartridge, etc. ..... for hazard ..... ☐ Yes ☐ No
   (b) Correct cartridge for respirator ..... ☐ Yes ☐ No
   (c) Evidence of cross-threading ..... ☐ Yes ☐ No
   (d) Shelf-life current ..... ☐ Yes ☐ No
   (e) Other Comments/Corrective Actions _____

7. **Canister Type Respirator:**
   (a) Breathing tube good condition ..... ☐ Yes ☐ No
   (b) Missing or loose hose clamps ..... ☐ Yes ☐ No
   (c) Broken/missing end connectors ..... ☐ Yes ☐ No
   (d) Canister harness OK ..... ☐ Yes ☐ No
   (e) Broken straps or fastenings ..... ☐ Yes ☐ No
   (f) Shelf-life on canister current ..... ☐ Yes ☐ No
   (g) Canister previously void ..... ☐ Yes ☐ No
   (h) Other Comments/Corrective Actions _____

SELF CONTAINED BREATHING APPARATUS (SCBA)
SUPPLIED AIR RESPIRATOR (SAR)

8. Inspect For:

(a) Type D Breathing Air ..... ☐ Yes ☐ No
(b) Cylinder sufficiently charged ..... ☐ Yes ☐ No
(c) Alarms Work ..... ☐ Yes ☐ No
(d) Valves function properly ..... ☐ Yes ☐ No
(e) Harness good condition ..... ☐ Yes ☐ No
(f) Properly stored & cleaned ..... ☐ Yes ☐ No
(g) Unit accessible ..... ☐ Yes ☐ No
(h) Airlines structurally sound ..... ☐ Yes ☐ No
(i) Locking connections between air liner sections ..... ☐ Yes ☐ No
(j) Air pressure maintained to 80-120 psi ..... ☐ Yes ☐ No
(k) Number of feet of airline used _____
(l) Tanks (hydrostatically tested) ..... ☐ Yes ☐ No
(m) Hydrostatic Testing in compliance ..... ☐ Yes ☐ No
(n) CO absorbent canister OK) (closed-circuit devices) ☐ Yes ☐ No
(o) Other Comments/Corrective Actions _____

OTHER

9. Hoods, Helmets, Blouses, or Suits:

(a) Properly stored ..... ☐ Yes ☐ No
(b) Suspension good condition ..... ☐ Yes ☐ No
(c) Integrity OK; No split seams, rips, or tears ..... ☐ Yes ☐ No
(d) Vision through face-piece adequate ..... ☐ Yes ☐ No
(e) Protective Screen intact ..... ☐ Yes ☐ No
(f) Type "D" Breathing Air ..... ☐ Yes ☐ No
(g) Compressor in OSHA compliance compliance (if used) ..... ☐ Yes ☐ No
(h) Regulators and valves good condition & functioning properly ..... ☐ Yes ☐ No
(i) Integrity of airlines & hoses OK ..... ☐ Yes ☐ No
(j) Other Comments/Corrective Actions _____

ONE-USE DISPOSAL RESPIRATORS

10. Examine Full Face-piece for:

(a) Stored in proper manner ..... ☐ Yes ☐ No
(b) Used without modification ..... ☐ Yes ☐ No
(c) Used properly ..... ☐ Yes ☐ No
(d) Other Comments/Corrective Actions _____

RESPIRATORY PROTECTION TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potentially hazardous nature of performing work under respiratory protection at_____, and that I have received project-specific respiratory protection training which included the elements presented below:

- Names of personnel and alternates responsible for the implementation of the site-specific respiratory protection program
- Safety, health and other hazards present on site
- Selection of respiratory protection
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Procedures for Proper use of respiratory equipment to be employed
  - Donning and doffing
  - Routine use and foreseeable emergency situations
  - Action levels for upgrade in protective levels and evacuation procedures
  - IDLH atmosphere rescue support
  - Supplied air respirators (air quality, quantities, and delivery systems)
- Respiratory protection maintenance procedures including inspection, cleaning, storing and repairing respiratory protection.
- Where applicable the contents of the health and safety plan including Tables 5-1 and 6-1 regarding health effects and physical properties of the contaminants and associated control measures. In situations where a HASP are not employed Tetra Tech NUS personnel will review contents of relevant Material Safety Data Sheets or other information where physical, chemical, and toxicological information may exist.
- Fit testing documentation

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

NAME(Print)	DATE	SIGNATURE

INSTRUCTOR(S): _____

_____

_____

APPENDIX C

SELECTED STANDARD OPERATING PROCEDURES

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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.

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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

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.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non applicable)*

~~PASSENGER AIRCRAFT~~ | CARGO AIRCRAFT ONLY | ~~CARGO AIRCRAFT~~

Airport of Departure:

Airport of Destination: 19CYS

Shipment type: *(delete non-applicable)*

NON-RADIOACTIVE | ~~RADIOACTIVE~~

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

FOR SHIPMENTS WITHIN USA, AK AND HI ONLY

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

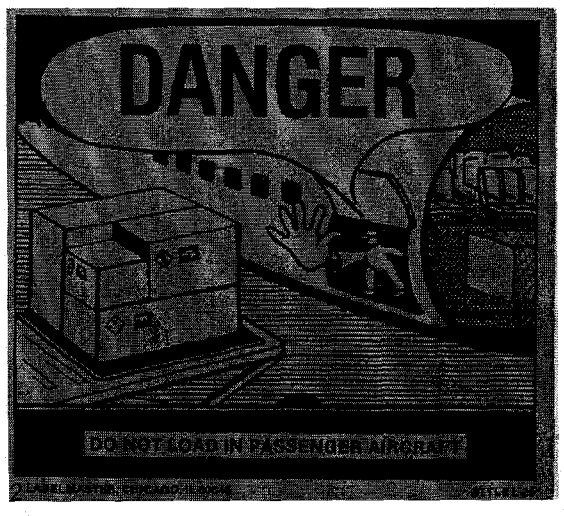
Place and Date

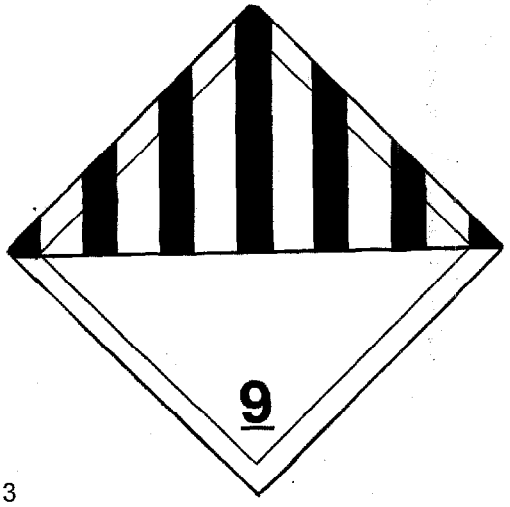
Signature *(see warning above)*

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

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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: Time:	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other
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 orH % 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

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): _____

SAMPLING DATA:

Date: / Time:	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other
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)

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:

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)

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:

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

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** _____

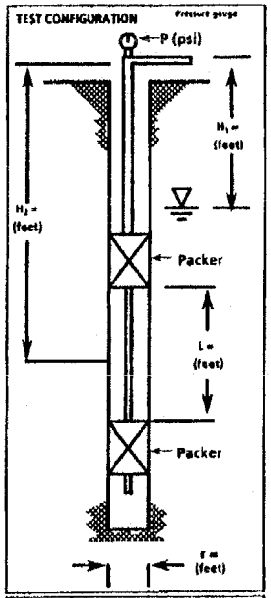
Flow Test					Calculated Results							
Pressure p (psi)	Elapsed Time (min)	Flow Reading	Δ Flow, ΔQ (ft³)	Δ Flow, ΔQ (gal)	Flow Rate Q (gal/min)	H_1* (ft)	Hp(Ft) = 2.31·(psi)	H_2* (ft)	H = Hp + (H1 or H2)	Cp	K (ft/yr) = Cp·Q/H	K (cm/sec) = 9.67 x 10⁷ K (ft/yr)

CP = (1/(2 π 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: _____

TEST CONFIGURATION



Length of Test Section in feet, l	Cp Drilling Bit Size			
	EX (1.5")	AX (1.875")	BX (2.31")	NX (3")
1	31,000	28,500	25,800	23,300
2	19,400	18,300	16,900	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	5,200	4,900
15	4,100	3,900	3,700	3,600
20	3,200	3,100	3,000	2,800

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					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			GROUP SYMBOL	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)				GROUP SYMBOL	TYPICAL NAMES
					Identification Procedures on Fraction Smaller than No. 40 Sieve Size					
						DAY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)		
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.	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.
		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	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	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	OL	Organic silts and organic silt-clays of low plasticity.
		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	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
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.		High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
		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	OH	Organic clays of medium to high plasticity.
	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.			Pt	Peat and other organic soils
		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 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 penetrated 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

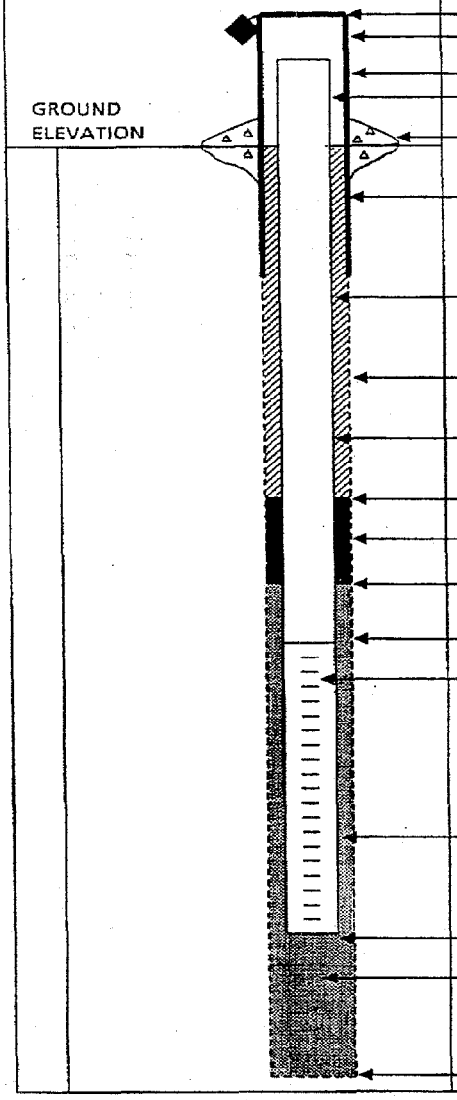
12/18

ATTACHMENT C-5
EXAMPLE OVERBURDEN MONITORING WELL SHEET

BORING NO.: _____

OVERBURDEN
MONITORING WELL SHEET

PROJECT _____ LOCATION _____ DRILLER _____
PROJECT NO. _____ BORING _____ DRILLING METHOD _____
ELEVATION _____ DATE _____ DEVELOPMENT METHOD _____
FIELD GEOLOGIST _____



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: _____ / _____

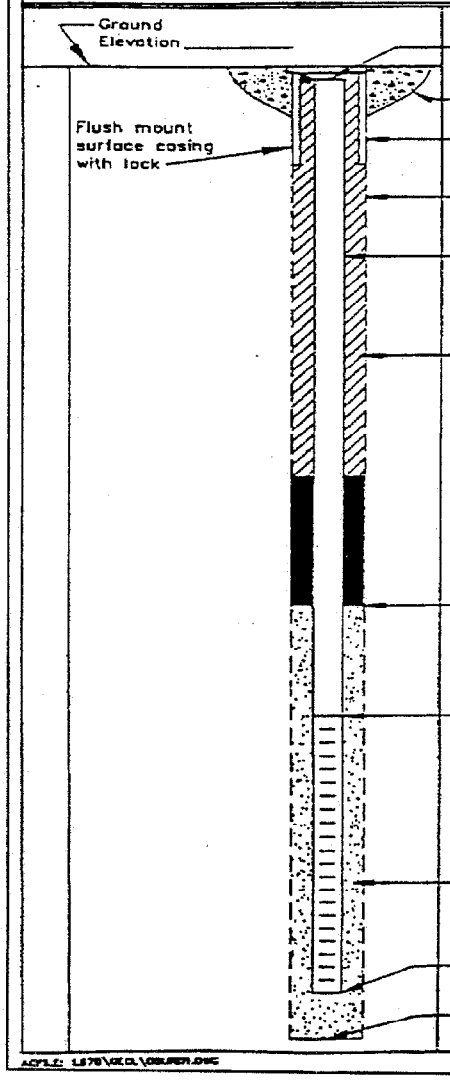
ATTACHMENT C-5A
EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)

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: _____

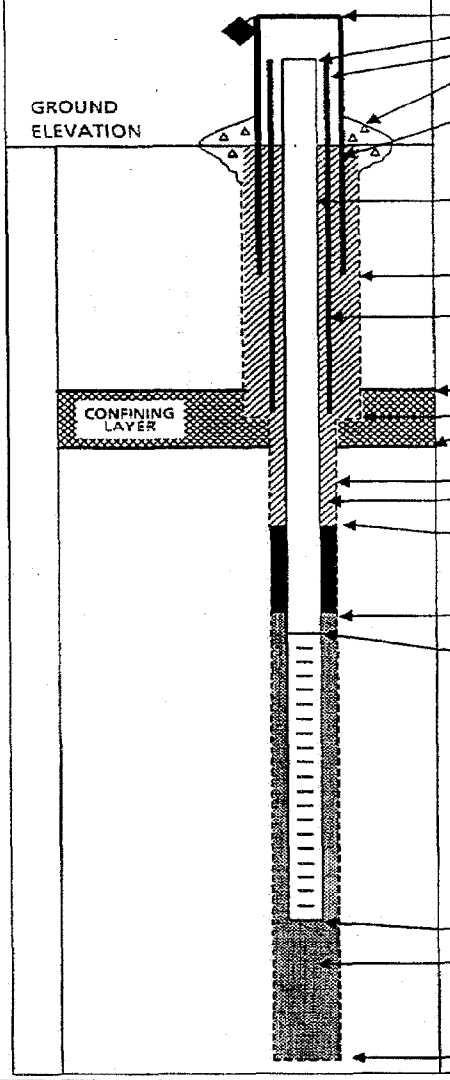
ATTACHMENT C-6
EXAMPLE CONFINING LAYER MONITORING WELL SHEET

BORING NO.: _____

CONFINING LAYER
MONITORING WELL SHEET

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



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: _____

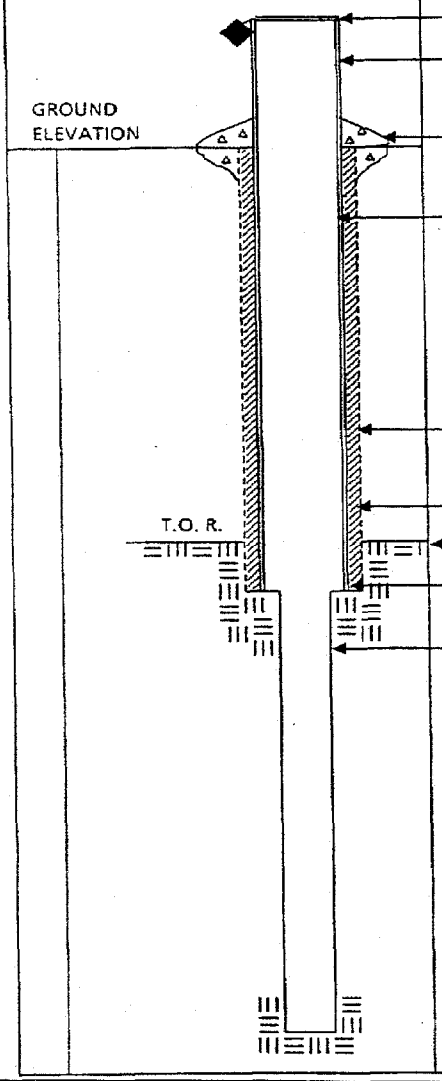
ATTACHMENT C-7
EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL

BORING NO.: _____

BEDROCK
MONITORING WELL SHEET
OPEN HOLE WELL

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



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: _____ / _____

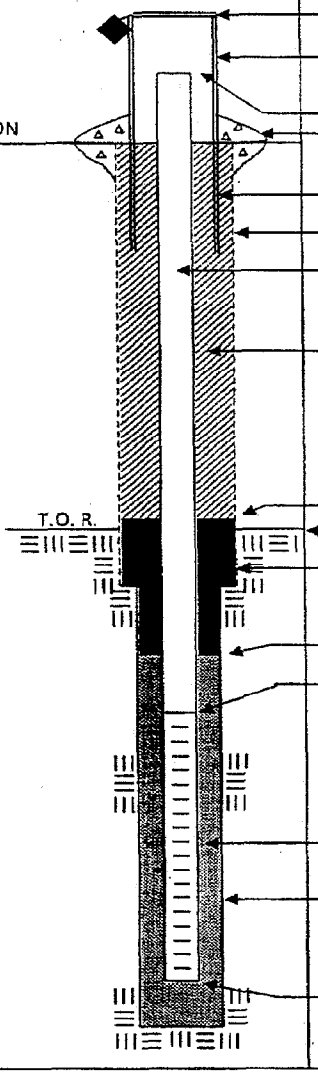
ATTACHMENT C-8
EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK

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: ____/____

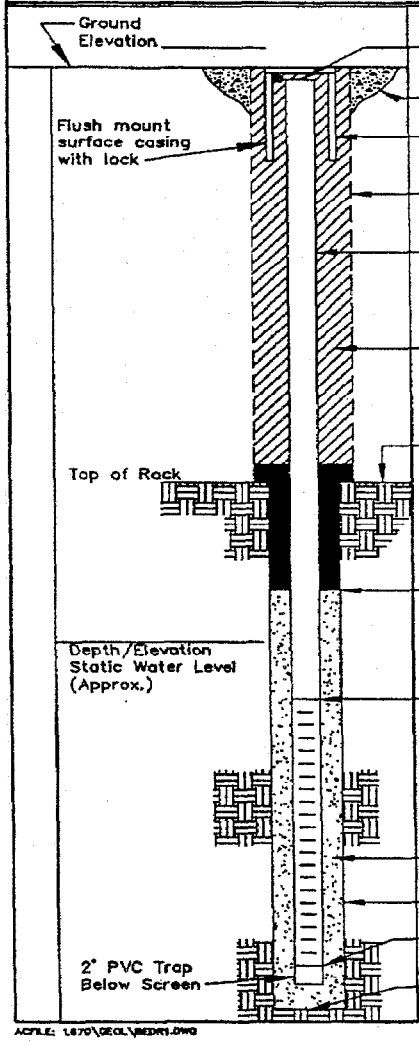
ELEVATION / DEPTH BOTTOM OF HOLE: ____/____

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: 1870\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 Name: _____
Date Installed: _____
Project Name: _____

Site Geologist: _____
Drilling Company: _____
Driller: _____
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 : _____

SITE NAME: _____

PROJECT No.: _____

INSTRUMENT NAME/MODEL: _____

MANUFACTURER: _____

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: _____

_____

_____

_____

TETRA TECH NUS, INC.	STANDARD OPERATING PROCEDURES	Number SA-1-1	Page 1 of 27
		Effective Date 06/99	Revision 4
		Applicability Tetra Tech NUS, Inc.	
		Prepared Earth Sciences Department	
Subject GROUNDWATER SAMPLE ACQUISITION AND ONSITE WATER QUALITY TESTING		Approved D. Senovich	

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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	0-160 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.

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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
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
		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	SILTS AND CLAYS Liquid Limit >50
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.	
		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 ML)	SM	Silty sands, poorly graded sand-silt mixtures.	HIGHLY ORGANIC SOILS
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.	

DRY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)
None to Slight	Quick to Slow	None
Medium to High	None to Very Slow	Medium
Slight to Medium	Slow	Slight
Slight to Medium	Slow to None	Slight to Medium
High to Very High	None	High
Medium to High	None to Very Slow	Slight to Medium
Readily identified by color, odor, sponge feel and frequently by fibrous texture		

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	
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	(Bl.)	1'-3'
Hard	Cannot be scratched	Breaks conchoidally (several blows); sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES

S-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

12/18

12/18

WATER LEVELS

▽ 12.6' Initial Level w/Date & Depth

▽ 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 @ 0800	0.0	7/6	1.5/2.0		M DENSE	BRN	SILTY SAND - SOME	SM	MOIST SL. ORG. ODOR	5	0	0	0
	2.0	9/10				TO BLK	ROCK FR. - TR BRICKS						
							(FILL)		FILL TO 4'±				
	4.0			4.0									
S-2 @ 0810		5/7	2.0/2.0		M DENSE	BRN	SILTY SAND - TR FINE	SM	MOIST - W ODOR	10	0	-	-
	6.0	9/8					GRAVEL		NAT. MATL. TOOK SAMPLE				
	•			7'± ▽					SB01-0406 FOR ANALYSIS				
	8.0			8.0									
S-3 @ 0820		6/8	1.9/2.0		DENSE	TAN BRN	FINE TO COARSE SAND	SW	WET	0	0	0	0
	10.0	17/16					TR. F. GRAVEL		HIT WATER = 7'±				
	12.0			12.0									
S-4 @ 0830		7/6	1.6/2.0		STIFF	GRAY	SILTY CLAY	CL	MOIST → WET	0	.5	-	-
	14.0	5/8											
	15.0			15.0					AUGER REF @ 15'				
				11 HSA 16	M HARD	BRN	SILTSTONE	VBR	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				
4.8/5.0	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, 4¼" 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.

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1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper monitoring well design, installation, and development.

2.0 SCOPE

This procedure is applicable to the construction of monitoring wells. The methods described herein may be modified by project-specific requirements for monitoring well construction. In addition, many regulatory agencies have specific regulations pertaining to monitoring well construction and permitting. These requirements must be determined during the project planning phases of the investigation, and any required permits must be obtained before field work begins. Innovative monitoring well installation techniques, which typically are not used, will be discussed only generally in this procedure.

3.0 GLOSSARY

Monitoring Well - A well which is screened, cased, and sealed which is capable of providing a groundwater level and groundwater sample representative of the zone being monitored. Some monitoring wells may be constructed as open boreholes.

Piezometer - A pipe or tube inserted into the water bearing zone, typically open to water flow at the bottom and to the atmosphere at the top, and used to measure water level elevations. Piezometers may range in size from 1/2-inch-diameter plastic tubes to well points or monitoring wells.

Potentiometric Surface - The surface representative of the level to which water will rise in a well cased to the screened aquifer.

Well Point (Drive Point) - A screened or perforated tube (Typically 1-1/4 or 2 inches in diameter) with a solid, conical, hardened point at one end, which is attached to a riser pipe and driven into the ground with a sledge hammer, drop weight, or mechanical vibrator. Well points may be used for groundwater injection and recovery, as piezometers (i.e., to measure water levels) or to provide groundwater samples for water quality data.

4.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The driller may also be responsible for obtaining, in advance, any required permits for monitoring well installation and construction.

Field Geologist - The field geologist supervises and documents well installation and construction performed by the driller, and insures that well construction is adequate to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

5.0 PROCEDURES

5.1 Equipment/Items Needed

Below is a list of items that may be needed when installing a monitoring well or piezometer:

- Health and safety equipment as required by the Site Safety Officer.
- Well drilling and installation equipment with associated materials (typically supplied by the driller).
- Hydrogeologic equipment (weighted engineer's tape, water level indicator, retractable engineers rule, electronic calculator, clipboard, mirror and flashlight - for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, and a field notebook).
- Drive point installation tools (sledge hammer, drop hammer, or mechanical vibrator; tripod, pipe wrenches, drive points, riser pipe, and end caps).

5.2 Well Design

The objectives and intended use for each monitoring well must be clearly defined before the monitoring system is designed. Within the monitoring system, different monitoring wells may serve different purposes and, therefore, require different types of construction. During all phases of the well design, attention must be given to clearly documenting the basis for design decisions, the details of well construction, and the materials used. The objectives for installing the monitoring wells may include:

- Determining groundwater flow directions and velocities.
- Sampling or monitoring for trace contaminants.
- Determining aquifer characteristics (e.g., hydraulic conductivity).

Siting of monitoring wells shall be performed after a preliminary estimation of the groundwater flow direction. In most cases, groundwater flow directions and potential well locations can be determined by an experienced hydrogeologist through the review of geologic data and the site terrain. In addition, data from production wells or other monitoring wells in the area may be used to determine the groundwater flow direction. If these methods cannot be used, piezometers, which are relatively inexpensive to install, may have to be installed in a preliminary investigative phase to determine groundwater flow direction.

5.2.1 Well Depth, Diameter, and Monitored Interval

The well depth, diameter, and monitored interval must be tailored to the specific monitoring needs of each investigation. Specification of these items generally depends on the purpose of the monitoring system and the characteristics of the hydrogeologic system being monitored. Wells of different depth, diameter, and monitored interval can be employed in the same groundwater monitoring system. For instance, varying the monitored interval in several wells, at the same location (cluster wells) can help to determine the vertical gradient and the depths at which contaminants are present. Conversely, a fully penetrating well is usually not used to quantify or vertically locate a contaminant plume, since groundwater samples collected in wells that are screened over the full thickness of the water-bearing zone will be representative of average conditions across the entire monitored interval. However, fully penetrating wells can be used to establish the existence of contamination in the water-bearing zone. The well diameter desired depends upon the hydraulic characteristics of the water-bearing zone, sampling requirements, drilling method and cost.

The decision concerning the monitored interval and well depth is based on the following (and possibly other) information:

- The vertical location of the contaminant source in relation to the water-bearing zone.
- The depth, thickness and uniformity of the water-bearing zone.
- The anticipated depth, thickness, and characteristics (e.g., density relative to water) of the contaminant plume.
- Fluctuation in groundwater levels (due to pumping, tidal influences, or natural recharge/discharge events).
- The presence and location of contaminants encountered during drilling.
- Whether the purpose of the installation is for determining existence or non-existence of contamination or if a particular stratigraphic zone is being investigated.
- The analysis of borehole geophysical logs.

In most situations where groundwater flow lines are horizontal, depending on the purpose of the well and the site conditions, monitored intervals are 20 feet or less. Shorter screen lengths (5 feet or less) are usually required where flow lines are not horizontal, (i.e., if the wells are to be used for accurate measurement of the potentiometric head at a specific point).

Many factors influence the diameter of a monitoring well. The diameter of the monitoring well depends on the application. In determining well diameter, the following needs must be considered:

- Adequate water volume for sampling.
- Drilling methodology.
- Type of sampling device to be used.
- Costs.

Standard monitoring well diameters are 2, 4, 6, or 8 inches. Drive points are typically 1-1/4 or 2 inches in diameter. For monitoring programs which require screened monitoring wells, either a 2-inch or 4-inch-diameter well is preferred. Typically, well diameters greater than 4 inches are used in monitoring programs in which open-hole bedrock monitoring wells are used. With smaller diameter wells, the volume of stagnant water in the well is minimized, and well construction costs are reduced; however, the sampling devices that can be used are limited.

In specifying well diameter, sampling requirements must be considered (up to a total of 4 gallons of water may be required for a single sample to account for full organic and inorganic analyses, and split samples), particularly if the monitored formation is known to be a low-yielding formation. The unit volume of water contained within a monitoring well is dependent on the well diameter as follows:

Casing Inside Diameter (Inch)	Standing Water Length to Obtain 1 Gallon Water (Feet)
2	6.13
4	1.53
6	0.68

If a well recharges quickly after purging, then well diameter may not be an important factor regarding sample volume requirements.

Pumping tests for determining aquifer characteristics may require larger diameter wells (for installation of high capacity pumps); however, in small-diameter wells in-situ permeability tests can be performed during drilling or after well installation is completed.

5.2.2 Riser Pipe and Screen Materials

Well materials are specified by diameter, type of material, and thickness of pipe. Well screens require an additional specification of slot size. Thickness of pipe is referred to as "Schedule" for polyvinyl chloride (PVC) casing and is usually Schedule 40 (thinner wall) or 80 (thicker wall). Steel pipe thickness is often referred to as "Strength". Standard Strength is usually adequate for monitoring well purposes. With larger diameter pipe, the wall thickness must be greater to maintain adequate strength. The required thickness is also dependent on the method of installation; risers for drive points require greater strength than wells installed inside drilled borings.

The selection of well screen and riser materials depends on the method of drilling, the type of subsurface materials the well penetrates, the type of contamination expected, and natural water quality and depth. Cost and the level of accuracy required are also important. The materials generally available are Teflon, stainless steel, PVC galvanized steel, and carbon steel. Each has advantages and limitations (see Attachment A of this guideline for an extensive presentation on this topic). The two most commonly used materials are PVC and stainless steel. Properties of these two materials are compared in Attachment B. Stainless steel is a good choice where trace metals or organic sampling is required; however, costs are high. Teflon materials are extremely expensive, but are relatively inert and provide the least opportunity for water contamination due to well materials. PVC has many advantages, including low cost, excellent availability, light weight, ease of manipulation, and widespread acceptance. The crushing strength of PVC may limit the depth of installation, but the use of Schedule 80 materials may overcome some of the problems associated with depth. However, the smaller inside diameter of Schedule 80 pipe may be an important factor when considering the size of bailers or pumps required for sampling or testing. Due to this problem, the minimum well pipe size recommended for Schedule 80 wells is 4-inch I.D.

Screens and risers may have to be decontaminated before use because oil-based preservatives and oil used during thread cutting and screen manufacturing may contaminate samples. Metal pipe may corrode and release metal ions or chemically react with organic constituents, but this is considered a minor issue. Galvanized steel is not recommended where samples may be collected for metals analyses, as zinc and cadmium levels in groundwater samples may become elevated from leaching of the zinc coating.

Threaded, flush-joint casing is most often preferred for monitoring well applications. PVC, Teflon, and steel can all be obtained with threaded joints. Welded-joint steel casing is also acceptable. Glued PVC may release organic contaminants into the well, and therefore, should not be used if the well is to be sampled for organic constituents.

When the water-bearing zone is in consolidated bedrock, such as limestone or fractured granite, a well screen is often not necessary (the well is simply an open hole in bedrock). Unconsolidated materials, such as sands, clay, and silts require a screen. A screen slot size of 0.010 or 0.020 inch is generally used when a screen is necessary, and the annular borehole space around the screened interval is artificially packed with an appropriately sized sand, selected based on formation grain size. The slot size controls the quantity of water entering the well and prevents entry of natural materials or sand pack. The screen shall pass no more than 10 percent of the pack material, or in-situ aquifer material. The site geologist

shall specify the combination of screen slot size and sand pack which will be compatible with the water-bearing zone, to maximize groundwater inflow and minimize head losses and movement of fines into the wells. For example, as a standard procedure, a Morie No. 1 or No. 10 to No. 20 U.S. Standard Sieve size filter pack is typically appropriate for a 0.020-inch slot screen; however, a No. 20 to No. 40 U.S. Standard Sieve size filter pack is typically appropriate for a 0.010-inch slot screen.

5.2.3 Annular Materials

Materials placed in the annular space between the borehole and riser pipe and screen include a sand pack when necessary, a bentonite seal, and cement-bentonite grout. The sand pack is usually a medium- to coarse-grained poorly graded, silica sand and should relate to the grain size of the aquifer sediments. The quantity of sand placed in the annular space is dependent upon the length of the screened interval, but should always extend at least 1 foot above the top of the screen. At least 1 to 3 feet of bentonite pellets or equivalent shall be placed above the sand pack. Cement-bentonite grout (or equivalent) is then placed to extent from the top of the bentonite pellets to the ground surface.

On occasion, and with the concurrence of the involved regulatory agencies, monitoring wells may be packed naturally (i.e., no artificial sand pack installed). In this case, the natural formation material is allowed to collapse around the well screen after the well is installed. This method has been used where the formation material itself is a relatively uniform grain size, or when artificial sand packing is not possible due to borehole collapse.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets, extending to the surface. The grout effectively seals the remaining borehole annulus and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom upward, to prevent bridging, and to provide a better seal. In shallow boreholes that don't collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

Grout is a general term which has several different connotations. For all practical purposes within the monitoring well installation industry, grout refers to the solidified material which is installed and occupies the annular space above the bentonite pellet seal. Grout, most of the time, is made up of one or two assemblages of material, (e.g., cement and/or bentonite). A cement-bentonite grout, which is the most common type of grout used in monitoring well completions, normally is a mixture of cement, bentonite, and water at a ratio of one 90-pound bag of Portland Type I cement, plus 3 to 5 pounds of granular or flake-type bentonite, and 6-7 gallons of water. A neat cement consists of one ninety-pound bag of Portland Type I cement and 6-7 gallons of water. A bentonite slurry (bentonite and water mixed to a thick but pumpable mixture) is sometimes used instead of grout for deep well installations where placement of bentonite pellets is difficult. Bentonite chips are also occasionally used for annular backfill in place of grout.

In certain cases, the borehole may be drilled to a depth greater than the anticipated well installation depth. For these cases, the well shall be backfilled to the desired depth with bentonite pellets/chips or cement grout. A short (1- to 2-foot) section of capped riser pipe sump is sometimes installed immediately below the screen, as a silt reservoir, when significant post-development silting is anticipated. This will ensure that the entire screen surface remains unobstructed.

5.2.4 Protective Casing

When the well is completed and grouted to the surface, a protective steel casing is typically placed over the top of the well. This casing generally has a hinged cap and can be locked to prevent vandalism. The protective casing has a larger diameter than the well and is set into the wet cement grout over the well upon completion. In addition, one hole is drilled just above the cement collar through the protective casing which acts as a weep hole for the flow of water which may enter the annulus during well development, purging, or sampling.

A protective casing which is level with the ground surface (flush-mounted) is used in roadway or parking lot applications where the top of a monitoring well must be below the pavement. The top of the riser pipe is placed 4 to 5 inches below the pavement, and a locking protective casing is cemented in place to 3 inches below the pavement. A large diameter, manhole-type protective collar is set into the wet cement around the well with the top set level with or slightly above the pavement. An appropriately-sized id is placed over the protective sleeve. The cement should be slightly mounded to direct pooled water away from the well head.

5.3 Monitoring Well Installation

Pertinent data regarding monitoring well installation shall be recorded on log sheets as depicted and discussed in SOP SA-6.3. Attachments to this referenced SOP illustrate terms and physical construction of various types of monitoring wells.

5.3.1 Monitoring Wells in Unconsolidated Sediments

After the borehole is drilled to the desired depth, well installation can begin. The procedure for well installation will partially be dictated by the stability of the formation in which the well is being placed. If the borehole collapses immediately after the drilling tools are withdrawn, then a temporary casing must be installed and well installation will proceed through the center of the temporary casing, and continue as the temporary casing is withdrawn from the borehole. In the case of hollow-stem auger drilling, the augers will act to stabilize the borehole during well installation.

Before the screen and riser pipe are lowered into the borehole, all pipe and screen sections should be measured with an engineer's rule to ensure proper placement. When measuring sections, the threads on one end of the pipe or screen must be excluded while measuring, since the pipe and screen sections are screwed flush together.

After the screen and riser pipe are lowered through the temporary casing, the sand pack can be installed. A weighted tape measure must be used during the installation procedure to carefully monitor installation progress. The sand is slowly poured into the annulus between the riser pipe and temporary casing, as the casing is withdrawn. Sand should always be kept within the temporary casing during withdrawal in order to ensure an adequate sand pack. However, if too much sand is within the temporary casing (greater than 1 foot above the bottom of the casing) bridging between the temporary casing and riser pipe may occur. Centralizers may be used at the geologist's discretion, one above and one below the screen, to assure enough annular space for sand pack placement.

After the sand pack is installed to the desired depth (at least 1 foot above the top of the screen), then the bentonite pellet seal (or equivalent), can be installed in the same manner as the sand pack. At least 1 to 3 feet of bentonite pellets should be installed above the sand pack. Pellets should be added slowly and their fall monitored closely to ensure that bridging does not occur.

The cement-bentonite grout is then mixed and tremied into the annulus as the temporary casing or augers are withdrawn. Finally, the protective casing can be installed as detailed in Section 5.2.4.

5.3.2 Confining Layer Monitoring Wells

When drilling and installing a well in a confined aquifer, proper well installation techniques must be applied to avoid cross contamination between aquifers. Under most conditions, this can be accomplished by installing double-cased wells. This is accomplished by drilling a large-diameter boring through the upper aquifer, 1 to 5 feet into the underlying confining layer, and setting and pressure grouting or tremie grouting a large-diameter casing into the confining layer. The grout material must fill the space between the native material and the outer casing. A smaller diameter boring is then continued through the confining layer for installation of the monitoring well as detailed for overburden monitoring wells. Sufficient time (determined by the field geologist), must be allowed for setting of the grout prior to drilling through the confined layer.

5.3.3 Bedrock Monitoring Wells

When installing bedrock monitoring wells, a large diameter boring is drilled through the overburden and approximately 5 –10 feet into bedrock. A casing (typically steel) is installed and either pressure grouted or tremie grouted in place. After the grout has cured, a smaller diameter boring is continued into bedrock to the desired depth. If the boring does not collapse, the well can be left open, and a screen is not necessary. If the boring collapses, then a screen is required and can be installed as detailed for overburden monitoring wells. If a screen is to be used, then the casing which is installed through the overburden and into the bedrock does not require grouting and can be removed when the final well installation is completed.

5.3.4 Drive Points

Drive points can be installed with either a sledge hammer, drop hammer, or a mechanical vibrator. The screen section is threaded and tightened onto the riser pipe with pipe wrenches. The drive point is simply pounded into the subsurface to the desired depth. If a heavy drop hammer is used, then a tripod and pulley setup is required to lift the hammer. Drive points typically cannot be manually driven to depths exceeding 10 feet.

Direct push sampling/monitoring point installation methods, using a direct push rig or drilling rig, are described in SOP SA-2.5.

5.3.5 Innovative Monitoring Well Installation Techniques

Certain innovative sampling devices have proven advantageous. These devices are essentially screened samplers installed in a borehole with only small-diameter tubes extending to the surface. This reduces drilling costs, decreases the volume of stagnant water, and provides a sampling system that minimizes cross-contamination from sampling equipment. Four manufacturers of these samplers include Timco Manufacturing Company, Inc., of Prairie du Sac, Wisconsin, BARCAD Systems, Inc., of Concord, Massachusetts, Westbay Instruments Ltd. of Vancouver, British Columbia, Canada and the University of Waterloo at Waterloo, Ontario, Canada.. Each manufacturer offers various construction materials.

5.4 Well Development Methods

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. Wells are typically developed until all fine material and drilling water is removed from the well. Sequential measurements of pH, conductivity and temperature taken during development may yield information (stabilized values) regarding whether sufficient development has been performed. The selection of the well development method shall be made by the field geologist and is based on the drilling methods, well construction and installation details, and the characteristics of the formation that the well is screened in. The primary methods of well development are summarized below. A more detailed discussion may be found in Driscoll (1986).

5.4.1 Overpumping and Backwashing

Wells may be developed by alternatively drawing the water level down at a high rate (by pumping or bailing) and then reversing the flow direction (backwashing) so that water is passing from the well into the formation. This back and forth movement of water through the well screen and gravel pack serves to remove fines from the formation immediately adjacent to the well, while preventing bridging (wedging) of sand grains. Backwashing can be accomplished by several methods, including pouring water into the well and then bailing, starting and stopping a pump intermittently to change water levels, or forcing water into the well under pressure through a water-tight fitting ("rawhiding"). Care should be taken when backwashing not to apply too much pressure, which could damage or destroy the well screen.

5.4.2 Surging with a Surge Plunger

A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is aggressively moved up and down within the well to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack. There are two basic types of surge plungers; solid and valved surge plungers. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

5.4.3 Compressed Air

Compressed air can be used to develop a well by either of two methods: backwashing or surging. Backwashing is done by forcing water out through the screens, using increasing air pressure inside a sealed well, then releasing the pressurized air to allow the water to flow back into the well. Care should be taken when using this method so that the water level does not drop below the top of the screen, thus introducing air into the formation and reducing well yield. Surging, or the "open well" method, consists of alternately releasing large volumes of air suddenly into an open well below the water level to produce a strong surge by virtue of the resistance of water head, friction, and inertia. Pumping of the well is subsequently done using the air lift method.

5.4.4 High Velocity Jetting

In the high velocity jetting method, water is forced at high velocities from a plunger-type device and through the well screen to loosen fine particles from the sand pack and surrounding formation. The jetting tool is slowly rotated and raised and lowered along the length of the well screen to develop the entire

screened area. Jetting using a hose lowered into the well may also be effective. The fines washed into the screen during this process can then be bailed or pumped from the well.

6.0 RECORDS

A critical part of monitoring well installation is recording of all significant details and events in the site logbook or field notebook. The geologist must record the exact depths of significant hydrogeological features, screen placement, gravel pack placement, and bentonite placement.

A Monitoring Well Sheet (see Attachments to SOP SA-6.3) shall be completed, ensuring the uniform recording of data for each installation and rapid identification of missing information. Well depth, length, materials of construction, length and openings of screen, length and type of riser, and depth and type of all backfill materials shall be recorded. Additional information shall include location, installation date, problems encountered, water levels before and after well installation, cross-reference to the geologic boring log, and methods used during the installation and development process. Documentation is very important to prevent problems involving questionable sample validity. Somewhat different information will need to be recorded, depending on whether the well is completed in overburden (single- or double-cased), as a cased well in bedrock, or as an open hole in bedrock.

The quantities of sand, bentonite, and grout placed in the well are also important. The geologist shall calculate the annular space volume and have an idea of the quantity of material needed to fill the annular space. Volumes of backfill significantly higher than the calculated volume may indicate a problem such as a large cavity, while a smaller backfill volume may indicate a cave-in or bridging of the backfill materials. Any problems with rig operation or down-time shall be recorded and may affect the driller's final fee.

7.0 REFERENCES

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Barcelona, M. J., P. P. Gibb and R. A. Miller, 1983. A Guide to the selection of Materials for Monitoring Well Construction and Groundwater Sampling. ISWS Contract Report 327, Illinois State Water Survey, Champaign, Illinois.

U.S. EPA, 1980. Procedures Manual for Groundwater Monitoring of Solid Waste Disposal Facilities. Publication SW-611, Office of Solid Waste, U.S. EPA, Washington, D.C.

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ATTACHMENT A

RELATIVE COMPATIBILITY OF RIGID WELL CASING MATERIAL (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material						
	PVC 1	Galvanized Steel	Carbon Steel	Lo-carbon Steel	Stainless Steel 304	Stainless Steel 316	Teflon*
Buffered Weak Acid	100	56	51	59	97	100	100
Weak Acid	98	59	43	47	96	100	100
Mineral Acid/ High Solids Content	100	48	57	60	80	82	100
Aqueous/Organic Mixtures	64	69	73	73	98	100	100
Percent Overall Rating	91	58	56	59	93	96	100

Preliminary Ranking of Rigid Materials:

1 Teflon®
2 Stainless Steel 316
3. Stainless Steel 304
4 PVC 1
5 Lo-Carbon Steel
6 Galvanized Steel
7 Carbon Steel

* Trademark of DuPont

RELATIVE COMPATIBILITY OF SEMI-RIGID OR ELASTOMERIC MATERIALS (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material								
	PVC Flexible	PP	PE Conv.	PE Linear	PMM	Viton®*	Silicone	Neoprene	Teflon®*
Buffered Weak Acid	97	97	100	97	90	92	87	85	100
Weak Acid	92	90	94	96	78	78	75	75	100
Mineral Acid/ High Solids Content	100	100	100	100	95	100	78	82	100
Aqueous/Organic Mixtures	62	71	40	60	49	78	49	44	100
Percent Overall Rating	88	90	84	88	78	87	72	72	100

Preliminary Ranking of Semi-Rigid or Elastomeric Materials:

1 Teflon®
2 Polypropylene (PP)
3. PVC Flexible/PE Linear
4 Viton®
5 PE Conventional
6 Plexiglas/Lucite (PMM)
7 Silicone/Neoprene

* Trademark of DuPont

Source: Barcelona et al., 1983

ATTACHMENT B

COMPARISON OF STAINLESS STEEL AND PVC FOR MONITORING WELL CONSTRUCTION

Characteristic	Stainless Steel	PVC
Strength	Use in deep wells to prevent compression and closing of screen/riser.	Use when shear and compressive strength are not critical.
Weight	Relatively heavier.	Light-weight; floats in water.
Cost	Relatively expensive.	Relatively inexpensive.
Corrosivity	Deteriorates more rapidly in corrosive water.	Non-corrosive -- may deteriorate in presence of ketones, aromatics, alkyl sulfides, or some chlorinated hydrocarbons.
Ease of Use	Difficult to adjust size or length in the field.	Easy to handle and work with in the field.
Preparation for Use	Should be steam cleaned if organics will be subsequently sampled.	Never use glue fittings -- pipes should be threaded or pressure fitted. Should be steam cleaned when used for monitoring wells.
Interaction with Contaminants*	May sorb organic or inorganic substances when oxidized.	May sorb or release organic substances.

* See also Attachment A.

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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 (±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: _____

APPENDIX D

FIELD DOCUMENTATION FORMS

TETRA TECH NUS INC.

FIELD MODIFICATION RECORD

Site Name: _____ Location: _____

Project Number: _____ Task Assignment: _____

To: _____ Location: _____ Date: _____

Description: _____

_____

_____

_____

Reason for Change: _____

_____

_____

Recommended Action: _____

_____

_____

Field Operations Leader (Signature): _____ Date: _____

Disposition/Action:

_____

_____

_____

Project Manager (Signature): _____ Date: _____

Distribution:

Program Manager:	_____	Others as Required:
Project Manager:	_____	_____
Quality Assurance Officer:	_____	_____
Field Operations Leader:	_____	_____
Project File:	_____	_____

Tt NUS Form 0003

TETRA TECH NUS, INC.

QUALITY NOTICE

DIVISION AUDITED:	AUDIT NO.:	QN NO.:	REPORTABLE PER 10CFR21? ☐ YES ☐ NO

PROJECT/PROGRAM:

RESPONSE ASSIGNED TO:	DUE DATE:	REPORTED BY:	DATE:

QN CATEGORY: ☐ OBSERVATION ☐ DEFICIENCY ☐ CONCERN	ACTIVITY:

PROCEDURE/PROGRAM/DOCUMENT REFERENCE:

REQUIREMENT:

CONDITION OBSERVED:

TO BE COMPLETED BY AUDITED ORGANIZATION

CONDITION OBSERVED:

RESPONSE SUBMITTED BY:	DATE:

TO BE COMPLETED BY AUDITED ORGANIZATION

AUDITED ORGANIZATION(S) RESPONSE: (SEE ATTACHED COVER LETTER)

1. **ROOT CAUSE ASSESSMENT**

2. **CORRECTIVE ACTION FOR IMMEDIATE PROBLEMS(S)**

3. **CORRECTIVE ACTION TO PRECLUDE PROBLEM RECURRENCE**

4. **FIRM SCHEDULE (DATES) FOR CORRECTIVE ACTION COMPLETION**

RESPONSE SUBMITTED BY:	DATE:

RESPONSE EVALUATION TO BE COMPLETED BY QUALITY ASSURANCE

FIRST RESPONSE: ☐ SATISFACTORY ☐ UNSATISFACTORY	☐ QN OPEN ☐ QN CLOSED
SECOND RESPONSE: ☐ SATISFACTORY ☐ UNSATISFACTORY	☐ QN OPEN ☐ QN CLOSED

REMARKS:

C/A VERIFIED: ☐ YES ☐ N/A	REVIEWED/APPROVED:	DATE:

TETRA TECH NUS, INC.

WEEKLY FIELD SUMMARY REPORT

TO: _____ FROM: _____

SITE: _____ JOB NO.: _____

DATES: _____ TO _____

DAY/DATE: _____ WEATHER: _____

PERSONNEL ONSITE: _____

SITE ACTIVITIES: _____

DAY/DATE: _____ WEATHER: _____

PERSONNEL ONSITE: _____

SITE ACTIVITIES: _____

DAY/DATE: _____ WEATHER: _____

PERSONNEL ONSITE: _____

SITE ACTIVITIES: _____

Tt NUS FORM 0016

WEEKLY FIELD SUMMARY REPORT (continued)

DAY/DATE: _____ WEATHER: _____

PERSONNEL ONSITE: _____

SITE ACTIVITIES: _____

DAY/DATE: _____ WEATHER: _____

PERSONNEL ONSITE: _____

SITE ACTIVITIES: _____

DAY/DATE: _____ WEATHER: _____

PERSONNEL ONSITE: _____

SITE ACTIVITIES: _____

DAY/DATE: _____ WEATHER: _____

PERSONNEL ONSITE: _____

SITE ACTIVITIES: _____

BORING LOG FOR:
PROJECT NO.:
LOGGED BY:
DRILLED BY (Company/Driller):
GRD. SURFACE ELEVATION:

TRANSCRIBED BY:

ELEVATION FROM:

BORING NO.:
START DATE:
COMPLETION: DATE:
MON. WELL NO.:
CHECKED BY:

DEPTH (FEET)	BLOWS PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA *METHOD* = [FID, (PPM)]

TYPE OF DRILLING RIG:
METHOD OF ADVANCING BORING:
METHOD OF SOIL SAMPLING:
METHOD OF ROCK CORING:
GROUNDWATER LEVELS:
OTHER OBSERVATIONS:

BORING NO.:

Tetra Tech NUS, Inc.

PAGE: OF

Ttnus Form 0018

OVERBURDEN MONITORING WELL CONSTRUCTION LOG — TETRA TECH NUS, INC.

PROJECT NAME: _____ PROJECT NO: _____

PROJECT LOCATION: _____ WELL NO: _____

CLIENT: _____ BORING NO: _____

CONTRACTOR: _____ DRILLER: _____ BORING LOCATION: _____

LOGGED BY: _____ DATE: _____

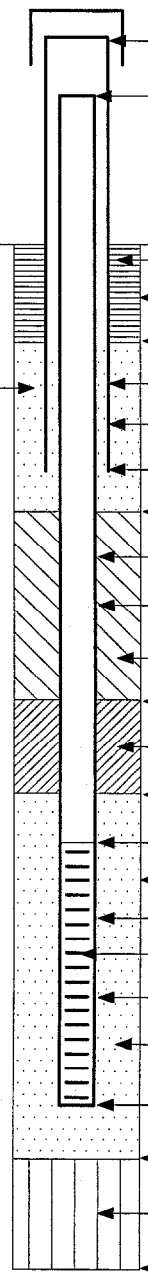
CHECKED BY: _____ DATE: _____

PAGE: 1 OF 1

ELEVATION TOP OF PROTECTIVE CASING _____

ELEVATION TOP OF RISER PIPE _____

GROUND ELEVATION _____



SAND DRAIN LAYER

- LENGTH OF PROTECTIVE CASING ABOVE GROUND SURFACE (Ft.) _____
- LENGTH OF RISER PIPE ABOVE GROUND SURFACE (Ft.) _____
- TYPE OF SURFACE SEAL _____
- DIA. SURFACE SEAL BGS (In.) _____
- DEPTH TO BOTTOM OF SURFACE SEAL (Ft.) _____
- I.D. OF PROTECTIVE CASING (In.) _____
- TYPE OF PROTECTIVE CASING _____
- DEPTH BOTTOM OF PROTECTIVE CASING (Ft.) _____
- DEPTH BOTTOM OF DRAIN LAYER (Ft.) _____
- RISER PIPE (In.) I.D.: _____ O.D.: _____
- TYPE OF RISER PIPE _____
- TYPE OF BACKFILL AROUND RISER PIPE _____
- DEPTH TOP OF SEAL (Ft.) _____
- TYPE OF SEAL _____
- DEPTH BOTTOM OF SEAL (Ft.) _____
- DEPTH TOP OF PERVIOUS SECTION (Ft.) _____
- DIAMETER OF BOREHOLE (In.) _____
- TYPE OF PERVIOUS SECTION _____
- TYPE OF OPENINGS _____
- PERVIOUS SECTION (In.) I.D.: _____ O.D.: _____
- TYPE OF FILTER PACK AROUND PERVIOUS SECTION _____
- DEPTH BOTTOM OF PERVIOUS SECTION (Ft.) _____
- DEPTH BOTTOM OF FILTER PACK (Ft.) _____
- TYPE OF BACKFILL BELOW FILTER PACK _____
- END OF BORING (Ft.) _____

GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

BEDROCK MONITORING WELL CONSTRUCTION LOG

TETRA TECH NUS, INC.

PROJECT NAME: _____ PROJECT NO: _____

PROJECT LOCATION: _____ WELL NO: _____

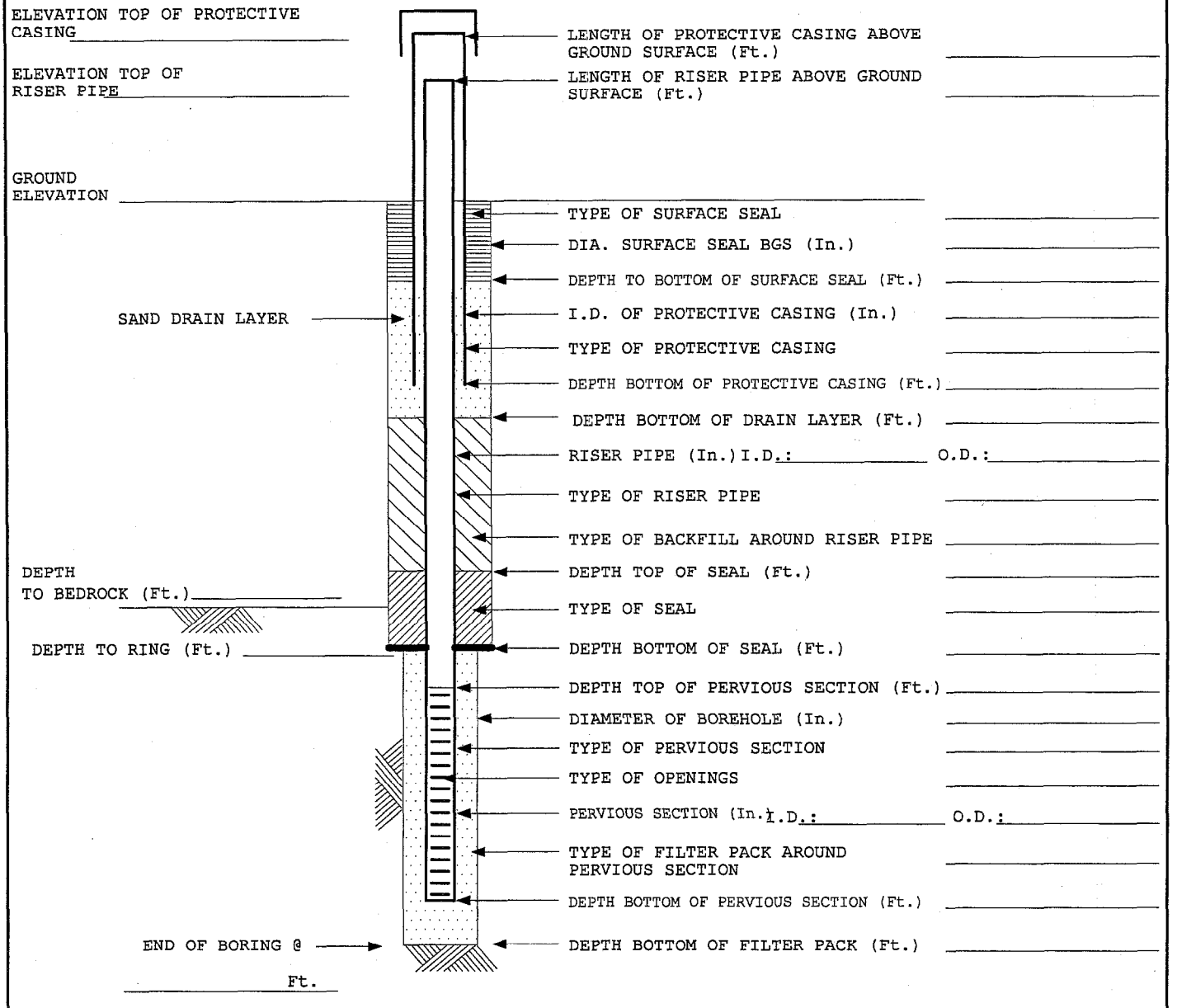
CLIENT: _____ BORING NO: _____

CONTRACTOR: _____ DRILLER: _____ BORING LOCATION: _____

LOGGED BY: _____ DATE: _____

CHECKED BY: _____ DATE: _____

PAGE: 1 OF 1



GENERAL NOTE:

1. Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

TETRA TECH NUS, INC.

PROJECT NAME: _____ RIG NUMBER & TYPE _____

PROJECT NUMBER: _____ DATE: _____

LOCATION: _____ INSPECTED BY: _____

	ITEM	√	COMMENTS
1	Number of Emergency shutdown switches_____ All personnel knowledgeable of their location (s). Switches have been tested prior to commencement of drilling operations		
2	Steel cables are not frayed		
3	Ropes are not frayed		
4	Hydraulic fluids, and lubricants are not leasking		
5	Equipment with proper guards in place (chains to cecure high-power air lines in the event of a break)		
6	Use of improper tools, pins, or other devices in poor condition		
7	Using worn air or hydraulic lines		
8	Cleaning-up the work site		
9	Storing fuels or other fluids in proper containers		
10	Hard hats, safety eyewear, steel toe/shank boots, hearing protection, Gloves, tyvek worn by driller/helper		
11	Proper protection equipment required by the Health & Safety Plan		
12	Decontamination Equipment		
13	Vehicle warning alarms (horn, mast, and back-up alarms)		
14	Fire extinguishers; fully charged and accessible		
15	Electrical wiring and switches		
16	Documentation of each driller's compliance with OSHA Health & Safety Training requirements		

TtNUS Form 0056

The FOL and SSO can request demonstration that the equipment is functioning properly.

TETRA TECH NUS, INC.

DAILY ACTIVITIES SUMMARY

PROJECT NAME: _____ PROJECT NO.: _____

CLIENT: _____ LOCATION: _____

DATE: _____ DRILLER: _____

BORINGS WORKED ON TODAY: _____

ITEM (1)	UNIT	ORIGINAL QUANTITY (2) ESTIMATE	BORING NO.	BORING NO.	BORING NO.	DAILY TOTAL
1. Mobilization/Demobilization	Lump Sum	1	N/A	N/A	N/A	N/A
2. Air Rotary Drilling (5 7/8-inch)	Foot	80 feet				
3. Steel Casing (6-inch)	Foot	135 feet				
4. Monitoring Well Installation (PVC, Contingency)	Foot	200 feet				
5. Flushmount Protective Casing	Each	4 each				
6. Well Development	Hour	8 hours				
7. Waste Containerization (55 gallon drums)	Drum	10 drums				
8. Standby*	Hour	2 hours				

COMMENTS: _____

(1) As listed in technical specification.
(2) Per foot items to nearest foot; hourly items to nearest quarter hour (except item 8. Standby: to nearest half hour). Assumed to be Level D unless otherwise noted.
* Specify reason for delay.

_____ DATE

_____ TETRA TECH NUS FIELD REPRESENTATIVE

_____ DATE

_____ DRILLER REPRESENTATIVE

Tt NUS FORM 0044

TETRA TECH NUS, INC.

WELL DEVELOPMENT DATA SHEET

Well No.: _____

PROJECT: _____

PROJECT NO.: _____

PERSONNEL: _____

DATE: _____

WEATHER: _____

Well Screen Depth: _____ / _____ ft. bgs

H&S Monitoring Instrument Reading _____

Pump Type/Material: _____

Pump Intake Depth: _____

Total Purge Volume = _____(gal)

Data Recorded By: _____

Time	Water Level ft below top PVC	Volume mL	Flow Rate mL/min	Temp °C	pH	Sp Cond mS/cm	DO mg/L	Turbidity NTU	Comments

Tt NUS Form 0013

TETRA TECH NUS, INC.

GROUNDWATER LEVEL MEASUREMENT SHEET

SITE INFORMATION

Site Name: _____ Municipality: _____

Project Number: _____ County: _____

Personnel: _____ State: _____

Date: _____ Street or Map Location: _____

(If Off-Site): _____

WEATHER CONDITIONS AND EQUIPMENT

Temperature Range: _____ Equipment No.: _____

Precipitation: _____ Equipment Number: _____

Barometric Pressure: _____ Latest Calibration Date: _____

Tidally-Influenced [ ] Yes [ ] No

Well or Piezometer Number	Date/Time	Elevation of Reference Point (Feet)*	Water Level Indicator Reading (Feet)*	Adjusted Depth (Feet)*	Groundwater Elevation (Feet)*

TtNUS Form 0010

* measured made to 0.00 feet

TETRA TECH NUS, INC.

AQUIFER TEST WATER LEVEL MEASUREMENT

SITE INFORMATION

Site Name: _____ Municipality: _____

Project Number: _____ County: _____

Personnel: _____ State: _____

Date: _____ Street or Map Location: _____

(If Off-Site): _____

WEATHER CONDITIONS AND EQUIPMENT

Temperature Range: _____ Equipment No.: _____

Precipitation: Time_____Reading_____ in Equipment Number: _____

Barometric Pressure: Time_____Reading_____cm Latest Calibration Date:_____

Flow-Meter: Time_____Reading_____ in Tidally-Influenced [ ] Yes [ ] No

Well or Piezometer Number	Date/Time	Elevation of Reference Point (Feet)*	Well or Piezometer Number	Date/Time	Elevation of Reference Point (Feet)*

Tt NUS Form 0052

TETRA TECH NUS, INC.

SAMPLE LOG SHEET - SOLID PHASE

Site Name: _____

Sample ID: _____

Tetra Tech NUS Charge No. _____

QC Information: _____(if applicable)

Sample Method: _____

Depth Sampled: _____feet

Sample Date & Time: ___/___/___ _____hours Dup____hours

Sampler(s): _____

Data Recorded By: _____

Signature

PID/OVA Monitor Reading: _____ ppm

TYPE OF SAMPLE: (Check all that apply)

____ Soil

____ Sediment

____ Lagoon/Pond

____ Grab

____ Trip Blank*

____ Rinsate Blank*

____ Field Duplicate collected

____ Other (Specify): _____

Description: (Sand, Clay, Muck, Peat, Dry, Moist, Wet, Etc.) _____

SAMPLE DATA/REMARKS: _____

ANALYSIS	BOTTLE LOT NO.

NOTES/SKETCH:

Tt NUS Form 0005A

TETRA TECH NUS, INC.

SAMPLE LOG SHEET - LIQUID PHASE

Site Name: _____
Sample ID: _____

Tetra Tech NUS Charge No. _____
QC Information: _____ (if applicable)

Sample Method/Device: _____
Depth Sampled: _____ feet Total Depth _____ feet (SW Only)
Sample Date & Time: ___/___/___ _____ hours
Sampler(s): _____

Recorded By: _____
Signature

TYPE OF SAMPLE: (Check all that apply)

____ Groundwater
____ Surface Water
____ Residential Supply
____ Grab
____ Composite

____ Trip Blank*
____ Rinsate Blank*
____ Field Duplicate Collected
____ Other (Specify): _____

* include sample source & lot No.

WELL PURGE DATA:

Well Depth	feet	Purge Start	hrs
Inside Diameter	Inches	Purge Stop Time	hrs
Water Level	feet	Total Gallons Purged	
Well Volume	gal.	Purge Method	

Color: _____ Turbidity: CLR/SL CLDY/CLDY/OPAQ

Micro Tip/OVA Monitor Reading: ppm

Sampling/Purge Data:

Vol. #	Temp °C	pH	Spec. Cond.	DO
0				
1				
3				
4				

ANALYSIS	BOTTLE LOT NO.	TRAFFIC REPORT NO.		COMMENTS
		ORGANIC	INORGANIC	

TtNUS Form 0004

TETRA TECH NUS, INC.

SAMPLE LOG SHEET - "LOW FLOW" GROUNDWATER

Site Name: _____
Sample ID: _____

Tetra Tech NUS Charge No. _____
QC: _____(If applicable)

Sample Method: _____
Depth Sampled: _____Feet Screened Interval Depth _____feet
Sample Date & Time: __/__/__ _____hours _____/Dup
Sampler(s): _____
Data Recorded By: _____ Signature: _____
Notes:

H&S Survey Meter _____ PPM Field Instrument Group A/B/C/D
Pre-pump insertion WL _____ ft Post - pump insertion WL _____ft

Analysis	Bottle Lot #	Analysis	Bottle Lot #	Analysis	Bottle Lot #

Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cumm. Volume Purged liters	Temp °C	Spec. Cond. 2 uS/cm	pH	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments

TtNUS Form 0009

1. Pump dial setting (for example: hertz, cycle/min, etc.)
2. Siemens per cm (same as umhos/cm) at 25 °C.
3. Oxidation reduction potential (stand in for Eh).

TETRA TECH NUS, INC.

SAMPLE LOG SHEET - "LOW FLOW" GROUNDWATER

Site Name: _____

Sample ID: _____

Tetra Tech NUS Charge No. _____

QC: _____(If applicable)

Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cumm. Volume Purged liters	Temp °C	Spec. Cond. 2 uS/cm	pH	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments

TtNUS Form 0009

1. Pump dial setting (for example: hertz, cycle/min, etc.)
2. Siemens per cm (same as umhos/cm) at 25 °C.
3. Oxidation reduction potential (stand in for Eh).

TETRA TECH NUS, INC.

JAR HEADSPACE ANALYSIS LOG

SITE NAME: _____

SITE LOCATION: _____

PROJECT NO./CTO NO.: _____

SAMPLE LOCATION: _____

INSTRUMENT: _____

SERIAL NO.: _____

MODEL NO.: _____

SAMPLE PREP METHOD[1] _____

HEADSPACE ANALYST: _____

DATE: _____

SAMPLE TYPE[2]/NUMBER	SAMPLE DEPTH (FEET)	READING (ppm)	COMMENTS

Tt NUS Form 0008

1) (a) ambient temp
(h) heated (air)
(w) hot water bath

2) Type of Sample
SB Soil Boring
SD Sediment Sample
GW Groundwater Sample
TP Test Pit Sample
SS Soil Sample

TETRA TECH NUS, INC.

SAMPLE COLLECTION SUMMARY RECORD

PROJECT NAME: _____ TETRA TECH NUS JOB NO./PMS: _____

SAMPLING EVENT: _____ CASE NO.: _____ DAS NO.: _____

DATE	TIME	SAMPLE LOCATION	FIELD QC							COMMENTS

Tt NUS Form 0012

TETRA TECH NUS, INC.

PHOTOIONIZATION DETECTOR FIELD CALIBRATION LOG

Serial No.: _____ Model No.: _____ Decal No.: _____

Site Name/Location: _____ Tetra Tech NUS Job No./PMS: _____

CALIBRATION DATE	STANDARD GAS-ISOBUTYLENE	CALIBRATION READING Isobutylene Equiv. (ppm)	CALIBRATION CHECK Isobutylene Equiv. (ppm)	SIGNATURE	COMMENTS
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				

Tt NUS Form 0006

TETRA TECH NUS, INC.

YSI 6820 MULTIPARAMETER METER

Serial No.: _____ Model No.: _____ Decal No.: _____

Site Name: _____ Job No.: _____

Instrument is calibrated in accordance with Manufacturer's Instructions

DATE:	Pre Calibration Readings	Post Calibration Readings	PM Check	Calibration STDs (lot #'s)	Signature	Remarks
Cond. mS/cm						
pH=4.0						
pH=7.0						
pH=10.0						
D.O. mg/l						
REDOX mV						
Turbidity 0 NTUs						
Turbidity 100 NTUs						
Temp °C						
Salinity 0/00						

DATE:						
Cond. mS/cm						
pH=4.0						
pH=7.0						
pH=10.0						
D.O. mg/l						
REDOX mV						
Turbidity 0 NTUs						
Turbidity 100 NTUs						
Temp °C						
Salinity 0/00						

Tt NUS Form 0024

TETRA TECH NUS, INC.

FIELD INSTRUMENT CALIBRATION LOG

INSTRUMENT NAME: _____ MODEL NO.: _____

SERIAL NO.: _____ DECAL NO.: _____ TETRA TECH NUS JOB NO./PMS _____

CALIBRATION DATE	INITIAL READING	PROCEDURE	FINAL READING	SIGNATURE	COMMENTS

Tt NUS Form 0007