N00164.AR.000957
NSWC CRANE
5090.3a

Quality Assurance Project Plan Addendum

for

PCB Capacitor Burial/Pole Yard Solid Waste Management Unit (SWMU) 17/04 Resource Conservation and Recovery Act Facility Investigation and Verification of Removal

Naval Surface Warfare Center Crane

Crane, Indiana

NAVFAC
Naval Facilities Engineering Command

Southern Division Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0376

June 2005

080105/P (Addendum)

QUALITY ASSURANCE PROJECT PLAN ADDENDUM
FOR
PCB CAPACITOR BURIAL/POLE YARD
SOLID WASTE MANAGEMENT UNIT (SWMU) 17/04
RESOURCE CONSERVATION AND RECOVERY ACT
FACILITY INVESTIGATION AND VERIFICATION OF REMOVAL

NAVAL SURFACE WARFARE CENTER, CRANE
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0376

JUNE 2005

ROGER A. CLARK, PhD.
TASK ORDER MANAGER
TETRA TECH NUS, INC.

DEBBIE HUMBERT
PROGRAM MANAGER
TETRA TECH NUS, INC.

PAUL V. FRANK
QUALITY ASSURANCE MANAGER
TETRA TECH NUS, INC.

DOUG GRIFFIN
PROJECT MANAGER
IDEM

BILL GATES
REMEDIAL PROJECT MANAGER
NAVAL FACILITIES ENGINEERING COMMAND

TOM BRENT
SITE MANAGER
NSWC CRANE

TABLE OF CONTENTS

SECTION **PAGE NO.**

(Note: This QAPP Addendum incorporates only those changes made to the original QAPP. These changes affect the Introduction, Acronym List, Section 1.0 Project Description, Section 2.0 Project Organization and Responsibiliites, Section 4.0 Sampling and Analysis Plan, References, and Appendices. Therefore only those changed sections are included in this QAPP Addendum.)

INTRODUCTION **1**

ACRONYM LIST **4**

1.0 PROJECT DESCRIPTION **1-1**
PROJECT PROBLEM STATEMENT 1-1
1.1 INTRODUCTION 1-2
1.1.1 Project Objectives and Decision Statement 1-2
1.1.2 Project Status/Phase 1-2
1.1.3 QAPP Preparation Guidelines and Requirements 1-3
1.1.4 Organization of the QAPP 1-3
1.2 SITE/FACILITY DESCRIPTION 1-4
1.2.1 Location and Description 1-4
1.2.2 Land Use Classification 1-4
1.2.3 Climatology and Meteorology 1-4
1.2.4 Physiography, Topography and Ground Cover 1-4
1.2.5 Geology and Stratigraphy 1-5
1.2.6 Hydrology and Hydrogeology 1-5
1.3 FACILITY HISTORY AND BACKGROUND 1-5
1.3.1 Facility Operational History 1-5
1.3.2 PCB Capacitor Burial/Pole Yard Operational History 1-5
1.3.3 Evaluation of Historical Data 1-6
1.4 INTENDED DATA USES 1-7
1.4.1 Project Target Parameters and Rationale for Selection 1-8
1.4.2 Laboratory Parameter 1-8
1.4.3 Decision Rules 1-8

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES **2-1**

4.0 SAMPLING AND ANALYSIS PLAN **4-1**
4.1 GENERAL APPROACH 4-1
4.2 SAMPLE IDENTIFICATION SYSTEM 4-1
4.3 SAMPLING LOCATIONS, ANALYSES, AND RATIONALES 4-2
4.3.1 Excavation Area 4-3
4.3.2 Drainage Channels 4-4
4.4 INVESTIGATION EQUIPMENT AND PROCEDURES 4-5
4.4.1 Clearance of Drilling Sites 4-5
4.4.2 DPT Sampling for Surface and Subsurface Soil and Perched Groundwater 4-5
4.5 QUALITY CONTROL SAMPLES 4-7

TABLE OF CONTENTS (Continued)

SECTION **PAGE NO.**

4.6 SAMPLE HANDLING, PACKAGING, AND SHIPPING 4-8
4.6.1 Sample Preservation 4-8
4.6.2 Sample Labeling 4-8
4.6.3 Sample Packaging 4-8
4.6.4 Sample Shipping 4-8
4.6.5 Sample Custody 4-8
4.7 RECORDKEEPING 4-8
4.7.1 Field Logbooks 4-9
4.7.2 Drilling Logs 4-9
4.7.4 Equipment Calibration Logs 4-9
4.7.5 Sample Collection Logs 4-9
4.7.6 Chain-of-Custody Forms 4-9
4.7.7 Shipping Forms/Air Bills 4-10
4.7.8 Permanent Record File 4-10
4.8 SURVEYING 4-10
4.9 EQUIPMENT DECONTAMINATION 4-10
4.10 MANAGEMENT OF INVESTIGATION-DERIVED WASTE 4-10
4.11 SAFETY 4-11
4.11.1 Health and Safety Plan 4-11
4.11.2 Health and Safety Training 4-11
4.11.3 Personal Protective Clothing and Equipment 4-11
4.11.4 Safety Meetings 4-11
4.12 ORGANIZATION AND LOGISTICS OF FIELD INVESTIGATIONS 4-12
4.12.1 Personnel 4-12
4.12.2 Subcontractors 4-12
4.12.3 Mobilization and Demobilization 4-12
4.12.4 Time Schedule 4-13

REFERENCES **R-1**

APPENDICES

A HISTORICAL PCB SOIL DATA
B FIELD STANDARD OPERATING PROCEDURES
C SITE-SPECIFIC HEALTH AND SAFETY PLAN

TABLES

NUMBER

1-1 PCB Concentrations
1-2 Detection Limits Versus Clean-Up Criteria
2-1 Key Project Personnel for PCB Capacitor/Pole Yard
4-1 Proposed Samples and Laboratory Analysis
4-2 Summary of Solid and Aqueous Analyses and Quality Control Samples
4-3 Summary of Sample Analyses, Container Types and Volumes, Preservation Requirements, Holding Times, and Analytical Laboratory for Solid and Aqueous Samples

FIGURES

NUMBER

1-1 Site Location Map
1-2 Site Features and Existing Sample Locations
2-1 Project Organization Chart
4-1 Proposed Sample Locations

ACRONYM LIST

AB	Ambient Conditions Blank
AMSL	Above Mean Sea Level
bgs	Below Ground Surface
COC	Chain of Custody Form
CS	Composite Sample
CTO	Contract Task Order
DPT	Direct-Push Technology
DQO	Data Quality Objectives
EM	Electromagnetic
FD	Field Duplicate
FOL	Field Operations Leader
GPS	Global Positioning System
GS	Grab Sample
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
IDEM	Indiana Department of Environmental Management
IDW	Investigation Derived Waste
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NFESC	Naval Facilities Engineering Services Center
NSWC	Naval Surface Warfare Center
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PRG	Preliminary Remedial Goal
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
RB	Rinsate Blank
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation

RLs	Reporting Limits
SB	Source Water Blank
SERA	Screening-level Ecological Risk Assessment
SOP	Standard Operating Procedure
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SSO	Site Safety Officer
SWMU	Solid Waste Management Unit
TB	Trip Blank
TOM	Task Order Manager
TSCA	Toxic Substances Control Act
TtNUS	Tetra Tech NUS, Inc.
TV	Threshold Value
U.S. EPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound

INTRODUCTION

This Quality Assurance Project Plan (QAPP) Addendum for the investigation of polychlorinated biphenyls (PCB) contamination of Solid Waste Management Unit (SWMU) 17 PCB Capacitor Burial Pole Yard was developed under the streamlined QAPP preparation procedures. Under this procedure, relevant information from QAPPs previously approved by United States Environmental Protection Agency (U.S. EPA) is incorporated by reference. In this case, information from the previously approved Quality Assurance Project Plan for RCRA Facility Investigation at Building 106 Pond (SWMU 8) Roads and Grounds Area (SWMU 15) (Tetra Tech, NUS, September, 2004) is incorporated by reference. The referenced QAPP will be referenced as the "approved Jeep Trail/Little Sulphur Creek QAPP." This is done for the reviewer's convenience.

In summary, the following Sections and pages of the original QAPP for the PCB Pole Yard (TtNUS, 2001) have been changed as part of preparing this Addendum:

- Cover Page; Title Page; Table of Contents and this introduction
- Section 1 PROJECT DESCRIPTION
- Section 2 PROJECT ORGANIZATION AND RESPONSIBILITIES
- Section 4 SAMPLING AND ANALYSIS PLAN, and
- References
- Appendices

The current understanding regarding the levels of contamination is based on:

- Historical PCB soil samples (Appendix A)
- Results presented in the RCRA Facility Investigation (RFI) for the PCB Capacitor Burial/ Pole Yard Solid Waste Management Unit (SWMU) 17 (TtNUS, 2002), and
- Results presented in the Interim Measures Report for the PCB Capacitor Burial Pole Yard Remediation (TolTest, 2004).

1.0 PROJECT DESCRIPTION

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Phase III investigation is being conducted in accordance with applicable RCRA corrective action requirements, including the need for RFIs to be conducted at the Naval Surface Warfare Center (NSWC) Crane, Crane, Indiana. This investigation will provide additional data on polychlorinated biphenyl (PCB) chemical concentrations in surface soils, subsurface soils, perched groundwater (if encountered), surface water and sediments at the PCB Capacitor Burial/Pole Yard, which is also known as Solid Waste Management Unit (SWMU) 17.

Four (4) areas at the site need additional information to fill data gaps following two recent soil investigations at the PCB Pole Yard. These investigations include an RFI conducted by TtNUS in 2002 (TtNUS, 2002) and an Interim Measure conducted by TolTest in 2004 (TolTest, 2004). Past soil sampling and analysis within these areas has shown that PCBs are the primary chemicals of concern. These areas include two locations within the footprint of the Interim Measure soil excavation area north of Building 357 and two areas within drainage channels; one located downgradient of the previous dump area and another located downgradient of Building 357 (beginning close to the southwest corner of Building 357). These four areas and proposed sample locations are discussed in greater detail in Section 4 of this QAPP Addendum and are illustrated on Figure 4-1.

The PCB concentrations detected in the environmental media at the PCB Pole Yard will be evaluated in a baseline human health risk assessment (BHHRA) and a screening level ecological risk assessment (SLERA). Additionally, contaminant levels will be compared to available State and U.S.EPA benchmarks such as the guidelines established by the Indiana Department of Environmental Management (e.g., the default closure values under the Risk Integrated System of Closure (RISC)) or the U.S.EPA under CERCLA or the Toxic Substances Control Act (TSCA). Remediation goals will be determined, as necessary, based on the results of the baseline BHHRA and SLERA and in consultation with IDEM and U.S.EPA Region 5. Remediation goals will consider the available ARARs as well as risk-based goals developed for land use scenario identified for the site.

PROJECT PROBLEM STATEMENT

Recent soil sampling at the PCB Capacitor Burial/Pole Yard for PCBs has shown the presence of PCBs in surface and subsurface soil at levels that exceed environmental soil cleanup standards promulgated under the Toxic Substances Control Act (TSCA) and the Indiana Department of Environmental

Management (IDEM) RISC Technical Resource Guidance. As a result, workers could be exposed to health risks due to exposure to soils containing PCBs.

1.1 INTRODUCTION

NSWC Crane is a U.S. Navy installation located within U.S. Environmental Protection Agency (EPA) Region 5. Tetra Tech NUS, Inc. (TtNUS) has prepared this QAPP Addendum on behalf on the U.S. Navy Southern Division Naval Facilities Engineering Command (SOUTHDIV) and NSWC Crane to be consistent with the approach and content described in Section 1.1 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004) and the approved PCB Capacitor Burial/Pole Yard SWMU 17 QAPP (TtNUS, 2001b).

This QAPP Addendum was prepared under Contract Number N62467-94-D-0888, Contract Task Order (CTO) Number 0376.

1.1.1 Project Objectives and Decision Statement

Past sampling identified the presence of PCBs at concentrations greater than applicable soil cleanup standards. Previous sampling associated with an RFI and an Interim Measure excavation has not been adequate to fully delineate the extent of PCB contamination. This investigation is designed to further delineate the nature and extent of PCB contamination in soil for further evaluation. The decision statement that will facilitate attainment of these project objectives is as follows:

> From data obtained, determine whether the nature and extent of PCB contaminant concentrations that exceed applicable cleanup levels has been bounded. If the extent of contamination is bounded, then stop sampling and evaluate future actions for the site. If the extent of contamination is not bounded, consider sampling to establish the extent of contamination, then evaluate future actions for the site.

1.1.2 Project Status/Phase

One sampling event is expected for this data gap investigation, with additional sampling possible to further delineate the extent of contamination if necessary. The need for additional sampling will depend on whether the extent of contamination is established within prescribed bounds. The strategy for all sampling events is similar when establishing extent of contamination. PCB concentrations will be compared to appropriate regulatory action levels to determine the adequacy of the delineation.

The data analyses and the approach to reconciling data with project objectives are incorporated by reference from Section 12.4 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004). Section 4 of this QAPP Addendum presents the sampling plan design and rationale for the proposed samples for this phase of the project.

1.1.3 QAPP Preparation Guidelines and Requirements

Information on QAPP preparation guidelines and requirements is discussed in Section 1.1.3 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004) and is incorporated by reference.

Additional guidance regarding development of this QAPP was obtained through a formal pre-QAPP meeting held on August 29, 2001 via conference call. Representatives from U.S. EPA Region 5, SOUTHIDV, NSWC Crane, Indiana Department of Environmental Management (IDEM), and TtNUS participated in the pre-QAPP conference call to introduce and discuss technical issues associated with QAPP preparation. The analyte lists were discussed, and the overall technical approach was agreed upon between the Navy and the U.S. EPA. U.S. EPA comments have been addressed in this document.

A pre-field work QAPP Addendum meeting and site visit was conducted on March 29, 2005 at the NSWC Crane SWMU 17 – PCB Capacitor/Pole Yard to meet the following objectives:

- Review the historical operations at the Pole Yard (SWMU 17) and discuss the objectives of the proposed project

- Conduct a site tour of the Pole Yard including the rationale and selection of media to be investigated, locations and depths to be sampled to fill existing the data gaps

1.1.4 Organization of the QAPP

This QAPP Addendum follows the U.S. EPA Region 5 model QAPP format with minor exceptions (U.S. EPA, 1998). An effort has been made to ensure that the flow of information from one section to another is logical, while adhering to U.S. EPA Region 5 requirements. The Table of Contents provides an overview of the document organization. Tables and figures are placed at the end of each section in which they are first referenced. As noted in the introduction, information from a previously approved QAPP is incorporated by reference.

1.2 SITE/FACILITY DESCRIPTION

This section is a presentation of background information, general site characteristics of the NSWC Crane facility, and physical site characteristics specific to the PCB Capacitor Burial/Pole Yard. PCB-contaminated soils have been excavated at the site as part of an Interim Measure (TolTest, 2004). This section contains information on site location, facility size and borders, natural and man-made features, climatology, topography, local hydrology and hydrogeology, surrounding land use, and ecological communities and habitats. This information was obtained from a previously approved QAPP (TtNUS, 2004).

1.2.1 Location and Description

Information regarding site location and description of NSWC Crane is incorporated by reference from Section 1.2.1 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004).

A location map of the NSWC Crane facility is provided as Figure 1-1. The PCB Capacitor Burial/Pole Yard study area is located in the northeastern portion of the installation. Figure 1-1 shows the location of the PCB Capacitor Burial/Pole Yard on the NSWC Crane facility.

1.2.2 Land Use Classification

Information regarding land use classification surrounding NSWC Crane is incorporated by reference from Section 1.2.2 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004).

1.2.3 Climatology and Meteorology

Information regarding climatology and meteorology of NSWC Crane is incorporated by reference from Section 1.2.3 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004).

1.2.4 Physiography, Topography and Ground Cover

The topography is generally flat in the vicinity of the PCB Capacitor Burial - Pole Yard site and ranges between 720 ft-above mean sea level (amsl) and 730 ft-amsl. The site sits at a local topographic high with surface elevation decreasing in the north, south and western directions. The topography could be described as steeply rolling hills. The industrialized portion of the site is devoid of vegetation. Woods are along the perimeter of the developed industrialized portion of the site.

1.2.5 Geology and Stratigraphy

Borings installed during previous investigations penetrated to a depth of four feet below ground surface (bgs) therefore site specific details of subsurface lithologic characteristics and stratigraphy below that depth is unknown. The borings that penetrated the upper four feet of soil consisted of a gray to brown silty clay intermixed with gray limestone pebbles (most likely road-construction material). Many of the borings encountered a layer of decomposed siltstone to sandstone with rust-colored mottles toward the base of the boring. Specific details of the geology of the site will be generated from boring logs and visual observations collected during the upcoming field effort. This information will be presented in the RFI Report Addendum.

1.2.6 Hydrology and Hydrogeology

Information regarding the hydrology and hydrogeology at NSWC Crane is incorporated by reference from Section 1.2.6 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004).

1.3 FACILITY HISTORY AND BACKGROUND

This section provides an overview of the site operations and summarizes past environmental investigations at the PCB Capacitor Burial/Pole Yard. An evaluation of historical data gathered from past investigations is also provided.

1.3.1 Facility Operational History

The facility operational history for NSWC Crane is incorporated by reference from Section 1.3.1 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004).

1.3.2 PCB Capacitor Burial/Pole Yard Operational History

The PCB capacitor Burial/Pole Yard (SWMU 17) has been in use since before 1966. Historically, the site has been used for the following:

- Storage of capacitors, some of which contained PCBs.
- Storage of transformers, some of which contained PCBs.
- Reported burial of capacitors, some of which may have contained PCBs.
- Storage of creosote-impregnated utility poles, some of which may contain PCBs as a result of ruptured transformers.

Pure PCBs have never been found in transformers or capacitors at NSWC Crane. The greatest concentrations of PCBs have been in the range of 10,000 ppm PCBs. Therefore, any releases of capacitor or transformer oil at SWMU 17 would be expected to exhibit concentrations less than 10,000 ppm PCBs. It is known that capacitors were buried at SWMU 17 in the early to mid 1970s. However, it is not known whether any capacitors were buried prior to the early 1970s or after mid-1970.

Figure 1-2 shows SWMU 17, including areas where activities have historically occurred.

1.3.3 Evaluation of Historical Data

The following describes in bulletized form the historical soil investigations for the PCB Capacitor Burial/Pole Yard.

March 2001 (SAIC – Soil Investigation)

- Surface soil (0-6 and 6-12") only
- 8 individual grab samples
- 6 sets of composite samples
- Analyzed for PCBs only
- Showed an area of elevated concentrations
- No GW samples
- Aroclor 1260 – CoC

March 2002 (TtNUS - RFI)

- Surface (0-2') and subsurface soil (2-4')
- All grab samples
- Showed 5 areas of concern including an area in a western drainageway
- Areas of concern – immediately N & W of Building 357
- 44 surface samples
- 44 subsurface samples
- Only one exceeded 1 mg/kg
- Geophysical survey identified a previous dumping area

September 2004 (TolTest - IM)

- 2140 tons of soil below 25 mg/kg excavated
- 790 tons of soil above 25 mg/kg excavated
- Excavated to 2 feet and covered with clean fill
- Due to contractual obligations, excavation operations ceased before all contaminated soils were removed.
- Post excavation sampling indicated PCBs remain in subsurface soils.
- The vertical extent of this contamination is unknown.
- Excavation around the dumping area found electrical insulators, a transformer and misc debris. (PCB soil contamination is found drainageway downgradient of this area.)

As part of these investigations to determine the suitability of the site soils, samples were collected and analyzed for PCBs. Table 1-1 lists soil data prior to the TolTest excavation and Table 1-2 presents applicable TSCA regulatory limits plus other pertinent information. Figure 4-1 shows the remaining areas of interest based on assessment of all of this data.

Additional historic data are presented in Appendix A. These data show that PCB 1260 is the primary contaminant. The presence of PCBs correlates with information regarding historical activities at the PCB Capacitor Burial/Pole Yard. PCBs were found at locations where capacitors are reportedly buried, transformers were stored, and creosote-impregnated utility poles were stored. PCBs were also found at a drainage area receiving runoff from the transformer storage and capacitor burial areas.

1.4 INTENDED DATA USES

This section provides a description of the project target parameters and intended data uses.

1.4.1 Project Target Parameters and Rationale for Selection

PCBs are the key target parameters for the investigation at SWMU 17. Capacitors and transformers stored at the PCB Capacitor Burial Pole Yard may have contained PCBs, which may have leaked onto the ground. Capacitors reportedly buried at SWMU 17 also may have contained PCBs. PCBs that may have been on poles from burst or leaking transformers may have leaked onto the ground.

1.4.2 Laboratory Parameter

Fixed-base laboratory analyses will be used to estimate PCB concentrations in surface and subsurface soils because the laboratory analysis allows for the lowest detection limit and allows for verifying the PCB aroclors of interest at each area of interest.

The data will be compared to:

- IDEM default residential and industrial soil closure levels (1.8 mg/kg for residential and 5.3 mg/kg for industrial) (RISC Technical Guidance, July 2001).

- Self-implementing on-site cleanup and disposal of PCB remediation waste cleanup levels (1 mg/kg) without further conditions for TSCA high occupancy areas [40 CFR 761.61(a)(4)(i)(A)].

- Self-implementing on-site cleanup and disposal of PCB remediation waste cleanup levels (25 mg/kg) for TSCA low occupancy areas [40 CFR 761.61(a)(4)(i)(B)].

Table 1-2 lists the laboratory parameters, analytical methods detection and reporting limits, and the target levels. Threshold values (TVs) based on statistically derived, matrix specific method detection limits (MDLs) will be the lowest limit that is reported as detected by the laboratory.

1.4.3 Decision Rules

The understanding of the site as described above and the data quality objective (DQO) process outputs to this point are consolidated in this section into a succinct description of how the data will be used for the PCB Capacitor Burial/Pole Yard.

1.4.3.1 Definition

The decision rule is a statement that integrates DQO planning process outputs into a concise summary of how data will be interpreted when making decisions about the site being investigated. The decision rules form a basis for establishing a sampling plan design that will enable data of the correct type, quantity, and quality to be collected for attaining project objectives.

1.4.3.2 Decision Rule

The decision rule applies to each area within the PCB Capacitor Burial/Pole Yard that is under investigation.

If the contamination boundary associated with SWMU 17 is not attained in this sampling event, (i.e., the PCB concentration is not less than the agreed-upon action level), evaluate residual risks based on these latest sampling results, or consider proceeding to another removal action if necessary. If the contamination boundary is reached in this sampling event (i.e., measured total PCB concentration is less than the action level concentration), stop sampling and write a report with appropriate recommendations.

TABLE 1-1

HISTORICAL PCB CONCENTRATIONS
PCB CAPACITOR BURIAL/POLE YARD (TOLTEST INTERIM MEASURE RESULTS NOT INCLUDED)
NSWC CRANE, CRANE, INDIANA

SAMPLE ID	SAMPLE DATE	MATRIX	TOP DEPTH	BOTTOM DEPTH	PEST/PCB AROCLOR-1016 UG/KG	PEST/PCB AROCLOR-1221 UG/KG	PEST/PCB AROCLOR-1232 UG/KG	PEST/PCB AROCLOR-1242 UG/KG	PEST/PCB AROCLOR-1248 UG/KG	PEST/PCB AROCLOR-1254 UG/KG	PEST/PCB AROCLOR-1260 UG/KG
17SB010204	03/08/02	SB	2	4	170 U	350 U	170 U	170 U	170 U	170 U	170 U
17SB020204	03/08/02	SB	2	4	130 U	280 U	130 U	130 U	130 U	130 U	130 U
17SB030204	03/10/02	SB	2	4	150 U	300 U	150 U	150 U	150 U	150 U	150 U
17SB040204	03/10/02	SB	2	4	140 U	300 U	140 U	140 U	140 U	140 U	140 U
17SB050204	03/08/02	SB	2	4	130 U	280 U	130 U	130 U	130 U	130 U	130 U
17SB060204	03/08/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB070204	03/08/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB080204	03/08/02	SB	2	4	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SB090204	03/09/02	SB	2	4	140 UJ	300 UJ	140 UJ	140 UJ	140 UJ	140 UJ	140 UJ
17SB100204	03/08/02	SB	2	4	130 U	270 U	130 U	130 U	130 U	130 U	130 U
17SB110204	03/09/02	SB	2	4	140 UJ	290 UJ	140 UJ	140 UJ	140 UJ	140 UJ	140 UJ
17SB110204-D	03/09/02	SB	2	4	130 UJ	270 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ
17SB120204	03/09/02	SB	2	4	130 UJ	270 UJ	130 UJ	130 UJ	130 UJ	130 UJ	130 UJ
17SB130204	03/09/02	SB	2	4	140 UJ	290 UJ	140 UJ	140 UJ	140 UJ	140 UJ	200 J
17SB140204	03/09/02	SB	2	4	130 U	280 U	130 U	130 U	130 U	130 U	690
17SB150204	03/10/02	SB	2	4	140 U	300 U	140 U	140 U	140 U	140 U	140 U
17SB160204	03/10/02	SB	2	4	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SB170204	03/10/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB180204	03/10/02	SB	2	4	130 U	280 U	130 U	130 U	130 U	130 U	130 U
17SB190204	03/08/02	SB	2	4	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SB200204	03/08/02	SB	2	4	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SB210204	03/09/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB220204	03/09/02	SB	2	4	150 UJ	300 UJ	150 UJ	150 UJ	150 UJ	150 UJ	150 UJ
17SB220204-D	03/09/02	SB	2	4	140 UJ	300 UJ	140 UJ	140 UJ	140 UJ	140 UJ	140 UJ
17SB230204	03/08/02	SB	2	4	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SB240204	03/09/02	SB	2	4	150 UJ	300 UJ	150 UJ	150 UJ	150 UJ	150 UJ	150 UJ
17SB250204	03/08/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB260204	03/09/02	SB	2	4	130 UJ	280 UJ	130 UJ	130 UJ	130 UJ	130 UJ	330 J
17SB270204	03/08/02	SB	2	4	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SB280204	03/08/02	SB	2	4	140 U	280 U	140 U	140 U	140 U	140 U	140 U
17SB290204	03/09/02	SB	2	4	150 UJ	320 UJ	150 UJ	150 UJ	150 UJ	150 UJ	150 UJ
17SB300204	03/08/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB300204-D	03/08/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB310204	03/08/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB320204	03/08/02	SB	2	4	140 U	300 U	140 U	140 U	140 U	140 U	140 U
17SB330204	03/08/02	SB	2	4	150 U	320 U	150 U	150 U	150 U	150 U	150 U
17SB340204	03/10/02	SB	2	4	150 U	300 U	150 U	150 U	150 U	150 U	150 U
17SB350204	03/08/02	SB	2	4	140 U	280 U	140 U	140 U	140 U	140 U	140 U
17SB360204	03/09/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB370204	03/09/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	430
17SB380204	03/08/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	1600
17SB390204	03/09/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB400204	03/09/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U

TABLE 1-1

HISTORICAL PCB CONCENTRATIONS
PCB CAPACITOR BURIAL/POLE YARD (TOLTEST INTERIM MEASURE RESULTS NOT INCLUDED)
NSWC CRANE, CRANE, INDIANA

SAMPLE ID	SAMPLE DATE	MATRIX	TOP DEPTH	BOTTOM DEPTH	PEST/PCB AROCLOR-1016 UG/KG	PEST/PCB AROCLOR-1221 UG/KG	PEST/PCB AROCLOR-1232 UG/KG	PEST/PCB AROCLOR-1242 UG/KG	PEST/PCB AROCLOR-1248 UG/KG	PEST/PCB AROCLOR-1254 UG/KG	PEST/PCB AROCLOR-1260 UG/KG
17SB410204	03/09/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB410204-D	03/09/02	SB	2	4	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SB420204	03/08/02	SB	2	4	130 U	270 U	130 U	130 U	130 U	130 U	130 U
17SB430204	03/09/02	SB	2	4	140 UJ	280 UJ	140 UJ	140 UJ	140 UJ	140 UJ	140 UJ
17SB440204	03/10/02	SB	2	4	130 U	280 U	130 U	130 U	130 U	130 U	260
17SS010002	03/08/02	SS	0	2	160 U	320 U	160 U	160 U	160 U	160 U	160 U
17SS020002	03/08/02	SS	0	2	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SS030002	03/10/02	SS	0	2	150 U	320 U	150 U	150 U	150 U	150 U	150 U
17SS040002	03/10/02	SS	0	2	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SS050002	03/08/02	SS	0	2	150 U	320 U	150 U	150 U	150 U	150 U	150 U
17SS060002	03/08/02	SS	0	2	160 U	320 U	160 U	160 U	160 U	160 U	160 U
17SS070002	03/08/02	SS	0	2	130 U	280 U	130 U	130 U	130 U	130 U	130 U
17SS080002	03/08/02	SS	0	2	130 U	270 U	130 U	130 U	130 U	130 U	830
17SS090002	03/09/02	SS	0	2	150 UJ	320 UJ	150 UJ	150 UJ	150 UJ	150 UJ	180 J
17SS100002	03/08/02	SS	0	2	130 U	270 U	130 U	130 U	130 U	130 U	120000
17SS110002	03/09/02	SS	0	2	150 UJ	310 UJ	150 UJ	150 UJ	150 UJ	150 UJ	1200 J
17SS120002	03/09/02	SS	0	2	130 UJ	270 UJ	130 UJ	130 UJ	130 UJ	130 UJ	1800 J
17SS130002	03/09/02	SS	0	2	140 UJ	290 UJ	140 UJ	140 UJ	140 UJ	140 UJ	820 J
17SS140002	03/09/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	20000
17SS150002	03/10/02	SS	0	2	140 U	280 U	140 U	140 U	140 U	140 U	4400
17SS160002	03/10/02	SS	0	2	140 U	280 U	140 U	140 U	140 U	140 U	170
17SS170002	03/10/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SS180002	03/10/02	SS	0	2	150 U	300 U	150 U	150 U	150 U	150 U	150 U
17SS190002	03/08/02	SS	0	2	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SS190002-D	03/08/02	SS	0	2	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SS200002	03/08/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	320
17SS210002	03/09/02	SS	0	2	140 U	280 U	140 U	140 U	140 U	140 U	3400
17SS220002	03/09/02	SS	0	2	150 U	300 U	150 U	150 U	150 U	150 U	1300
17SS230002	03/08/02	SS	0	2	140 U	300 U	140 U	140 U	140 U	140 U	240
17SS240002	03/09/02	SS	0	2	140 UJ	290 UJ	140 UJ	140 UJ	140 UJ	140 UJ	440 J
17SS240002-D	03/09/02	SS	0	2	150 UJ	320 UJ	150 UJ	150 UJ	150 UJ	150 UJ	1200 J
17SS250002	03/08/02	SS	0	2	140 U	300 U	140 U	140 U	140 U	140 U	140 U
17SS260002	03/09/02	SS	0	2	130 UJ	270 UJ	130 UJ	130 UJ	130 UJ	130 UJ	600 J
17SS270002	03/08/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SS280002	03/08/02	SS	0	2	140 U	300 U	140 U	140 U	140 U	140 U	140 U
17SS290002	03/09/02	SS	0	2	140 UJ	300 UJ	140 UJ	140 UJ	140 UJ	140 UJ	140 UJ
17SS300002	03/08/02	SS	0	2	140 U	300 U	140 U	140 U	140 U	140 U	140 U
17SS310002	03/08/02	SS	0	2	140 U	300 U	140 U	140 U	140 U	140 U	140 U
17SS320002	03/08/02	SS	0	2	150 U	320 U	150 U	150 U	150 U	150 U	150 U
17SS330002	03/08/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	890
17SS330002-D	03/08/02	SS	0	2	140 U	300 U	140 U	140 U	140 U	140 U	660
17SS340002	03/10/02	SS	0	2	150 U	310 U	150 U	150 U	150 U	150 U	150 U
17SS350002	03/08/02	SS	0	2	150 U	310 U	150 U	150 U	150 U	150 U	150 U

TABLE 1-1

HISTORICAL PCB CONCENTRATIONS
PCB CAPACITOR BURIAL/POLE YARD (TOLTEST INTERIM MEASURE RESULTS NOT INCLUDED)
NSWC CRANE, CRANE, INDIANA

SAMPLE ID	SAMPLE DATE	MATRIX	TOP DEPTH	BOTTOM DEPTH	PEST/PCB AROCLOR-1016 UG/KG	PEST/PCB AROCLOR-1221 UG/KG	PEST/PCB AROCLOR-1232 UG/KG	PEST/PCB AROCLOR-1242 UG/KG	PEST/PCB AROCLOR-1248 UG/KG	PEST/PCB AROCLOR-1254 UG/KG	PEST/PCB AROCLOR-1260 UG/KG
17SS360002	03/09/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	140 U
17SS370002	03/09/02	SS	0	2	140 U	280 U	140 U	140 U	140 U	140 U	1600
17SS370002-D	03/09/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	1100
17SS380002	03/08/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	280
17SS390002	03/09/02	SS	0	2	140 U	290 U	140 U	140 U	140 U	140 U	420
17SS400002	03/09/02	SS	0	2	130 U	280 U	130 U	130 U	130 U	130 U	11000
17SS410002	03/09/02	SS	0	2	130 U	270 U	130 U	130 U	130 U	130 U	360
17SS420002	03/08/02	SS	0	2	130 U	280 U	130 U	130 U	130 U	130 U	140000 J
17SS420002-D	03/08/02	SS	0	2	130 U	270 U	130 U	130 U	130 U	130 U	130 UJ
17SS430002	03/09/02	SS	0	2	150 UJ	310 UJ	150 UJ	150 UJ	150 UJ	150 UJ	870 J
17SS440002	03/10/02	SS	0	2	130 U	270 U	130 U	130 U	130 U	130 U	130 U
CSS01	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	17000
CSS02	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	7300
CSS03	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	110
CSS04	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	67
CSS04-D	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	54
CSS05	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	11000
CSS06	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	830
CSUB01	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	9300
CSUB02	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	37000
CSUB03	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U
CSUB04	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U
CSUB04-D	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U
CSUB05	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	67000
CSUB06	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	290
GSS01	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U
GSS02	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	650
GSS03	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	1700
GSS04	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	180000
GSS05	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	96000
GSS06	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	170000
GSS07	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	120
GSS08	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U
GSUB01	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U
GSUB02	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	200
GSUB03	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	1500
GSUB04	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	15000	50 U	50 U	3000
GSUB05	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	210000
GSUB06	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	350
GSUB07	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	84
GSUB08	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PBKG01FS	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PBKG01SS	03/01/01	SO	-9999	-9999	50 U	50 U	50 U	50 U	50 U	50 U	50 U

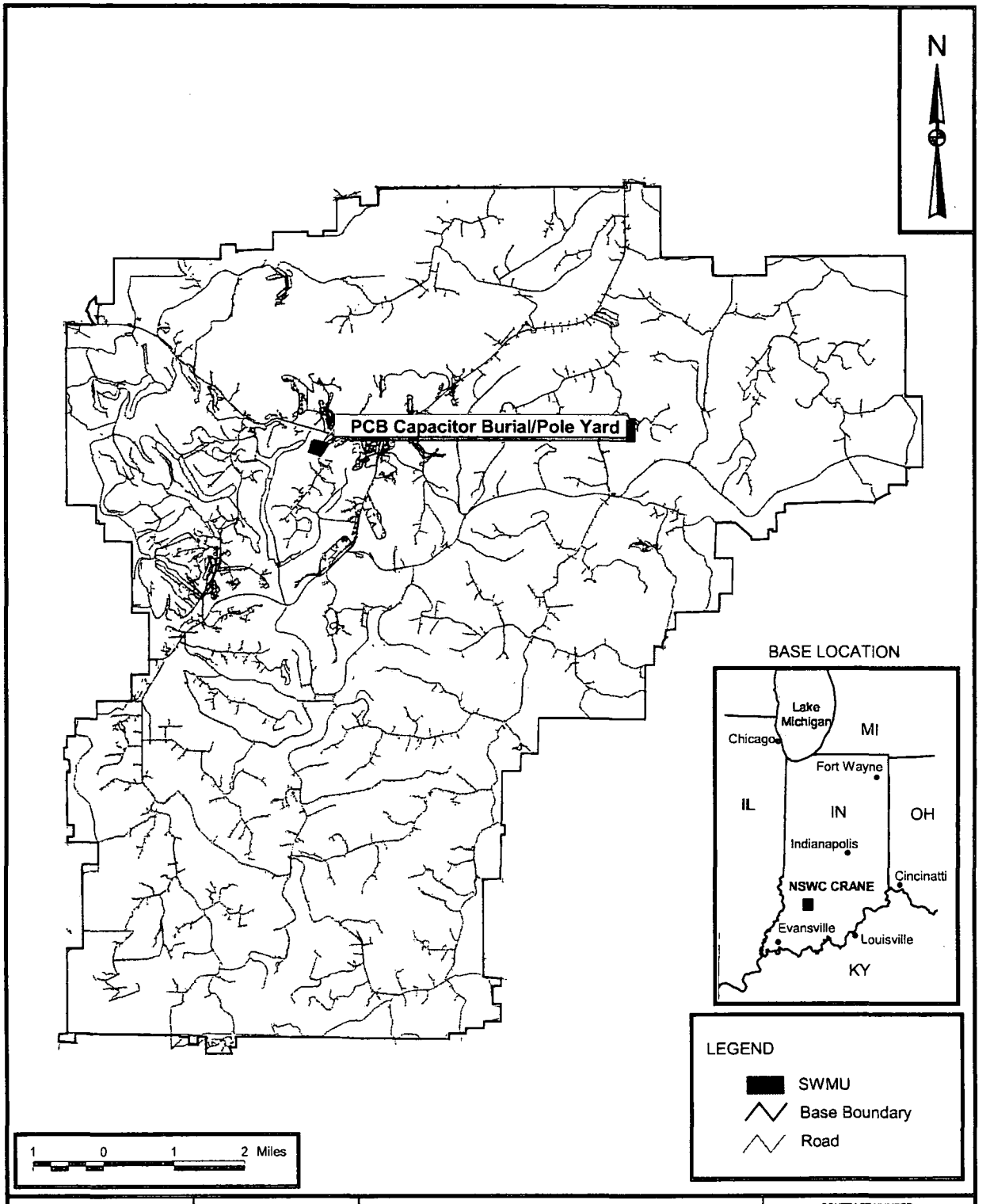
TABLE 1-2

DETCTION LIMITS VERSUS CLEANUP CRITERIA FOR SOILS
PCB CAPACITOR BURIAL/POLE YARD
NSWC CRANE, CRANE, INDIANA

Parameter	CAS NUMBER	Aqueous Matrix		Solid Matrix					
		Laboratory TV[1] (ug/L)	Laboratory RL[1] (ug/L)	Laboratory TV[1] (mg/kg)	Laboratory RL[1] (mg/kg)	TSCA High Occupancy[2][3] (mg/kg)	TSCA Low Occupancy[2][4] (mg/kg)	IDEM Residential[2][5] (mg/kg)	IDEM Industrial[2][5] (mg/kg)
PCBs SW-846 METHOD 8082									
Aroclor-1016	12674-11-2	0.25	0.5	0.017	0.033	1.0	25	1.8	5.3
Aroclor-1221	11104-28-2	0.25	0.5	0.034	0.067	1.0	25	1.8	5.3
Aroclor-1232	11141-16-5	0.25	0.5	0.017	0.033	1.0	25	1.8	5.3
Aroclor-1242	53469-21-9	0.25	0.5	0.017	0.033	1.0	25	1.8	5.3
Aroclor-1248	12672-29-6	0.25	0.5	0.017	0.033	1.0	25	1.8	5.3
Aroclor-1254	11097-69-1	0.25	0.5	0.017	0.033	1.0	25	1.8	5.3
Aroclor-1260	11096-82-5	0.25	0.5	0.017	0.033	1.0	25	1.8	5.3

TV = threshold value.
RL = reporting limit.
µg/L = micrograms per liter.
mg/kg = milligrams per kilogram.

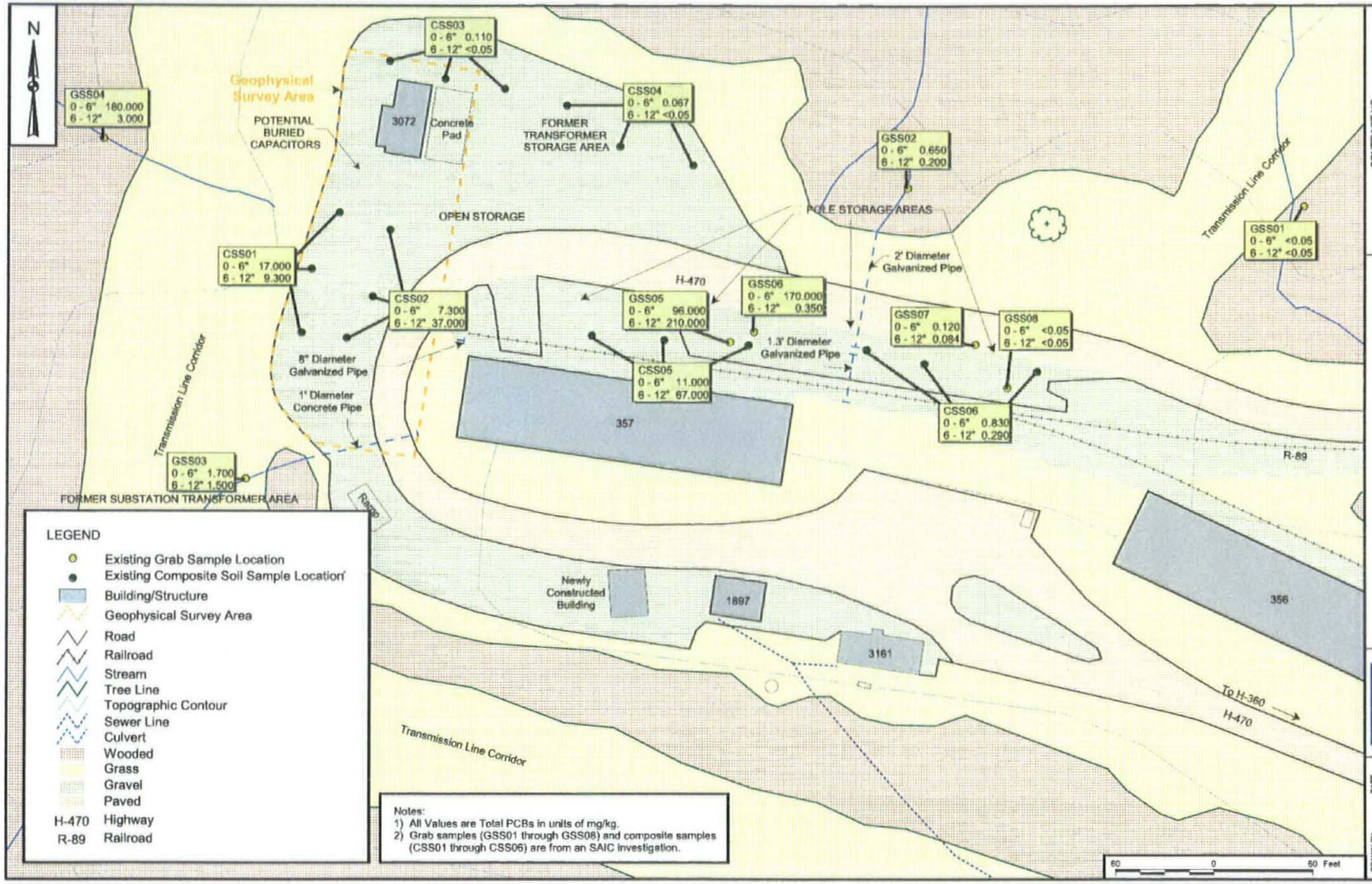
1. Threshold values (TVs) and reporting limits (RLs) as provided by Laucks Testing Laboratories, Inc. The values may change prior to the SWMU investigations as laboratory MDLs are updated.
2. The levels apply to total PCBs. Total PCBs represent the total of all aroclors. For example, the limit for an individual aroclor would be either 1 mg/kg or 25 mg/kg for high or low occupancy respectively only if no other aroclors were detected.
3. 40 CFR 761.61(a)(4)(i)(A)
4. 40 CFR 761.61(a)(4)(i)(B)
5. RISC Technical Guidance, July 2001



DRAWN BY J. LAMEY	DATE 5/6/02	SITE LOCATION MAP SWMU 17 - PCB CAPACITOR BURIAL/POLE YARD NAVAL SURFACE WARFARE CENTER CRANE, INDIANA	CONTRACT NUMBER 4070
CHECKED BY	DATE		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED	NAVFAC		DRAWING NO. FIGURE 1-1 REV 0

P:\GIS\NSWC_CRANE\POLE_YARD.APR SITE LOCATION 5/7/02 JAL

P:\GIS\NSWC_CRANE\POLE_YARD.APR SITE FEATURES AND EXISTING SAMPLE LOCATIONS 5/30/02 JAL



CONTRACT NO. 4070

APPROVED BY — DATE

APPROVED BY — DATE

DRAWING NO. — FIGURE 1-2 — REV

SITE FEATURES AND EXISTING SAMPLE LOCATIONS
SWMU 17 - PCB CAPACITOR BURIAL/POLE YARD
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

NAVFAC

DRAWN BY J. LAMBY — DATE 5/7/02

CHECKED BY — DATE

COST/SCHED-AREA

SCALE AS NOTED

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section presents the project management and organization for conducting field operations at the PCB Capacitor Burial/Pole Yard (SWMU 17/04) at NSWC Crane. Staffing and coordination requirements are described in Section 2.0 of the approved Building 106 Pond and Roads and Grounds Area QAPP (TtNUS, 2004). Table 2-1 and Figure 2-1 were updated to include the most current contact information for the involved parties and are included in this section.

TABLE 2-1

KEY PROJECT PERSONNEL FOR PCB CAPACITOR BURIAL/POLE YARD
NAMES, PHONE NUMBERS AND ADDRESSES
NSWC CRANE, CRANE, INDIANA
PAGE 1 OF 2

PERSON / TITLE / ORGANIZATION	ADDRESS	TELEPHONE/FAX
Doug Griffin RCRA Corrective Action Office of Solid and Hazardous Waste IDEM	Hazardous Waste Permits Section RCRA Corrective Action Office of Solid and Hazardous Waste 100 N. Senate Avenue MC 64-45 IGCN 1101 Indianapolis, Indiana 46204-2251	Phone: (317) 233-2710 FAX: (317) 233-3403
Bill Gates Remedial Project Manager U.S. Navy SOUTHNAVFACENGCOM	Department of Navy SOUTHNAVFACENGCOM Code 1864 2155 Eagle Drive Charleston, South Carolina 29406	Phone: (843) 820-7360 FAX: (843) 820-7465
Tom Brent Environmental Site Manager NSWC Crane	NSWC Crane Code RP3-TB B-3245 300 Highway 361 Crane, Indiana 47522-5009	Phone:(812) 854-6160 FAX: (812) 854-3981
Debbie Humbert Program Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8968 FAX: (412) 921-4040
Paul Frank Quality Assurance Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8950 FAX: (412) 921-4040
Matt Soltis Health and Safety Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8912 FAX: (412) 921-4040
Roger Clark Task Order Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8415 FAX: (412) 921-4040
Terry Rojahn Field Operations Leader Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8857 FAX: (412) 921-4040
Joseph Samchuck Data Validation Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220	Phone: (412) 921-8510 FAX: (412) 921-4040
Ed Sedlmeyer Project Chemist Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8704 FAX: (412) 921-4040
Tom Johnston Quality Assurance Advisor Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220	Phone: (412) 921-8615 FAX: (412) 921-4040

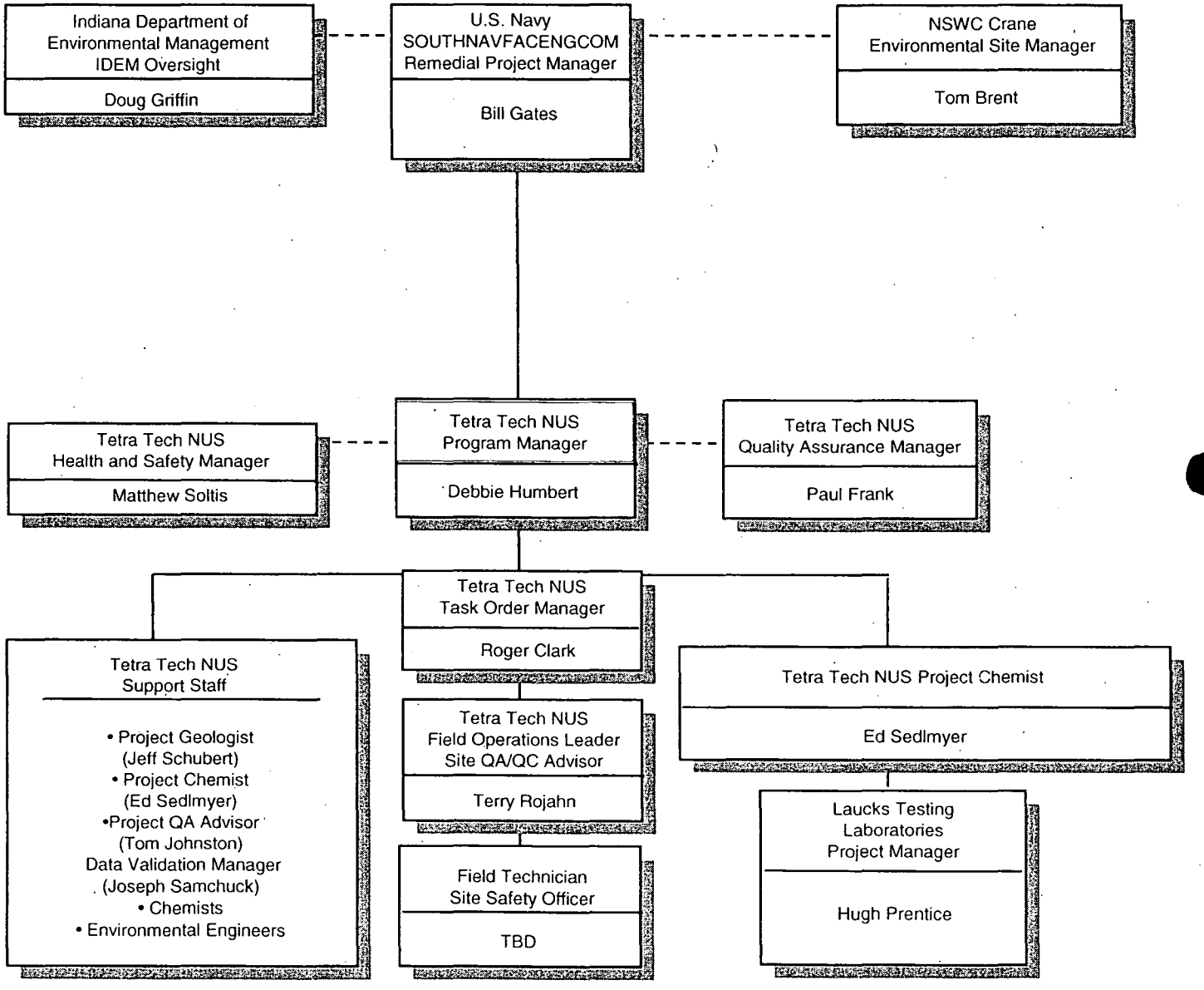
TABLE 2-1

KEY PROJECT PERSONNEL FOR PCB CAPACITOR BURIAL/POLE YARD
NAMES, PHONE NUMBERS AND ADDRESSES
NSWC CRANE, CRANE, INDIANA

PERSON / TITLE / ORGANIZATION	ADDRESS	TELEPHONE/FAX
Hugh Prentice Project Manager Laucks Testing	Laucks Testing 940 South Harney Street Seattle, Washington 98108	Phone: (206) 767-5060 FAX: (206)767-5063
Kathy Krepps Lab Operations Manager Laucks Testing	Laucks Testing 940 South Harney Street Seattle, Washington 98108	Phone: (206) 767-5060 FAX: (206)767-5063
Jeremy Carmichael/ Sara Safarpour Lab Sample Custodian Laucks Testing	Laucks Testing 940 South Harney Street Seattle, Washington 98108	Phone: (206) 767-5060 FAX: (206)767-5063

FIGURE 2-1

PROJECT ORGANIZATION CHART
PCB CAPACITOR BURIAL/POLE YARD
NSWC CRANE, CRANE, INDIANA



4.0 SAMPLING AND ANALYSIS PLAN

4.1 GENERAL APPROACH

This section describes sampling locations and sampling rationales. This section also describes the equipment and procedures to be used for collecting, handling, preserving, and shipping the samples to the analytical laboratories. The text references Standard Operating Procedures (SOPs) and the Health and Safety Plan (HASP), when applicable.

Sampling and analysis for additional site characterization is expected to be performed in one mobilization. The scope of site characterization work includes collecting surface and subsurface soil samples, a perched groundwater sample (if encountered), sediment samples, and surface water samples as outlined on Table 4-1 to further delineate the nature and extent of PCB contamination.

Prior to commencement of field work:

- the Task Order Manager (TOM) will ensure that all field personnel read and understand this QAPP Addendum and HASP
- the Field Operations Leader (FOL) will ensure that all required field equipment for non-health-and-safety operations is available and operational, and
- the Site Safety Officer (SSO) will ensure that all health-and-safety-related equipment is available and operational.

4.2 SAMPLE IDENTIFICATION SYSTEM

All samples will be properly labeled with an adhesive-backed sample label affixed to, and a tag tied to, each sample container in accordance with SOP CTO205-01. The sample labels and tags will include the following information: project name, project location, sample tracking number, sampling date, sampling time, type of analysis required, matrix type, preservative, initials of sampler, and the name of the analytical laboratory to which the sample will be submitted.

Each sample will be assigned a unique sample tracking number. The sample tracking number for soil and sediment samples is a four-segment, alphanumeric code beginning with the site identification (17 represents the SWMU number) and followed by codes for the sample type, sample location, and sample

depth. This numbering scheme is described in SOP CTO205-02. Any other pertinent information regarding sample identification will be recorded in the field logbooks and sample log sheets.

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

Matrix spike and matrix spike duplicate (MS/MSD) samples will be designated on the field documentation forms and chain-of-custody form (see SOP CTO205-03). It should be noted that all referenced SOPs for CTO 205 refer to the original SWMU 17 QAPP.

4.3 SAMPLING LOCATIONS, ANALYSES, AND RATIONALES

This section presents sampling locations, QA samples to be collected, analyses to be performed, and rationale for the sampling and analytical program. Details regarding the equipment and procedures for collecting, preserving, packaging, and shipping the samples are included in Section 4.6. Proposed sampling locations to further delineate the extent of PCB contamination are shown on Figure 4-1.

Four (4) areas at the site need additional information to fill data gaps following two recent soil investigations at the PCB Pole Yard (TtNUS, 2002 and TolTest, 2004). Past soil sampling and analysis within these areas has shown that PCBs are the primary chemicals of concern. These areas shown in Figure 4-1 include two locations within the footprint of the Interim Measure soil excavation area (cross-hatched areas north of Building 357) and two areas within drainage channels; one located downgradient of the previous dump area (west of dashed line for "Geophysical Survey Area") and another located downgradient of Building 357 (beginning close to the southwest corner of Building 357).

The PCB concentrations detected in the environmental media at the PCB Pole Yard will be evaluated in a baseline human health risk assessment (HHRA) and a screening-level ecological risk assessment (SERA). Additionally, contaminant levels will be compared to available State and U.S.EPA benchmarks such as the guidelines established by the Indiana Department of Environmental Management (e.g., the default closure values under the Risk Integrated System of Closure (RISC)) or the U.S.EPA under CERCLA or the Toxic Substances Control Act (TSCA). Remediation goals will be determined, as necessary, based on the results of the baseline HHRA and SERA and in consultation with IDEM and U.S.EPA Region 5. Remediation goals will consider the available ARARs as well as risk-based goals developed for land use scenario identified for the site.

Additional discussion on the excavation area and the drainage channels follow.

4.3.1 Excavation Area

Confirmatory samples collected from within the footprint of the recently excavated area (due north of Building 357) indicated that two discrete subareas remain and contain PCB soil contamination exceeding the TSCA Low Occupancy Standard of 25 mg/kg (TolTest, 2004). Although the horizontal extent of the contamination within these subareas is relatively well defined, the depth of contamination is unknown. Therefore within each of the subareas, two soil borings will be advanced (one on either side of the subareas) using a DPT to a depth of refusal, assumed to be less than 15 feet bgs at this location.

These locations are illustrated on Figure 4-1 as borings 17SB45 through 17SB48. Samples will be collected at two-foot intervals for visual lithologic characterization and up to three samples (shallow, intermediate and deep as outlined on Table 4-1) will be submitted to the laboratory for PCB analyses. The deepest sample will be collected from the soil/bedrock interface. Results of the laboratory analyses will be used to determine the total depth of contamination and to determine if additional excavation is necessary.

A geologist will log these borings. Detailed lithologic observations will be made of the soil/bedrock interface to determine the potential for contaminated groundwater to penetrate or flow across this interface. Based on subsurface investigations at other similar areas within NSWC Crane, the contact between the surface soil and underlying Pennsylvanian bedrock is typically not a distinct boundary, but rather a transitional sequence from soil into fractured and weathered siltstone/sandstone units that rest on more competent bedrock. Determining the lithologic characteristics of this contact will help develop the conceptual site model for potential contaminant migration in future reports for SWMU 17.

An additional soil boring will be installed (17SB49) at the downgradient edge of the former dump area. Soil samples will be collected at two-foot intervals from the surface to depth of refusal for visual lithologic characterization and up to three samples (shallow, intermediate and deep) will be submitted to the laboratory for PCB analyses. One groundwater sample will be collected from the first perched groundwater zone if encountered. Results of the laboratory analyses will be used to determine if contamination is migrating from the former dumping area and to determine if additional excavation is necessary. As with the previous borings, a geologist will log these borings and record detailed lithologic observations of the soil/bedrock interface to determine the potential for contaminated groundwater to penetrate or flow across this interface.

If perched groundwater is encountered and sampling becomes necessary, the DPT probe assembly will consist of a removable drive point and screened groundwater sampler and associated probe rods. The groundwater sampler is threaded onto the lead rod, just behind the drive point, and the entire probe assembly is advanced to a specified depth below the top of the water table. The probe assembly is then pulled up, leaving the drive point behind and creating an open borehole. An extension rod ram is inserted into the probe assembly to push the groundwater sampler out of the probe assembly into the saturated soil section. Groundwater levels will be measured following stabilization and then groundwater samples will be collected using a peristaltic pump. After the samples have been collected, the entire probe assembly, excluding the drive point, is withdrawn from the subsurface. The probe assembly will be decontaminated between sampling events.

4.3.2 Drainage Channels

During previous investigations, PCBs were found within a drainage ditch located downgradient of a former dumping area. A small volume of soil was removed from the area containing an elevated concentration of PCBs within the ditch during the TolTest soil removal effort (TolTest, 2004). The actual source and distribution of this PCB contamination is unknown. In order to delineate the extent of this contamination the following is proposed.

Three (3) sediment samples (17SD01 through 17SD03 shown on Figure 4-1) will be collected from within the ditch (herein referred to as the main drainage ditch) beginning immediately downgradient of a large (approximate 2 foot by 2 foot) concrete block (see Figure 4-1) located within the upgradient part of the ditch, and at two (2) other locations equally spaced, within the ditch and downgradient of this block. Samples 17SD01 through 17SD03 will be collected from the surface to 6" below the surface for sediment only at these locations. The third of these downgradient samples (17SD03) will be collected at the intersection of an intermediate drainage ditch located immediately to the northeast of the main drainage ditch.

Due north of this intermediate drainage ditch, surface water is collected in a small tributary which is located at the base of the hillside. Any substantial surface water coming off of the northern part of this SWMU would be intercepted by this tributary. Therefore, a surface water and sediment sample (17SW/SD04) will be collected at a location approximately twenty-five feet upgradient of where this tributary intersects the main stream (adjacent to the railroad track just before it goes under the tracks). A surface water and sediment sample (17SW/SD05) will be collected within a pool adjacent to the tracks.

A munitions storage bunker (identified as 2219 on Figure 4-1) is located on the west side of these previously mentioned drainageways. A seep is present on the east side of this bunker and is observed to originate along the hillside downgradient of the dump area and the previously mentioned drainage channels. A sediment sample (17SD06) will be collected from this seep area at a location twenty feet from an obvious recent excavation adjacent to the bunker. The samples collected from the drainage ditches, tributaries, pond and seep will be used to determine if contaminants are migrating off the SWMU by surface discharge or through groundwater seeps.

PCBs were also detected during the TtNUS RFI (TtNUS, 2002) at a separate drainage ditch located immediately southwest of Building 357. A sediment sample (17SD07) will be collected from within this ditch at a location where this primary ditch and the first intersecting secondary ditch merge.

All sediment and surface water samples collected from the above-described drainageways will be analyzed in the laboratory for PCBs.

4.4 INVESTIGATION EQUIPMENT AND PROCEDURES

4.4.1 Clearance of Drilling Sites

Prior to drilling, the field team members will lay out the sampling point system. The Crane utility clearance procedure will be used to clear utilities at the site and issue a digging permit. The drilling will commence when the requirements of the Navy and the TtNUS FOL are satisfied.

4.4.2 DPT Sampling for Surface and Subsurface Soil and Perched Groundwater

DPT (e.g., Geoprobe®) will be used to collect surface and subsurface soil samples from the unconsolidated overburden. The procedure for soil sampling using DPT is included in SOP CTO205-04. A new acetate liner will be used for each 2-foot section of soil core. Each removed soil core will be scanned for volatile organic compounds (VOCs). The soil core will be visually inspected and logged by the field geologist, noting the soil texture, grain size (sand, silt or clay), color (and any unusual discoloration), moisture content, and classification according to the Unified Soil Classification System (USCS). The soil depositional environment will be identified by the field geologist.

After slicing the soil core liner open with a Geoprobe® MC Liner Kit, the soils will be scanned to determine if significant VOC concentrations are present in the soils (see SOP CTO205-05). The measurements will be recorded on the boring log form (see SOP CTO205-06). A new form will be used for each boring.

For the first sampling interval in each boring, the photoionization detector (PID) will be used to scan the soil core for the presence of VOCs. The soil core will then be placed in a decontaminated stainless-steel mixing bowl; rocks, gravel, and other coarse debris will be removed; the sample will be mixed with a decontaminated stainless-steel spoon; and appropriate jars will be filled and properly labeled. The bowl and spoon will be decontaminated between each sample following procedures in SOP CTO205-09. Details regarding the collection and labeling of soil samples are included in SOPs CTO205-01 and CTO209-07.

When the soil cores for deeper samples have been brought to the surface, they will be scanned for VOCs in the same manner as the surface sample. The soil cores will be logged by a geologist (see SOP CTO205-06). The remainder of the soil core will be mixed together in a decontaminated stainless-steel mixing bowl; rocks, gravel, and other coarse debris will be removed; and the soil will be thoroughly mixed with a decontaminated stainless-steel spoon. The bowl and spoon will be decontaminated between each sample. Other sample jars will be filled as appropriate and properly labeled.

For each Geoprobe® boring, three soil samples will be collected. The samples will be containerized, labeled, tagged, and bagged (see SOP CTO205-07); they will be placed in a cooler containing ice until the samples can be properly packaged and prepared for shipment (Section 4.6). As samples are added to a cooler, the chain-of-custody form will be updated to include each new sample container (per SOP CTO205-03).

When a boring has been sampled and backfilled with soil, it will be identified by a tall wooden lathe driven into the soil near the boring; a 2- by 2-inch inch wooden stake will be driven into the center of the backfilled boring. The stake and the lathe will both have brightly colored flagging attached to them to increase visibility, and both will be labeled by a waterproof marker with a unique soil boring number, corresponding to the boring log containing the survey data for the boring.

Should perched groundwater sampling be necessary, the probe assembly will consist of a removable drive point and screened groundwater sampler and associated probe rods. The groundwater sampler is threaded onto the lead rod, just behind the drive point, and the entire probe assembly is advanced to a specified depth below the top of the water table. The probe assembly is then pulled up, leaving the drive point behind and creating an open borehole. An extension rod ram is inserted into the probe assembly to push the groundwater sampler out of the probe assembly into the saturated soil section. Groundwater levels will be measured following stabilization and then groundwater samples will be collected using a peristaltic pump. After the samples have been collected, the entire probe assembly, excluding the drive

point, is withdrawn from the subsurface. The probe assembly will be decontaminated between sampling events.

4.5 QUALITY CONTROL SAMPLES

This section focuses on field QC samples that will be collected as part of this environmental investigation. Field QC samples include field duplicates, source water blanks, and equipment rinsate blanks. Section 8.1 of the approved Jeep Trail/Little Sulphur Creek QAPP (TtNUS, 2001a) provides definitions and details for these and all other QC checks to be used during this investigation. Field QC sample requirements for field duplicates, source water blanks, and equipment rinsate blanks required for this project are described below. Table 4-2 summarizes field QC requirements for this project.

Field Duplicates. Field duplicates are obtained during a single act of sampling and are used to assess the overall precision of the sampling and analysis program. Duplicate samples will be collected at a rate of one for every 10 environmental samples of each type of environmental medium. All duplicate samples will be analyzed for the same parameters in the laboratory as their environmental sample counterparts. Duplicate samples will be preferentially collected where field evidence (staining) indicates that contamination is likely to be present in the environmental sample. The duplicate samples will be given unique QC sample IDs (see SOP CTO 205-02).

Equipment Rinsate Blanks. Equipment rinsate blanks will be obtained under representative field conditions by running analyte-free water through sample collection equipment after decontamination and placing it in the appropriate sample containers for analysis. Equipment rinsate blanks will be collected for non-dedicated equipment for all sampling rounds. For surface and subsurface soil sampling activities, rinsate blanks will be collected by running analyte-free water over a decontaminated stainless-steel bowl and mixing spoon; these items are used to mix soil before it is placed in sample jars. One rinsate blank will be collected every ten samples.

Source Water Blanks. Source water blanks will be obtained by sampling each water source (e.g., potable water and distilled water) used for decontamination activities during the field investigation. Source water blanks will be used to determine whether the water or the laboratory bottles are contributing to sample contamination. Source water blanks will be collected for each type of water used for decontamination and will be submitted at a frequency of one per sampling event. Source water blanks, as applicable, will be analyzed for the entire suite of parameters under investigation. It is anticipated that no more than three source water blanks will be collected during the field investigation: one potable water sample; one sample of distilled water used for decontamination; and one sample of water from the drillers reservoir.

4.6 SAMPLE HANDLING, PACKAGING, AND SHIPPING

4.6.1 Sample Preservation

All solid and aqueous samples need only be cooled to 4°C ± 2°C; no chemical preservatives are necessary. All samples will be promptly chilled with ice to 4°C ± 2°C and packaged in an insulated cooler. Procedures in SOP CTO205-11 should be followed. Table 4-3 summarizes sample preservation requirements.

4.6.2 Sample Labeling

Before samples are packaged, the sample labels and tags will be checked to ensure that all information on the label and tag is complete and correct (see SOP CTO205-01). This information should be checked to ensure that it matches the information placed on the sample collection log sheets and the chain-of-custody form.

4.6.3 Sample Packaging

Sample packaging procedures are discussed in SOP CTO205-11.

4.6.4 Sample Shipping

Sample shipping procedures are discussed in SOP CTO205-11.

4.6.5 Sample Custody

Custody of samples must be maintained and documented at all times in accordance with SOP CTO205-03, beginning with the collection of samples in the field. Sample custody procedures are addressed in Section 5.0.

4.7 RECORDKEEPING

Standard forms, field notebooks, and a field logbook will be used to record all sample collection activities, field measurements, observations concerning site conditions, and other project-related information. These records include sample log sheets, daily activity records, field logbooks, drilling and well completion log sheets, and field instrument calibration log sheets, among others. More details regarding recordkeeping are included in SOP CTO205-03.

4.7.1 Field Logbooks

Bound, weatherproof field notebooks will be maintained by sampling personnel. All information related to sampling and other field activities will be recorded in field notebooks. This information will include, but is not limited to, sampling time, weather conditions, unusual events, field measurements, and descriptions of photographs.

A bound, weatherproof logbook will be maintained by the FOL. This book will contain a summary of each day's activities and will reference the field notebooks when applicable.

4.7.2 Drilling Logs

A drilling log will be completed for every boring that occurs during these field activities. A trained technician will complete the boring log, which will include information regarding date, time, personnel, drilling and sampling equipment, geologic materials encountered, fracture locations and density in bedrock (where appropriate), color, texture, odors, and readings made with the screening instruments (see SOPs CTO205-05 and CTO205-06).

4.7.4 Equipment Calibration Logs

An equipment calibration log sheet will be used to record each time an instrument is calibrated or recalibrated or when calibration is checked against a standard or background. The procedures and standards to be used for instrument calibration are discussed in Section 6.1, and each instrument's SOP is contained in Appendix B.

4.7.5 Sample Collection Logs

One sample collection log sheet will be completed for every environmental sample, every duplicate sample, and every field blank sample collected during the field activities. Only the MS and MSD samples do not require their own individual sample collection log sheet.

4.7.6 Chain-of-Custody Forms

A chain-of-custody form will be completed for every cooler that contains samples being shipped to an off-site laboratory for analyses. These forms are a record of the people that have custody of the samples from the time the samples are collected to the time they are analyzed and disposed (see SOP

CTO205-03). The completed field chain-of-custody document will be signed, placed in a sealed plastic envelope, and taped to the top inside cover of the shipping container before it is shipped. A copy of the document will be retained by the FOL.

4.7.7 Shipping Forms/Air Bills

Copies of all forms and/or air bills related to the shipment of coolers will be retained by the FOL in order to trace the shipment, if necessary, and to communicate with the receiving laboratory.

4.7.8 Permanent Record File

At completion of the field activities, the FOL will submit to the TOM all field records, data, field notebooks, logbooks, COC records, sample log sheets, daily activity logs, and other records concerning the project, including all the forms and log sheets listed above. The FOL will check these records for legibility and completeness prior to submitting them to the TOM. These forms, data, and field notes will become part of the permanent project record.

4.8 SURVEYING

The location of every soil boring will be marked with a wooden lathe and flagging, and a hole number will be marked on the lathe. In addition, a 2- by 2-inch wooden stake, 6 inches long, will be driven into the ground at the center of the backfilled boring. This stake will have a piece of brightly-colored flagging tacked onto its top, and the hole number will be indelibly marked on the side of the stake.

The horizontal location will be surveyed by an Indiana-licensed surveyor for all locations to the Indiana State Plane Coordinates within the nearest foot and referenced to the 1983 North American Datum (NAD83). The vertical elevations of the ground surface for the borings will be measured to the nearest 0.01 foot.

4.9 EQUIPMENT DECONTAMINATION

All equipment used to collect soil samples will be decontaminated in accordance with SOP CTO205-09.

4.10 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Refer to SOP CTO205-08 for details explaining the procedure for disposal of investigation-derived waste.

4.11 SAFETY

Health and safety issues and concerns are critically important during any field investigation involving drilling and hazardous wastes. Sampling team members working at the site must be fully aware of the potential dangers involved with sampling activities, must be trained and prepared to deal with problems or health-related issues as they arise, and should minimize to the greatest possible extent the potential for exposure to harmful chemicals or accidents. To ensure that field activities are performed at a high level of safety, the following are included in the health and safety activities related to the sampling program.

4.11.1 Health and Safety Plan

A separate HASP has been prepared describing specific health and safety requirements, concerns, and information related to the site activities. This document must be read and understood by each person working at the site. Each worker or visitor to the site must sign an acknowledgment that he or she has read and understands the HASP. The site-specific HASP is found as Appendix C.

4.11.2 Health and Safety Training

All workers involved with the site investigations will have successfully completed the Occupational Safety and Health Administration (OSHA)-mandated, 40-hour health and safety training and follow-up annual 8-hour refresher courses when appropriate.

TtNUS and subcontractor personnel must supply OSHA documentation prior to beginning work.

4.11.3 Personal Protective Clothing and Equipment

Workers at the site must be part of a medical monitoring program and must be medically approved to perform their duties without physical limitations. Protective clothing and equipment, as specified in the HASP, will be worn while performing site activities.

4.11.4 Safety Meetings

Safety meetings will be held among on-site workers whenever the SSO feels it is appropriate. The SSO will discuss safety issues related to activities being performed and will ensure site workers are aware of any new conditions that could potentially affect health or safety.

4.12 ORGANIZATION AND LOGISTICS OF FIELD INVESTIGATIONS

4.12.1 Personnel

The duties, responsibilities, and line of command for each person working on the project are described in Section 2.0 of the approved Jeep Trail/Little Sulphur Creek QAPP (TtNUS, 2001) and displayed on Figure 2-1. Persons working on the project should be intimately familiar with their roles and responsibilities. In addition, they should be familiar with the mechanisms and procedures for coordinating tasks, improving communications, and reporting incidences or irregularities. The FOL is responsible for coordinating all on-site personnel and activities. The SSO is responsible for health and safety monitoring and ensures that the HASP is adhered to during all field activities. The SSO has the authority to stop work if an imminent safety hazard is encountered.

4.12.2 Subcontractors

Subcontractors will perform site activities involving drilling and surveying. The FOL will direct all subcontractor activities.

4.12.3 Mobilization and Demobilization

Following approval of this QAPP Addendum, mobilization activities will begin. All field team members will review the QAPP Addendum (including the HASP) prior to mobilization. In addition, a field team orientation meeting will be held to familiarize personnel with the scope of the field activities. Items to be presented during that meeting include

- Identification of the QAPP Addendum, including the HASP and applicable field SOPs (Appendix B).
- Site-specific safety concerns and requirements.
- Project objectives.
- Sampling designs and strategies for soil.
- Site-specific particulars of field operations (e.g., locations of utilities, physical access to sampling locations, communication mechanisms, lines of authority and responsibility, scheduling requirements, sample shipping concerns, etc.).
- Laboratory and other subcontractor coordination.
- Site access requirements.
- Travel requirements.

The FOL will coordinate the mobilization activities for this project. The equipment required for the field activities will be mobilized from the subcontractor home office or a third-party vendor. If electricity is not available on site, power for electric pumps and all other electric-powered equipment will be supplied from portable gas-powered generators. It is presently anticipated that no portable gas-powered equipment will be used during field operations but, if conditions arise that require such equipment, an application for their use will be made to the NSWC Crane Fire Department.

The FOL and crew will demobilize from the site upon completion of the field operations and transport field equipment back to the TtNUS Pittsburgh office, as necessary. All areas will be thoroughly checked and trash will be removed and disposed. All drums containing IDW will be checked to ensure that lids are secured and proper labels have been attached to the drums.

4.12.4 Time Schedule

Field activities described in this section are scheduled to be performed in no more than one 10-day shift. Any additional site activities that may be required will depend upon evaluation of the results obtained from this followup investigation phase.

TABLE 4-1

PROPOSED SAMPLES AND LABORATORY ANALYSIS
PCB CAPACITOR BURIAL/POLE YARD
NSWC CRANE, CRANE, INDIANA
PAGE 1 OF 2

Soil Sample No.[1]	**Depth (FT-BGS) and Interval**		**Analysis**
17SS45 0002	0-2	Shallow	PCBs
17SB45 020X	2-X	Intermediate	PCBs
17SB45 XXYY	XX-YY	Deep	PCBs
17SS46 0002	0-2	Shallow	PCBs
17SB46 020X	2-X	Intermediate	PCBs
17SB46 XXYY	XX-YY	Deep	PCBs
17SS47 0002	0-2	Shallow	PCBs
17SB47 020X	2-X	Intermediate	PCBs
17SB47 XXYY	XX-YY	Deep	PCBs
17SS48 0002	0-2	Shallow	PCBs
17SB48 020X	2-X	Intermediate	PCBs
17SB48 XXYY	XX-YY	Deep	PCBs
17SS49 0002	0-2	Shallow	PCBs
17SB49 020X	2-X	Intermediate	PCBs
17SB49 XXYY	XX-YY	Deep	PCBs
Perched Groundwater Sample Number (if encountered)[1]	**Depth (FT-BGS) and Interval**		**Analysis**
17GW49 XXYY	XX-YY	Shallow, Intermediate, or Deep – wherever it is encountered	PCBs

Notes:

1) Map locations on Figure 4-1 for soil and perched groundwater samples are designated as the surface soil sample location as shown in the following example: 17SS05 XXYY, where XXYY is the depth range in feet below ground surface.

TABLE 4-1

PROPOSED SAMPLES AND LABORATORY ANALYSIS
PCB CAPACITOR BURIAL/POLE YARD
NSWC CRANE, CRANE, INDIANA

Sediment Sample No.(2)	Depth (inches-BGS)	Analysis
17SD01 0006	0-6	PCBs
17SD02 0006	0-6	PCBs
17SD03 0006	0-6	PCBs
17SD04 0006	0-6	PCBs
17SD05 0006	0-6	PCBs
17SD06 0006	0-6	PCBs
17SD07 0006	0-6	PCBs

Surface Water Sample No.(2)	Surface Water Round	Analysis
17SW04 01	1	PCBs
17SW05 01	1	PCBs

Notes:

2) Map locations on Figure 4-1 for surface water and sediment samples are collocated at sampling locations 17SW/SD04 and 17SW/SD05, and designated as in the following example: 17SW/SD05 XXYY, where XX equals the sampling round for a surface water sample and XXYY is the depth range in inches below ground surface for a sediment sample.

TABLE 4-2

SUMMARY OF SOLID AND AQUEOUS ANALYSES AND QUALITY CONTROL SAMPLES
PCB POLE YARD STUDY AREA
NSWC CRANE, CRANE, INDIANA

Media	Parameter[1]	Samples	Field Duplicates[1]	Rinsate Blanks[2]	Matrix Spike/ Matrix Spike Duplicates[3]	Total
Solid	PCBs	22	3	3	2/2	28
Aqueous	PCBs	8	1	1	1/1	10

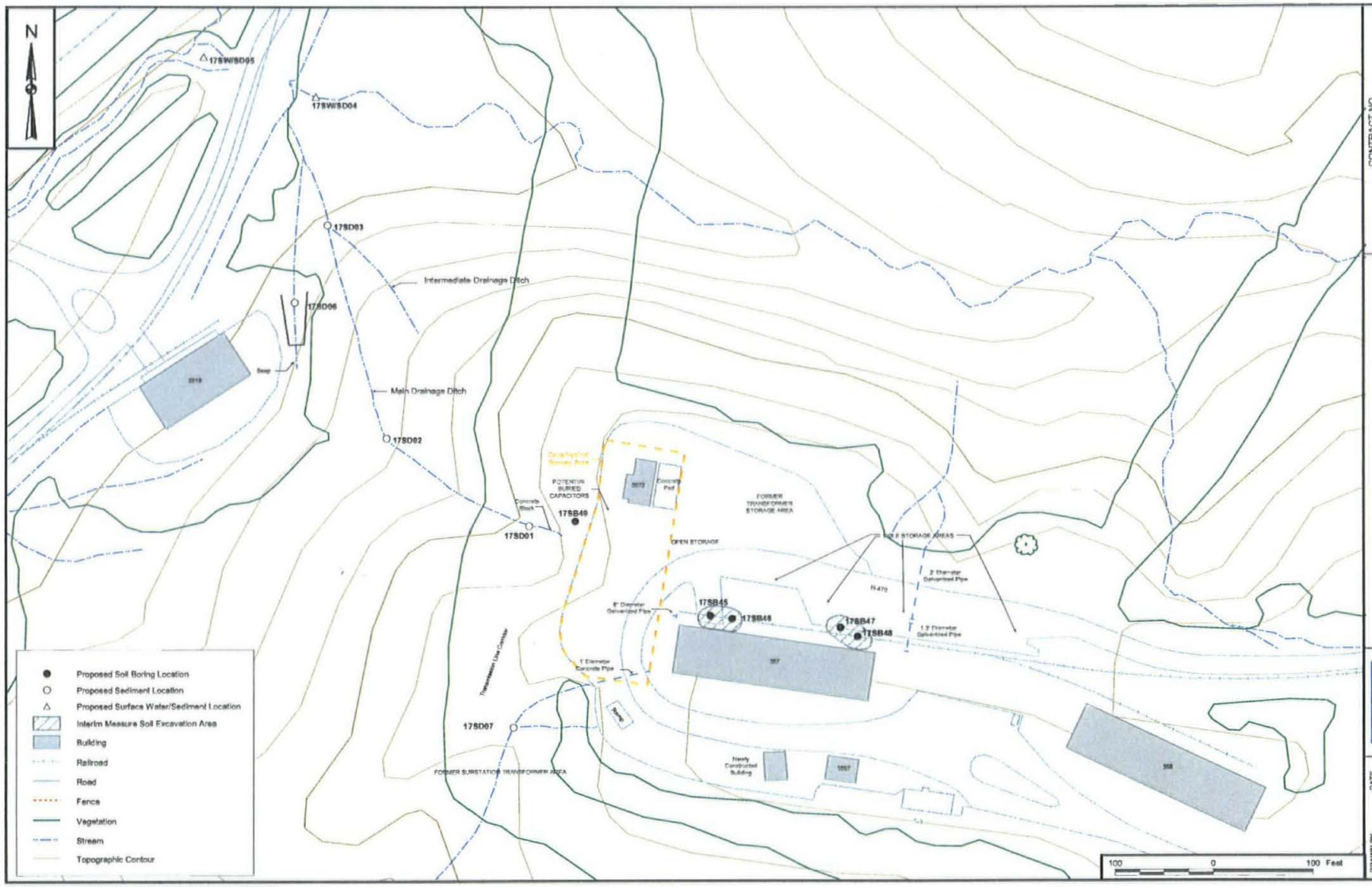
1 Field duplicates will be collected at a frequency of one per every 10 samples.
2 Rinsate blanks will be collected at a frequency of one per every 10 samples, with a minimum of one per day of sampling, per sampling device/instrument. These amounts are estimates and may vary.
3 Matrix spike (MS) and matrix spike duplicate (MSD) samples will be collected at a frequency of one per every 20 samples. MS/MSDs are not applicable (NA) for field analyses. MS/MSD are not considered in the total number of analyses.

TABLE 4-3

SUMMARY OF SAMPLE ANALYSES, CONTAINER TYPES AND VOLUMES, PRESERVATION REQUIREMENTS, HOLDING TIMES AND ANALYTICAL LABORATORY FOR SOLID AND AQUEOUS SAMPLES PCB POLE YARD STUDY AREA NSWC CRANE, CRANE, INDIANA

Matrix	Parameter	Sample Container	Container Volume	Preservation	Maximum Holding Time[1]	Analytical Laboratory
Solid	PCBs	Wide-mouth jar, Teflon-lined plastic cap	8 ounce	Cool to 4 °C, dark	Extraction 14 days; analysis within 40 days of extraction	Laucks
Aqueous	PCBs	Amber glass, Teflon-lined plastic cap	1000 ml (2 bottles each)	Cool to 4 °C, dark	Extraction 7days; analysis within 40 days of extraction	Laucks

1 All holding times are from date of collection.



CONTRACT NO. 0042

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 4 - 1

REV -

PROPOSED SAMPLE LOCATIONS
SWMU 17 - PCB CAPACITOR BURIAL/POLE YARD
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

NAVFAC

DRAWN BY C. FOSTER DATE 4/26/05

CHECKED BY R. CLARK DATE 4/26/05

COST/SCHED-AREA

SCALE AS NOTED

F:\GIS\CRANE_NSWC\MAP\DOCS\MAPS\SWMU17.APR PROPOSED LOCS LAYOUT 8/14/05 CF

REFERENCES

Indiana Department of Environmental Management (IDEM), 2001. RISC Technical Resource Guidance, Indianapolis, Indiana. July 24.

Naval Facilities Engineering Service Center (NFESC), 1999. Navy Installation Restoration Laboratory Quality Assurance Guide, NFESC Interim Guidance Document. Naval Facilities Engineering Services Command, September 1999.

Tetra Tech NUS, Inc. (TtNUS), 2000. Background Soil Report, Naval Surface Warfare Center, Crane, Indiana. March.

Tetra Tech NUS, Inc. (TtNUS), 2001b. Quality Assurance Project Plan for PCB Capacitor Burial/Pole Yard Solid Waste Management Unit (SWMU) 17 Resource Conservation and Recovery Act Facility Investigation and Verification. December.

Tetra Tech NUS, Inc. (TtNUS), 2002. Resource Conservation and Recovery Act Facility Investigation for the PCB Capacitor Burial/ Pole Yard Solid Waste Management Unit (SWMU) 17, August.

Tetra Tech NUS, Inc. (TtNUS), 2004. Quality Assurance Project Plan for RCRA Facility Investigation at Building 106 Pond (SWMU 8) Roads and Grounds Area (SWMU 15). September.

Tol Test, Inc. (TolTest, 2004). Interim Measures Report for the PCB Capacitor Burial Pole Yard Remediation; NSWC Crane; Crane, Indiana; Revision 1; November.

United States Environmental Protection Agency (U.S. EPA), 1998. Region 5 QAPP Policy. Waste, Pesticides, and Toxics Division, Chicago, Illinois. April.

United States Environmental Protection Agency (U.S. EPA), 1999. Self-implementing on-site cleanup and disposal of PCB remediation waste cleanup level regulations found at 40 CFR 761.61(a)(4)(i)(A) [63 FR 35448, June 29, 1998, as amended at 64 FR 33761, June 24, 1999].

United States Environmental Protection Agency (U.S. EPA), 1999. Guidance for the Data Quality Objective Process. EPA/600/R-96/055. September.

APPENDIX A

HISTORICAL PCB DATA
(SWMU 17/04)

POLE YARD SAMPLING ANALYSIS				BACKGROUND SAMPLES	
Parameter	Method #	Detection Limit (mg/kg)	State Closure Levels (mg/kg)	PBKG01SS	PBKG01FS
PCB	EPA 8081				
Aroclor 1016		0.05	5.3	<0.05	<0.05
Aroclor 1221		0.05		<0.05	<0.05
Aroclor 1232		0.05		<0.05	<0.05
Aroclor 1242		0.05		<0.05	<0.05
Aroclor 1248		0.05		<0.05	<0.05
Aroclor 1254		0.05	5.3	<0.05	<0.05
Aroclor 1260		0.05		<0.05	<0.05

COMPOSITE SAMPLES													
CSS01	CSUB01	CSS02	CSUB02	CSS03	CSUB03	CSS04	CSUB04	CSS04DUP	CSUB04DUP	CSS05	CSUB05	CSS06	CSUB06
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
17	9.3	7.3	37	0.11	<0.05	0.067	<0.05	0.054	<0.05	1.1	67	0.83	0.29

GRAB SAMPLES							
GSS05	GSUB05	GSS06	GSUB06	GSS07	GSUB07	GSS08	GSUB08
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
96	2.10	170	0.35	0.12	0.084	<0.05	<0.05

GRAB SAMPLES[1]							
GSS01	GSUB01	GSS02	GSUB02	GSS03	GSUB03	GSS04	GSUB04
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	15
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<0.05	<0.05	0.65	0.2	1.7	1.5	180	3

1 Grab samples collected in surface water drainage pathway.

APPENDIX B

FIELD STANDARD OPERATING PROCEDURES

SOP TABLE OF CONTENTS

CTO205-01	Sample Labeling
CTO205-02	Sample Identification Nomenclature
CTO205-03	Sample Custody and Documentation of Field Activities
CTO205-04	Borehole Advancement and Soil Coring Using Direct Push Technology
CTO205-05	Calibration and Use of Photoionization Detector
CTO205-06	Borehole and Soil Sample Logging
CTO205-07	Surface and Subsurface Soil Sampling
CTO205-08	Management of Investigation-Derived Waste
CTO205-09	Decontamination of Field Sampling Equipment
CTO205-10	Soil Sample Compositing
CTO205-11	Sample Preservation, Packaging, and Shipping
CTO205-12	Use of Immunoassay Test Kit for PCBs.

STANDARD OPERATING PROCEDURE
NUMBER CTO205-01

SAMPLE LABELING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used for labeling and tagging sample containers. Sample labels and tags are used to document the sample ID, date, time, analysis to be performed, preservative, matrix, sampler, and the analytical laboratory. A sample label and a sample tag will be attached to each sample container. The label and tag for each container will contain identical information.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil

Disposable medical-grade gloves (e.g. latex, nitrile)

Sample logsheets

Required sample containers: All sample containers for analysis by fix-based laboratories will be supplied and deemed certified clean by the laboratory.

Preprinted sample labels and sample tags

Chain-of-custody records

Sealable polyethylene bags

Heavy-duty cooler

Ice

3.0 PROCEDURES

3.1 The following information will be printed on the labels and tags prior to field activities.

- Project number (CTO 205)
- Project Location (NSWC Crane)
- Sample ID
- Preservative

- Analysis to be performed
- Matrix type
- Laboratory name

3.2 Preprinted sample labels and tags will be prepared prior to mobilizing to the field. Check to determine if

- One sample label and tag exists for each sample container that is to be collected for all media during the field activities.
- The information printed on each tag and label are correct.
- Extra blank labels and tags are brought to the site in case additional environmental samples or QA samples are collected that are not anticipated in the QAPP. Additional blank labels and tags should also be brought to the site in case a sample container is broken or some of the preprinted labels or tags are accidentally lost before attached to a container.

3.3 Once at the field site, sample containers should have labels affixed before sampling activities begin.

3.4 Select the labeled containers that are appropriate for a given sample and fill in the date, time, and sampler's initials just before sampling begins. Use a black waterproof marker or pen.

3.5 Fill the appropriate containers with sample material. Securely close the container lids without overtightening.

3.6 Write the same date, time, and sampler's initials on the sample tag as written on the label.

3.7 Place the sample container in a ziplock plastic bag and place in a cooler containing ice.

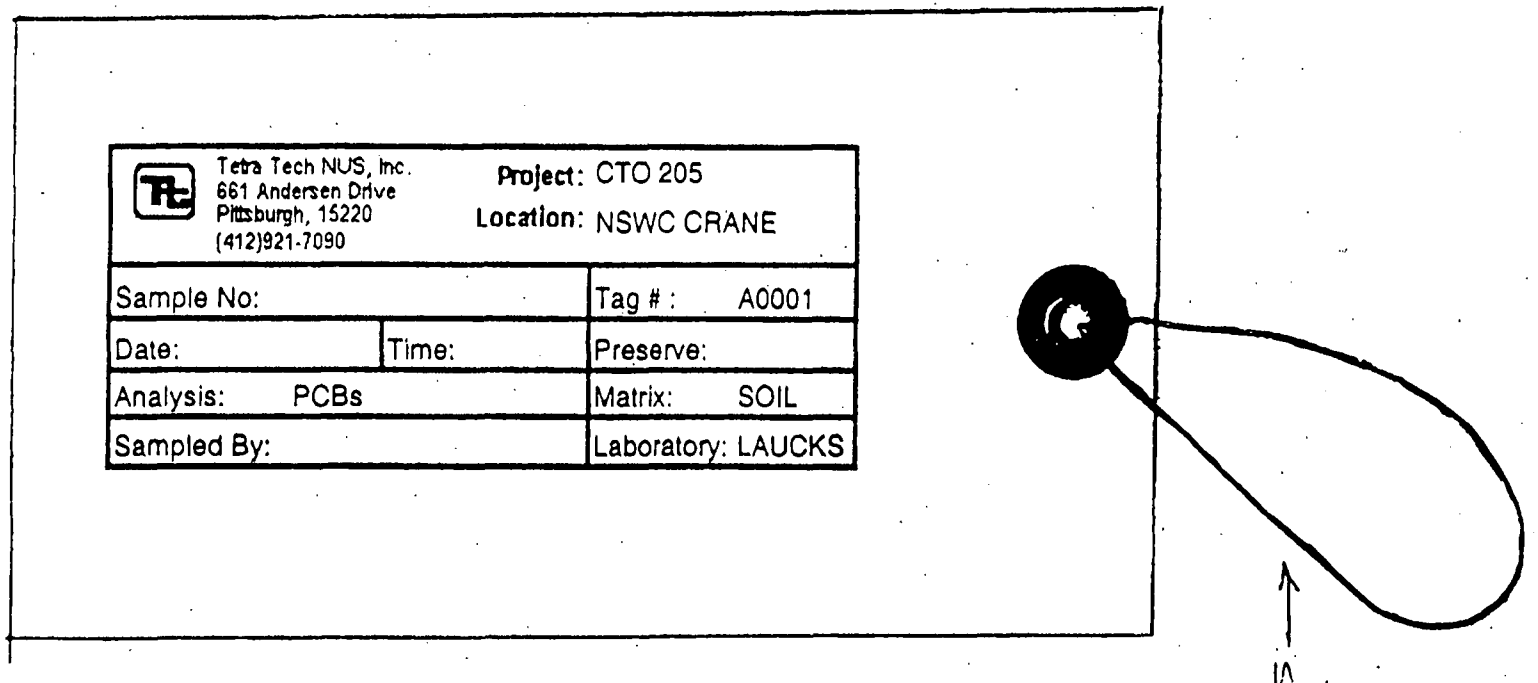
3.8 Fill in appropriate information on the Sample Collection Log form and the Chain-of-Custody form.

Example sample labels and tags are attached at the end of this SOP.

4.0 ATTACHMENTS

1. Sample Label and Tag

ATTACHMENT 1
SAMPLE LABEL AND TAG



STANDARD OPERATING PROCEDURE
NUMBER CTO205-02

SAMPLE IDENTIFICATION NOMENCLATURE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish a consistent sample nomenclature system that will facilitate subsequent data management at the Naval Surface Warfare Center (NSWC). The sample nomenclature system has been devised such that the following objectives can be attained:

- Sorting of data by site, location, or matrix
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints
- Ease of identification and direct link to site and year

The NSWC Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Pen with indelible ink
Sample tags
Sample container labels

3.0 SAMPLE IDENTIFICATION NOMENCLATURE

3.1 Monitoring Samples

All site characterization and verification samples collected at NSWC Crane will be properly labeled with a sample label affixed to the sample container and a tag tied around the neck of the sample container. Each sample will be assigned a unique sample tracking number. The sample tracking number will consist of a four-or five-segment alpha-numeric code that identifies the sample's associated solid waste

management unit (SWMU) or associated site, sample type, and location. For soil samples, the final four tracking numbers will identify the depth at which the soil or sediment sample was collected.

The alpha-numeric coding to be used in the NSWC Crane sample system is explained in the diagram and the subsequent definitions:

NN	**AA**	**A or N** **2 to 7-Characters**	**NNNN** **Soils and Sediment only**
SWMU or Site Number	Sample Type	Location	Depth Interval

Character Type:

A = Alpha

N = Numeric

SWMU or Site Number:

17 = PCB Capacitor Burial/Pole Yard

Sample Type:

Site Characterization			Verification Sampling		
SB	-	Soil Boring Sample	SW	-	Sidewall Sample
SS	-	Surface Soil Sample	FL	-	Floor Sample

Location:

The sample location code is 1) the soil proposed sample location, 2) northing and easting value (N_E_), 3) excavation number (X). The location code for each sample is listed.

Depth Interval, Soil and Sediment only:

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

Depth (for soils, in feet bgs)

0002 = soil collected from 0 to 2 feet bgs

0204 = soil collected from 2 to 4 feet bgs

0810 = soil collected from 8 to 10 feet bgs

3.1.1 Examples of Sample Nomenclature for Site Characterization Samples

A surface soil sample collected from soil boring 15 at the PCB Capacitor Burial/Pole Yard at the 0- to 2-foot interval would be designated as 17SS150002.

A subsurface soil sample from the same soil boring 15 at an interval of 4 to 5 feet bgs would be designated as 17SB150405.

3.1.2 Examples of Sample Nomenclature for Verification Sampling

a) For sites where the width of the excavation in greater than the depth - Surficial

Example 1: 17 FL E 670 N 530 D0002
A floor soil sample (at 2 feet below original grade) taken from sampling grid node E 670 and N 530.

E represents Easting. N represents northing.

b) For sites where the width of the excavation is less than the depth - pit excavating

Example 1: 17 SW x 01 N1 0005
A soil sample taken from the sidewall (SW) of excavation (X) 1's northern wall, 5 feet below original grade. Subsequent samples taken from the northern wall will be N2, N3, N4, etc.

Attachment 1 shows proposed sample nomenclature procedures applied to hypothetical excavations at Site 17. Attachment 2 shows same field notes for documenting PCB verification samples.

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

Field QA/QC samples are described in the approved field sampling plan and QAPP. They will be designated using a different coding system. The QC code will consist of a three- to four-segment alpha-

numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN
QC Type	Date	Sequence Number (per day)

The QC types are identified as

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

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

3.2.2 Examples of Field QA/QC Sample Nomenclature

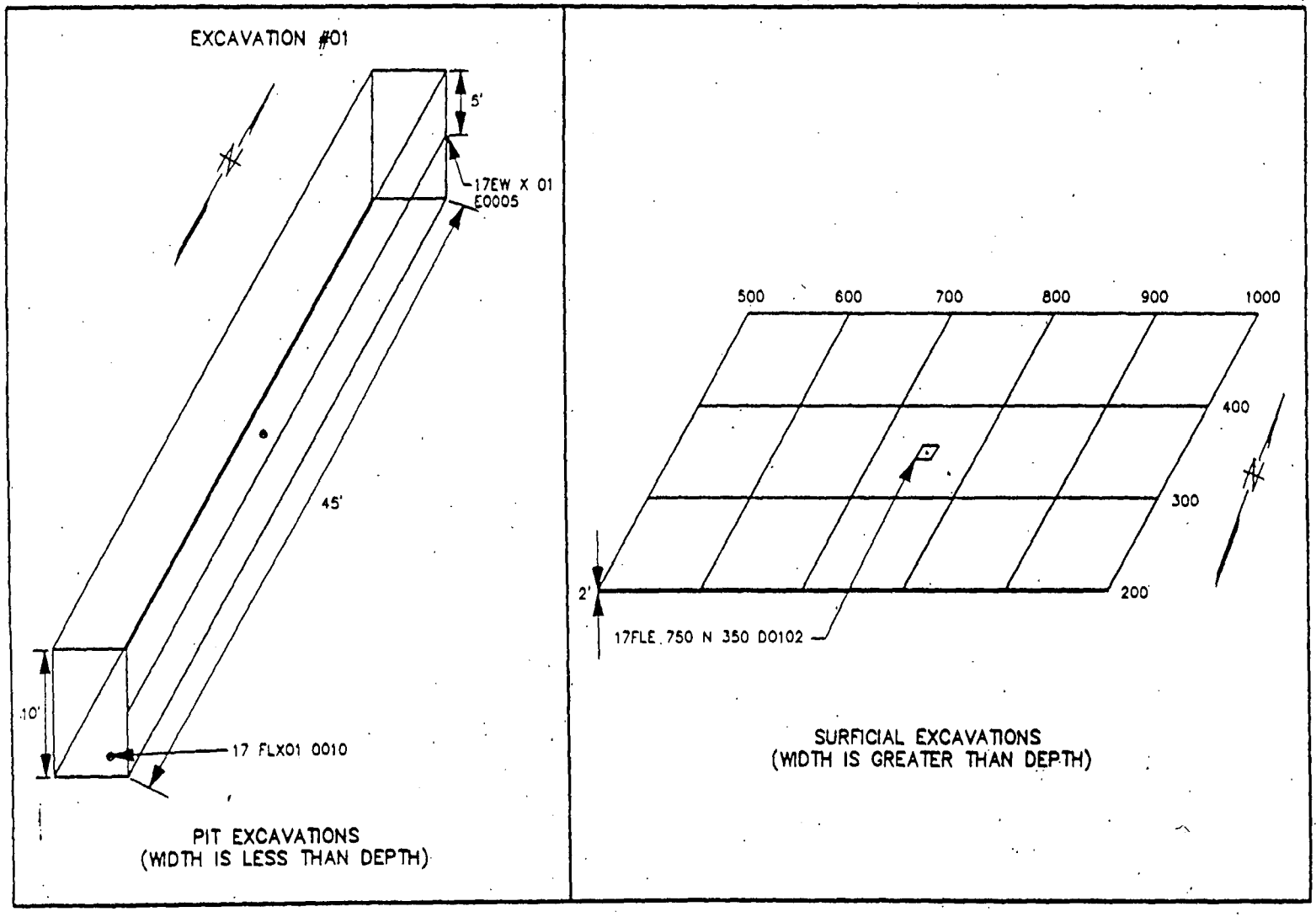
The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2003 would be designated as FD11170303.

The only rinsate blank collected on November 17, 2001 would be designated as RB11170101.

Attachment 1

Sample Nomenclature Applied to Hypothetical Excavations at Site 17

(Verification Sampling Only)



ATTACHMENT 1
SAMPLE NOMENCLATURE APPLIED TO HYPOTHETICAL
EXCAVATIONS AT SITE 17.. (VERIFICATION SAMPLING ONLY)

Attachment 2

EXAMPLE FIELD NOTES

Composite Sample 17SWx01 E0005

Sample represents nine sample aliquots evenly spaced over a grid that is from 0 to 5 feet below grade on the eastern side of the pit excavation. The composite sample name was written on survey pin flags and located at ground surface in proximity to the excavation side wall.

Composite Sample 17FLE750 N350 D0102

Sample represents nine sample aliquots evenly spaced over a 225-square- foot (20.25 square meter) grid. The center of the grid is at E75 N350. The sample was taken from 1 to 2 feet below original grade.

STANDARD OPERATING PROCEDURE
NUMBER CTO205-03

SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures for sample custody and documentation of field sampling and field analyses activities.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following logbooks, forms, and labels, are required.

Site logbook
Field logbook
Sample label
Chain-of-custody form
Custody seals
Equipment Calibration Log
Monitoring Well Inspection Form
Water Level Measurement Form
Low-Flow Purge Data Sheet
Ground Water Sample Log Sheet
Surface Water Sample Log Sheet

3.0 PROCEDURES

This section describes custody and documentation procedures. All entries made into the logbooks, custody documents, logs, and log sheets described in this SOP must be made in indelible ink (black is preferred). No erasures are permitted. If an incorrect entry is made, the entry will be crossed out with a single strike mark, initialed, and dated.

3.1 Site Logbook

The site logbook is a hardbound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, the following activities/events shall be recorded (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of sampling activities
- Daily on-site activities performed each day
- Sample pickup information
- Health and safety issues
- Weather conditions

The site logbook is initiated at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that on-site activities take place.

The following information must be recorded on the cover of each site logbook:

- Project name
- Project number
- Book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). At the completion of each day's entries, the site logbook must be signed and dated by the field operations leader (FOL).

3.2 Field Logbooks

The field logbook is a separate dedicated notebook used by field personnel to document his or her activities in the field. This notebook is hardbound and paginated.

3.3 Sample Labels

Adhesive sample container labels must be completed and applied to every sample container. Information on the label includes the project name, location, sample number, date, time, preservative, analysis, matrix, sampler's initials, and the name of the laboratory performing the analysis.

3.4 Chain-of-Custody Form

The Chain-of-Custody Form (COC) is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as it is transferred from person to person. Each COC is numbered. This form must accompany any samples collected for laboratory chemical analysis. A copy of a blank chain-of-custody form is attached at the end of this SOP.

The FOL must include the name of the laboratory in the "Remarks" section to ensure that the samples are forwarded to the correct location. If more than one COC is necessary for any cooler, the FOL will indicate "Page __ of __" on each COC. The original (top) signed copy of the COC form will be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. Once the samples are received at the laboratory, the sample custodian will check the contents of the cooler(s) against the enclosed COC(s). Any problems are noted on the enclosed COC form (bottle breakage, discrepancies between the sample labels, COC form, etc.) and will be resolved through communication between the laboratory point-of-contact and the task order manager (TOM). The COC form is signed and retained by the laboratory and becomes part of the sample's corresponding analytical data package.

3.5 Custody Seal

The Custody Seal is an adhesive-backed label with a number on each seal. It is part of the 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 transit to the laboratory. The Custody Seals are signed and dated by the samplers and affixed across the opening edges of each cooler (two seals per cooler) containing environmental samples. The laboratory sample custodian will examine the Custody Seal for evidence of tampering and will notify the TOM if evidence of tampering is observed.

3.6 Equipment Calibration Log

The Equipment Calibration Log is used to document calibration of measuring equipment (e.g., multi-parameter water-quality meter) used in the field. The Equipment Calibration Log 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 requiring calibration. Entries must be made for each day the equipment is used.

3.7 Soil Sample Log Sheet

The Soil and Sediment Sample Log Sheets are used to document the sampling of soils. This sheet is used in conjunction with SOP CTO205-07.

4.0 ATTACHMENTS

1. Chain-of-Custody Record

ATTACHMENT 1
CHAIN-OF-CUSTODY RECORD

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

DATE YEAR	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	CONTAINER TYPE PLASTIC (P) or GLASS (G)	PRESERVATIVE USED	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)

FORM NO. TINUS-001 3/99

STANDARD OPERATING PROCEDURE
NUMBER CTO205-04

BOREHOLE ADVANCEMENT AND SOIL CORING USING DIRECT PUSH TECHNOLOGY

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for collecting surface and subsurface soil cores from unconsolidated overburden materials using direct-push technology (DPT) for the PCB Capacitor Burial/Pole Yard at the NSWC Crane facility. For this investigation, a Geoprobe® rig with a Macrocore Sampler will be the type of DPT used.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Cut-resistant non-latex impermeable gloves
Cotton gloves
Disposable medical-grade gloves (e.g., latex, nitrile)
Writing utensil
Boring log sheets: A copy of this form is included in SOP CTO205-06
Photoionization detector (PID) (see SOP CTO 205-05)
Geoprobe® or equivalent DPT equipment
Geoprobe® Macrocore Sampler or equivalent
Geoprobe® Sampling Kit or equivalent
Clear acetate liners: one new liner for each soil core
Required decontamination materials (see SOP CTO205-09)
Bentonite pellets

3.0 BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A GEOPROBE®

Direct-push technology (DPT) will be employed to collect soil cores. DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional rotary drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. Geoprobe® is a manufacturer of a hydraulically powered, percussion/probing machine utilizing DPT to

collect subsurface environmental samples. This type of rig with a Macrocore Sampler will be used at the PCB Capacitor Burial/Pole Yard to collect soil cores.

3.1 Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).

3.2 Place a new clear acetate liner in the detachable Macrocore core barrel and attach coring device to the Geoprobe® rig.

3.3 Drive macrocore sampler (lined with acetate) into the ground to a depth of 2 feet using hydraulic pressure. The 0- to 2-foot depth soil interval is considered to be the surface soil.

3.4 Retract the sampler from the borehole and remove the acetate liner and the soil core from the Macrocore barrel.

3.5 Attach the metal trough from the Geoprobe® Sampling Kit firmly to the tail gate of a vehicle. If a vehicle with a tailgate is not available, secure the trough on another suitable surface.

3.6 Place the acetate liner containing the soil core in the trough.

3.7 While wearing cut-resistant gloves (constructed of non-latex over cotton), cut 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. **CAUTION**: Do not attempt to cut the acetate liner while holding it in your hand.

3.8 Scan the entire length of the soil core for volatile organic compounds (VOCs) using the PID. Record the specific depth interval and the associated PID reading on the Boring Log Sheet. Collect a soil VOC sample using Encore samplers from the soil interval that had the highest PID reading. If no above-background PID readings were detected, collect the VOC sample from an interval that is discolored or displays other visual signs of being contaminated. If no visual sign of contamination is evident, collect the soil VOC sample from the center of the core interval (i.e., one foot depth).

3.9 Log the soil core on the Boring Log Sheet (see SOP CTO205-06).

3.10 Place the soil core in a stainless-steel mixing bowl, homogenize, and collect the remainder of the soil sample aliquots, as described in SOP CTO205-07.

3.11 Repeat steps 3.2 through 3.10 for the next depth intervals.

3.12 The depth to bedrock should be recorded on the Boring Log, and the estimated moisture content of the soil and the presence or absence of water in the boring should be noted.

3.13 If readings from the PID are all at background levels below field screening criteria, then excess soil core materials will be returned to the hole and tamped. If insufficient soil is available to fill the hole to the ground surface, then bentonite pellets mixed with the soil will be used to backfill the hole.

3.14 If screening instruments indicate that contaminants may be present in the soil materials, then all excess soil core materials will be placed in a plastic bag (or drum if larger quantities). The bag will be tagged identifying the location and depths from where the soils came and the date. The bag will then be placed in a 55-gallon drum and stored on-site until laboratory analyses of the soil are completed and classification of the soil waste materials can be determined (see SOP CTO205-08).

3.15 If soil materials from the boring are suspected of being contaminated (see 3.14 above), the soil boring will be backfilled with bentonite pellets up to the ground surface.

3.16 Decontaminate all soil sampling equipment in accordance with SOP CTO205-09 prior to collecting the next sample.

STANDARD OPERATING PROCEDURE
NUMBER CTO205-05

CALIBRATION AND USE OF PHOTOIONIZATION DETECTOR

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes procedures for the maintenance, calibration, and use of a photoionization detector (PID). The Photovac 2020 Photoionization Air Monitor will be used during the PCB Capacitor Burial/Pole Yard investigation. The procedures for its use are discussed in detail in the following sections.

2.0 GLOSSARY

Electron-volt (eV) - A unit of energy equal to the energy acquired by an electron when it passes through a potential difference of 1 volt in a vacuum.

Intrinsically Safe (I.S.) - Based on wiring, configuration, design, operation, gasketing, construction, this instrument may be employed within locations where flammable gases and/or vapors may exist.

Ionization Potential (I.P.) - The energy required to remove an electron from a molecule yielding a positively charged ion and a negatively charged free electron. The instrument measures this energy level.

Photoionization Detector (PID) - PID is employed as the general reference to air monitors of this type. PID's detection method employs ultraviolet (UV) radiation as an energy source. As air and contaminants are drawn through the ionization chamber, the UV light source causes the contaminant with ionization potentials equal to or less than the UV source to break into positive and negatively charge ions. The created ions are subjected to an electrostatic field. The voltage difference is measured in proportion to the calibration reference and the concentration of the contaminant.

Ultraviolet Radiation (UV) Lamp - Ultraviolet radiation is the energy source employed by the instrument to ionize collected sample gas streams. The UV lamp source is required to be equal to or greater than the ionization potential of the substance drawn through the instrument in order to create separate ionized species.

3.0 REQUIRED EQUIPMENT

Pen

Equipment Calibration Form

Photoionization detector

Isobutylene calibration gas (i.e., span gas)

Regulator

4.0 PROCEDURES

4.1 Principle of Operation

The Photovac portable photoionizer detects many organic (and a few inorganic) species. The basis for detection of this instrument is the ionization of components in gaseous streams. The incoming gas molecules are subjected to UV radiation, which is energetic enough to ionize many compounds associated with industrial activities. Molecules are transformed into charged-ion pairs, creating a current between two electrodes. Each molecule has a characteristic ionization potential, which is the energy required to remove an electron from the molecule, yielding a positively charged ion and a free electron. The instrument measures this energy level.

This instrument measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. It does not distinguish between individual substances. Readings that are displayed represent the total concentration of all photoionizable chemicals present in the sample. This instrument is factory-set to display concentration in units of ppm or mg/m^3. The meter display updates itself once per second.

The 2020 also performs short-term exposure limit (STEL), time-weighted average (TWA), and peak calculations. The user can view any of these results, but only one mode may be viewed at a time.

The 2020 has six keys for alphanumeric entry and for accessing multiple functions. The keys are used to set up and calibrate 2020. They allow the user to manipulate the concentration data in various ways.

All information entered with the keys and stored in the 2020's memory is retained when the instrument is switched off. The clock and calendar continue to operate and do not need to be set each time the 2020 is turned on.

4.1.1 Displays

The 2020 has a meter display for reporting detected concentration and a display used for status/ information to guide the user through configuration options. All functions of the 2020 will be controlled or reported using one of these displays.

4.1.1.1 Meter Display

The meter display is four digits. It will always be used for reporting detected concentration. When the detector and pump are off, the meter display will be blank.

In order to accommodate the range of concentrations the 2020 can detect, the meter reading will be reported using one of two resolutions. A resolution of 0.1 will be used for concentrations below 100 ppm, and a resolution of 1 will be used for concentrations above 100 ppm.

4.1.1.2 Status Display

The status display is a two line by 16-character display. The top line is used to display status/information and prompts the user for inputs. The bottom line is used for soft key names. Up to three names can be displayed for the three soft keys. If a name does not appear for a soft key, then the soft key has no associated function.

4.1.2 Keys

4.1.2.1 Fixed Keys

The three round keys below the soft keys each have a fixed function. The first key is the ON/OFF key, the middle key is the EXIT key, and the last key is the ENTER key.

The ON/OFF key is used to both turn power on and off. To turn on the 2020, press the ON/OFF key. To turn the power off, press the ON/OFF key and hold it down for 2 seconds, and then release it. This is done to prevent accidental power off.

The EXIT key provides a way of returning to the default display. In the functional map, the soft keys allow the user to advance and the EXIT key provides a way to go back. If the user is at the initial entry of the menu, EXIT will return to the default display.

The ENTER key has a context sensitive function. When operating or navigating through the function map, the ENTER key is used to exit the functions and return to the default display. When entering data such as a name, number, date, or time, ENTER is used to confirm the entry.

4.1.2.2 Soft Keys

The three soft keys on the 2020 are located directly below the status display. Each key has varying functions for configuring the 2020, editing the data logger, and controlling the display. Because only three soft keys are available, each function is broken down into a path.

4.1.2.3 Entering Text With the Soft Keys

For all information that the user must enter, the left, center, and right soft keys correspond to the up, down, and right arrow.

The up and down arrows are used to change the character highlighted by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right most character, it wraps around to the first character again. To accept the changes, press the ENTER key. To ignore the change, press EXIT.

Formatting characters, such as the colon (:) in the time, the decimal (.) in a concentration, and the slash (/) in the date, are skipped when advancing the cursor.

All inputs are an eight-character input, which is displayed on the right side of the top line of the status display. The prompt, describing the input, occupies the left half of the top line. The soft keys are defined on the bottom line of the status display.

4.2 Default Display

The meter display shows the detected concentration. The resolution of the display changes with the magnitude of the reading. A reading of 0 to 99.9 will be displayed with a resolution of 0.1 ppm. A reading greater than 99.9 will be shown with a resolution of 1 ppm or 1 mg/m^3. The meter will display concentrations up to 2,000 ppm or 2(99) mg/m^3.

The status display is used to display the instrument status, date, time, units, and active soft keys.

The default display provides the following information: instrument status, current detected concentration, time, date, and measurement units. The status display toggles between showing time and units and then the date.

When the display mode is MAX, the date and time correspond to the date and time the MAX concentration was recorded. In TWA mode, the time represents the number of hours and minutes during which the TWA has been accumulating. For PEAK and STEL monitoring, the date and time correspond to the current date and time.

4.3 Monitoring

4.3.1 Instrument Status

The instrument status is shown on the left of the first line of the status display and on the Table and Graph outputs. Each status has a priority assigned to it. If more than one status is in effect, then the status with the highest priority is displayed until the condition is corrected or until the option is turned off.

4.3.2 Alarms

While operating the instrument, any one of three alarm conditions can occur. To accurately identify the source of the alarm, each type of alarm has been given a unique status.

In addition to the status, the 2020 also has an audible alarm and a visual alarm LED. To conserve power, the 2020 alternates between these two alarm indicators, rather than operating both concurrently. Different alarms are identified by the frequency at which the 2020 alternates, as follows: PEAK alarm - 5 times per second; STEL alarm - 2.5 times per second; and TWA alarm - 1.25 times per second.

The left soft key is used for acknowledging alarms and is labeled "Ack." If no alarm exists, then the "Ack" key is not shown. To clear the alarm, press the "Ack" key. Once acknowledged, the alarm indicators are cleared. The alarm status will remain until the alarm condition clears.

The 2020 updates the peak concentration once every second. Following every update, the peak concentration is compared to the peak alarm level, and, if exceeded, an alarm is triggered.

If a 15-minute average concentration exceeds the selected STEL, a STEL alarm is generated.

The TWA alarm is generated when the current average concentration over an 8-hour period, since the TWA was last cleared, has exceeded the TWA exposure limit.

During calibration, all alarms are disabled. Once the calibration is complete, the alarms are re-enabled.

4.4 STEL, TWA, MAX, and PEAK Operation

The 2020's meter display can be configured to show one of four values: STEL, TWA, PEAK, and MAX.

4.4.1 Short-Term Exposure Limit Mode

The STEL mode displays the concentration as a 15-minute moving average. The 2020 maintains 15 samples, each representing a 1-minute averaging interval.

Once every minute, the oldest of the 15 samples is replaced with a new 1-minute average. This moving average provides a 15-minute average of the last 15 minutes with a 1-minute update rate. Because the average is calculated using 15 one-minute averages, the meter display will only update once every minute.

The STEL is set to zero each time the instrument is turned on. Because STEL is a 15-minute moving average, there is no need to clear or reset the STEL.

STEL calculations are always being performed by the 2020. The user can display the results of the calculations by selecting "STEL" as the Display mode.

4.4.2 Time-Weighted Average (TWA) Mode

The TWA accumulator sums concentrations every second until 8 hours of data have been combined. If this value exceeds the TWA alarm setting, a TWA alarm is generated. The TWA is not calculated using a moving average. Once 8 hours of data have been summed, the accumulation stops. In order to reset the TWA accumulator, press the "Clr" key.

This sum will only be complete after 8 hours, so the meter displays the current sum divided by 8 hours. While in TWA mode, the time on the status display will show the number of minutes and hours of data that TWA has accumulated. When this reaches 8 hours, the 2020 stops accumulating data and the TWA is complete.

TWA calculations are always being performed by the 2020. The user can display the results of the calculations by selecting TWA as the Display mode.

4.4.3 MAX Mode

The MAX mode displays the maximum signal, with the date and time that it was recorded. The 2020 continues to log data according to the selected averaging interval, but only the maximum detected concentration is displayed on the meter display.

The right soft key is used to clear the meter when displaying MAX. The "Clr" key only affects the reading that the meter is displaying. For example, if you display the MAX reading and the user presses "Clr," only the MAX value is cleared. The TWA is still accumulating in the background.

4.4.4 PEAK Mode

The PEAK mode displays the current detected concentration. The reading is updated once a second. In the background, the 2020 data logger is sampling the concentration and measuring minimum, maximum, and average concentrations for the selected averaging interval. At the end of every interval, one entry is placed in the data logger until the data logger is full. For CTO 205, the instrument should be operated in this mode. Operation within the other specialized modes is the responsibility of the SSO.

4.5 Set Functions

Set functions are used to set up the 2020. There are three functions that can be set on the 2020: Pump, Clock, and Calibration.

4.5.1 Pump

The Pump function is used to control the pump. After Set Pump is selected, the 2020 responds by displaying the new pump status.

The detector is also turned off when the pump is turned off. This prevents the detector from being damaged when there is no sample flowing through the detector.

When the pump and the detector are off, the meter display will be blank. Turn the pump and detector off when concentration measurements are not necessary, and the 2020 will only be used for reviewing data

or generating reports. By operating the instrument with the pump and detector off when they are not needed, the user will conserve the lives of the battery and ultraviolet (UV) lamp.

To set the pump

1. Press the ENTER key. The top line of the status display changes to "Select?" The bottom line displays three soft key names: "Set," "Log," and "Disp."

2. Press the soft key below "Set."

3. The names of the soft keys change to reflect the Set options. The display now shows three devices that can be set: "Clock," "Pump," and "Cal." Press the "Pump" key.

4. The 2020 turns the pump off. If the pump was off, pressing "Pump" will turn the pump on.

5. A message will be displayed to show the status of the pump. The 2020 reverts back to the previous menu after a few seconds.

6. To return to the default display, press the ENTER key.

4.5.2 Clock

The Clock function is used to set both the current date and time.

To set the clock

1. Press the ENTER key.

2. Press the "Set" key.

3. When the names of the soft keys change, press the "Clock" key.

   The up and down arrows are used to change the character underlined by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right-most character, it wraps around to the first character again.

Formatting characters, such as the colon (:) in the time and the slash (/) in the date, are skipped when advancing the cursor.

4. Use the "arrow keys" to enter the correct time. The time is formatted as Hour:Minute:Second.

5. Press the ENTER key to confirm the time and move to the date option.

6. When setting the date, the 2020 prompts to user for the current date, formatted as Year/Month/Day. Use the "arrow keys" to enter the correct date.

7. Press the ENTER key to confirm the date and return to the Set options. The user can wait for the display to timeout or press ENTER to return to the default display.

4.5.3 Calibration (Cal)

"Cal" allows you to setup and calibrate the 2020. There are three options under the Cal function: "Zero," "Span," and "Mem."

A calibration memory consists of a name, a response factor, and PEAK, TWA, and STEL alarm levels.

The "Zero" and "Span" keys are covered in detail in the manufacturer's operations manual for the instrument.

To edit the calibration memory, select "Mem" and then "Chng." The 2020 prompts with two new soft keys: "User" and "Lib."

4.5.4 Library (Lib)

Library selections simplify Cal Memory programming and provide standard response factors for approximately 70 applications. "Lib" allows the user to select an entry from a pre-programmed library. The name, response factor, and three alarm levels are all set from the library. To select a library entry to program the selected Cal Memory

1. Select "Set," "Cal," "Mem," "Chng," and "Lib."
2. Use the "Next" and "Prev" keys to scroll through the list. See the manufacturer's manual Appendix 8.7 for a list of the library entries.

4.6 Preparing for Field Operation of the Photovac 2020

Turning The 2020 On

1. Turn the 2020 on by pressing the ON/OFF key.

2. The 2020 will display the software version number. Wait for the 2020 to proceed to the default display.

3. Allow 10 minutes for the instrument to warm up and stabilize.

4. Press the Enter Key. The default display will provide three soft key selection "Set," "Log," and "Display."

5. Press "Set." From this option, three other soft key selections will be offered: "Pump," "Clock," and "Cal."

6. Press "Cal." This will begin the calibration sequence. The first selection is to Zero the instrument.

7. Press Enter; zeroing will begin. (Note: When employing zero gas, attach and activate zero gas supply at this time.)

8. The next selection offered will be Span. Press Enter, at which time the concentration will be requested. The isobutylene calibration gas employed under general service will be marked on the side of the container. Use the soft keys to toggle into position and to log the concentration. Once the concentration is logged, press "Enter." The direction on the status display will indicate spanning. At this time, hook up the span gas with a regulator to the Photovac 2020 and open it to supply enough flow to elevate the flow rate indicator to the green indicator line (1/8 inch from the rest position).

9. Once spanning is complete, the alarms, which have been disabled during calibration, will activate, indicating that calibration is complete.

10. Document this calibration procedure using a Document of Calibration form (included in Appendix A).

This instrument is ready for general purpose application.

Calibration is to be performed daily or prior to each use in accordance with this section.

4.7 Maintenance and Calibration Schedule

Function	Frequency
Routine Calibration	Prior to each use
Factory Inspection and Calibration	Once a year, or when malfunctioning
Wipe Down the Outer Casing of the Unit	After each use
Clean UV Light Source	Every 24 hours of operation
Sample Inlet Filter	Change on a weekly basis or as required by level of use
Battery charging	After each use
Clean ionization chamber	Monthly

4.7.1 Cleaning the UV Light Source Window

1. Turn the FUNCTION switch to the OFF position. Use the 2020 multi-tool and remove the lamp housing cover. CAUTION: The UV lamp is delicate and expensive; handle carefully.

2. Tilt the lamp housing with one hand over the opening, and slide the lamp out of the housing.

3. The lamp window may now be cleaned with any of the following compounds using lens paper:
   a. 11.7 eV lamp - dry aluminum oxide powder (3.0 micron powder)
   b. All other lamps - HPLC grade methanol

4. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace the o-ring as necessary, reinstall the lamp housing cover, and tighten it using the 2020 multi-tool. (Do not over tighten.)

5. Recalibrate the instrument as per Section 4.6.

4.7.2 Cleaning the Ionization Chamber

1. Turn the FUNCTION switch to the OFF position and remove the lamp housing cover and lamp as per Section 4.7.1.

2. Using a gentle jet of compressed air, gently blow out any dust or dirt.

3. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace the o-ring as necessary, reinstall the lamp housing cover, and tighten it using the 2020 multi-tool. (Do not over tighten.)

4. Recalibrate the instrument as per Section 4.6.

4.8 Instrument Advantages

The Photovac 2020 is easy to use in comparison to many other types of monitoring instrumentation. Its detection limit range is in the low parts-per-million range. Response rapidly reaches 90 percent scale of the indicated concentration (less than 3 seconds for benzene). This instrument's automated performance covers multiple monitoring functions simultaneously, incorporating data logging capabilities.

4.9 Limitations of the Photovac 2020 Photoionization Monitor

- Because the 2020 is a nonspecific total gas/vapor detector, it cannot be used to identify unknown chemicals; it can only quantitate them in relationship to a calibration standard (relative response ratio).

- For appropriate application of the 2020, ionization potentials of suspected contaminants must be known.

- Because the types of compounds that the 2020 can potentially detect are only a fraction of the chemicals possibly present at a hazardous waste site or incident, a background or zero reading on this instrument does not necessarily signify the absence of air contaminants.

- The 2020 instrument can only monitor certain vapors and gases in air. Many nonvolatile liquids, toxic solids, particulates, and other toxic gases and vapors cannot be detected.

- PIDs are generally not specific. Their response to different compounds is relative to the calibration gas used. This is referred to as relative response ratio. Instrument readings may be higher or lower than the true concentration. This can be an especially serious problem when monitoring for total contaminant concentrations if several different compounds are being detected at once.

- The 2020 is a small, portable instrument that cannot be expected to yield results as accurately as laboratory instruments.

4.9.1 Variables Affecting Monitoring Data

Monitoring a hazardous waste site environment can pose a significant challenge in assessing airborne concentrations and the potential threats to site personnel. Several variables may influence both dispersion and the instrument's ability to detect actual concentrations. Some of the variables, which may impact these conditions, are as follows:

- Temperature - Changes in temperature or pressure will influence volatization and affect airborne concentrations. Additionally, an increase or decrease in temperature ranges may have an adverse effect on the instrument's ability to detect airborne concentrations.

- Humidity - Excessive levels of humidity may interfere with the accuracy of monitoring results.

- Rainfall - Through increased barometric pressure and water, rain fall may influence dispersion pathways affecting airborne emissions.

- Electromagnetic interference - High voltage sources, generators, other electrical equipment may interfere with the operation and accuracy of direct-reading monitoring instruments.

5.0 TROUBLESHOOTING

5.1 <u>Fault Messages</u>

When the "Fault" status is displayed, the 2020's operation is compromised.

Fault 1: Signal from zero gas is too high.

Cause: If another fault occurred while the 2020 was setting its zero point, then this fault is displayed.
Action: Ensure no faults are occurring and calibrate the 2020 again.

Cause: Sample line, sample probe, or fittings are contaminated before the detector.

Action: Clean or replace the sample line, sample probe, or the inlet filter.

Cause: Span gas and zero air are switched.

Action: Ensure clean air is used to zero the 2020. If you are using gas bags, mark the calibration and zero gas bags clearly.

Cause: Ambient air is contaminated.

Action: If unsure about the quality of ambient air, use a supply of commercial zero-grade air to zero the 2020.

Fault 2: Signal from span gas is too small.

Cause: Operator may have switched the span gas and zero air.

Action: Ensure clean air is used to zero the 2020. If you are using gas bags, mark the calibration and zero gas bags clearly.

Action: Ensure the span gas is of a reliable concentration.

Cause: UV lamp window is dirty.

Note: Do not remove the detector lamp in a hazardous location.

Action: Clean the UV lamp window.

Cause: UV lamp is failing.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a new UV lamp.

Cause: Incompatible application.

Action: The concentration and sample gas are incompatible for use with the 2020.

Fault 3: UV lamp fault. UV lamp has not started.

Cause: The UV lamp has not started immediately.

Action: This fault may be seen momentarily when 2020 is first turned on. Allow 30 to 60 seconds for the UV lamp to start and the fault to clear.

Cause: The UV lamp serial number label is blocking the photocell.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If using a UV lamp with a white serial number label, it is possible that the label is blocking the photocell. Rotate the lamp approximately 90 degrees and then try to start the 2020 again. If the fault persists, replace the lamp.

Cause: the UV lamp is not installed.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a UV lamp.

Cause: The UV lamp has failed.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: Install a new UV lamp.

Cause: There is a Electronic problem.

Action: If a new UV lamp still generates this fault, then contact the Photovac Service Department.

Fault 4: Pump current too low or too high.

Cause: If the pump sounds labored, then the pump is operating beyond normal operating parameters.

Action: Check for an obstruction in the sample line. Make sure sample line, sample probe, or inlet filter are not plugged.

Note: Do not replace the inlet filter in a hazardous location.

Action: Replace the inlet filter.

Action: Ensure the sample outlet, located on the underside of the 2020, is not obstructed.

Cause: The UV lamp is too wide, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If using a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the TtNUS equipment manager.

Cause: The 2020 has been exposed to a solvent that can pass through the inlet filter and liquid has been aspirated.

Action: Contact the TtNUS equipment manager.

Cause: The pump has failed.

Action: Contact the TtNUS equipment manager.

5.2 Specific Problems

Problem: Very low or no instrument response detected, yet compounds are known to be present.

Cause: The 2020 has not been calibrated properly.

Action: Ensure the calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Section 4.6 of the User's Manual. After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the TtNUS equipment manager.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Disconnect the battery charger before calibrating the 2020.

Cause: Calibration memories have not been programmed correctly.

Action: Program all the calibration memories required for the application. Use the correct calibration gas and concentration for each Cal Memory.

Cause: The response factor has been set to zero.

Action: Enter the correct response factor. Refer to Appendix 8.6 for a list of response factors. If the compound is not listed in Appendix 8.6 or gas mixtures are being measured, then enter a value of 1.0. See User's Manual provided by the manufacturer.

Cause: The correct Cal Memory is not being used.

Action: Select the correct Cal Memory for the application.

Note: It does not matter which Cal Memory is selected or which response factor is entered. The 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

Cause: Detector is leaking. A decrease in sensitivity may be due to a leak in the detector.

Note: Do not remove or replace the detection lamp in a hazardous location.

Action: Ensure the UV lamp has been installed correctly.

Action: Ensure the lamp cover has been tightened down. Do not overtighten the cover.

Action: Ensure the o-ring seal on the lamp cover is positioned correctly.

Cause: The UV lamp is too long, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If a UV lamp with a white serial number label is in use, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the TtNUS equipment manager.

Cause: UV lamp is too wide, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If a UV lamp with a white serial number label is in use, it is possible that the lamp is too wide for the lampholder. Contact the TtNUS equipment manager.

Cause: The sampling environment is extremely humid.

Action: Water vapor is not ionized by the PID, but it does scatter and absorb the light and results in a lower reading. The 2020 detector has been designed to operate under high humidity conditions. Under extreme conditions, decreased response due to humidity may be noticed.

Cause: The UV lamp is failing.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: High concentration of non-ionizable compounds. Chemical compounds, such as methane, with IPs greater than the 10.6 eV scatter and absorb the UV light. Sensitivity may be decreased significantly. Application with high backgrounds of such materials may be incompatible with the 2020. Contact the Photovac Applications Group for more information.

Problem: Erroneously high readings.

Cause: Sampling environment is extremely humid.

Action: Water vapor may contain mineral salts, which carry a charge. The water vapor becomes an electrolytic solution, which becomes ionized when it enters the detector. Atmospheric water in areas around the sea or stagnant water may produce a response in the absence of contaminants. The same effect may be seen when conducting groundwater investigations in areas where the water is hard because it contains a significant concentration of minerals.

Cause: The 2020 has not been calibrated properly.

Action: Ensure the calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Section 4.6. After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the TtNUS equipment manager.

Cause: Cal Memories have not been programmed correctly.

Action: Program all the Cal Memories required for the application. Use the correct calibration gas and concentration for each Cal Memory. See Section 3.4, of the User's Manual.

Cause: The correct Cal Memory is not being used.

Action: Select the correct Cal Memory for the application. See Section 3.2.2 or 3.3.2 of the User's Manual.

Note: It does not matter which Cal Memory is selected or which response factor is entered. The 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

Cause: The detector has been short circuited by foreign matter in the detector cell.

Note: Do not service the 2020 in a hazardous location.

Action: Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to remove any dust in the detector cell.

Warning: Do not insert any object, other than the UV lamp, into the lampholder.

Cause: There is an undetermined problem.

Action: Contact the TtNUS equipment manager.

Problem: Date and time settings are not retained.

Cause: The battery pack was removed before the 2020 was turned off.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Replace the battery pack and reset the time and date. Ensure that the 2020 has been turned off before removing the battery pack.

Cause: The 2020 has not been used for 3 months or more and the internal battery (not the external battery pack) has discharged.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Connect the 2020 to the AC adapter and turn the 2020 on. Turn the pump off. While the 2020 is running, the internal battery is charging. Leave the instrument running for approximately 24 hours.

Problem: Instrument status shows "Over."

Cause: High concentrations of gases and vapors will cause a rapid change in signal level. The detector and associated electronics may become temporarily saturated.

Action: Wait a few seconds for the status to return to normal. PIDs are designed to detect relatively low concentrations of gases and vapors. Exposure to very high concentrations may result in a very high or maximum response.

Cause: The detector has become saturated.

Action: Move the 2020 to a location where it can sample clean air. Sample clean air until the reading stabilizes around 0.

Cause: Detector has been short circuited by foreign matter in the detector cell.

Note: Do not service the 2020 in a hazardous location.

Action: Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to remove any dust or dirt in the detector cell.

Warning: Do not insert any object, other than the UV lamp, into the lampholder.

Cause: There is an undetermined problem.

Action: Contact the TtNUS equipment manager.

Problem: Display is blank.

Cause: Battery pack is critically low.

Note: Do not remove or recharge the battery pack in a hazardous location.

Action: Replace the battery pack or connect the 2020 to the AC adapter.

Cause: The battery pack is not connected to the instrument correctly.

Action: Ensure the battery pack connector is securely attached to the connector on the 2020.

Cause: There is an undetermined problem.

Action: Reset the 2020. Leave the instrument on while you disconnect the battery pack. This will reset the instrument. Reconnect the battery pack and close the battery hatch. Turn on the 2020; set the time and date and program all the calibration memories to be used.

Action: Contact the TtNUS equipment manager.

Problem: Sample flow rate is less than 300 ml/min.

Cause: The inlet filter is plugged.

Note: Do not replace the inlet filter in a hazardous location.

Action: Replace the inlet filter.

Cause: The inlet filter has not been installed properly.

Action: Ensure that the inlet filter has been installed correctly.

Cause: The UV lamp is too long, causing flow to be restricted.

Note: Do not remove or replace the detector lamp in a hazardous location.

Action: If a UV lamp with a white serial number label is in use, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the TtNUS equipment manager.

Cause: The UV lamp is too wide, causing flow to be restricted.

Action: If a UV lamp with a white serial number label is in use, it is possible that the lamp is too wide for the lampholder. Contact the TtNUS equipment manager.

Cause: The 2020 has been exposed to a solvent that can pass through the inlet filter and liquid has been aspirated.

Action: Contact the TtNUS equipment manager.

Cause: Sample outlet is obstructed.

Action: Ensure the sample outlet is not obstructed in any way.

Cause: Pump has been damaged.

Action: Contact the TtNUS equipment manager.

Problem: Liquid has been aspirated.

Cause: The 2020 has been exposed to a solvent that can pass through the inlet filter.

Action: Contact the TtNUS equipment manager.

Problem: Corrosive gases and vapors have been sampled.

Cause: The 2020 has been exposed to corrosive gases and vapors.

Action: Corrosive gases and vapors can affect the electrodes within the detector, as well as the lamp window. Prolonged exposure to corrosive materials may result in permanent fogging or etching

of the window. If the 2020 is exposed to corrosive material, contact the TtNUS equipment manager.

6.0 SHIPPING

The Photovac may be shipped as cargo or carried on as luggage if there is no calibration gas cylinder accompanying the kit. When shipping or transporting the calibration gas, a Hazardous Airbill must be completed.

7.0 REFERENCES

Photovac 2020 Photoionization Monitor User's Manual, 1995.

8.0 ATTACHMENTS

1. Equipment Calibration Log

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : ____________________ INSTRUMENT NAME/MODEL: ____________________

SITE NAME: ____________________ MANUFACTURER: ____________________

PROJECT No.: ____________________ SERIAL NUMBER: ____________________

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

ATTACHMENT 1
EQUIPMENT CALIBRATION LOG

STANDARD OPERATING PROCEDURE
NUMBER CTO205-06

BOREHOLE AND SOIL SAMPLE LOGGING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the standard procedures and technical guidance on the logging of soil cores collected at the PCB Capacitor Burial/Pole Yard, at the NSWC Crane facility.

2.0 FIELD FORMS AND EQUIPMENT

Knife
Ruler (marked in tenths and hundredths of feet)
Boring log: An example of this form is attached.
Photoionization detector (PID) (see SOP CTO205-05)
Writing utensil

3.0 RESPONSIBILITIES

A field geologist or engineer is responsible for supervising all boring activities and assuring that each borehole is properly and completely logged.

4.0 PROCEDURES FOR BOREHOLE AND SAMPLE LOGGING

To maintain a consistent classification of soil, it is imperative that the field geologist understands and accurately uses the field classification system described in this SOP. This identification is based on visual examination and manual tests.

4.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (attached to this SOP).

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 distinguishable 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 will be divided into categories: 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" will 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 still, it will 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.

4.2 Color

Soil colors will 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." Because 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 will 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" will be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

4.3 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).

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 the following table.

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

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined by hand by determining the resistance to penetration by the thumb. The thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample. The sample will be broken in half and the thumb 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. One of the other methods will be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in the above-listed table.

4.4 Weight Percentages

In nature, soils comprise 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

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.

4.5 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 gloved 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 field activity.

4.6 Classification of Soil Grain Size for Chemical Analysis

To determine the gross grain size classification (e.g., clay, silt, and sand) from the USCS classification described above, the following table will be used.

Gross Soil Grain Siz Classification	USCS Abbreviation	Description
Clay	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays,
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
Silt	ML	Inorganic silts and very fine sands, rock four, silty or clayey fine sands with slight plasticity
	OL	Organic silts and organic silty clays of low plasticity
	MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils

Gross Soil Grain Size Classification	USCS Abbreviation	Description
Sand	SW	Well graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures

4.7 Summary of Soil Classification

In summary, soils will be classified in a similar manner by each geologist or engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Other distinguishing features
- Grain size
- Depositional environment

4.0 ATTACHMENTS

1. Figure 1 - Unified Soil Classification System
2. Boring Log

ATTACHMENT 1

FIGURE 1 - UNIFIED SOIL CLASSIFICATION SYSTEM

Unified Soil Classification System

Field Guide

Coarse Grained Soils (more than half of soil > No. 200 sieve)	Gravels (More than half of coarse fraction > no. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Sandy gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-silt mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
Fine Grained Soils (more than half of soil < No. 200 sieve)	Silts and Clays LL = < 50	ML	Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays LL = > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic silts of high plasticity, fat clays
		OH	Organic clays of high plasticity, organic silty clays, organic silts
Highly Organic Soils		Pt	Peat and other highly organic soils

Grain Size Chart

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size In Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 7.76
coarse	3" to 3/4"	76.2 to 4.76
fine	3/4" to No.4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.074
coarse	No.4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.074
Silt and Clay	Below No. 200	Below 0.074

Relative Density (SPT)

SANDS AND GRAVELS	BLOWS/FOOT
VERY LOOSE	0 – 4
LOOSE	4 – 10
MEDIUM DENSE	10 – 30
DENSE	32 – 50
VERY DENSE	OVER 50

Consistency (SPT)

SILTS AND CLAYS	BLOWS/FOOT
VERY SOFT	0 – 2
SOFT	2 – 4
MEDIUM STIFF	4 – 8
STIFF	8 – 16
VERY STIFF	16 – 22
HARD	OVER 32

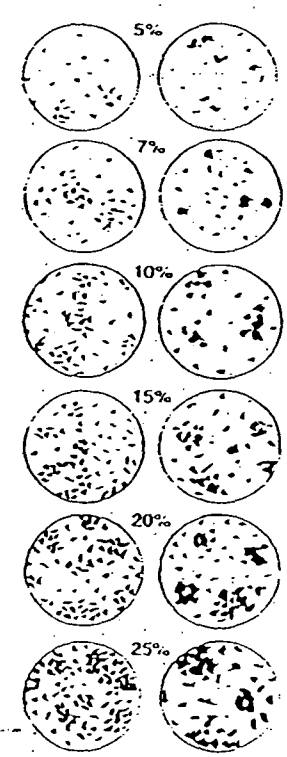
ATTACHMENT 1

FIGURE 1 - UNIFIED SOIL CLASSIFICATION SYSTEM

Group Symbols Chart

				Group Symbol		Group Name
GRAVEL % gravel % sand	5% fines	Well-graded		GW	<15% sand	Well-graded gravel
					15% sand	Well-graded gravel with sand
		Poorly-graded		GP	<15% sand	Poorly graded gravel
					15% sand	Poorly graded gravel with sand
	10% fines	Well-graded	fines = ML or MH	GW-GM	<15% sand	Well-graded gravel with silt
					15% sand	Well-graded gravel with silt and sand
			fines = CL or CH	GW-GC	<15% sand	Well-graded gravel with clay
					15% sand	Well-graded gravel with clay and sand
		Poorly-graded	fines = ML or MH	GP-GM	<15% sand	Poorly graded gravel with silt
					15% sand	Poorly graded gravel with silt and sand
			fines = CL or CH	GP-GC	<15% sand	Poorly graded gravel with clay
					15% sand	Poorly graded gravel with clay and sand
	15% fines		fines = ML or MH	GM	<15% sand	Silty gravel
					15% sand	Silty gravel with sand
			fines = CL or CH	GC	<15% sand	Clayey gravel
					15% sand	Clayey gravel with sand
SAND % sand % gravel	5% fines	Well-graded		SW	<15% gravel	Well-graded sand
					15% gravel	Well-graded sand with gravel
		Poorly-graded		SP	<15% gravel	Poorly graded sand
					15% gravel	Poorly graded sand with gravel
	10% fines	Well-graded	fines = ML or MH	SW-SM	<15% gravel	Well-graded sand with silt
					15% gravel	Well-graded sand with silt and gravel
			fines = CL or CH	SW-SC	<15% gravel	Well-graded sand with clay
					15% gravel	Well-graded sand with clay and gravel
		Poorly-graded	fines = ML or MH	SP-SM	<15% gravel	Poorly graded sand with silt
					15% gravel	Poorly graded sand with silt and gravel
			fines = CL or CH	SP-SC	<15% gravel	Poorly graded sand with clay
					15% gravel	Poorly graded sand with clay and gravel
	15% fines		fines = ML or MH	SM	<15% gravel	Silty sand
					15% gravel	Silty sand with gravel
			fines = CL or CH	SC	<15% gravel	Clayey sand
					15% gravel	Clayey sand with gravel

Group Symbol				Group Name
CL	<30% plus No. 200	<15% plus No. 200		Lean clay
		15-25% plus No. 200	% sand % of gravel	Lean clay with sand
			% sand <% of gravel	Lean clay with gravel
	30% plus No. 200	% sand % of gravel	<15% gravel	Sandy lean clay
			15% gravel	Sandy lean clay with gravel
		% sand <% of gravel	<15% sand	Gravelly lean clay
			15% sand	Gravelly lean clay with sand
ML	<30% plus No. 200	<15% plus No. 200		Silt
		15-25% plus No. 200	% sand % of gravel	Silt with sand
			% sand <% of gravel	Silt with gravel
	30% plus No. 200	% sand % of gravel	<15% gravel	Sandy Silt
			15% gravel	Sandy Silt with gravel
		% sand <% of gravel	<15% sand	Gravelly silt
			15% sand	Gravelly silt with sand
CH	<30% plus No. 200	<15% plus No. 200		Fat clay
		15-25% plus No. 200	% sand % of gravel	Fat clay with sand
			% sand <% of gravel	Fat clay with gravel
	30% plus No. 200	% sand % of gravel	<15% gravel	Sandy fat clay
			15% gravel	Sandy fat clay with gravel
		% sand <% of gravel	<15% sand	Gravelly fat clay
			15% sand	Gravelly fat clay with sand
MH	<30% plus No. 200	<15% plus No. 200		Elastic silt
		15-25% plus No. 200	% sand % of gravel	Elastic silt with sand
			% sand <% of gravel	Elastic silt with gravel
	30% plus No. 200	% sand % of gravel	<15% gravel	elastic silt
			15% gravel	elastic silt with gravel
		% sand <% of gravel	<15% sand	elastic silt
			15% sand	elastic silt with sand
OL/OH	<30% plus No. 200	<15% plus No. 200		Organic soil
		15-25% plus No. 200	% sand % of gravel	Organic soil with sand
			% sand <% of gravel	Organic soil with gravel
	30% plus No. 200	% sand % of gravel	<15% gravel	Sandy organic soil
			15% gravel	Sandy organic soil with gravel
		% sand <% of gravel	<15% sand	Gravelly organic soil
			15% sand	Gravelly organic soil with sand



ATTACHMENT 2

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 (FL) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/FL) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole	Drilling 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. #: _____

STANDARD OPERATING PROCEDURE
NUMBER CTO205-07

SURFACE AND SUBSURFACE SOIL SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used for surface and subsurface soil sampling using direct-push technology (DPT) or split-barrel samplers during field activities at the PCB Capacitor Burial/Pole Yard at the NSWC Crane facility.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil with indelible ink
Disposable medical-grade gloves (i.e., latex, nitrile)
Boring log
Soil sample logsheets
Stainless-steel mixing bowls
Stainless-steel trowel or soup spoon
EnCore handle and samplers
Required sample containers: All sample containers including shipping coolers for analysis by fix-based laboratories will be supplied and deemed certified clean by the laboratory.
Required decontamination materials
Chain-of-custody records
Required personnel protective equipment (PPE)
Photoionization detector (PID) (see SOP 205-05)
Wooden stakes or pin flags
Sealable polyethylene bags
Heavy-duty cooler
Ice
Razor knife
Geoprobe and sampling equipment
Sample labels and tags

3.0 COLLECTION OF OTHER SOIL SAMPLE ALIQUOTS

Note: A surface soil sample is collected from the 0- to 2-feet depth (i.e., one core length). Additional subsurface soil samples each consist of two 2-foot core segments.

3.1 The soil interval will be composited and used to fill the remainder of the sample containers. Any surface debris (e.g., herbaceous vegetation, twigs, rocks, litter, etc.) should first be removed from the top of the surface soil core. For other core intervals, the top 2 inches of each core should be discarded because it often contains material scraped from the side of the borehole and not fresh material from the bottom of the borehole.

3.2 Slide the remaining core material out of the acetate liner and into a clean, decontaminated stainless-steel mixing bowl. Mix the soil thoroughly with a stainless-steel spoon and remove gravel, large pebbles, and other coarse materials.

3.3 Complete all required information on the sample labels (see SOP CTO205-01).

3.4 Fill in all required information on the sample tag and secure the tag to the sample container.

3.5 Place the sample container in a ziplock plastic bag and seal shut. Place the bag in a cooler containing ice and cool to 4 $\pm$ 2°C.

3.6 Record the required information on the Soil Sample Log Sheet and the COC form.

4.0 PACKAGING AND SHIPPING OF SAMPLES

Samples will be packaged and shipped according to SOP CTO205-11.

5.0 ATTACHMENTS

1. Soil and Sediment Sample Log Sheet

ATTACHMENT 1

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	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	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):

TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE **2**

2.0 SCOPE **2**

3.0 GLOSSARY **2**

4.0 RESPONSIBILITIES **3**

5.0 PROCEDURES **3**

5.1 GENERAL 3
5.1.1 Geohydrologic Framework of the Vadose Zone 3
5.1.2 Vadose Zone Properties Which Affect Contaminant Movement 4
5.1.3 Preparation for Vadose Zone Sampling 5
5.2 DETERMINATION OF FLUID STORAGE PROPERTIES 5
5.2.1 Vadose Zone Thickness 5
5.2.2 Porosity and Bulk Density 6
5.2.3 Moisture Content 6
5.2.4 Soil Moisture Potential 6
5.2.5 Specific Retention, Specific Yield and Fillable Porosity 7
5.3 DETERMINATION OF FLUID TRANSMISSION PROPERTIES 7
5.3.1 Infiltration Rate 7
5.3.2 Unsaturated Hydraulic Conductivity 8
5.4 VADOSE ZONE WATER SAMPLING SYSTEMS 9
5.4.1 Sampling From Unsaturated Soils 9
5.4.2 Sampling Perched Groundwater 11
5.4.3 Sample Handling and Management 11

6.0 REFERENCES **12**

ATTACHMENTS

A ADVANTAGES AND LIMITATIONS OF SOIL MOISTURE CONTENT MEASURING DEVICES 13
B SOIL-WATER CHARACTERISTIC CURVES FOR WETTING AND DRYING, ILLUSTRATING HYSTERESIS 14
C TYPICAL UNSATURATED HYDRAULIC CONDUCTIVITY VERSUS SOIL MOISTURE CURVE 15
D VACUUM-PRESSURE AND HIGH-PRESSURE VACUUM LYSIMETERS 16
E FILTER CANDLE AND MEMBRANE FILTER SAMPLERS 17

1.0 PURPOSE

This procedure describes the general concepts of vadose (unsaturated) zone monitoring and sampling at hazardous waste sites. Several specific methods of monitoring and sampling are also described.

2.0 SCOPE

This procedure applies to any hazardous waste sites which require vadose zone monitoring and/or sampling.

3.0 GLOSSARY

Bulk Density - The density of soil or rock, including solids plus voids, after oven-drying at 105 degrees Centigrade to constant weight. Also called dry density.

Capillary Zone (Capillary Fringe) - The transition between the vadose zone and the saturated zone. The soil-water pressure is less than atmospheric, but some or all of the soil interstices (pores) are filled with water that is continuous with the water in the zone of saturation. This water is held above the water table by capillarity (the attractive force between two unlike molecules, which causes water to rise in capillary tubes) acting against gravity.

Fillable Porosity - The volume of water that an unconfined aquifer stores during a unit rise of the water table. Usually less than the specific yield because of the entrapment of air during the rise of the water table (see Section 5.2.4).

Hydraulic Conductivity (K) - A quantitative measure of the ability of porous material to transmit water. The volume of water that will flow through a unit cross-sectional area of porous material per unit time under a head gradient. Hydraulic conductivity is dependent upon properties of the medium and fluid. Also referred to as "permeability."

Infiltration - The vertical flow or movement of water through the soil surface into the ground under the influence of gravity. The maximum rate at which water enters a soil is the infiltration capacity.

Infiltrometer - A device for measuring infiltration rates. Sprinkler infiltrometers and cylinder infiltrometers are most commonly used.

Lysimeter - A device for obtaining water samples from unsaturated soils, consisting essentially of a porous ceramic cup bonded to an airtight tube through which access tubes for vacuum application and fluid sampling pass. When a vacuum is applied to the in-place lysimeter, soil pore water flows into the cup. The water is recovered by pressurizing the lysimeter, forcing water up the sampling tube.

Perched Groundwater - Groundwater separated from the water table by an impermeable bed of soil or rock, which is underlain by unsaturated materials. Perched groundwater forms a perched water table.

Porosity - Percentage of the total volume of a soil or rock occupied by pores or other openings. Effective porosity is that volume of connected pore space which is available for fluid transmission.

Psychrometer - A device for measuring soil-water pressure under very dry conditions.

Saturated - Rock or soil is saturated with respect to water if all of its fillable interstices (pores) are filled with water.

Specific Retention (Field Capacity) - The amount of water held in a soil by capillary action after gravitational water has percolated downward and drained away; expressed as a ratio (percentage) of the volume of water retained per unit volume of soil. Field capacity is a similar measure, but it is expressed as a ratio of the weight of water retained per unit weight of soil.

Specific Yield - The amount of water that a saturated soil will yield by gravitational drainage; expressed as a ratio (percentage) of the volume of water drained per unit volume of soil. In a saturated soil, the sum of specific yield plus specific retention equals the effective porosity.

Tensiometer - A device for measuring negative soil-water (i.e., less than atmospheric) pressure. It consists basically of a porous ceramic cup bonded to an airtight, water-filled tube from which a small diameter tube leads to a mercury manometer or pressure gauge.

Vadose Zone - Soil zone above the zone of saturation, i.e., the zone of aeration. The vadose zone may contain some saturated areas (i.e., perched water).

Water Table - A surface in an aquifer where groundwater pressure is equal to atmospheric pressure (i.e., the pressure head is zero) and below which all strata are saturated with water.

4.0 RESPONSIBILITIES

Project Manager with input from the project geohydrologist and geochemist is responsible for determining that vadose zone monitoring or sampling is necessary, and for developing an adequate program (as part of the Work Plan and/or Sampling and Analysis Plan) to accomplish this.

Geohydrologist and Geochemist is responsible for alerting the Project Manager that vadose zone sampling may be required, since this solid zone is often overlooked as a migration pathway or reservoir for contaminants. Also responsible for determining which properties of the vadose zone need to be determined, and the proper methods for acquiring that information.

5.0 PROCEDURES

5.1 General

Although soil sampling is usually undertaken in the vadose zone, sampling of vadose zone water and soil gas is often overlooked. Of course, the need for vadose zone sampling depends on conditions of the site and contaminants present. If the water table is relatively shallow (less than 10-15 feet below the surface) and vadose zone materials consist of coarse sands and gravels or fractured rock, the vadose zone will probably minimally affect contaminant migration and retention.

If, however, the vadose zone is thick (it may be hundreds of feet thick in arid areas), its properties will be important in the migration of fluids from the ground surface to the water table, and some (or all) of the contamination may be retained in the vadose zone, either adsorbed to soil, in soil water or perched groundwater, or in soil gas.

5.1.1 Geohydrologic Framework of the Vadose Zone

The geological profile extending from the ground surface to the upper surface of the principal water-bearing formation is called the vadose zone. The term "vadose zone" is preferable to the often-used term

"unsaturated zone," because saturated regions are frequently present in some vadose zones. The vadose zones can be subdivided into three regions designated as: the surface soil zone, the intermediate vadose zone, and the capillary fringe.

The surface soil zone is generally recognized as that region that manifests the effects of weathering of native geological material. The movement of water in the surface soil zone occurs mainly as unsaturated flow caused by infiltration, percolation, redistribution, and evaporation. In some soils, primarily those containing horizons of low permeability, saturated regions may develop during surface flooding, creating shallow perched water tables.

Weathered materials of the soil zone may gradually merge with underlying deposits, which are generally unweathered, comprising the intermediate vadose zone. This zone may range in thickness from being practically non-existent to several hundred feet (e.g., in arid western alluvial basins). Water in the intermediate vadose zone may exist primarily in the unsaturated state, and in regions receiving little inflow from above, flow velocities may be negligible. Perched groundwater, however, may develop above low permeability layers or lenses. Such perched layers may be hydraulically connected to ephemeral or perennial stream channels so that, respectively, temporary or permanent perched water tables may develop. These layers can serve as underground spreading regions, transmitting water and contaminants laterally away from the overlying source area. Eventually, water either leaks downward from these layers to the water table, discharges laterally, or it evaporates. Any of these conditions can lead to the presence of contamination at unexpected locations.

Alternatively, saturated conditions may develop in the intermediate vadose zone as a result of deep percolation of water from the soil zone during prolonged surface application (e.g., infiltration of leachate from a lagoon), leading to the development of a groundwater mound.

The base of the vadose zone (the capillary fringe) merges with underlying saturated deposits of the principal water-bearing formation. This zone is not characterized as much by the nature of geological materials, as it is by the presence of water under conditions of saturation or near saturation. Both the hydraulic conductivity and flux of fluid may remain high for some vertical distance in the capillary fringe, depending on the nature of the materials. In general, the thickness of the capillary fringe is greater in fine materials than in coarse deposits. It has been reported that oil percolating downward through the vadose zone may flow in a lateral direction within the capillary fringe (along the top of the water table) because of its immiscibility with water (Freeze and Cherry, 1979).

5.1.2 Vadose Zone Properties Which Affect Contaminant Movement

The three types of vadose zone properties which may require investigation are:

- Fluid storage properties
- Fluid transmission properties
- Chemistry of groundwater, soil, and soil gas

Storage properties are important in that pollutants are placed in temporary storage within the void space of the vadose zone before movement in groundwater. In some cases, such as in western alluvial basins, the storage space may be sufficient to preclude movement into underlying aquifers. The storage properties of interest are:

- Total thickness of the vadose zone
- Porosity and bulk density
- Moisture content

- Soil-moisture potential
- Specific retention, specific yield, and fillable porosity

Information on the fluid transmission properties can indicate the velocity (or travel time) of water through the vadose zone. Contaminants may not necessarily travel at the same rate as water because of attenuation or biodegradation in the vadose zone. Consequently, the travel time of water represents an upper limit on the mobility of most pollutants. Some pollutants, however, may move at a higher rate than water because of physical and chemical properties. For example, based on differences in viscosity, the velocity of gasoline should be about 1.5 times that of water. The fluid transmission properties of interest include:

- Infiltration rate
- Porosity
- Percolation rate (unsaturated hydraulic conductivity) as a function of soil-moisture potential
- Hydraulic gradient and direction of fluid flow

Soil and groundwater chemistry can affect the movement of contaminants through the vadose zone. Soil properties which affect contaminant movement through attenuation/adsorption include:

- Mineral composition and percent organic matter
- Presence of iron/manganese oxide or organic coatings on soil particles
- Specific surface area
- Ion-exchange capacity (affects attenuation of trace metals)

Groundwater parameters which may affect contaminant movement include:

- pH
- Redox potential (pE, Eh, or ORP)
- Salinity/major ion composition

In addition, bacteria in the groundwater or attached to soil particles may biodegrade contaminants in the vadose zone.

5.1.3 Preparation for Vadose Zone Sampling

Before initiating a vadose zone sampling program, background information should be obtained on the following items: (1) nature of pollutants, (2) pollutant source loading, (3) existing groundwater usage and quality, and (4) a description of the geohydrologic framework, including infiltration potential and hydraulic/geochemical properties of the vadose and groundwater zones. Specific, detailed soil survey data may be available through State agricultural experiment stations, the Soil Conservation Service, or other agencies. Such surveys generally include information on depths of soil horizons, presence of hardpan, clay pan, color, porosity, structure, texture, organic matter content, soil pH, and infiltration rates. Water Supply Papers of the U.S. Geological Survey (USGS) are also a good source of information.

5.2 Determination of Fluid Storage Properties

5.2.1 Vadose Zone Thickness

The storage capacity of the vadose zone is related to its overall thickness, which may fluctuate both temporally (due to seasonal or artificial recharge/discharge variation) and geographically (due to variable stratigraphy, structure and geohydrology). The simplest way to determine vadose zone thickness is to

construct an isopleth map of the difference between ground surface elevation and the static water levels in wells (note that cascading water in wells may indicate a perched water table). Thermal infrared imagery provides an indirect method to determine the presence of perched groundwater or a shallow water table, because the heat flux through soils underlain by shallow water tables differs from that through dry soils (Everett, et al., 1983). In addition, geophysical methods (resistivity or conductivity surveys) can give an indication of the depth to the water table.

5.2.2 Porosity and Bulk Density

Bulk density and porosity are best measured on undisturbed core samples in a geotechnical laboratory. Bulk densities generally range from 1.3 gm/cm (80 lb/cubic ft.) for clay soils, to 2.1 gm/cm (130 lb/cubic ft.) for sandy soils. The pore size distribution and degree of interconnection can also affect specific retention of water. Sandy soils have large, uniform-sized pores allowing easy drainage; loamy soils (containing a mixture of clay, silt and sand) may be more porous than sands, but have a wider pore size distribution and poorer interconnection, leading to slower drainage and greater water retention.

5.2.3 Moisture Content

The volumetric moisture content (Θ) is defined as:

$$\Theta = Vw/Vt$$

where Vw = volume of soil moisture and
Vt = volume of total sample.

The soil moisture content can be determined on carefully preserved samples (to avoid loss of moisture), or in the field using the following techniques:

- Neutron moisture logging uses a geophysical logging device lowered down a borehole, or a neutron probe emplaced in the soil.
- Gamma-gamma logging uses a geophysical logging device lowered down a borehole.
- Resistivity or conductivity surveys conducted along the ground surface.
- Electrical resistance blocks, consisting of two electrodes embedded in a porous matrix, emplaced in the soil.
- Heat dissipation sensors, consisting of a diode with a heating circuit embedded in a porous matrix, emplaced in the soil.
- Capacitance sensors, consisting of a pair of electrodes emplaced in the soil.
- Tensiometers emplaced in the soil.

The relative advantages and disadvantages of these methods are presented in Attachment A.

5.2.4 Soil Moisture Potential

The theoretical maximum saturation value of soil is the effective porosity. As soil drains, a range of soil-water content values is possible, depending on various forces acting on the solids-water system. The

soil-moisture potential (soil-water pressure) is a measure of these forces, which include gravitational, osmotic and matrix forces. Matrix forces include forces related to the surface tension of water, the cohesion of water molecules, the adhesion of water molecules to the surface of soil particles, and electrical forces at the molecular level. The soil moisture potential is usually expressed in terms of pressure (energy per unit volume) or an equivalent head of water which is energy per unit weight. When the soil water exists below atmospheric pressure, the pressure potential is considered negative. The negative pressure potential, or matrix potential, is often called the soil suction.

Soil-moisture potential is important because liquids in the vadose zone migrate in response to gradients in soil moisture potential, just as groundwater always flows down the hydraulic soil moisture potential, one can determine the direction of liquid movement and one may even be able to estimate the velocity of flow.

The relationship between soil-moisture potential and water content is termed the soil-moisture characteristic. The moisture content for a given soil at a particular soil-moisture potential (suction) will vary depending on whether the soil is in a wetting or drying cycle. The moisture content at a given suction is greater during a drying cycle than during a wetting cycle, because of the entrapment of air in pore spaces during wetting. This behavior is termed hysteresis, and is illustrated by the wetting and drying soil-water characteristic curves in Attachment B. When a partially drained soil is wetted, or a partially wetted soil drained, the suction-moisture content relation follows an intermediate path, or scanning curve, between the main branches.

The soil suction can be measured in the laboratory on undisturbed soil cores, or in-situ using a tensiometer or thermocouple psychrometer. Either device can be installed in clusters (at varying depths) to characterize the direction of unsaturated water movement in the vadose zone. The advantages and limitations of tensiometers are briefly described in Attachment A. The installation and use of tensiometers is similar to lysimeters and is fully described in Everett, et al. (1983). Tensiometers are relatively simple devices, and if properly installed in the soil and deaerated, they are dependable and require little servicing. If filled with ethylene glycol rather than water, they can be left in the ground during freezing conditions.

Thermocouple psychrometers measure the relative humidity of the soil pore air, which is related to the soil-moisture potential by a simple equation (Griswold and Daniel, 1984). These devices are more fragile than tensiometers and subject to corrosion, but they are not limited by freezing weather.

5.2.5 Specific Retention, Specific Yield and Fillable Porosity

Specific retention, specific yield and fillable porosity can be obtained using neutron moisture logs obtained in vadose zone sediments near the water table as the water table fluctuates (Everett, et al., 1983). Alternately, if the soil in the vadose and saturated zones are similar, the specific yield of the underlying saturated sediments can be obtained during pumping tests and it can be assumed that this represents the specific yield of the vadose zone.

5.3 Determination of Fluid Transmission Properties

5.3.1 Infiltration Rate

Methods for field measurement of the soil infiltration rate are described in detail in U.S. EPA (1977) and Everett, et al. (1983). These methods consist essentially of a means of applying water (or other infiltrating liquid) at a known rate to a known surface area of soil using infiltrometers or test basins. The initial infiltration rate of a dry soil is high, but this rate decreases toward an asymptotic value (the saturated hydraulic conductivity) as the soil is saturated (i.e., as the soil suction potential approaches zero). Thus,

the infiltration rate should be recorded as a function of time, to obtain both initial infiltration rates and saturated hydraulic conductivity (which can be used to estimate the unsaturated hydraulic conductivity).

Factors affecting the infiltration capacity of a soil include soil texture, soil structure, head of water above soil, initial and confined air, biological activity, entrained sediment, and salinity of applied water. Soil structure has a strong effect on infiltration rate, particularly at the beginning of infiltration. Water moves preferentially very rapidly through the larger cracks in the soil at the beginning of infiltration. Later, as the soil swells and closes the cracks, water movement occurs more slowly through the soil pores. Shallow impeding layers, entrapped or confined air, microbial metabolic byproducts, and entrained fine sediment all serve to reduce the infiltration rate. In clayey soils, water with a high sodium content may cause the clays to swell, also reducing the infiltration rate. Thus, infiltration tests should be conducted with the above-mentioned parameters duplicating those in existence at the time for which the infiltration rate values are needed (e.g., to estimate past infiltration from an emptied lagoon, the head of water in the full lagoon, and lagoon salinity and soil-moisture profile should be simulated).

5.3.2 Unsaturated Hydraulic Conductivity

The rate of water movement through the vadose zone is a function of the unsaturated hydraulic conductivity, which varies tremendously with the soil moisture content (see Attachment C) and is probably the most difficult vadose zone parameter to determine. There are several different approaches for obtaining the rate of water flow through the vadose zone, including:

- Methods based on Darcy's equation and the equation of continuity
- Water budgeting
- Direct measurement
- Tracer techniques

These methods are described briefly below, and reviewed in detail in U.S. EPA (1977), Everett, et al. (1983), and Griswold and Daniel (1984).

Darcy's equation for unsaturated flow is:

$$J = Q/A = K(\Theta)$$

where J = unit flux (quantity of fluid crossing a unit area per unit time)
Q = flow volume through an area A
$K(\Theta)$ = unsaturated hydraulic conductivity as a function of moisture content (Θ) (see Attachment C)

The average linear velocity of flow through the unsaturated zone (V) is expressed as:

$$\overline{V} = J/n_e$$

Where n_e is the effective porosity and is thought to be equal to the volumetric moisture content, Θ (Everett, et al., 1983, and Griswold and Daniel, 1984).

The equation of continuity states that the change in moisture content with time through a soil profile (i.e., during drainage) is equal to the net flux of water from that profile.

However, since Θ varies continuously with depth in unsaturated soils, $K(\Theta)$ also varies continuously (i.e., there is a large uncertainty in the in-situ unsaturated hydraulic conductivity). In practice, the saturated

hydraulic conductivity, measured, for example, by cylinder infiltrometers, is often used to determine a maximum flux or velocity since saturated K is greater than unsaturated K.

The water budget method estimates the flux at a particular point in the soil profile as the difference between total inflow (rainfall, irrigation, infiltration from ponds) plus change in storage (i.e., change in moisture content) minus other outflow parameters (runoff, evapotranspiration, drainage). This method requires accurate determination of water balance parameters and is difficult to apply in heterogeneous or highly stratified soils. Two direct measurement methods are measurement of flow through a porous tube containing a sensitive flow transducer emplaced in the soil, or measurement of the transfer of a heat pulse by soil water moving through a porous cup. The latter method requires laboratory calibration and its accuracy is questionable.

Using tracers is probably the simplest and most accurate method for measuring the flux (percolation) rate of soil water. Potential tracers include chemical tracers such as chloride ion, fluorescent dyes or fluorocarbons, and radioactive tracers such as tritium (^{3}H), carbon 14 (^{14}C), or chloride (^{36}Cl). Other radiotracers such as ^{60}Co, ^{90}Sr, or ^{137}Cs are not reliable due to attenuation (adsorption) by soils. With any conservative (non-attenuated) tracer, flux is measured by modeling a known input function (point or continuous) against a measured vertical tracer profile in the soil.

5.4 Vadose Zone Water Sampling Systems

5.4.1 Sampling From Unsaturated Soils

Methods to sample water from saturated soils (e.g., wells, open pits) cannot be used in unsaturated soils where negative (subatmospheric) pressures exist so that water will not drain into open cavities. Various devices to extract pore water from the vadose zone include lysimeters, filter candles, fiber samples and membrane filter samples. One of the more significant problems with all of these methods is that the use of a vacuum affects the concentration of any volatile contaminants in the soil water being sampled. An alternate method is to extract and tightly package an undisturbed soil sample from the vadose zone (via drilling methods), and to extract the soil moisture from the sample in the analytical laboratory under controlled conditions which collect and measure contaminant volatiles released during the extraction procedure.

Lysimeters - Lysimeters consist of a porous ceramic cup bonded to a PVC tube and sealed at one end. Access tubes pass through the seal for vacuum application and fluid extraction. The porous ceramic cup becomes an extension of the surrounding soil, and as a vacuum is applied to the interior of the device, pore water flows into the cup and PVC tube. Although lysimeters have limitations, they appear to be the best method available for sampling water from unsaturated soils (Everett, et al., 1983).

The three common types of lysimeters are vacuum lysimeters, pressure-vacuum lysimeters, and high pressure-vacuum lysimeters. The vacuum lysimeter is designed for sampling from shallow depths of six feet or less. A vacuum is applied using a hand vacuum-pressure pump and the sample is sucked into a collection flask. To extract samples from greater depths, a vacuum-pressure lysimeter (see Attachment D) is used. With these devices, a vacuum is applied to the system to allow the lysimeter to fill with pore water, and the system is then pressurized (with an inert gas such as nitrogen) to force the sample to the surface. Some of the water is also forced back through the cup into the surrounding soil. Consequently, it is not recommended that these devices be used at depths greater than 50 feet (to limit the pressure applied). To prevent the sample from being forced back through the porous cup upon application of pressure, high pressure-vacuum lysimeters were developed. This device consists of two chambers separated by a check valve (see Attachment D). After the sample is drawn through the porous cup and lower chamber and into the upper chamber (about 1 liter volume) by the vacuum, the pressure

which is applied to extract the sample closes the check valve, isolating the upper chamber from the porous cup. High pressures can then be used to collect the sample without forcing it back through the porous cup into the soil. Depths greater than 100 feet can be sampled with this device.

Installation of the shallow vacuum-type samplers is similar to the installation of tensiometers. A cavity is first augered to the desired depth. Soil from the base of the hole is wetted to form a slurry (Soil Moisture Equipment Corporation, 1978). The sampler is placed in the hole, forcing the cup into the slurry. The entire cup should be covered by the slurry. The hole is then backfilled with soil, tamping to prevent side leakage.

The pressure-vacuum type lysimeters, either with or without the check valves, can be installed singly in a cavity or clustered with two or more units in a cavity. The base of the borehole should be sealed with bentonite. A layer of silica sand is then placed on top of the bentonite plug. The lowermost cup is placed on the silica sand and subsequently surrounded by more sand. Native soil is backfilled in the cavity to an elevation near that of the next sampler. Bentonite is added as a plug. Silica sand is then added, the second unit is installed, and backfilling proceeds as above. A layer of bentonite should be added above the shallowest lysimeter to prevent leakage from the surface through the relatively permeable backfill.

The aboveground assembly comprises a pressure-vacuum system and collection bottles. For a system with several samplers, a pressure-vacuum manifold assembly is advantageous. Generally, pressure should be added with an inert gas such as nitrogen to preclude oxidation of chemical constituents.

Filter Candles - The filter candle pore water sampling system consists of a porous ceramic rod ("candle") about 12 inches long and 1-1/4 inches in diameter, placed within a galvanized sheet metal trough. A plastic pipe connects the rod to a sampling bottle in a nearby manhole or trench. The sheet metal trough is filled with soil, placed in a rectangular horizontal cavity (formed by first augering a horizontal hole at the desired depth, then forcing a rectangular shaper into the hole) and pressed against the in-situ soil above the trough with a rubber air pillow or mechanical jack (see Attachment E). The vacuum which is applied to the system is determined from adjacent tensiometers so that groundwater flows into the candles at the same rate as the surrounding soil (Everett, et al., 1983, and Griswold and Daniel, 1984). The drawback of this system is that it requires construction of a trench or manhole and excavation of the horizontal cavity in which the filter candle is placed. Filter candles are therefore more appropriate to emplace during construction (e.g., of a landfill) rather than during a remedial investigation.

Hollow Fiber Samples - These samples consist of bundles of semi-permeable cellulose acetate hollow fibers, which are installed and function in a manner similar to filter candles. These devices permit rapid collection of samples without significantly affecting natural flow conditions (Everett, et al., 1983, and Griswold and Daniel, 1984). However, the cellulose acetate material may be subject to biodegradation.

Membrane Filter Samplers - Membrane filter samplers consist of a "Swinnex"-type filter holder (syringe filter) containing a polycarbonate or cellulose acetate filter and a glass fiber pre-filter. The sampler is placed in a hole containing several sheets of glass fiber "collectors" and smaller glass fiber "wick" disks that are in contact with the pre-filter (see Attachment E). Soil water enters the "collectors" by capillarity. When a vacuum is applied to the filtering system, the water flows up the "wick" disks and into the filter holder. Using the "wick" disks and pre-filter, clogging of the membrane filter by fine material is minimized. These samplers are inexpensive to construct and install, and allow contact with a large soil area, but can operate only over a limited range of soil moisture (flow cannot be generated under low moisture conditions).

The range of applications and limitations of the various types of suction samplers are similar and may be grouped as follows: soil physical properties; soil moisture limitations; sampler-wastewater interactions;

and climatic factors. With regard to soil physical properties, contact between the cup (or filter) is difficult to maintain in very coarse textures soils (sands and gravels). Furthermore, in highly structured soils and fractured material, the composition of fluid in cracks may differ from that in pores. Cups and filters sample only from small pores. Consequently, samples may not be representative of "average" fluid.

Low soil moisture prevents samples from being obtained (when soils dry to the point that air enters the cups when applying a vacuum). Sampler-wastewater interactions include plugging of cups or filters by soil fines, bacteria or chemical precipitates, and potential adsorption of heavy metals or organics on the cup or filter. Various experiments (described in Morrison, 1983) have shown that lysimeter cups can:

- "Filter" fecal coliforms, reducing the counts in recovered water by two to four orders-of-magnitude.
- Reduce concentrations of Ni, Cu, Pb, Zn, Fe, and Mn by 5 to 10 percent.
- Adsorb phosphorus and ammonia.
- Reduce concentrations of chlorinated hydrocarbons (DDT, DDE, DDD) by 70 to 94 percent.

Climatic limitations refer to freezing, which may rupture the samplers if they contain water, or shift them during freeze-thaw cycles so that they lose contact with the soil.

5.4.2 Sampling Perched Groundwater

Shallow perched groundwater can be sampled using the following methods:

- Tile drains
- Collection pans and manifolds
- Wells
- Piezometers
- Multilevel samples (e.g., Barcad samplers)

The latter three methods are common techniques in groundwater sampling.

If a tile drainage system has been installed to control the elevation of a perched groundwater table, samples can be collected from the tile outfall. Collection pans and manifolds can also be installed in areas where temporary saturation lenses develop during the percolation of water from overlying surface sources. In construction, pan collectors are similar to the filter candle troughs, except that a ceramic filter candle is not included. Thus, the media in the trough (usually gravel, to prevent clogging) must be saturated. Commonly, the collector pans are connected to a central chamber or trench containing sample bottles and accessories. Both tile drains and collection pans are more commonly constructed as part of the monitoring system at a new site (i.e., a landfill) or during remedial construction, and are not frequently used for remedial investigation (RI) purposes. A perched water sampling system can also be constructed using geosynthetics (layers of impermeable geomembrane, geonet, and geotextile) as is used for leachate collection and monitoring at new landfills.

5.4.3 Sample Handling and Management

The guidance provided in the following procedures should be followed with regard to sample containers, preservation, shipment and documentation.

- Non-Radiological Sample Handling (Procedure SA-6.1)
- Field Documentation (Procedure SA-6.3)

6.0 REFERENCES

Bouwer, H., 1964. Measuring Horizontal and Vertical Conductivities of Soil with the Double Tube Method. Soil Sci. Soc. Amer. Proc. 28:19-23.

Bouwer, H. 1966. Rapid Field Measurement of Air-Entry Value and Hydraulic Conductivity of Soil as Significant Parameters in Flow System Analyses. Water Resources Research 2:729-738.

Cedergren, H. R., 1977. Seepage, Drainage and Flow Nets (2nd edition). J. Wiley and Sons, New York, New York.

Davis, S. N. and R. J. M. DeWiest, 1966. Hydrogeology. J. Wiley and Sons, New York. 463 pp.

Everett, L. G., L. G. Wilson and E. W. Hoylman, 1983. Vadose Zone Monitoring for Hazardous Waste Sites. EPA-600/X-83-064. U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

Freeze, R. A. and J. A. Cherry, 1979. Groundwater. Prentice Hall, Englewood Cliffs, New Jersey. 604 pp.

Griswold, D. B. and D. E. Daniel, 1984. A Survey of Techniques to Monitor the Vadose Zone. Texas Low Level Radioactive Waste Authority, Austin, Texas.

Morrison, R. D., 1983. Groundwater Monitoring Technology . Timco Mfg., Inc., Prairie Du Sac, Wisconsin.

U.S. EPA, 1977. Process Design Manual for Land Treatment of Municipal Wastewater. EPA-625/1-77-008, U.S. Environmental Protection Agency Center for Environmental Research Information, Cincinnati, Ohio.

7.0 ATTACHMENTS

Attachment A - Advantages and Limitations of Soil Moisture Content Measuring Devices
Attachment B - Soil-water Characteristic Curves for Wetting and Drying, Illustrating Hysteresis
Attachment C - Typical Unsaturated Hydraulic Conductivity versus Soil Moisture Curve
Attachment D - Vacuum-pressure and High-pressure Vacuum Lysimeters
Attachment E - Filter Candle and Membrane Filter Samplers

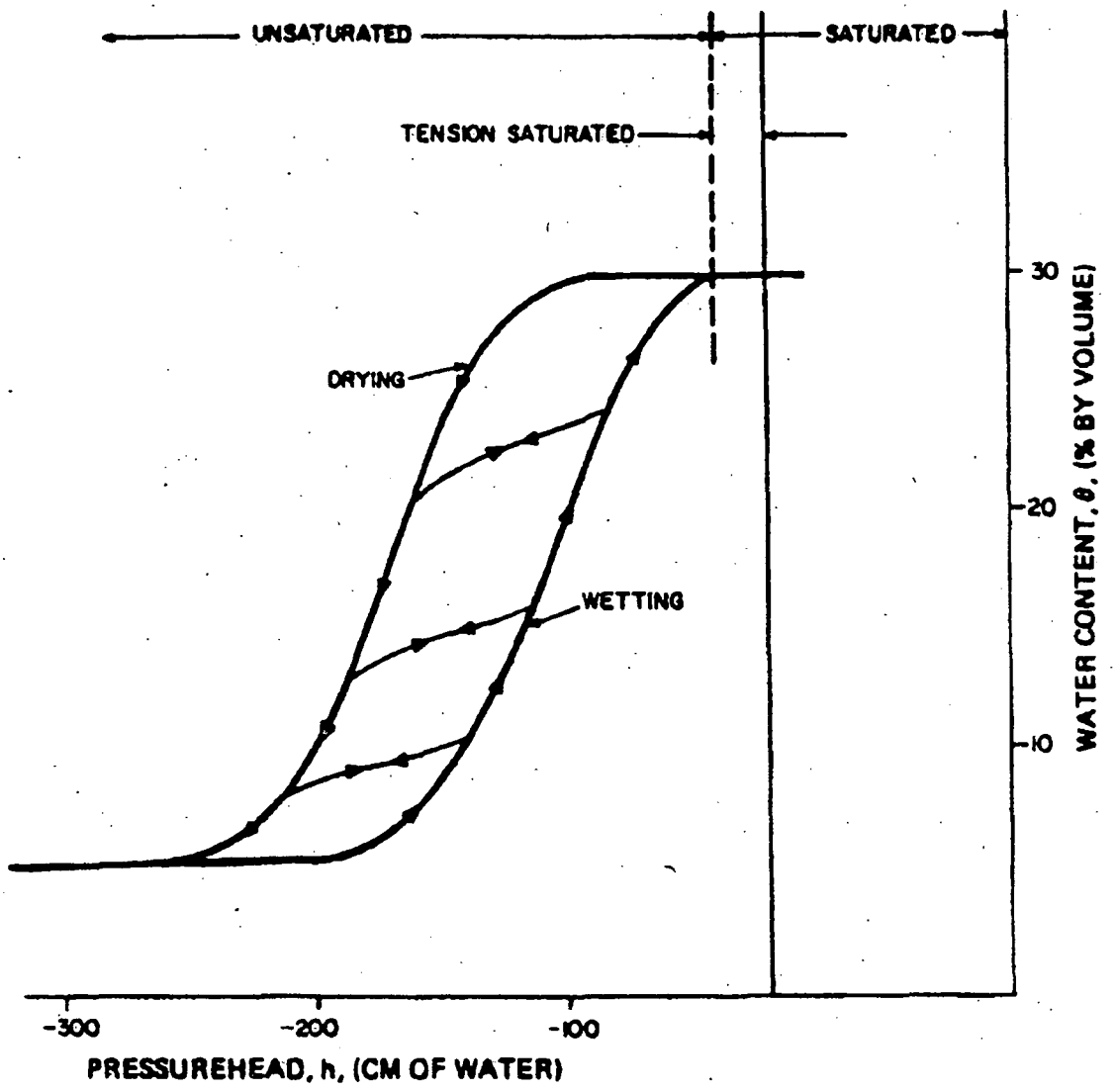
ATTACHMENT A

ADVANTAGES AND LIMITATIONS OF SOIL MOISTURE CONTENT MEASURING DEVICES

Method	Advantages	Disadvantages/Limitations
Neutron Moisture Logging	• Rapid and accurate in uncased or steel-cased wells • In-situ method	• Requires a boring or emplacement in soil • Not accurate in plastic-cased wells or in presence of other neutron-moderators at high concentrations (B, Cl, hydrocarbons)
Gamma-Gamma Logging	• Rapid; can penetrate any well casing • Accurate • In-situ method	• Requires a boring • Requires knowledge of soil dry density • Inaccurate in expansive soils
Resistivity or Conductivity Surveys	• Remote method • Rapid/Inexpensive for large areas	• Least accurate method • Difficult to interpret • Contaminant plumes may lead to erroneous interpretation
Electrical Resistance Blocks	• Inexpensive • Accurate when properly calibrated • Good for long-term monitoring • Can be interfaced with automatic data recording systems	• Requires emplacement in soil • Requires laboratory calibration using site soil samples • Provides single point data only • Affected by temperature or salinity changes
Heat Dissipation Sensors	• Same advantages as electrical resistance blocks • Independent of soil salinity	• Same disadvantages as electrical resistance blocks
Capacitance Sensors	• Same advantages as electrical resistance blocks	• Same disadvantages as electrical resistance blocks
Tensiometers	• Inexpensive • Good for long-term monitoring; can be interfaced with automatic data recorders • Do not require external power source • Accurate	• Require emplacement in soil; difficult to emplace in coarse soils or fractured or indurated media • Provide single point data only • Differing surface tension of some organic contaminants may affect accuracy • Time lag in response and problems with hysteresis • Fragile; if not used with ethylene glycol (antifreeze), must be removed in freezing weather

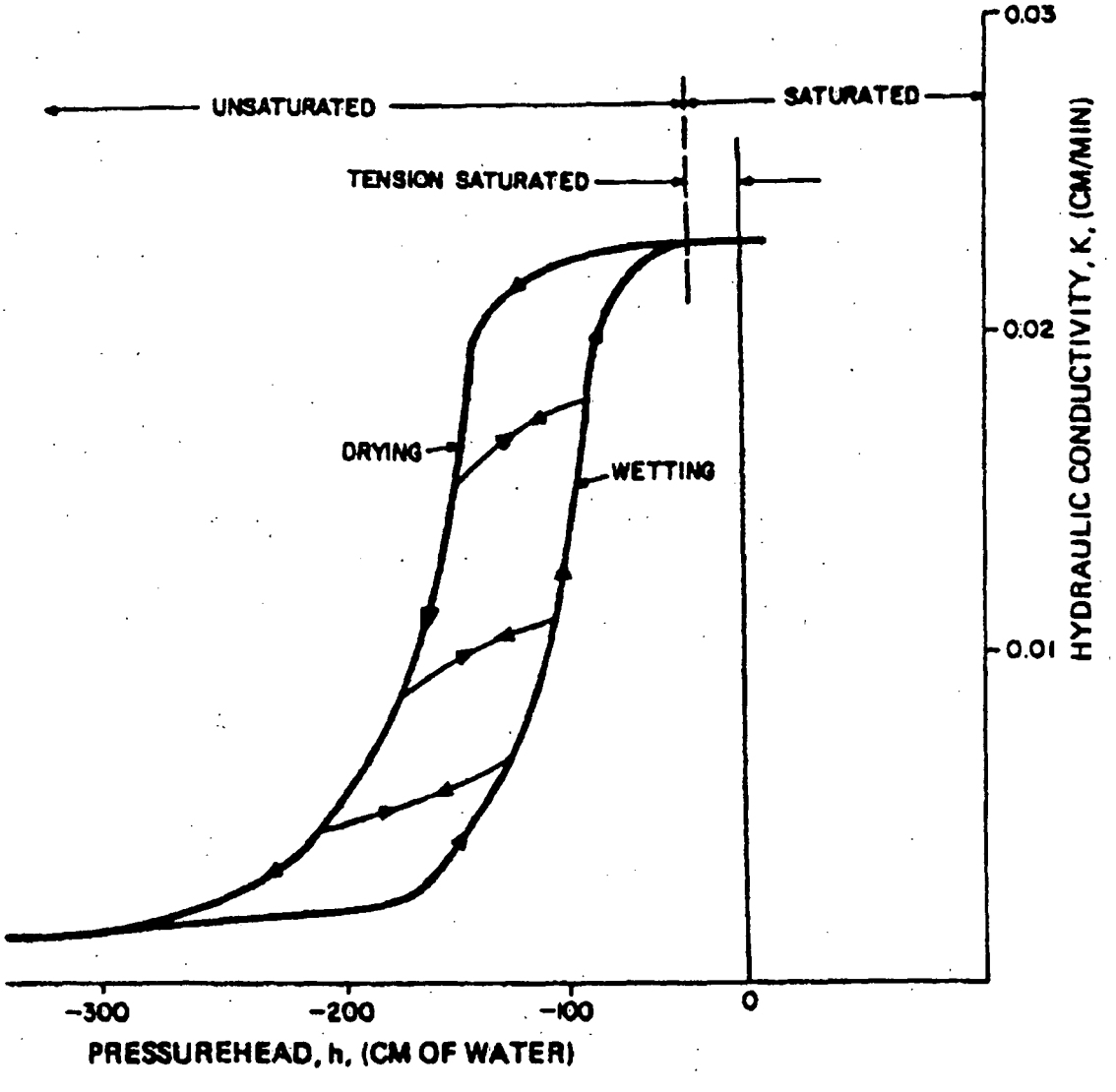
ATTACHMENT B

SOIL-WATER CHARACTERISTIC CURVES FOR WETTING AND DRYING, ILLUSTRATING HYSTERESIS



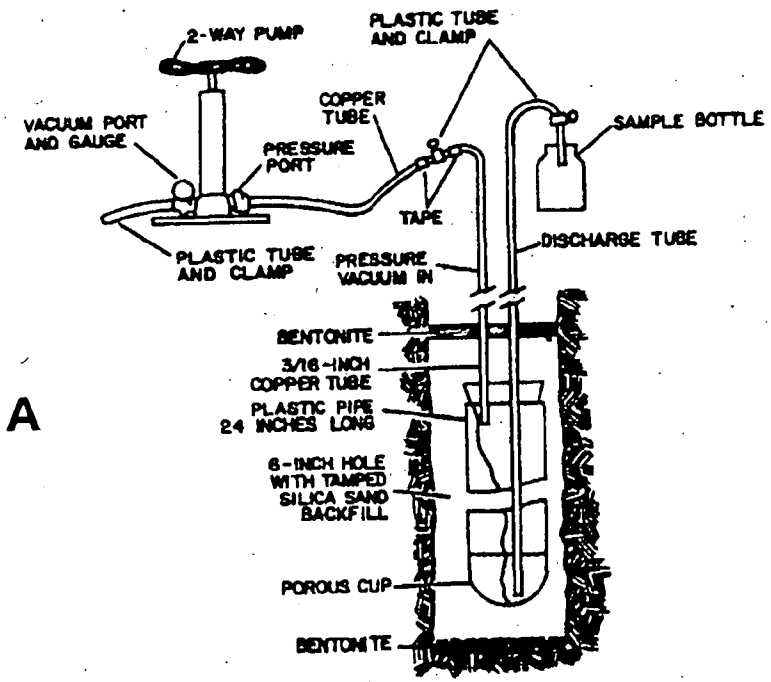
ATTACHMENT C

TYPICAL UNSATURATED HYDRAULIC CONDUCTIVITY VERSUS SOIL MOISTURE CURVE

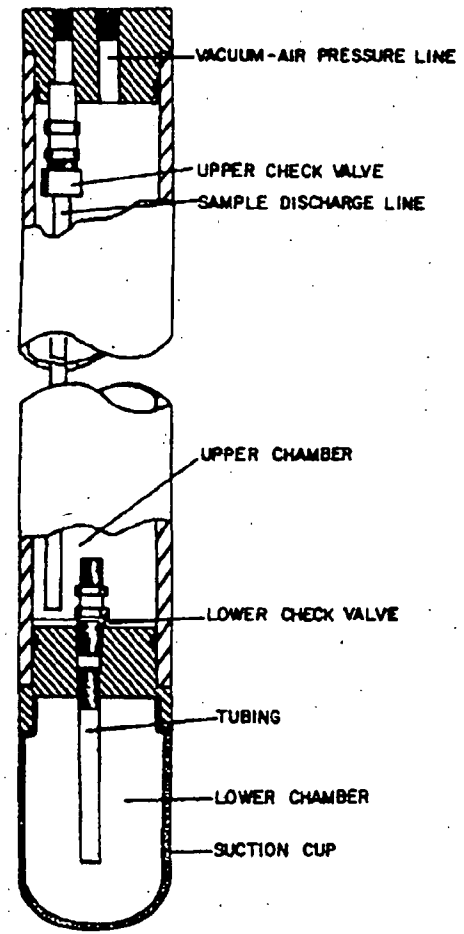


ATTACHMENT D

VACUUM-PRESSURE AND HIGH-PRESSURE VACUUM LYSIMETERS



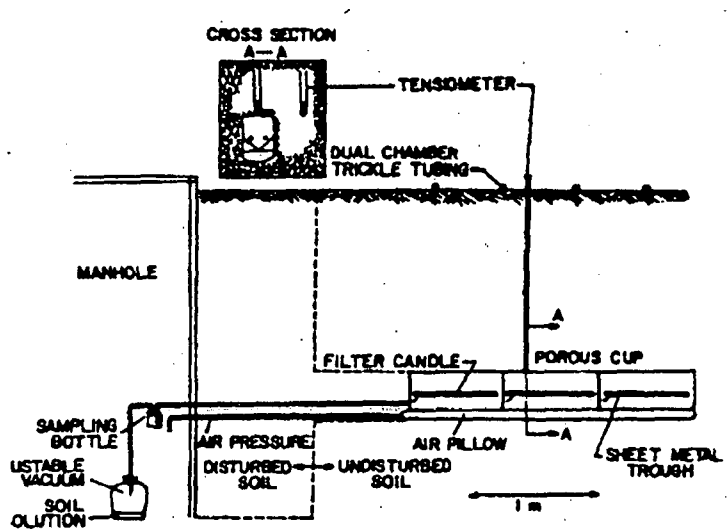
A



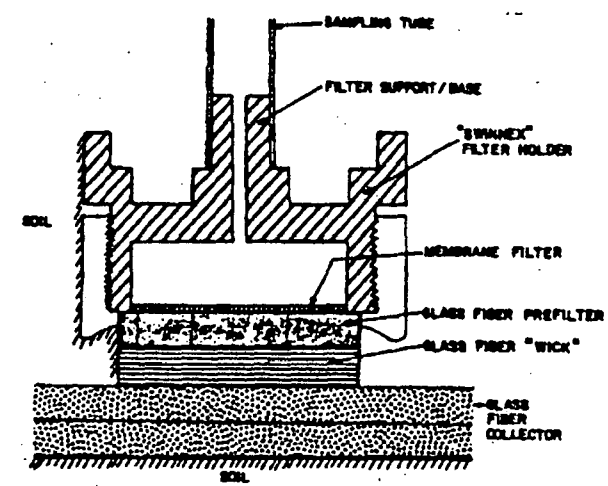
B

ATTACHMENT E

FILTER CANDLE AND MEMBRANE FILTER SAMPLERS



A



B

STANDARD OPERATING PROCEDURE
NUMBER CTO205-08

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes how investigation-derived waste (IDW) will be collected, segregated, classified, and managed during the field investigations at the PCB Capacitor Burial/Pole Yard at the NSWC Crane facility. The following types of IDW will be generated during this investigation:

- Excess soil and rock materials remaining from subsurface drilling activities
- Decontamination solutions
- Personal protective equipment (PPE) and clothing
- PCB field test kits
- Miscellaneous trash and incidental items

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Health and safety equipment (with PPE)
Decontamination equipment
Fi ld logbook and indelible ink pen
Plastic sheeting and/or tarps
55-gallon drums with sealable lids
IDW labels for drums
Waste water container tanks
Plastic garbage bags

3.0 PROCEDURES

Management of IDW includes the collection, segregation, temporary storage, classification, final disposal, and documentation of the waste-handling activities.

3.1 Liquid Wastes

Liquid wastes that will be generated during the site activities include decontamination solutions from drilling and sampling equipment and solutions from PCB test kits. As they are collected, the drilling fluids wastewaters will be placed in a 300-gallon (or smaller) portable container attached to a truck. Whenever the container is full, a sample will be collected and analyzed for total PCBs by a fixed-base laboratory. If the PCB concentration is less than 3 parts per billion (ppb) it will be transported to a central location at NSWC Crane adjacent to a Crane-designated sanitary sewer manhole. The water in the portable container will be discharged to the sewer by gravity draining. If the PCB concentration is not less than 3 ppb the contents of the container will be taken to an off-site wastewater treatment facility for treatment or disposal in accordance with TSCA regulations.

An accurate record will be kept by the FOL of all wastewaters that have been placed in the large holding tank. At a minimum, this information will include

- The location and type of each water that has been placed in the tank (e.g., decon water from rig)
- The quantity of water from each source,
- The date the wastewater was generated,
- The date and time the wastewater was placed in the tank,
- The person(s) present when the wastewaters were discharged to the sewer.

All free liquids from the PCB field test kits will be placed in a disposal vessel and turned over to NSWC Crane personnel for disposal.

3.2 Drill Cuttings and Cores

As cuttings are removed from borings, they will be screened for VOCs. If these results do not show above-background levels of VOCs, the cuttings materials will be mixed with bentonite and returned to the borehole when sampling activities in the hole are completed or spread on the ground in the area of the borehole. The backfill materials will be tamped as they are placed in the hole to increase density and reduce permeability of the backfill material.

If any soil materials from a screened borehole interval show evidence of contamination (based on the field screening results), then the soil material from the screened interval will be placed in a plastic trash bag (or directly in a drum if a larger quantity) and the bag will be tagged. Information included on the tag will consist of the hole from which the material came, the depth interval from which the material came, the

date, and the name of the person filling out the tag. The bag will then be placed in a 55-gallon drum and sealed (more than one bag may be placed in a drum). The waste drums will be stored on site temporarily until laboratory results have been received concerning the soil samples that were collected from the suspect borehole. If the results indicate that no contamination is present in the soil samples, then the soils will be disposed on site. If the levels of contamination of any of the samples from a borehole exceed Toxicity Characteristics Leaching Procedures (TCLP) limits (using the total soil concentrations), then all excess soil from the borehole will be considered as RCRA-hazardous and disposed off site in accordance with RCRA waste disposal regulations. Alternatively, the toxicity characteristic leaching procedure may be conducted for any constituent that could exceed the toxicity characteristic (TC) limits based on total concentrations. In the event tests show that the soils exceed TC limits, the soil will be considered a hazardous waste and disposed in accordance with RCRA waste disposal regulations.

Cuttings from well borings will be handled in the same manner as soil boring cuttings.

3.3 DPT Sample Liners and Incidental Trash

All DPT sample liners and incidental trash materials (e.g., wrapping or packing materials from supply cartons, waste paper, solid wastes from PCB test kits) will be decontaminated (if contaminated), double-bagged, securely tied shut, and placed in a designated waste receptacle at NSWC Crane.

STANDARD OPERATING PROCEDURE
NUMBER CTO205-09

DECONTAMINATION OF FIELD SAMPLING EQUIPMENT

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures to be followed when decontaminating non-dedicated field sampling equipment during the field investigations at the PCB Capacitor Burial/Pole Yard at the NSWC Crane facility.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Waterproof pens
Non-latex rubber or plastic gloves
Cotton gloves
Field log book
Potable water
Deionized water
Liquinox detergent
Isopropanol
Brushes, spray bottles, paper towels, etc.
55-gallon drum or other container to collect and transport decontamination fluids

3.0 DECONTAMINATION PROCEDURES

3.1 Don non-latex and/or cotton gloves and decontaminate sampling equipment (in accordance with the following steps) prior to field sampling and between samples.

3.2 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.3 Wash the equipment with a solution of Liquinox detergent. Prepare the Liquinox wash solution in accordance with the instructions on the Liquinox container. Collect the Liquinox wash solution into a container. Use brushes or sprays as appropriate for the equipment. If oily residue has

accumulated on the sampling equipment, remove the residue with an isopropanol wash and repeat the Liquinox wash.

3.4 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.5 Rinse the equipment with deionized water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the deionized water rinsate into a container.

3.6 Remove excess water by air drying, shaking, or wiping with paper towels as necessary.

3.7 Document decontamination by recording it in the field logbook.

3.8 Containerized decontamination solutions will be managed in accordance with the procedures described in SOP CTO205-08.

STANDARD OPERATING PROCEDURE
NUMBER CTO205-10

SOIL SAMPLE COMPOSITING

1.0 PURPOSE

This SOP describes procedures to be followed for the collection of composite soil samples for PCB analysis at CTO 205. The procedures are based on 40 CFR 761.289. Although several methods of composite sampling for cleanup verification are presented in 40 CFR 761.289, this SOP will describe a single method that appears to be most applicable to this project.

Application

Compositing is a method of combining several samples of a specified bulk PCB remediation waste into a single chemical analysis. Composite sample must be from the same waste material. It is anticipated that the site will be characterized by soil contaminated with PCBs that are not present as oils. It is also anticipated that the soil types encountered at this site will lack variability (e.g., clays versus gravels). If variations to these assumptions are encountered, additional composite samples will be necessary to characterize the materials.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil with indelible ink
Disposable medical-grade gloves (i.e. latex, nitrile)
Soil sample logsheets
Stainless-steel mixing bowls
Stainless-steel trowel or soup spoon
Required sample containers: All sample containers including shipping coolers for analysis by fix-based laboratories will be supplied and deemed certified clean by the laboratory.
Required decontamination materials
Chain-of-custody records
Required personal protective equipment (PPE)
Photoionization detector (PID) (see SOP 205-05)
Wooden stakes or pin flags

Sealable polyethylene bags

Heavy-duty cooler

Ice

Razor knife

Sampling equipment

Surveyor's measurement tape

Sample labels and tags

3.0 PROCEDURES

The procedures for composite sampling at surficial sites for verification sampling are described below. Sampling of pit locations is addressed exclusively in the work plan because these samples present a physical hazard during sample collection.

1) Across the entire site, map out a sampling grid that is oriented parallel to magnetic north. A minimum of two persons are necessary to lay out this grid, one to operate the theodolite or tranist and one to insert the survey pins. Use a theodolite or transit to ensure that the grid lines are straight. Insert pin flags every 1.5 meters in both the northern and eastern directions (Figure 4-2) to create the sampling grid. This grid spacing will produce numerous cells that are 1.5 meters by 1.5 meters. For each composite sample, a three-cell by three-cell area (20.25 square meters) should be constructed. This will produce a composite sample area with nine cells.

   At a minimum, three composite samples are necessary to characterize a remediation area. The area contained by this sampling grid will need to be large enough to accommodate the collection of three separate composite samples for adequate site characterization. For sites that have too little surface area to collect three composite samples from the grid, the grid spacing should be reduced to less than 1.5 meters to allow for the three-sample minimum.

2) After the measured grid is mapped (laid out) in the field, each sample should be represented by a three- by three-square of cells (i.e., nine cells total). Each of the nine cells will have an aliquot of sample collected from them.

   The composite sample is produced from nine sample aliquots that are collected at equal depths and contain equal soil volumes. Each aliquot must be collected from the same type of remediation waste or soil type. The sample from any of the sampled grids should not be

represented in another composite sample. Assure that composite sample areas and individually analyzed samples completely overlie the entire cleanup site.

3) Thoroughly mix equal portions of soil sample from the nine different locations for each sample grid in a decontaminated stainless-steel mixing bowl, following the steps in SOP CTO205-7.

4) Follow procedures in SOP CTO205-11 for shipment of samples.

STANDARD OPERATING PROCEDURE

NUMBER CTO205-11

SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for sample preservation, packaging, and shipping to be used in handling environmental samples obtained for chemical analysis at the PCB Capacitor Burial Pole Yard.

The Naval Surface Warfare Center (NSWC) Crane Environmental Protection Department must approve any deviations from this procedure.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Shipping labels
Custody seals
Chain-of-custody (COC) forms
Sample containers with preservatives: All sample containers for analysis by fixed-base laboratories will be supplied and deemed certified clean by the laboratory.
Sample shipping containers (coolers): All sample shipping containers are supplied by the laboratory.
Packaging material: Bubble wrap, Ziploc bags, strapping tape, etc.
Temperature blank

3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

3.1 The laboratory provides sample containers that are certified clean for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at 4°C ±2°C. This will be accomplished through refrigeration (used to hold samples prior to shipment) and/or ice.

3.2 The sampler will maintain custody of the samples until the samples are relinquished to another custodian or to the common carrier.

3.3 Check that the sample container is properly identified on the label and tag, the lid securely fastened, and the container sealed in a Ziploc bag.

3.4 Place the sample container into a bubble wrap shipping bag and seal the bag using the self-sealing, pressure-sensitive tape supplied with the bag.

3.5 Inspect the insulated shipping cooler. Check for any cracks, holes, broken handles, etc. If the cooler has a drain plug, make certain it is sealed shut. If the cooler is questionable for shipping, the cooler must be discarded.

3.6 Place the sample container into a shipping cooler in an upright position (all containers will be upright for shipment). Continue filling the cooler with samples and packing material until the cooler is full and the movement of the sample containers is limited.

3.7 Place a temperature blank in the cooler.

3.8 Fill the voids in between the bubble wrap shipping bags with ice and continue filling the cooler with ice to the top, using a minimum of 8 pounds of ice for a medium-size cooler.

3.9 Complete a chain-of-custody (COC) form. List on the COC form each sample bottle contained in the cooler. Include the air bill number on the COC form. Use a ballpoint pen and make sure that all the carbon forms are legible.

3.10 Place the original (top) signed copy of the COC form inside a large Ziploc bag. Tape the bag to the inside of the lid of the shipping cooler.

3.11 Close the cooler and seal the cooler with approximately four wraps of strapping tape at each end of the cooler. Prior to wrapping the last wrap of strapping tape, apply a signed and dated custody seal to each side of the cooler (a total of four signed custody seals must be used per cooler). Cover the custody seal with the last wrap of tape. This will provide a tamper-evident custody seal system for the sample shipment.

3.12 Affix a shipping label to the top of the cooler containing all of the shipping information. Overnight (e.g., FedEx Priority Overnight) courier services will be used for all sample shipments. Include the air bill number on the COC.

3.13 All samples will be shipped to the laboratory no more than 72 hours after completion of sampling. Under no circumstances will sample holding times be exceeded for hold times.

STANDARD OPERATING PROCEDURE
NUMBER CTO205-12

USE OF IMMUNOASSAY TEST KIT FOR PCBS

1.0 PURPOSE

This SOP describes the procedures to be followed for the field analysis of soil samples for PCBs at CTO 205. The rationale for this SOP is to ensure that the field analysis follows good laboratory practices in generating field results.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

- Writing utensil with indelible ink
- Bound and paginated notebook
- PCB EnSys 12T Soil Test Kit, SDI Part # 7020301
- PCB Soil Sample Extraction Kit, SDI Part # 7020301EA
- PCB EnSys 12T Accessory Kit Rental, SDI Part #6997020
- PCB Custom Soil QC Standard for PCB 1260 @ 25 mg/Kg, Environmental Resource Associates

  or
- PCB Custom Soil QC Standard for PCB 1260 @ 1 mg/kg, Environmental Resource Associates

3.0 PROCEDURES

1) Specific procedures for extraction of PCBs in soils are provided in the Sample Extraction Test Kit.

2) Specific procedures for analysis of PCBs in soils and interpretation of results are provided in the Sample Test Kit.

3) <u>For a clean up standard of 25 mg/kg</u>: In addition to the standard provided with each kit, a standard at 25 mg/kg should also be extracted and analyzed with each analytical batch of up to 20 samples. Samples that develop less color than the 25 mg/kg standard are interpreted as

containing 25 mg/kg or greater of PCBs. Samples that develop more color than the 25 mg/kg standard are interpreted as containing less than 25 mg/kg of PCBs.

or

4) For a clean up standard of 1 mg/kg: In addition to the standard provided with each kit, a standard at 1 mg/kg should also be extracted and analyzed with each analytical batch of up to 20 samples. Samples that develop less color than the 1 mg/kg standard are interpreted as containing 1 mg/kg or greater of PCBs. Samples that develop more color than the 1 mg/kg standard are interpreted as containing less than 1 mg/kg of PCBs.

APPENDIX C

SITE-SPECIFIC HEALTH AND SAFETY PLAN

Health and Safety Plan
for
Field Investigation
at the
PCB Capacitor Burial/Pole Yard

Naval Surface Warfare Center
Crane Division
Crane, Indiana

NAVFAC
Naval Facilities Engineering Command

Southern Division
Naval Facilities Engineering Command
CONTRACT NUMBER N62467-94-D-0888

Contract Task Order 0376

June 2005

HEALTH AND SAFETY PLAN
FOR
FIELD INVESTIGATION
AT THE
PCB CAPACITOR BURIAL/POLE YARD

NAVAL SURFACE WARFARE CENTER (NSWC)
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
TetraTech NUS
Foster Plaza 7, 661 Andersen Drive
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0376

JUNE 2005

PREPARED UNDER THE
SUPERVISION OF:

ROGER CLARK, PhD, PG
TASK ORDER MANAGER
TETRA TECH NUS
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:

MATTHEW M. SOLTIS, CIH, CSP
CLEAN HEALTH AND SAFETY MANAGER
TETRA TECH NUS
PITTSBURGH, PENNSYLVANIA

TABLE OF CONTENTS

Section			Page No.
1.0	**INTRODUCTION**		**1-1**
	1.1	KEY PROJECT PERSONNEL AND ORGANIZATION	1-1
	1.2	SITE INFORMATION AND PERSONNEL ASSIGNMENTS	1-3
2.0	**EMERGENCY ACTION PLAN**		**2-1**
	2.1	INTRODUCTION	2-1
	2.2	EMERGENCY PLANNING	2-1
	2.3	EMERGENCY RECOGNITION AND PREVENTION	2-2
	2.3.1	Recognition	2-2
	2.3.2	Prevention	2-3
	2.4	SAFE DISTANCES AND PLACES OF REFUGE	2-3
	2.5	EVACUATION ROUTES AND PROCEDURES	2-3
	2.6	DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT	2-4
	2.7	EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES	2-4
	2.8	PPE AND EMERGENCY EQUIPMENT	2-5
	2.9	EMERGENCY CONTACTS	2-5
	2.10	EMERGENCY ROUTE TO HOSPITAL	2-7
	2.11	INJURY/ILLNESS REPORTING	2-15
3.0	**SITE BACKGROUND**		**3-1**
	3.1	SITE HISTORY	3-1
	3.2	SWMU 17 PCB CAPACITOR/POLE YARD	3-1
4.0	**SCOPE OF WORK**		**4-1**
5.0	**TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES**		**5-1**
	5.1	GENERAL SAFE WORK PRACTICES	5-1
	5.2	SOIL BORING – SAFE WORK PRACTICES	5-3
6.0	**HAZARD ASSESSMENT**		**6-1**
	6.1	CHEMICAL HAZARDS	6-1
	6.2	PHYSICAL HAZARDS	6-3
	6.2.1	Slips, Trips and Falls	6-3
	6.2.2	Cuts or Other Injuries Associated with Hand Tool Use	6-3
	6.2.3	Energized Systems (Contact with Underground or Overhead Utilities	6-4
	6.3	NATURAL HAZARDS	6-4
	6.3.1	Insect Bites and Stings	6-4
	6.3.2	Snakes and Other Wild Animals	6-6
	6.3.3	Poisonous Plants	6-8
	6.3.4	Inclement Weather	6-9
7.0	**AIR MONITORING**		**7-1**
	7.1	INSTRUMENTS AND USE	7-1
	7.1.1	Photoionization Detector or Flame Ionization Detector	7-1
	7.1.2	Hazard Monitoring Frequency	7-1
	7.2	INSTRUMENT MAINTENANCE AND CALIBRATION	7-2

TABLE OF CONTENTS (Continued)

Section **Page No.**

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS 8-1
8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING 8-1
8.1.1 Requirements for TtNUS Personnel 8-1
8.1.2 Requirements for Subcontractors 8-1
8.2 SITE SPECIFIC TRAINING 8-3
8.3 MEDICAL SURVEILLANCE 8-3
8.3.1 Medical Surveillance Requirements for TetraTech NUS Personnel 8-3
8.3.2 Medical Surveillance Requirements for Subcontractors 8-5
8.3.3 Medical Data Sheet 8-5
8.4 SUBCONTRACTOR EXCEPTION 8-5

9.0 SPILL CONTAINMENT PROGRAM 9-1
9.1 SCOPE AND APPLICATION 9-1
9.2 HAZARDOUS SOILS AND FLUIDS 9-1
9.3 POTENTIAL SPILL AREAS 9-1
9.3.1 Site Drums/Containers 9-2
9.4 LEAK AND SPILL DETECTION 9-2
9.5 PERSONNEL TRAINING AND SPILL PREVENTION 9-2
9.6 SPILL PREVENTION AND CONTAINMENT EQUIPMENT 9-2
9.7 SPILL CONTROL PLAN 9-3

10.0 SITE CONTROL 10-1
10.1 EXCLUSION ZONE 10-1
10.1.1 Exclusion Zone Clearance 10-1
10.2 CONTAMINATION REDUCTION ZONE 10-2
10.3 SUPPORT ZONE 10-2
10.4 SITE VISITORS 10-2
10.5 SITE SECURITY 10-3
10.6 SITE MAP 10-3
10.7 BUDDY SYSTEM 10-3
10.8 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS 10-3
10.9 COMMUNICATION 10-4
10.10 SAFE WORK PERMITS 10-4

11.0 CONFINED SPACE ENTRY 11-1

12.0 MATERIALS AND DOCUMENTS 12-1
12.1 MATERIALS TO BE POSTED OR MAINTAINED AT THE SITE 12-1

13.0 GLOSSARY 13-1

ATTACHMENT I – INJURY/ILLNESS PROCEDURE AND REPORT FORM
ATTACHMENT II - MEDICAL DATA SHEET
ATTACHMENT III – EQUIPMENT INSPECTION CHECKLIST
ATTACHMENT IV – UTILITY LOCATING AND EXCAVATION CLEARANCE
ATTACHMENT V – SAFE WORK PERMITS

FIGURES

Figure		Page No.
2-1	Hospital Route Map (Bedford Gate)	2-8
2-2	Hospital Route Map (Bloomington Gate)	2-11
2-3	Emergency Response Protocol	2-16
7-1	Documentation of Field Calibration	7-3
8-1	Training Letter	8-2
8-2	Site Specific Training Documentation	8-4
8-3	Subcontractor Medical Approval Form	8-6
8-4	Medical Surveillance Letter	8-8
10-1	Safe Work Permit	10-5

TABLES

Table		Pag No.
2-1	Emergency Reference	2-6
5-1	Tasks/Hazards/Control Measures Compendium	5-5
6-1	Chemical, Physical, And Toxicological Data	6-2

1.0 INTRODUCTION

This Health and Safety Plan (HASP) is specifically written for site activities that are to be conducted at the Naval Surface Warfare Center Crane (NSWC Crane), located in Crane, Indiana. This investigation will provide data on polychlorinated biphenyl (PCB) concentrations in surface soils at the PCB Capacitor Burial/Pole Yard, Solid Waste Management Unit (SWMU) 17. In addition to this HASP, a copy of the Tetra Tech NUS, Inc. (TtNUS) Health and Safety Guidance Manual must be present at the site during the performance of site activities. This guidance manual provides detailed information pertaining to the HASP as well as TtNUS standard operating procedures (SOPs). Both documents must be present at the site to comply with the requirements stipulated in the Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.120.

This HASP has been developed using the latest available information regarding known or suspected chemical contaminants and potential physical hazards associated with the proposed work and site activities. This HASP will be modified if new information becomes available. Changes to the HASP will be requested through the TtNUS Health and Safety Manager (HSM) and the Task Order Manager (TOM). It is the responsibility of the TOM to notify affected personnel of changes to this HASP. A Site Safety Follow-up Report will document changes to this HASP.

The elements of this HASP are in compliance with the requirements established by OSHA 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER) and sections of 29 CFR 1926 "Safety and Health Regulations For Construction." The information contained in this plan, as well as policies on conducting on-site operations, have been obtained from the TtNUS Health and Safety Program and NSWC Crane policies and procedures.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for TtNUS and subcontractor employees engaged in on-site activities. Personnel assigned to these positions will exercise the primary responsibility for on-site health and safety. These persons 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.

- The TtNUS Task Order Manager (TOM) is responsible for the overall direction of health and safety for this project.

- The Project Health and Safety Officer (PHSO) is responsible for developing the HASP in accordance with applicable OSHA regulations. Specific responsibilities include:
  i. providing information regarding site contaminants and physical hazards associated with the site
  ii. establishing air monitoring and decontamination procedures
  iii. assigning personal protective equipment
  iv. determining emergency response procedures and emergency contacts
  v. stipulating training requirements and reviewing appropriate training and medical surveillance certificates
  vi. providing standard work practices to minimize potential injuries and exposures associated with hazardous waste work.

- The TtNUS Field Operations Leader (FOL) is responsible for implementation of the HASP with the assistance of an appointed Site Safety Officer (SSO). The FOL manages field activities, executes the work plan, and enforces safety procedures as applicable to the work plan.

- The Site Safety Officer (SSO) supports site activities by advising the FOL on the aspects of health and safety on-site. These duties may include:
  i. coordinates health and safety activities with the FOL
  ii. selects, applies, inspects, and maintains personal protective equipment
  iii. establishes work zones and control points
  iv. implements air monitoring program for on-site activities
  v. verifies training and medical of on-site personnel status in relation to site activities
  vi. implements hazard communication and respiratory protection programs
  vii. coordinates emergency services.
  viii. provides site specific training for on-site personnel

- Compliance with the requirements stipulated in this HASP is monitored by the SSO and coordinated through the CLEAN Health and Safety Manager.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: NSWC Crane

Address: Crane, Indiana

Client Contact: Mr. Thomas Brent

Phone Number: (812) 854-6160

Alternate Contact: Ms. Chris Freeman

Phone Number: (812) 854-4423

Project Team:

TtNUS Personnel:	Discipline/Tasks Assigned:
Roger A. Clark, PhD, PG	Task Order Manager (TOM)
Matthew M. Soltis, CIH, CSP	Manager of Health and Safety (HSM)
James K. Laffey	Project Health and Safety Officer (PHSO)
Terry Rojahn	Field Operations Leader (FOL)
TBD	Field Technician
Terry Rojahn	Site Safety Officer (SSO)

Non-TtNUS Personnel	Affiliation/Discipline/Tasks Assigned
TBD	Drilling Subcontractor
TBD	Surveyor

Hazard Assessments (for purposes of OSHA 29 CFR 1910.132) and HASP preparation conducted by:
James K. Laffey

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an emergency. In the event of on-site emergencies, which cannot be handled by on-site personnel, site personnel will be evacuated to a safe place of refuge and the appropriate emergency response agencies will be notified. It has been determined that a majority of potential emergency situations would be better supported by outside emergency responders. Based on this determination, TtNUS and subcontractor personnel will not provide emergency response support beyond the capabilities of on-site response. Workers who are ill or who have suffered a non-serious injury may be transported by site personnel to nearby medical facilities, provided that such transport does not aggravate or further endanger the welfare of the injured/ill person. 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. These agencies are located within a reasonable distance from the area of site operations, which ensures adequate emergency response time. This emergency action plan conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), as allowed in OSHA 29 CFR 1910.120(l)(1)(ii).

TtNUS will include incidental response measures for incidents such as:

- Incipient stage fire fighting support and prevention
- Incipient spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Provide initial medical support for injuries or illnesses requiring only first-aid level support
- Provide site control and security measures as necessary

2.2 EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, injuries or illnesses resulting from exposure to chemical or physical hazards or fire are the most probable emergencies that could be encountered during site activities.

To minimize and eliminate these potential emergency situations, emergency planning activities associated with this project include the following. The SSO and/or the FOL are responsible for:

- Coordinating with NSWC Crane Emergency Services personnel to ensure that TtNUS emergency action activities are compatible with existing facility 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 logbook identifying personnel on site each day.

It will be the responsibility of the TtNUS FOL to ensure this information is available and present at the site.

- Identifying a chain of command for emergency action.
- Educating site workers to the hazards and control measures associated with planned activities at the site, and to provide early recognition and prevention where possible.
- Drill and practice incidental response measures periodically.

It is understood that the use of two-way communication devices (cellular phones and radios) must be approved by the NSWC Crane Safety Office and such equipment will only be used with official permission. However, TtNUS is authorized to utilize two-way radio assigned to the Environmental Department. This radio is to be used only in the event of an emergency. It should only be activated if needed as the battery will only be charged periodically throughout the shift.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

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 overexposures. To adequately recognize exposures to site contaminants, site personnel must have a clear knowledge of 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 unto which 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 periodic site surveys to eliminate any situation predisposed to an emergency. The FOL, and the SSO will make up

the site evaluation committee responsible for these periodic surveys. Site surveys will be conducted at least once a week during the initiation of this effort.

The above actions will provide early recognition for potential emergency situations. Should an incident occur, TtNUS will take defensive and offensive measures to control these situations. However, if the FOL and the SSO determine that an incident has progressed to a serious emergency situation, TtNUS will withdraw, and notify the appropriate response agencies.

2.3.2 Prevention

TtNUS and subcontractor personnel will minimize the potential for emergencies by ensuring compliance with the HASP, the Health and Safety Guidance Manual and applicable OSHA regulations.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

In the event that the site must be evacuated, personnel will immediately stop activities and report to the telephone communications point at the support zone. Telephone communication points and safe places of refuge will be identified prior to the commencement of site activities and will be conveyed to personnel as part of the daily safety meeting conducted each morning. During an evacuation, personnel reporting to the refuge location will remain there until directed otherwise by the TtNUS FOL. The FOL or the SSO will take a head count at this location to account for and to confirm the location of site personnel. The site logbook will be used to take the head count. Emergency response personnel will be immediately notified of any unaccounted personnel.

2.5 EVACUATION ROUTES AND PROCEDURES

An evacuation will be initiated whenever; severe weather is encountered; a fire or explosion occurs; readings on monitoring instrumentation indicate levels of contamination greater than instituted action levels; or if personnel show signs or symptoms of overexposure to potential site contaminants. In the event of an evacuation, personnel will proceed immediately to the designated place of refuge in the support zone, unless doing so would further jeopardize the welfare of workers. In such an event, personnel will proceed to a designated alternate location and remain until further notification from the TtNUS FOL.

Evacuation procedures will be discussed prior to the initiation of any work at the site. 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.

2.6 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 postponed if the action that initiates an evacuation would further endanger the lives of workers if workers were to perform decontamination procedures. However, it is unlikely that an evacuation would occur at this site which would require workers to evacuate the site without first performing decontamination procedures.

2.7 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

Since TtNUS personnel will be working in close proximity to each other, hand signals, voice commands, and air horns, will be sufficient to alert site personnel of an emergency. If site personnel will be working in remote locations or if site activities are conducted in separate sites simultaneously, two-way radios will be used to communicate between teams of workers.

If an emergency occurs on Base, the following procedures are to be initiated:

- Initiate an evacuation by hand signals, voice commands, air horn, or two-way radios. Report to the designated refuge assembly point in the support zone.

- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred and as many details as possible. Once personnel are evacuated, incipient response procedures will be enacted to control the situation.

In the event that site personnel cannot control the incident through offensive and defensive measures, the FOL and SSO will enact the emergency notification procedures to secure additional outside assistance in the following manner:

- On base call 854-3300 or 864-1333* or other emergency contacts (Table 2-1) and report the emergency. Give the emergency operator the location of the emergency, the type of emergency, the number of injured, and a brief description of what occurred. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

***NOTE:** On-base extensions 3300 and 1333 are the primary emergency phone numbers. From an NSWC Crane phone, on Base extensions must be preceded by "854." Off-base numbers can only be reached by dialing "991" first. Furthermore, emergencies involving site activities should subsequently be reported to the Environmental Protection Department (x-3114/1132/6160).

- Conduct a head count of site personnel using the site logbook.

2.8 PPE AND EMERGENCY EQUIPMENT

A first aid kit, eye wash units, and fire extinguishers (strategically placed) will be maintained on-site and shall be immediately available for use in the event of an emergency.

2.9 EMERGENCY CONTACTS

Prior to performing work at any of the sites, personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an accident. A mobile phone may be available on site. Table 2-1 provides a list of emergency contacts and their associated telephone numbers. This table must be posted on site where it is readily available to site personnel.

In addition, TtNUS personnel who are injured or become ill on the job must notify appropriate company representatives. Figure 2-3 presents the procedure for reporting an injury/illness, and the form to use for this purpose. **If the emergency involves personnel exposures to chemicals, follow the steps in Figure 2-3.**

TABLE 2-1

EMERGENCY REFERENCE

NSWC CRANE, INDIANA

AGENCY	TELEPHONE
Base Emergency Number (Fire Department, Base Security, Ambulance)	854-3300 or 854-1333
Base Environmental Office	(812) 854-3114
Bedford Ambulance	(812) 279-6545
Bloomington Hospital (Bloomington, IN)	(812) 336-9515
Hospital, Bedford Medical Center (Bedford, IN)	(812) 275-1200
Poison Control Center	1-800-222-1222
National Response Center	1-800-424-8802
Base Contact, Thomas Brent	(812) 854-6160
Contract Task Order Manager, Roger Clark	(412) 921-8415
TtNUS Crane Field Office Building 3245	(812)-854-0280
Field Operations Leader, Terry Rojahn	(412) 921-8857
TtNUS Office, Pittsburgh	(412) 921-7090
CLEAN Health and Safety Manager, Matthew M. Soltis, CIH, CSP	(412) 921-8912
Project Health and Safety Officer, James K. Laffey	(412) 921-8678

Note: Most phones require the number to be preceded by 991 (i.e., 991-812-854-0280) or by "99" (if 812 is left off) (i.e., 99-854-0280)

2.10 EMERGENCY ROUTE TO HOSPITAL

Directions to the Bloomington Hospital:*

Bloomington Hospital
601 West 2nd Street
Bloomington, IN 47403

Exit NSWC Crane on H-45 through the Bloomington gate. Follow Highway 45 North to Bloomington at Highway 45 and Highway 37. Continue going straight over the overpass (Bloomfield Road). Follow Bloomfield Road North; this road turns into 2nd Street. Follow 2nd Street, hospital will be on the right

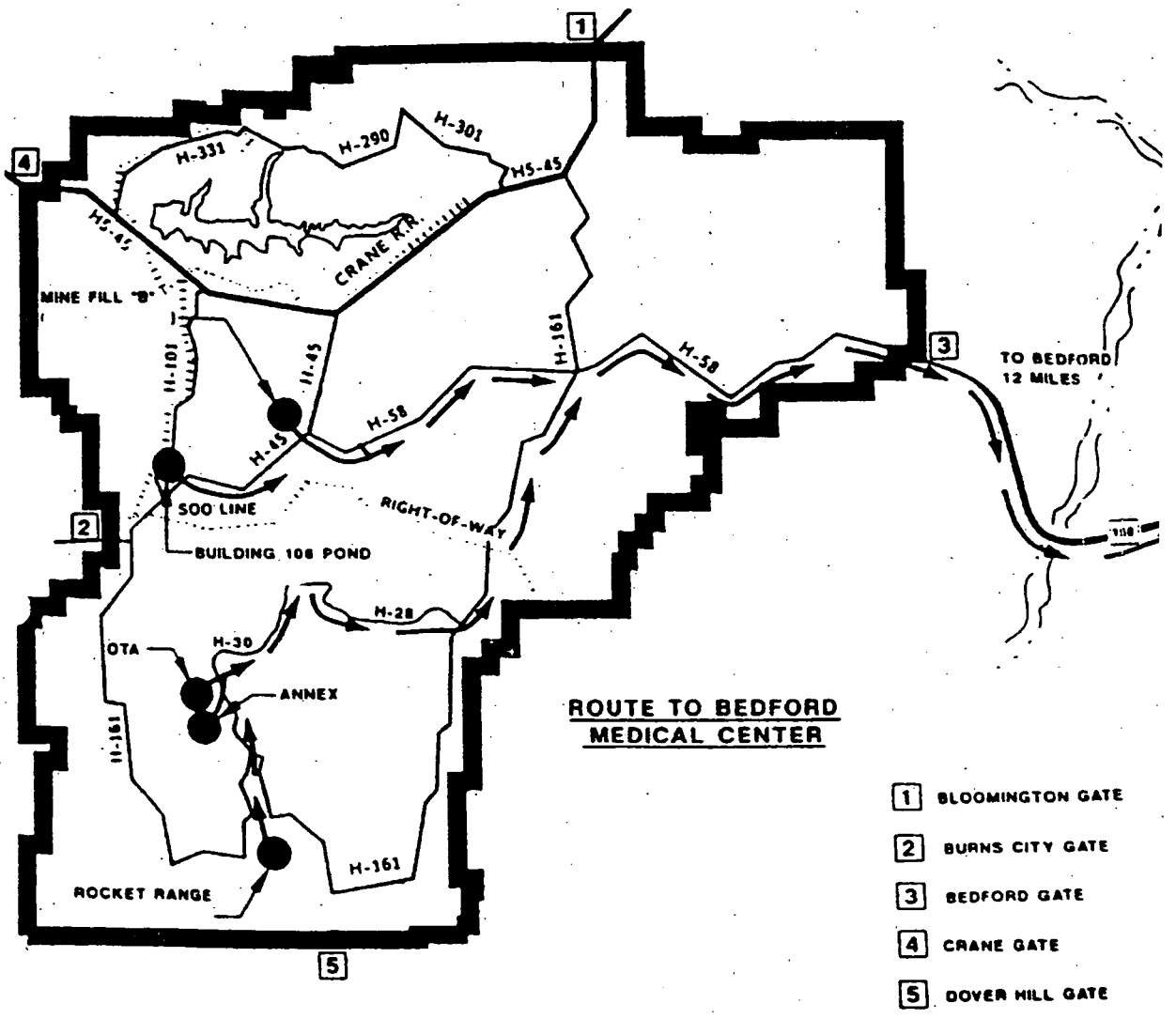
Directions to Bedford Regional Medical Center:**

Bedford Regional Medical Center
2900 16th Street
Bedford, IN 47421

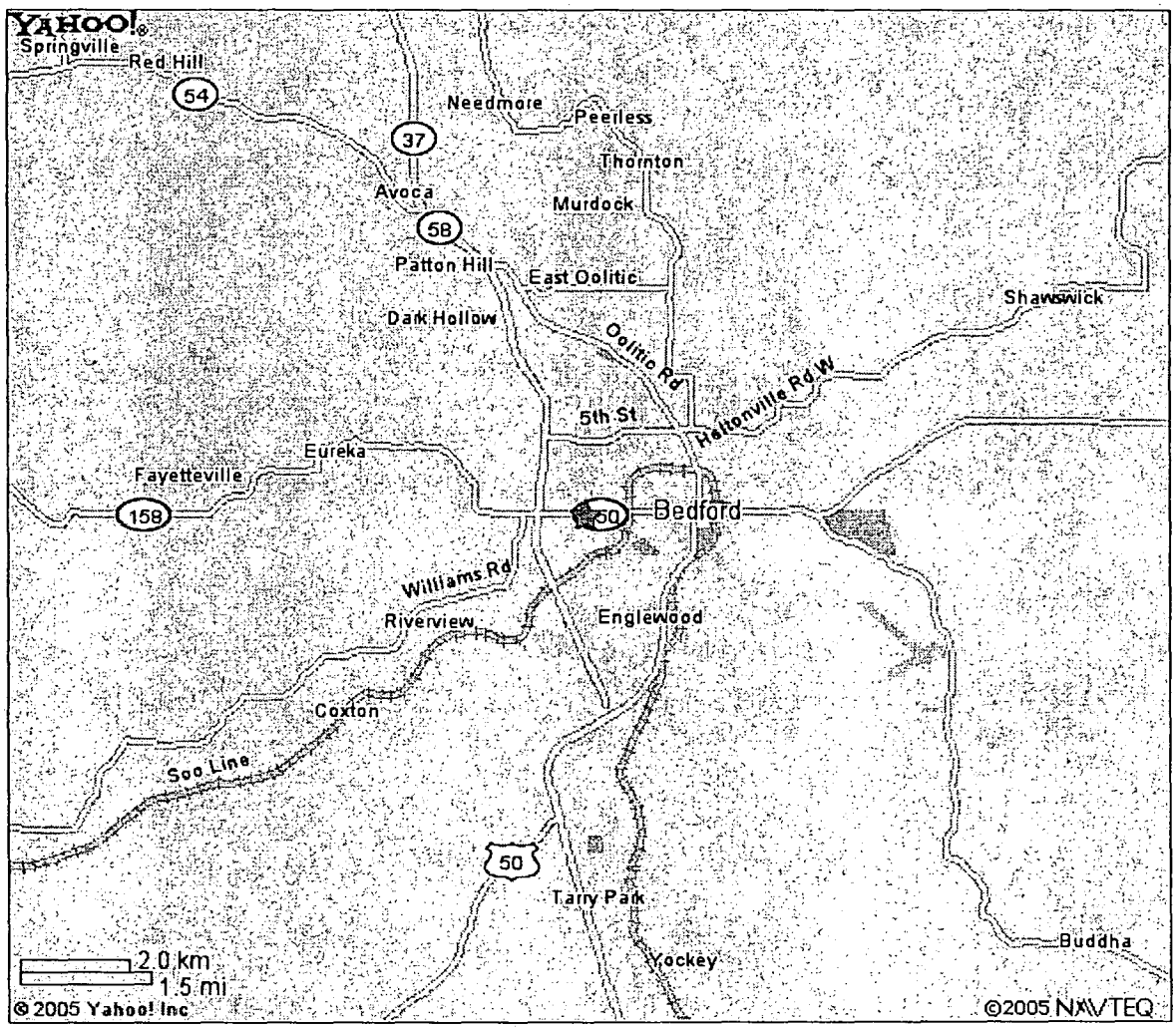
Exit the base on H-58, through the Bedford Gate. Head West on State Highway 158. State Highway 158 becomes 16th Street upon entering the City of Bedford. The medical center is on the right shortly after Plaza Drive.

Figure 2-1
Hospital Route Maps
Bedford Gate

***Note: The Bedford Gate is open only from 0600 - 0830 and 1500 - 1800 hours.**



Greater Bedford Area



City of Bedford
Medical Center Location

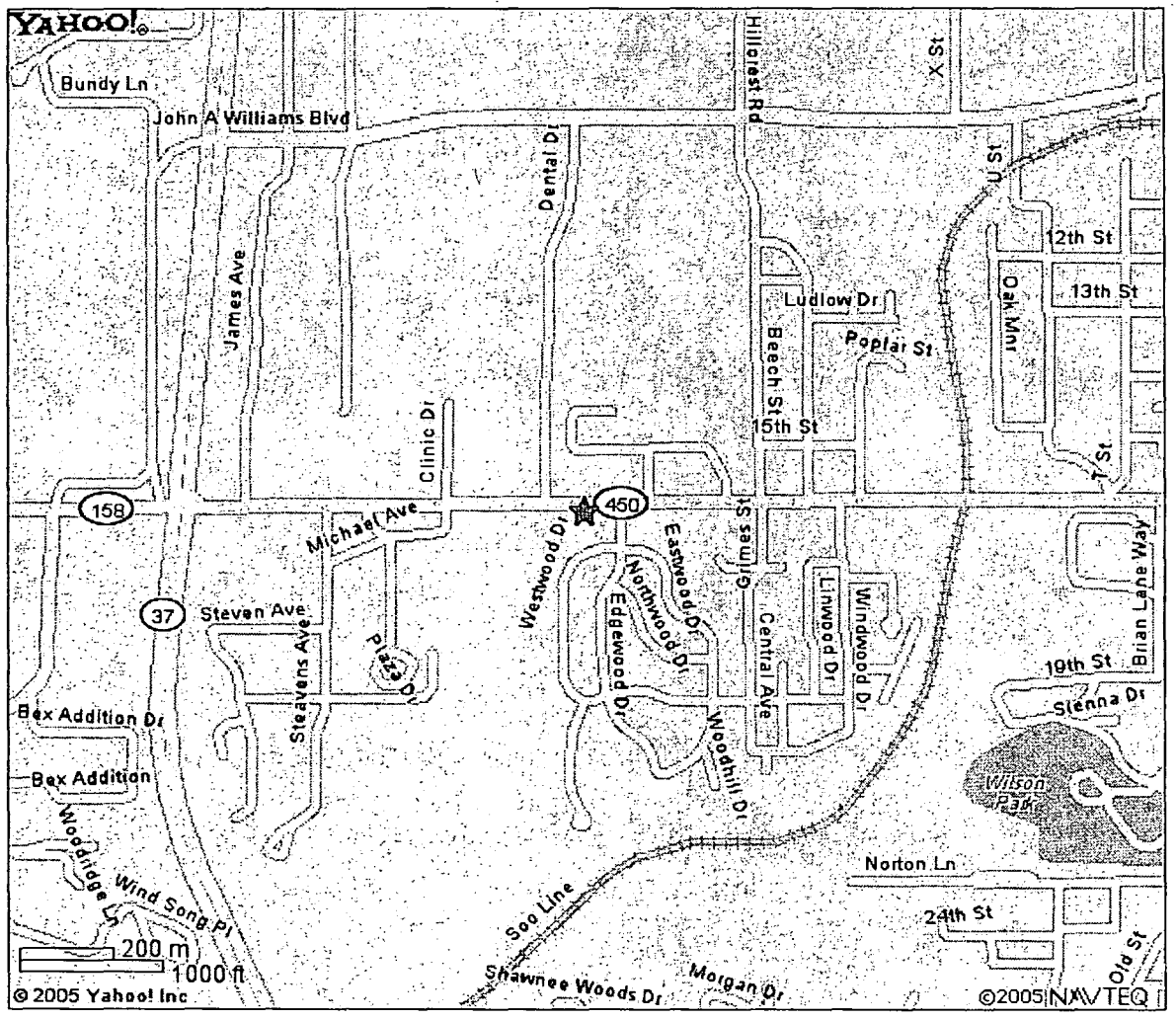
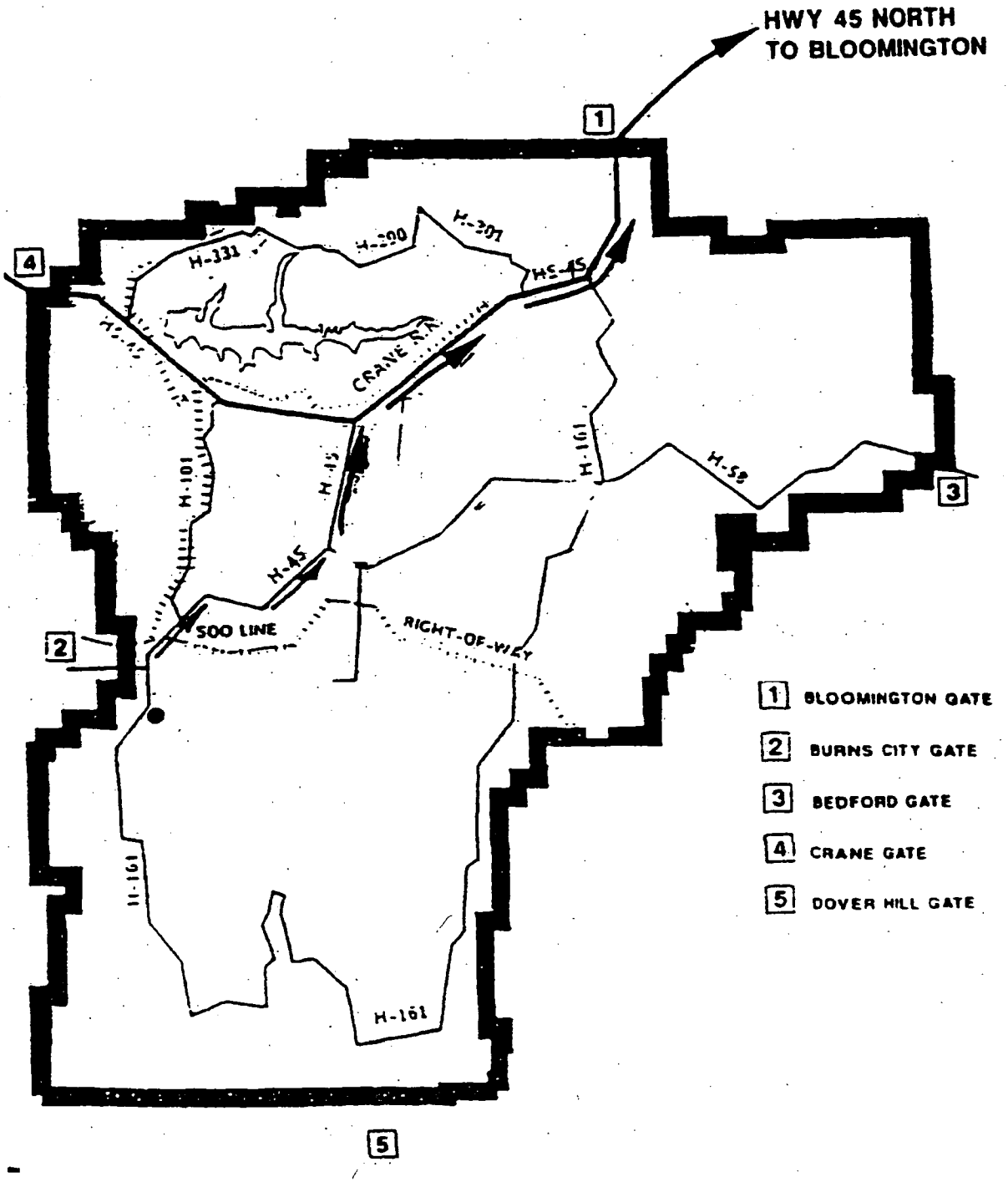


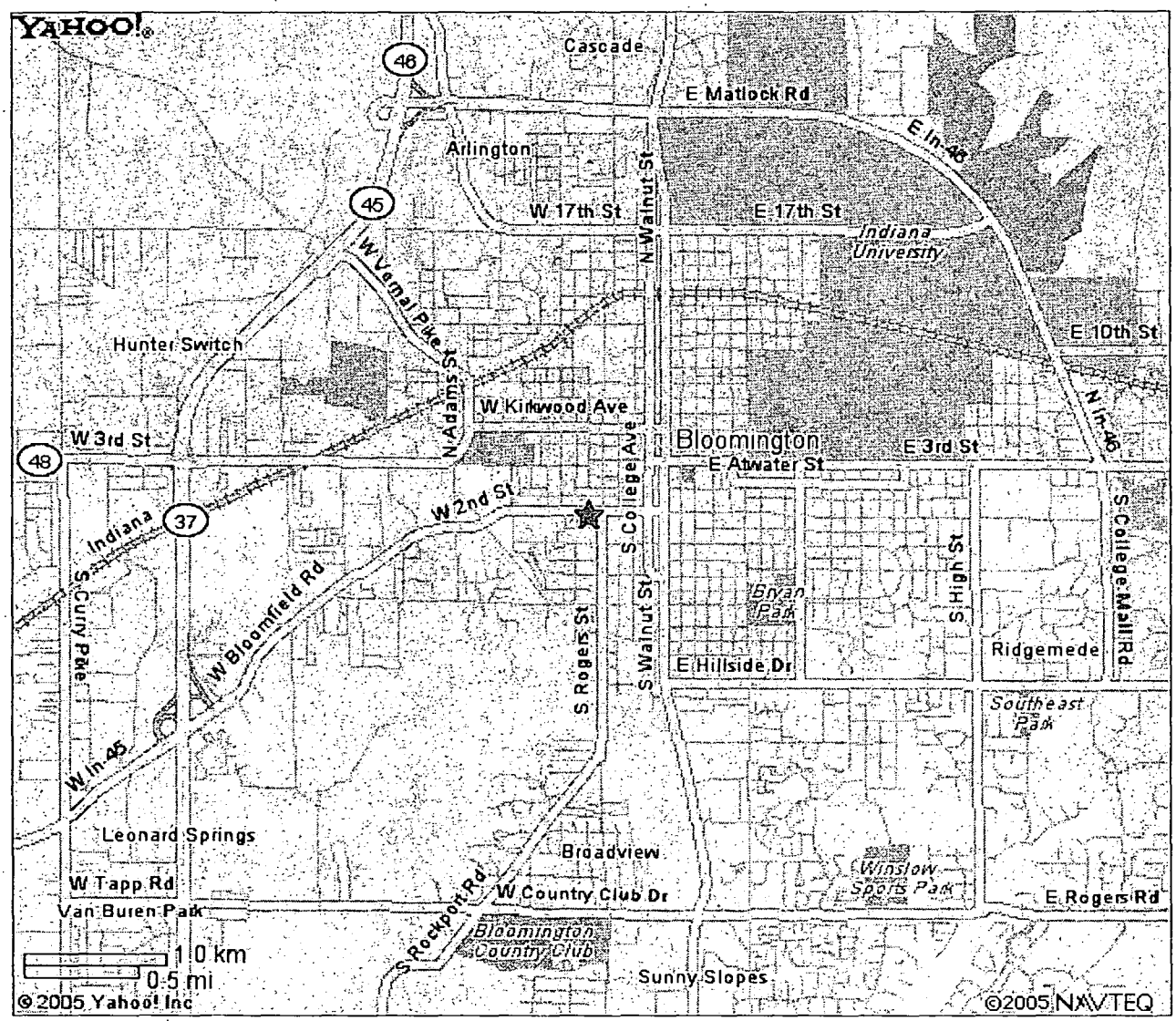
Figure 2-2
Hospital Route Maps
Bloomington Gate

****Note: The Bloomington Gate is open 24 hours.**

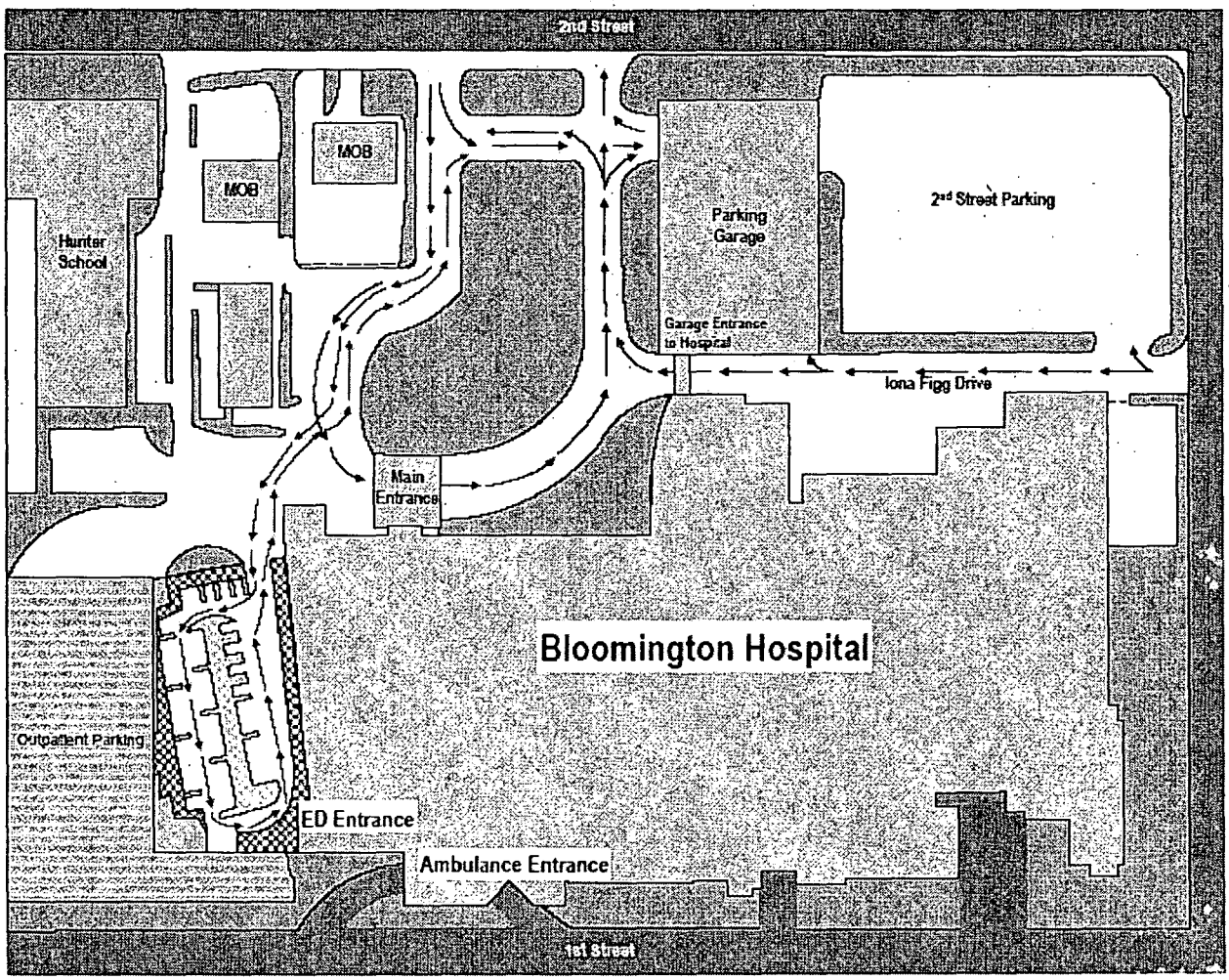
ROUTE TO BLOOMINGTON HOSPITAL



City of Bloomington
Hospital Location



Bloomington Hospital
Emergency Room and Parking



2.11 INJURY/ILLNESS REPORTING

If any TtNUS personnel are injured or develop an illness as a result of working on site, the TtNUS "Injury/Illness Procedure" (Attachment I) must be followed. Following this procedure is necessary for documenting of the information obtained at the time of the incident.

Any pertinent information regarding allergies to medications or other special conditions will be provided to medical service personnel. This information is listed on Medical Data Sheets (Attachment II) filed onsite. If an exposure to hazardous materials has occurred, provide information on the chemical, physical, and toxicological properties of the subject chemical(s) to medical service personnel.

FIGURE 2-3
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 TtNUS 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 be 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 TtNUS, 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) and Human Resources (Marilyn Duffy) 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 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 2-3 (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
Chest Tightness / Pressure
Nausea / Vomiting
Dizziness
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: _____

3.0 SITE BACKGROUND

This section provides information pertaining to NSWC Crane and the site that is to be investigated. This information will be revised if additional information becomes available or if additional sites are going to be investigated.

3.1 SITE HISTORY

The Naval Surface Warfare Center Crane (NSWC Crane) is located in Crane, Indiana approximately 75 miles southwest of Indianapolis and 71 miles northwest of Louisville, Kentucky. The facility encompasses more than 100 square miles (64,463 acres) in Daviess, Greene, Lawrence, and Martin Counties. It is located in a rural, sparsely populated area. The acreage surrounding the base is either wooded or farmed land. The facility, originally called Naval Ammunition Depot (NAD), Burns City, was opened in 1941 to serve as an inland ammunition production and storage center. The Depot's name was changed to NAD, Crane in 1943. In 1975, the name was changed to Naval Weapons Support Center, Crane and in 1992, the name was again changed to Naval Surface Warfare Center, Crane. Today NSWC Crane's mission is to "provide quality and responsive engineering, technical and material support to the Fleet for combat subsystems, equipment and components, microelectronic technology, microwave components, electronic warfare, acoustic sensors tests, engineering pyrotechnics, small arms, electronic module test and system command." Under the Single Service Management Program, a segment of the Center's mission is to provide support (including environmental protection) to the Crane Army Ammunition Activity (CAAA). The Army is tasked with the production and renovation of conventional ammunition and related items, the performance of manufacturing, engineering, and product quality assurance to support production; and the storage, shipment, demilitarization, and disposal of conventional ammunition and related components. Because of the nature of the Army's operations, CAAA contributes significant financial support for the environmental program through an Inter-service Support Agreement.

3.2 SWMU 17 PCB CAPACITOR BURIAL/POLE YARD

This HASP covers CTO 0376 RCRA Phase III Facility Investigation at the PCB Capacitor Burial/Pole Yard at the Naval Surface Warfare Center Crane Division. The PCB Capacitor Burial/Pole Yard (SWMU 17) has been in use since the 1970s. Historically, the site has been used to store and possibly bury capacitors and transformers, some of which contained PCBs. In addition, utility poles impregnated with creosote and potentially contaminated with PCBs, were also stored in this area. It is known that capacitors were buried at SWMU 17 the early 1970s. NSWC Crane intends to utilize the area for different

purposes than its current use. In September, 2004 more than 2930 tons of soil was excavated to 2 feet and the site was covered with clean fill. Due to contractual obligations, excavation operations ceased before contaminated soils were removed. The vertical extent of this contamination is unknown. Excavation around the dumping area found electrical insulators, transformers and miscellaneous debris. PCB contaminated soil was found in the drainageway downgradient of the area.

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 each of the tasks that are to be performed as part of the scope of work conducted at the site. As new phases or tasks are to be performed at the site, Table 5-1 will be modified accordingly. If tasks other than those presented below are performed at the site, this section will be modified accordingly.

Sampling and analyses for site characterization is expected to be performed in one mobilization. The scope of site characterization work includes collecting both sediment, surface and subsurface soil samples to determine the nature and extent of PCB contamination. The Field Investigation at the PCB Capacitor Burial Pole Yard, will consist of the following tasks:

- Mobilization/Demobilization
- Soil boring activities include direct push technology (DPT) and hand augeing techniques.
- Multi-Media Sampling including:
  - Surface Soils
  - Subsurface Soils
  - Sediment
- Decontamination of sampling and heavy equipment
- IDW Management
- Geographical survey

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

Table 5-1 of this section serves as the primary portion of the site specific HASP which identifies the tasks that are to be performed as part of the scope of work. The anticipated hazards, recommended control measures, air monitoring recommendations, required Personal Protective Equipment (PPE), and decontamination measures for each site task are discussed in detail. This table and the associated control measures will be revised, if the scope of work, contaminants of concern, or other conditions change.

Through using the table, site personnel can determine which hazards are associated with each task and at each site, and what associated control measures are 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.

A Health and Safety Guidance Manual must accompany this table and the HASP. This will require the FOL to obtain and maintain a Guidance Manual on site. The manual is designed to further explain supporting programs and elements for other site-specific aspects as required by 29 CFR 1910.120. The Guidance Manual should be referenced 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' SOPs are also provided in this Guidance Manual.

Safe Work Permits (SWP) issued for major activities (See Section 10.11) will use elements defined in Table 5-1 as the primary reference. The FOL or the SSO completing the SWP will add additional site-specific information. In situations where the SWP 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.

5.1 GENERAL SAFE WORK PRACTICES

In addition to the task-specific work practices identified on Table 5-1, the following safe work practices will be observed when conducting work involving known and unknown site hazards. These safe work practices establish a pattern of general precautions and measures for reducing risks associated with hazardous site operations.

- Refrain from eating, drinking, chewing gum or tobacco, taking medication, or smoking in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists.

- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible if excessive skin contamination occurs.

- Avoid contact with potentially contaminated substances by walking around puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on equipment. Do not place monitoring equipment on potentially contaminated surfaces.

- Be familiar with and adhere to the instructions in the site-specific HASP.

- Be aware of the location of the nearest telephone and emergency telephone numbers. See Section 2.0, Table 2-1.

- Attend briefings on anticipated hazards, equipment requirements, Safe Work Permits, emergency procedures, and communication methods before going on site.

- Plan and mark entrance, exit, and emergency escape routes. See Section 2.0.

- Rehearse unfamiliar operations prior to implementation.

- Maintain visual contact with each other and with other on-site team members by remaining in close proximity in order to assist each other in case of emergency.

- Establish appropriate Safety Zones including Support, Contamination Reduction, and Exclusion Zones.

- Minimize the number of personnel and equipment in contaminated areas (such as the Exclusion Zone). Non-essential vehicles and equipment should remain within the Support Zone.

- Establish appropriate decontamination procedures for leaving the site.

- Immediately report injuries, illnesses, and unsafe conditions, practices, and equipment to the Site Safety Officer (SSO).

- Observe coworkers for signs of toxic exposure and heat or cold stress.

- Inform co-workers of potential symptoms of illness, such as headaches, dizziness, nausea, or blurred vision.

5.2 SOIL BORING SAFE WORK PRACTICES

The following safe work practices will be followed when working around DPT operations.

- Heavy equipment (DPT) will be inspected by a Competent Person (the SSO or designee), prior to the acceptance of the equipment at the site and prior to the use of the equipment. Repairs or deficiencies identified will be corrected prior to use. The inspection will be accomplished using the Equipment Inspection Checklist provided in Attachment III. Inspection frequencies will be once every 10-day shift or following repairs.

- Identify underground utilities and buried structures before intrusive operations are performed. Use the Utility Locating and Excavation Clearance Standard Operating Procedure provided in Attachment IV.

- The DPT assistant will establish an equipment staging and lay down area plan. The purpose of this is to keep the work area clear of clutter and slips, trips, and fall hazards.

- Potentially contaminated tooling will be wrapped in polyethylene sheeting for storage and transport to the centrally located decontamination unit.

- One employee will be designated by the DPT operator as the individual with primary responsibility for immediate activation of emergency stop devices in the event of an emergency.

- Prior to engaging boring equipment, the equipment operator will ensure workers are clear of moving parts and will verbally alert workers in the vicinity of moving equipment.

- Minimize contact to the extent possible with contaminated tooling and environmental media.

- Support functions (sampling and screening stations) will be maintained a minimum distance from the DPT rig equal to the height of the mast plus five feet to remove these activities from within physical hazard boundaries.

- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the DPT rig.

- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should move auger flights and other heavy tooling.

- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone. Site visitors will be escorted.

- Equipment used within the exclusion zone will undergo a complete decontamination and evaluation by the SSO to determine cleanliness prior to moving to the next location, exiting the site, or prior to down time for maintenance.

- Motorized equipment will be fueled prior to the commencement of the day's activities. During fueling operations, equipment will be shut down and bonded to the fuel provider.

- When not in use DPT rigs will be shut down, and emergency brakes set. DPT rigs will have their wheels chocked to assist in controlling movement.

Areas subjected to subsurface investigative methods will be restored to equal or better condition than original to remove any contamination brought to the surface and to remove any physical hazards. In situations where these hazards cannot be removed these areas will be barricaded to minimize the impact on field crews working in the area.

TASKS/HAZARDS/CONTROL MEASURES
NAVAL SURFACE WARFARE CENTER CRANE DIVISION, CRANE, INDIANA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment (Items in italics are deemed optional as conditions or the FOL or SSO require.)	Decontamination Procedures
Mobilization/ Demobilization	*Physical Hazards* 1) Lifting (strain/muscle pulls) 2) Pinches and compressions 3) Slips, trips, and falls 4) Heavy equipment hazards (rotating equipment, hydraulic lines, etc.) 5) Vehicular and foot traffic 6) Ambient temperature extremes (cold stress) *Natural hazards* 7) Insect/animal bites and stings, poisonous plants, etc. 8) Inclement weather	1) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 2) Keep any machine guarding in place. Avoid moving parts. Use tools or equipment where necessary to avoid contacting pinch points. 3) Preview work locations for unstable/uneven terrain. 4) All equipment will be - Inspected in accordance with OSHA and manufacturer's design. - Operated by knowledgeable operators and ground crew. 5) Traffic and equipment considerations are to include the following: - Establish safe zones of approach. - Secure all loose articles. - All equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the site requirements. 6) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold stress is provided in Section 4 of the Health and Safety Guidance Manual. 7) Avoid nesting areas, use repellents. Report potential hazards to the SSO. Follow guidance presented in Section 4 of the Health and Safety Guidance Manual. 8) Suspend or terminate operations until directed otherwise by SSO.	Not required	Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Steel toe safety shoes - *Safety glasses* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Reflective vest for high traffic areas* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.*	Not required
Decontamination of Sampling and Heavy Equipment.	*Chemical Hazards* 1) Previous analytical data identified PCB's (Aroclor-1260) and creosote as potential contaminants of concern. None of the contaminants are anticipated to be present in concentrations that would present an inhalation hazard. Table 6-1 provides additional information about each of the identified contaminants of concern. 2) Decontamination fluids - Liquinox (detergent), acetone or isopropanol *Physical Hazards* 3) Lifting (strain/muscle pulls) 4) Noise in excess of 85 dBA 5) Flying projectiles 6) Vehicular and foot traffic 7) Ambient temperature extremes (cold stress) 8) Slips, trips, and falls *Natural Hazards* 9) Inclement weather	1) and 2) Use protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Obtain manufacturer's MSDS for any decontamination fluids used on-site. These must be used in well-ventilated areas, such as outdoors. Use appropriate PPE as identified on MSDS. All chemicals used must be listed on the Chemical Inventory for the site, and site activities must be consistent with the Hazard Communication section of the Health and Safety Guidance Manual (Section 5). 3) Use multiple persons where necessary for lifting and handling sampling equipment for decontamination purposes. 4) Wear hearing protection when operating pressure washer. 5) Use eye and face protective equipment when operating pressure washer. All other personnel must be restricted from the area. 6) Traffic and equipment considerations are to include the following: - Establish safe zones of approach. - All equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the site requirements. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold stress is provided in Section 4 of the Health and Safety Guidance Manual. 8) Preview work locations for unstable/uneven terrain. 9) Suspend or terminate operations until directed otherwise by SSO.	Use visual observation to ensure all equipment has been properly cleaned of contamination and dried.	For Heavy Equipment This applies to high pressure soap/water, steam cleaning wash and rinse procedures. Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Steel toe safety shoes - Chemical resistant boot covers - Nitrile outer gloves - Safety glasses underneath a splash shield - Hearing protection (plugs or muffs) - *PVC Rainsuits or PE or PVC coated Tyvek* For sampling equipment (trowels, MacroCore Samplers, bailers, etc.), the following PPE is required Note: Consult MSDS for PPE guidance. Otherwise, observe the following. Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Steel toe safety shoes - Nitrile outer gloves - Safety glasses In the event of overspray of chemical decontamination fluids employ PVC Rainsuits or PE or PVC coated Tyvek as necessary. **Note:** The Safe Work Permit(s) for this task (see Attachment V) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** will consist of a soap/water wash and rinse for reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable). The decon function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer boots and gloves, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Disposable PPE will be removed and bagged. **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing steam or pressure washers. Heavy equipment will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will have restricted access to exclusion zones, and have their wheels/tires sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the onsite activity. **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements in the Quality Assurance Project Plan. MSDS for any decon solutions (Alconox, isopropanol, etc.) will be obtained and used to determine proper handling / disposal methods and protective measures (PPE, first-aid, etc.). 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 leaving the site. No equipment will be authorized access or exit without this evaluation.

TASKS/HAZARDS/CONTROL MEASURES
NAVAL SURFACE WARFARE CENTER CRANE DIVISION, CRANE, INDIANA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO require)*	Decontamination Procedures
Multi-media sampling, including surface and ground water; sediment; surface and subsurface soils.	*Chemical Hazards* 1) Previous analytical data identified PCB's (Aroclor-1260) and creosote as potential contaminants of concern. None of the contaminants are anticipated to be present in concentrations that would present an inhalation hazard. Table 6-1 provides additional information about each of the identified contaminants of concern. 2) Transfer of contamination into clean areas *Physical hazards* 3) Noise in excess of 85 dBA 4) Lifting (strain/muscle pulls) 5) Pinches and compressions 6) Slips, trips, and falls 7) Ambient temperature extremes (cold stress) 8) Vehicular and foot traffic *Natural hazards* 9) Insect/animal bites and stings, poisonous plants, etc. 10) Inclement weather	1) Use safe work practices and identified PPE to control exposures to potentially contaminated media. Generation of dusts should be minimized. If airborne dusts are observed, area wetting methods may be used. If area wetting methods are not feasible, activities must be suspended until dust levels subside, or until an acceptable alternative control method can be selected. Air monitoring instruments will be used as a precautionary measure to evaluate the presence of VOCs. 2) Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. 3) When sampling at the operating DPT rig use hearing protection. The use of hearing protection outside of 25 feet from the DPT rig should be incorporated under the following condition: If you have to raise your voice to talk to someone who is within 2 feet of your location, hearing protection must be worn. 4) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 5) Avoid moving parts. Use tools or equipment where necessary to avoid contacting pinch points. - A remote sampling device must be used to sample near rotating tools. The equipment operator shall shutdown machinery if the sampler is near moving machinery parts. 6) Preview work locations for unstable/uneven terrain. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold stress is provided in Section 4 of the Health and Safety Guidance Manual. 8) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 5 feet). See Section 9 of the HASP for specific safety zones based on media being sampled. - All equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the site requirements. 9) Avoid nesting areas, use repellents. Report potential hazards to the SSO. Follow guidance presented in Section 4 of the Health and Safety Guidance Manual. 10) Suspend or terminate operations until directed otherwise by the SSO.	As a precaution, direct reading Photoionization Detector (PID) with a 10.6 eV lamp or higher, or a Flameionization Detector (FID), will be used to screen samples and to detect the presence of any VOCs. Source monitoring of the sample collection area will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location(s) which may impact operations 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 background in the breathing zone of the at-risk employees requires site activities to be suspended and site personnel to retreat to an unaffected area. - Work may only resume if airborne readings in worker breathing zone return to below background. If elevated readings in worker 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 minimized to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be performed by observing work conditions for visible dust clouds. Potential exposure to contaminated dust will be controlled using water suppression, by avoiding dust plumes, or evacuating the operation area until dust subsides. Where the utility clearance cannot be obtained in a reasonable period, or not located, intrusive activities shall proceed with extreme caution using a magnetometer for periodic down hole surveys every 2 feet to a depth of at least 6 feet. See Attachment IV Utility Locating And Excavation Clearance of this HASP.	Level D protection will be utilized for the initiation of all sampling activities. Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Steel toe safety shoes - Safety glasses - Surgical style gloves *(double-layered if necessary)* - *Reflective vest for high traffic areas* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential for soiling work attire exists.* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.* **Note:** The Safe Work Permit(s) for this task (see Attachment V) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** will consist of a removal and disposal of non-reusable PPE (gloves, coveralls, etc., as applicable). The decon function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Outer coveralls, boot covers, and/or outer glove removal (as applicable) - Removal, segregation, and disposal of non-reusable PPE in bags/containers provided - Soap/water wash and rinse of reusable PPE (e.g., hardhat) if potentially contaminated - Wash hands and face, leave contamination reduction zone.

TASKS/HAZARDS/CONTROL MEASURES
NAVAL SURFACE WARFARE CENTER CRANE DIVISION, CRANE, INDIANA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO require.)*	Decontamination Procedures
Soil borings using Direct-Push Technology [Geoprobe®], hand auger methods.	*Chemical Hazards* 1) Previous analytical data identified PCB's (Aroclor-1260) and creosote as potential contaminants of concern. None of the contaminants are anticipated to be present in concentrations that would present an inhalation hazard. Table 6-1 provides additional information about each of the identified contaminants of concern. 2) Transfer of contamination into clean areas or onto persons *Physical hazards* 3) Heavy equipment hazards (pinch/compression points, rotating equipment, hydraulic lines, etc.) 4) Noise in excess of 85 dBA 5) Energized systems (contact with underground or overhead utilities) 6) Lifting (strain/muscle pulls) 7) Slips, trips, and falls 8) Vehicular and foot traffic 9) Ambient temperature extremes (cold stress) *Natural hazards* 10) Insect/animal bites and stings, poisonous plants, etc. 11) Inclement weather	1) Use safe work practices and identified PPE to control exposures to potentially contaminated media (air, water, soils, etc.). Generation of dusts should be minimized. If airborne dusts are observed, area wetting methods may be used. If area wetting methods are not feasible, activities must be suspended until dust levels subside, or until an acceptable alternative control method can be selected. 2) Decontaminate all equipment and supplies between boreholes and prior to leaving the site. 3) All equipment to be used will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturers design and documented as such using Equipment Inspection Sheet (see Attachment III of this HASP). - Operated by knowledgeable operators and ground crew. - Repaired using only manufacturer approved parts and equipment. In addition to the equipment considerations, the following standard operating procedures will be employed: - All personnel not directly supporting the DPT operation will remain at least the mast height plus 5 feet from the point of operation. - All loose clothing/protective equipment will be secured to avoid possible entanglement. - Hand signals will be established prior to the commencement of DPT activities. - A remote sampling device must be used to sample near rotating tools. - Work areas will be kept clear of clutter. - All personnel will be instructed in the location and operation of the emergency shut off device(s) for DPT rigs (if applicable). This device will be tested initially (and then periodically) to insure its operational status. - Areas will be inspected prior to the movement of DPT rigs and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. 4) Hearing protection will be used during all subsurface activities using the DPT rig. 5) All DPT activities must proceed in accordance with the TtNUS SOP "Utility Locating and Excavation Clearance" (see Attachment IV of this HASP). All utility clearances must be obtained, in writing, prior to activities. Also, prior to any subsurface investigations, the locations of all underground utilities must be identified and marked. Overhead utilities must be identified per the SOP. 6) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 7) Preview work locations for unstable/uneven terrain. 8) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 5 feet). See Section 9 of the HASP for specific safety zones based on media being sampled. - All equipment shall be equipped with movement warning systems. - All activities are to be conducted consistent with the site requirements. 9) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold stress is provided in Section 4 of the Health and Safety Guidance Manual. 10) Avoid nesting areas, use repellents. Wear appropriate clothing. Report potential hazards to the SSO. Follow guidance presented in Section 4 of the Health and Safety Guidance Manual. 11) Suspend or terminate operations until directed otherwise by SSO.	As a precaution, direct reading Photoionization Detector (PID) with a 10.6 eV lamp or higher, or a Flameionization Detector (FID), will be used to screen the work area to detect the presence of VOCs. Source monitoring of the borehole will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location(s) which may impact operations 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 background in the breathing zone of the at-risk employees requires site activities to be suspended and site personnel to retreat to an unaffected area. - Work may only resume if airborne readings in worker breathing zones return to below background. If elevated readings in worker 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 minimized to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be performed by observing work conditions for visible dust clouds. Potential exposure to contaminated dust will be controlled using water suppression, by avoiding dust plumes, or evacuating the operation area until dust subsides. Where the utility clearance cannot be obtained in a reasonable period, or not located, intrusive activities shall proceed with extreme caution using a magnetometer for periodic down hole surveys every 2 feet to a depth of at least 6 feet. See Attachment IV Utility Locating And Excavation Clearance of this HASP.	All subsurface operations are to be initiated in Level D protection. Level D protection constitutes the following minimum protection - Standard field attire (Sleeved shirt; long pants) - Steel toe safety shoes - Safety glasses - Hardhat - Hearing protection during soil boring activities and for other high noise areas as directed by the SSO. - Nitrile gloves or leather gloves with surgical style inner gloves - *Reflective vest for traffic areas* - *Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential exists for soiling work attire.* **Note:** The Safe Work Permit(s) for this task (see Attachment V) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** - Will consist of a soap/water wash and rinse for reusable protective equipment (e.g., gloves). This function will take place at an area adjacent to the DPT operations bordering the support zone. This decontamination procedure for Level D protection will consist of - Equipment drop - Soap/water wash and rinse of reusable outer gloves, as applicable - Outer coveralls, boot covers, and/or outer glove removal - Removal, segregation, and disposal of non-reusable PPE in bags/containers provided - Wash hands and face, leave contamination reduction zone.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL SURFACE WARFARE CENTER CRANE DIVISION, CRANE, INDIANA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment (Items in italics are deemed optional as conditions or the FOL or SSO require.)	Decontamination Procedures
Surveying – Geographical	*Chemical hazards:* Significant exposure to site contaminants is anticipated to be unlikely given the nature of this task. *Physical hazards:* 1) Slips, trips, and falls 2) Ambient temperature extremes (cold stress *Natural Hazards:* 3) Inclement weather 4) Insect/animal bites or stings, poisonous plants, etc.	1) Preview work locations and site lines for uneven and unstable terrain. Clear necessary vegetation, establish temporary means for traversing hazardous terrain (i.e., rope ladders, etc.) 2) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold stress is provided in Section 4 of the Health and Safety Guidance Manual. 3) Suspend or terminate operations until directed otherwise by SSO 4) Avoid nesting areas, use repellents. Report potential hazards to the SSO. Follow guidance presented in Section 4 of the Health and Safety Guidance Manual.	No air monitoring is needed given the unlikelihood that airborne contaminants will be present. The potential for exposure to site contaminants during this activity is considered minimal.	Surveying activities shall be performed in Level D protection Level D Protection consists of the following: - Standard field dress including sleeved shirt and long pants - Steel toe safety shoes - *Safety glasses, hard hats (if working near machinery)* - *Snake chaps for heavily wooded area where encounters are likely.* - *Tyvek coveralls may be worn to provide additional protection against poisonous plants and insects, particularly ticks. Work gloves may be worn if desired.* Note: The Safe Work Permit(s) for this task (see Attachment V) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** - A structured decontamination is not required as the likelihood of encountering contaminated media is considered remote. However, survey parties should inspect themselves and one another for the presence of ticks when exiting wooded areas, grassy fields, etc. This action will be employed to stop the transfer of these insects into vehicles, homes, and offices.

6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical and physical hazards associated with the NSWC Crane Site and the activities that are to be conducted as part of the scope of work. Table 6-1 provides information related to the chemical hazards that may be present at the site. Specifically, toxicological information, exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data are discussed in the table. It should be noted that the contaminants of concern might vary between tasks.

6.1 CHEMICAL HAZARDS

General contaminants of concern associated with these sites include PCB and Creosote. Pure PCBs have never been found in transformers or capacitors at NSWC Crane. The greatest concentrations of PCBs have been in the range of 10,000-ppm PCB. Therefore, any releases of capacitor or transformer oil at SWMU 17 would be expected to exhibit concentrations, in the range of 10,000 ppm PCB. Previous sampling events show that PCBs are present at concentrations exceeding criteria for industrial soils. The presence of PCBs correlates with information regarding historical activities at the PCB Capacitor Burial Pole Yard. PCBs were found at locations where capacitors are reportedly buried, transformers were stored, and creosote-impregnated utility poles were stored.

It is not anticipated that levels will be encountered that are of concern to field crews. It is recommended that exposure (via inhalation, ingestion, or skin contact) to these contaminants be minimized through the use of PPE and good hygiene practices.

For further information on these contaminants and other potential contaminants see Table 6-1.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA

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 limits of: OSHA; ACGIH: 0.2 mg/m^3 NIOSH: 0.1 mg/m^3 **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).
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 - PID is not anticipated to detect this 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/m^3 (skin) NIOSH: 0.001 mg/m^3 IDLH: 5 mg/m^3	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.

6.2 PHYSICAL HAZARDS

The following is a list of physical hazards that may be encountered at the site or may present during the performance of site activities associated with the scope of work. Some of these hazards are discussed below while the rest are discussed in the TtNUS Health and Safety Guidance Manual.

- Slips, trips, and falls
- Cuts (or other injuries associated with hand tool use)
- Energized systems (contact with underground or overhead utilities)
- Lifting (strain/muscle pulls)
- Ambient temperature extremes (cold and heat stress)
- Pinches and compressions
- Heavy equipment hazards (rotating equipment, hydraulic lines, etc.)
- Vehicular and foot traffic
- Noise in excess of 85 dBA

6.2.1 Slips, Trips, And Falls

Conditions such as steep terrain and/or heavy vegetation may create an increased potential for slip, trip, and fall hazards

- The safest approach to sample points will be identified and cleared to permit field crew access to sample locations.
- Establish anchor points and rope handrails for traversing/ascending/descending angles and slopes greater than 45% grade.
- Footwear with an adequate traction.
- Prepare work areas by removing tripping hazards (ruts, roots, debris). This is especially critical around rotating equipment, where a fall into the rotating apparatus could be life threatening.

6.2.2 Cuts or Other Injuries Associated with Hand Tool Use

The control measures presented below will help minimize the potential for physical and cutting hazards.

- Wear leather or heavy cotton work gloves when using tools to protect against blisters, cuts, or other hand injuries.
- Wear eye protection (safety glasses with side shields) to protect the eyes from flying debris.
- Wear long pants and long-sleeved shirts to protect against abrasions.

- Inspect hand tools before each use.
- Ensure knives are sharp to facilitate cutting action. This will avoid persons forcing to cut and increasing potential hazards.
- Use the proper tool for the intended purpose. The proper tool for cutting the acetate tube for sampling is the retention tub recommended by Geoprobe. This will avoid potential injury possibly created through improper cutting procedures.

6.2.3 Energized Systems (Contact with Underground or Overhead Utilities)

Underground utilities such as pressurized lines, water, telephone, buried utility, and high voltage power lines may be present throughout the facility. **Therefore, subsurface activities must be conducted following the requirements of the Tetra Tech NUS SOP for "Utility Locating and Excavation Clearance (HS-1.0)".** A copy of this SOP is provided as Attachment IV. Clearance of underground and overhead utilities for each location will be coordinated with the Site Contact. Additionally, DPT operations will be conducted at a safe distance from overhead power lines as discussed in Attachment IV. In certain cases, there may be a need to de-energize electrical cables using facility lockout/tagout procedures to insure electrical hazards are eliminated.

6.3 NATURAL HAZARDS

Insect/animal bites and stings, poisonous plants, and inclement weather are natural hazards that may be present given the location of activities to be conducted. As previously discussed, some portions of the site include vegetated areas which increases the potential for field crews to encounter ticks, bees, mosquitoes/insects, snakes, and poisonous vegetation.

6.3.1 Insect Bites and Stings

Insect/animal bites and stings are difficult to control given the climate and environmental setting of NSWC Crane. However, in an effort to minimize this hazard the following control measures will be implemented where possible.

- Commercially available bug sprays and repellents will be used whenever possible – Pesticides analytical screening includes chlordane, endrin, lindane, methoxychlor, toxaphene and heptachlor. Commercially available repellants may be used providing they don't contain substances which appear on the analytical list for pesticide analysis. Products such as DEET should not be applied directly to the skin due to potential irritation. This product, when permitted for use, should be applied over clothing articles.

- Where possible, loose-fitting and light-colored clothing with long sleeves should be worn. This will also aid in insect control by providing a barrier between the field person and the insects and to provide easy recognition of crawling insects against the lighter background. Pant legs should be secured to the work-boots using duct tape to prevent access by ticks. Mosquito nets are also recommended for use when commercially available repellents are not permitted.

- Clothing/limited body checks for ticks and other crawling insects should be conducted upon exiting heavily vegetated areas. Workers should perform a more detailed check of themselves when showering in the evening. Ticks prefer moist areas of the body (arm-pits, genitals, etc.) and will migrate to those locations.

- The FOL/SSO will preview access routes and work areas in an effort to identify physical hazards including nesting areas in and around the work sites. These areas will be flagged and communicated to site personnel.

- The FOL/SSO must determine if site personnel (through completion of Medical Data Sheets), suffer allergic reactions to bee and other insect stings and bites. Field crew members who are allergic to bites should have their emergency kit containing antihistamine and a preloaded syringe of epinephrine readily available.

Any allergies (insect bites, bee stings, etc.) must be reported on the Medical Data Sheet and to the SSO.

Tick and Mosquito Transmitted Illnesses and Diseases

Ticks and mosquitoes have been identified in the transmission of diseases including Lyme's disease and malaria. Warm months (Spring through early Fall) are the most predominant time for this hazard. Information concerning Lyme's Disease including recognition, evaluation, tick removal, and control is provided in Section 4.0 of the Health and Safety Guidance Manual.

Malaria may occur when a mosquito or other infected insect sucks blood from an infected person, and the insect becomes the carrier to infect other hosts. The parasite reproduces within the mosquito, and is then passed on to another person through the biting action. Acute symptoms include chills accompanied by fever and general flu like symptoms. This generally terminates in a sweating stage. These symptoms may recur every 48 to 72 hours.

The Indiana State Department of Health has been monitoring the arrival of WNV in the state. Crows found in Marion and Floyd Counties are the first positive indicator that West Nile virus has officially arrived

in Indiana. State health officials say that although this is the first time West Nile encephalitis virus, which is transmitted by mosquitoes, has been identified in the state, it is not unexpected. No human cases have been found in Indiana. West Nile Encephalitis cases occur primarily in the late summer or early fall.

Mild infections are common and include fever, headache, and body aches, often with skin rash and swollen lymph glands. More severe infection is marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, occasional convulsions, paralysis and, rarely, and death (especially in the elderly and very young). The incubation period of West Nile encephalitis is usually 3 to 12 days. There is no specific therapy or vaccine against West Nile encephalitis.

Precautions include:

- Limit outdoor activities during peak mosquito times – at dusk and dawn.
- Avoid standing water
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Apply insect repellent according to manufacturers instruction to exposed skin. An effective repellent will contain 20% to 30% DEET (N,N-diethyl-meta-toluamide). Avoid products containing more than 30% DEET.
- Spray clothing with repellents containing permethrin or DEET, mosquitoes may bite through thin clothing.

6.3.2 Snakes and Other Wild Animals

Indigenous animals including snakes (poisonous and non-poisonous varieties), raccoons, and other animals native to the region may be present at the site. These animals may be encountered if work locations encroach on nesting or territories claimed by these animals.

To avoid the obvious hazards conveyed as part of a direct encounter, the following actions will be taken to minimize impact on the field crews and/or operations. The FOL/SSO will preview access routes and work locations for nesting areas or signs of animal activities (tracks, foraging areas, etc.). Identified suspect areas will be communicated to the field crews. Snake chaps will be required as a precaution.

Venomous Snakes of Indiana

There are few poisonous snakes in Indiana. Indiana's poisonous snakes are very heavy-bodied – they look "fat." They also have broad, spade-shaped heads that are distinctly wider than their narrow necks. The heads of non-venomous snakes are typically about the same width as their bodies. Such distinctions are not completely reliable, as some species such as water snakes can be rather stout, and many species

of snakes will flatten their heads when bluffing, giving the head a spade-like shape as well. The pupils of the venomous snakes of Indiana are vertical slits rather than round. This distinction may not hold elsewhere, but works in this state.

Do not attempt to handle or kill a snake that you believe may be venomous. Simply keep at a safe distance and move on your way. Snakes do not actively seek out people and bite them. Given the chance, snakes will almost always try to escape an encounter. If you leave them alone, they will make every effort to leave you alone as well. Be very careful to avoid the head when handling dead snakes. A snake's reflexes can remain functional hours after death, and supposedly "dead" snakes have bitten people.

Copp rhead

The most common venomous species is the copperhead, and even it has a restricted range in the hills of southern Indiana.

Appearance: The copperhead is a moderately large snake that typically measures 24 to 36 inches in length. Its head is reddish-brown in color and its body is tan. The body is marked with 15 to 19 mahogany lateral bands with darker edges that are wide on the sides and narrow on the back. The lateral bands are occasionally interrupted along the midline. Viewed from above, these bands appear hourglass shaped. Irregular brown spots are often found between the bands. The copperhead has a wedge-shaped head, sensory pits, and vertically elliptical "cat-like" pupils. The young are pale with a yellow tipped tail and are 8 to 9 inches in length.

Ecology: The copperhead is found primarily in high, dry, rocky and well-forested areas dominated by oaks and hickories. This species is very secretive and does not tolerate human presence. The copperhead is active at night the warmest part of the year and is more likely to defend itself during the evening hours. It can be found resting under logs, in cracks of foundations, and under rocks. Small rodents such as mice are its primary prey, but it also eats large moth larvae and lizards.

Timb r Rattlesnakes

Timber rattlesnakes are rare and usually restricted to some of the forested hills in south central Indiana.

Appearance: These snakes are Indiana's largest, averaging 48 to 72 inches in length with a rattle on the end of their tail. They can be found in the hill country of south central Indiana. The timber rattlesnake is a thick-bodied snake with a wide head distinct from the neck, typical of our venomous snakes. The color pattern of the timber rattler is very variable, ranging from sulfur yellow and buff brown, to dark gray.

Regardless of the pattern, a series of wide black cross bands line the back along the length of the body. These cross bands have been described as "blunt chevrons." Its distinctly wedge-shaped head, sensory pit, and elliptical eye slits are characteristic of snakes in the viper family.

Ecology: The timber rattlesnake is native to heavily forested areas in the hills of southern Indiana. It feeds on small mammals and birds. The timber rattler hibernates inside the cracks and crevices of rocky hillsides. Timber rattlesnakes do not stalk their prey, but rather remain motionless and wait for their prey to move within striking distance. Populations of timber rattlesnakes are mostly limited to areas fairly isolated from human development.

Snake Bites

Initial efforts will be directed to avoid, where possible, nesting and territorial areas. However, should field personnel come in contact with these animals and receive a bite, the following actions are necessary.

- Obtain a detailed description of the snake. This and the bite mark will enable medical personnel administering medical aid to provide prompt and correct antidotes, as necessary.

- Immobilize the bite victim to the extent possible. Physical exertion will mobilize the toxins (if poisonous varieties) from the bite point systemically through the body.

- Apply a pressure wrap (for extremities), just above and over the bite area. With a couple wraps of the pressure wrap in place over the bite area, apply a splint, and continue the application of the pressure wrap. The purpose for the splint is to restrict the movement of the extremity, this along with the pressure wrap will aid in restricting the toxins from leaving the site of the bite.

- Seek medical attention immediately.

6.3.3 Poisonous Plants

Various plants which can cause allergic reactions may be encountered during field work. These include, poison ivy, poison oak, and poison sumac. Contact with these plants may occur when clearing vegetation for access to work areas, or as a result of movement through these plants. An irritating, allergic reaction can occur after direct contact with the plant or indirect contact through some piece of equipment or clothing article. Oils are transferred from the plant to exposed skin, clothing, or piece of equipment. The degree of the irritating, allergic reaction can vary significantly from one person to the next.

Protective measures to control and minimize the effects of this hazard may include, but not be limited to, the following:

- Identify plants for field personnel.

  - Poison Ivy - Characterized by climbing vines, three leaf configuration ovate to elliptical in shape, deep green leaves with a reddish tint, greenish flowers, and white berries.

  - Poison Sumac - Characterized as a tall bush of the sumac family bearing compound leaves (7-13 entire leaflets), branched from a central axis, drooping, with axillary clusters of white fruit: However, these white fruits and berries may exist only during pubescent stages.

  - Poison oak - Characterized as similar to poison ivy consisting of a shrub, stems erect, 0.3 to 2.0 meters tall, leaflets consist of broad thick lobes coarsely serrated configuration, denser at the base, less so than the top.

- Protective measures may include wearing disposable garments such as Tyvek when clearing brush. These may be carefully removed and disposed of along with any oils accumulated from the plants.

- Personal Hygiene - The oils obtained from the plants will only elicit an allergic response when the person's bare skin layer is contacted. This can be aggravated when skin pores are open (perspiring), or through breaks in the skin such as cuts, nicks, scratches, etc. This can also be accomplished when using excessively hot water for cleaning the skin, which also causes pores to open. Prior to break time, lunchtime, etc. personnel should wash with cool water and soap to remove as much of the oils as possible. In heavily vegetated areas of these plants, additional measures including barrier creams and blocks may be used to prevent the oils from accessing and penetrating the skin.

These plants present an airborne sensitization hazard when burned. This is not to occur as part of this scope of work and therefore will not be addressed.

6.3.4 Inclement Weather

Project tasks under this Scope of Work will be performed outdoors. As a result, inclement weather may be encountered. In the event that adverse weather conditions arise (electrical storms, tornados, hailstorms, etc.), the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

7.0 AIR MONITORING

Direct reading instruments will be used at the site to evaluate the presence of detectable site contaminants and other potentially hazardous conditions. As a result, specific air monitoring measures and requirements are established in Table 5-1 pertaining to the specific hazards and tasks of an identified operation. Additionally, the Health and Safety Guidance Manual, Section 1.0, contains detailed information regarding direct reading instrumentation, as well as general calibration procedures of various instruments.

7.1 INSTRUMENTS AND USE

Instruments will be used primarily to monitor source points and worker breathing zone areas, while observing instrument action levels. Action levels are discussed in Table 5-1 as they may apply to a specific task or location.

7.1.1 Photoionization Detector or Flame Ionization Detector

Site contaminants are not likely to be readily detected using typical field instrumentation. However, a Photoionization Detector (PID) with a lamp energy of 10.6 eV or higher will be used to measure the presence of VOCs. This instrument will be used to monitor boreholes, sampling locations and to screen the breathing zones of employees during site activities. The PID has been selected because it is capable of various organic vapors compounds. (NOTE: A Flame Ionization Detector [FID] may be used as an alternative to the PID).

As a precautionary measure, prior to the commencement of any field activities, the background levels of the site must be determined and noted. Daily background readings will be taken away from any areas of potential contamination. These readings, any influencing conditions (i.e., weather, temperature, humidity) and site location must be documented in the field operations logbook or other site documentation (e.g., sample log sheet).

7.1.2 Hazard Monitoring Frequency

Table 5-1 presents the frequencies that hazard monitoring will be performed as well as the action levels which will initiate the use of elevated levels of protection. The SSO may decide to increases these frequencies based on instrument responses and site observations. The frequency at which monitoring is performed will not be reduced without the prior consent of the PHSO or HSM.

7.2 INSTRUMENT MAINTENANCE AND CALIBRATION

Hazard monitoring instruments will be maintained and pre-field calibrated by the TtNUS Equipment Manager. Operational checks and field calibration will be performed on the instruments each day prior to their use. Field calibration will be performed on instruments according to manufacturer's recommendations (for example, the PID must be field calibrated daily and an additional field calibration must be performed at the end of each day to determine any significant instrument drift). These operational checks and calibration efforts will be performed in a manner that complies with the employees health and safety training, the manufacturer's recommendations, and with the applicable manufacturer standard operating procedure (copies of which can be found in the Health & Safety Guidance Manual which will be maintained on site for reference). Calibration efforts must be documented. Figure 7-1 is provided for documenting these calibration efforts. This information may instead be recorded in a field operations logbook, provided that the information specified in Figure 7-1 is recorded. This required information includes the following:

- Date calibration was performed
- Individual calibrating the instrument
- Instrument name, model, and serial number
- Any relevant instrument settings and resultant readings (before and after) calibration
- Identification of the calibration standard (lot no., source concentration, supplier)
- Any relevant comments or remarks

FIGURE 7-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: _____ PROJECT NO.:_____

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

8.1.1 Requirements for TtNUS Personnel

TtNUS personnel must complete 40 hours of introductory hazardous waste site training in accordance with 29 CFR 1910.120(e) prior to performing work at NSWC Crane. Additionally, TtNUS 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 being cleared for site work. 8-hour Supervisory Training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of TtNUS Health and Safety Training will be maintained at the project site. Copies of certificates or other official documentation will be used to fulfill this requirement.

At the request of the U.S. Navy, TtNUS will conduct a brief meeting daily to discuss operations planned for that day. At the end of the workday, a short meeting will be held to discuss the operations completed and any problems that were encountered.

8.1.2 Requirements for Subcontractors

TtNUS subcontractor drilling personnel must have completed 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 NSWC Crane. Surveyors are only required to have the OSHA HAZWOPER training when they could possibly be exposed to hazardous chemicals. 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 provided in Figure 8-1, and providing copies of training certificates.

FIGURE 8-1

TRAINING LETTER

The following statements must be typed on company letterhead and signed by an officer of the company and accompany copies of associated training certificates:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Roger Clark, PhD
Project Manager
Tetra Tech NUS
Foster Plaza 7
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: HAZWOPER Training for NSWC Crane

Dear Dr. Clark:

As an officer of XYZ Corporation, I hereby state that I am aware of potential hazardous nature of the subject project. I also understand that is out responsibility to comply with applicable occupational safety and health regulations including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1900 through 1910 and Part 126.

I also understand that Title 29 CFR 1910.120 entitled "Hazardous Waste Operations and Emergency Response" requires 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 required by 29 CFR 1910.120(e)(8),

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 of Company Officer)

8.2 SITE-SPECIFIC TRAINING

TtNUS will provide site-specific training to TtNUS employees and subcontractor personnel who will perform work on this project. Site-specific training will also be provided to site visitors (DOD, EPA, etc.) who may enter the site to perform functions that may or may not be directly related to site operations. Site-specific training will include:

- Names of 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 to site contaminants
- The contents of the site-specific health and safety plan including the contents of Table 5-1 and 6-1.
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review the contents of relevant Material Safety Data Sheets
- Review Safe Work Permits

Site-specific documentation will be established through the use of Figure 8-2. Site personnel and visitors must sign this document upon receiving site-specific training prior to commencement of site activities.

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements For TtNUS Personnel

TtNUS personnel participating in project field activities will have had a physical examination meeting the requirements of TtNUS' 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 Pittsburgh office and made available as necessary.

FIGURE 8-2

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing investigation activities at NSWC Crane, and that I have received site-specific training that included the elements presented below:

- Names of 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
- The contents of the health and safety plan including Table 5-1 and 6-1
- Emergency response procedures (evacuation and assembly points)
- Review contents of relevant Material Safety Data Sheets
- Review of Safe Work Permits

I have been given the opportunity to ask questions and that my questions have been answered to my satisfaction. The dates of my training and my medical surveillance requirements are accurate and correct to the best of my knowledge.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

8.3.2 Medical Surveillance Requir ments For Subcontractors

Subcontractor personnel 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 of this HASP shall be used to satisfy this requirement providing that 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 "Subcontractor Medical Approval Form" with a letter, on company letterhead, containing the information in the example letter presented in Figure 8-4.

8.3.3 Medical Data Sheet

Each field team member (including subcontractors and visitors entering the exclusion zone) shall be required to complete and submit a copy of the Medical Data Sheet found in the TtNUS 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 EXCEPTION

Subcontractors and surveyors who will not enter the 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. The use of this type of exemption is permissible only with the prior consent of the CLEAN HSM.

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 found to be medically -

   ( ) qualified to perform work at the NSWC Crane work site
   ( ) not qualified to perform work at the NSWC Crane work site

   and,

2. Undergone a physical examination as per OSHA 29 CFR 1910.134(b)(10) and 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 which 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 that 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 that require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the NSWC Crane work 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
Nowheresville, Kansas 55555

Month, day, year

Roger Clark, PhD
Project Manager
Tetra Tech NUS
Foster Plaza 7
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: Medical Surveillance for NSWC Crane

Dear Dr. Clark:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate 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" 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 NSWC Crane 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 of Company Officer)

9.0 SPILL CONTAINMENT PROGRAM

9.1 SCOPE AND APPLICATION

This program applies to the single or aggregate accumulation of bulk storage materials (over 55-gallons). As the classification of certain materials such as IDW is unknown, materials will be treated as hazardous, pending laboratory certification to the contrary. The types of materials for which this program will apply are as follows:

- Investigative Derived Wastes (IDW) such as decontamination fluids.

The spill containment and control will be engaged any time there is a release of the above identified materials from a containment system or vessel. This spill containment program will be engaged in order to minimize associated hazards.

9.2 HAZARDOUS SOILS AND FLUIDS

Quantities of bulk potentially hazardous materials (greater than 55-gallons) will not be handled during site activities conducted as part of the scope of work. If for some reason significant quantities of hazardous waste water (decontamination, and purge) and hazardous Investigative-Derived Wastes (IDW) are generated as part of site activities the following procedures will be applied. As needed, 55 -gallon drums will be used to contain hazardous waste waters, IDW, and other unwanted items generated during investigatory activities. These drums will be labeled with the site name, drum number, the type of contents (purge waters), volume, the date, point of contact with telephone number.

Samples will be analyzed to characterized the material and determine appropriate disposal measures. Once characterized they can be removed from the staging area and disposed of in accordance with Federal, State and local regulations.

9.3 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 following:

- Areas used for central staging of resources
- Areas used for central staging of IDW materials

- Decontamination area

Additionally, areas designated for handling, loading, and unloading of potentially contaminated waters, and debris present limited potential for leaks or spills. Monitoring of these areas will be done at least weekly.

9.3.1 Site Drums/Containers

Drums/containers used for containing liquids will be sealed, labeled, and staged within a centralized area awaiting shipment or disposal. Drums used for the storage and transportation of IDW will meet the packaging requirements for steel drums category U.N. 1A2, removable head as specified in paragraph 9.6.1, United Nations Transport of Dangerous Goods.

9.4 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic (once a week) 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 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 too, will be containerized for disposal pending analyses. Inspections will be documented in the project logbook.

9.5 PERSONNEL TRAINING AND SPILL PREVENTION

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.

9.6 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment which will be maintained at the staging area for the purpose of supporting this Spill Prevention/Containment Program.

Spill Response Equipment:

- Sand, clean fill, vermiculite, or other noncombustible absorbent (oil-dry);
- Drums (55-gallon U.N 1A2)

- Portable storage tanks or additional drums
- Shovels, rakes, and brooms
- Labels

PPE stored at the staging area:

- Rubber boot covers, nitrile outer gloves, PVC rain-suit or other form of impermeable splash protection, should it be required.

9.7 SPILL CONTROL PLAN

This section describes the procedures the TtNUS 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 the personnel 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) Spills occurring on soils, grassy areas, gravel lots will be re-containerized including 2-inches of top cover on which the spill occurred, and 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 emergency response agencies will be carried out by the FOL or SSO.

10.0 SITE CONTROL

This section outlines the means by which TtNUS will delineate work zones and use these work zones in conjunction with decontamination procedures 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 those areas of the site of known or suspected contamination. It is not anticipated that significant amounts of surface contamination are present in the proposed work areas of this site. The exclusion zone for this activity will be fragmented to represent the areas where the soil is disturbed through intrusive activities. When necessary, exclusion zones will be delineated using barrier tape, cones and/or drive poles, and postings to inform personnel other than the field crew. The exclusion zones for this project will be limited to those areas of the site where active work is being performed:

- Soil Boring Activity (Direct Push Technology). The exclusion zone for this activity will be set at the height of the mast, plus five feet surrounding the point of operation, with a minimum of 25 feet. This distance will also apply when subsurface soil sampling from behind these type rigs.

- Multi-media sampling. The exclusion zone for this activity will be set at 10 feet surrounding the monitoring well or sampling location.

- Decontamination operation. The exclusion zone for this activity will be set at 25 feet surrounding the gross contamination wash and rinse as well as 25 feet surrounding the heavy equipment decontamination area.

10.1.1 Exclusion Zone Clearance

Access to work areas will be controlled by TtNUS personnel. No persons will be permitted to enter site exclusion zones without site-specific training. Site visitors will be provided site-specific training and will be escorted by TtNUS personnel (see Section 10.4).

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 not take place in this area, but will take place at a central location established for this project. This area instead will serve as a focal point in supporting exclusion zone 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 be the area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. 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
- Regulatory personnel (EPA, OSHA, etc.)
- NSWC Crane or DOD Personnel
- Other authorized visitors

Personnel working on this project are required to gain initial access to the NSWC Crane by coordinating with the TtNUS FOL or designee and following established NSWC Crane access procedures.

Once access to NSWC Crane is obtained personnel who require site access into areas of ongoing operations will be required to obtain permission from the FOL and SSO. The prerequisites for site visitors wishing to observe operations in progress in the exclusion zone are discussed below:

- 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.

- 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, 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. Visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit. Any unauthorized site visitation will cause the termination of on-site activities until the unauthorized visitor is removed from the area. Removal of unauthorized visitors will be accomplished with support from the Base Contact and Base Security. Site visitors granted access to the exclusion zones during ongoing operations will be escorted by a TtNUS representative (arranged for by the FOL) while the visitor remains in the exclusion zone.

10.5 SITE SECURITY

TtNUS will retain control over active operational areas. The FOL will serve as a focal point for site personnel, and will serve and the final line of security for the work areas. Work will cease in the event of unauthorized personnel entering the exclusion zone. Work will remain temporarily suspended until the unauthorized visitor can be removed. The Base Contact will serve as the primary enforcement contact for removing unauthorized visitors.

10.6 SITE MAP

Once the areas of contamination, access routes, utilities, topography, and dispersion 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. Site maps will be posted to illustrate up-to-date collection of contaminants and adjustment of zones and access points.

10.7 BUDDY SYSTEM

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of the personnel involved in this operation.

10.8 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

TtNUS personnel will provide MSDSs for 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 these substances on site. A chemical inventory of chemicals used on site will be developed. (See Section 5.0 of the Health and Safety Guidance Manual) A copy of the Chemical Inventory List will be

provided to the Fire Department, as they would serve as primary responders to the work/storage building should the need arise. The MSDSs will then be maintained in a central location and will be available for anyone to review upon request.

10.9 COMMUNICATION

As personnel may not always be working in proximity to one another during field activities, a supported means of communication between field crews will be used as necessary. As a result, two-way radio communication devices will be used by field personnel while at the site. Two-way radio communications intended for use at NSWC Crane, will have GSA approval prior to being brought on-site for use.

External communication will be accomplished by using provided telephones at the site. External communication will primarily be used for the purpose of resource and emergency resource communications.

10.10 SAFE WORK PERMITS

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. Attachment V contains partially completed safe work permits for tasks that are to be performed as part of the investigation. Information such as field crew performing the task, date, time, procedure reviews, and equipment preparation information need to be completed by the FOL or SSO prior to the initiation of site activities. Safe work permits will be further supported by the daily safety meetings. This effort will ensure site specific considerations and changing conditions are incorporated into the planning effort. Permits will require the signature of the FOL and/or SSO. Personnel engaged in on-site activities will be aware of the elements indicating levels of protection and precautionary measures to be used.

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 SWP will take precedence over the HASP when more conservative measures are required based on specific site conditions.

Upon completion of work specified on the SWP, the person accepting the permit will return it to the SSO.

Any problems encountered regarding control measures taken will be annotated on the permit or a separate sheet of paper and returned to the SSO for review and evaluation.

FIGURE 10-1
SAFE WORK PERMIT

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** _____

II. **Primary Hazards:** Potential hazards associated with this task: _____

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. **Protective equipment required**
Level D ☐ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☐

Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

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/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – Work)	☐ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Steel toe work shoes or boots	☐ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** _____

Permit Issued by: _____ Permit Accepted by: _____

11.0 CONFINED SPACE ENTRY

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 that 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.
- 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, serious, safety or health hazard.

For further information on confined space consult the Health and Safety Guidance Manual or call the Manager, Health Sciences. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will be addressed in an addendum or the site specific health and safety plan.

12.0 MATERIALS AND DOCUMENTS

The TtNUS 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 chemicals brought on site, including decon solutions, fuels, lime, sample preservatives, calibration gases, etc.
- A full-size OSHA Job Safety and Health Poster (posted in the site trailers)
- Training/Medical Surveillance Documentation Form (Blank)
- Emergency Reference Information (Section 2.0, extra copy for posting)

12.1 MATERIALS TO BE POSTED OR MAINTAINED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations where posting these documents is not feasible, (such as no office trailer), these documents should be separated and immediately accessible.

Chemical Inventory Listing (posted) - This list represents chemicals brought on-site, including decontamination solutions, sample preservations, fuel, etc.. This list should be posted in a central area.

Material Safety Data Sheets (MSDS) (maintained) - The MSDSs should also be in a central area accessible to site personnel. These documents should match the listings on the chemical inventory list for substances used 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 (posted) - 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 defaces, altered, or covered by other material.

Site Clearance (maintained) - This list is found within the training section of the HASP (See Figure 8-2). This list identifies site personnel, dates of training (including site-specific training), and medical surveillance. The 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) (posted) - This list of numbers and directions will be maintained at phone communications points and in each site vehicle.

Medical Data Sheets/Cards (maintained) - Medical Data Sheets will be filled out by 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 personnel to be carried on their person.

Hearing Conservation Standard (29 CFR 1910.95) (posted) - this standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring (maintained) - Results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels (maintained) - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using DOT placards and acceptable (Hazard Communication 29 CFR 1910.1200(f)) labels.

The purpose of maintaining or posting this information, as stated above, is to allow site personnel quick access. Variations concerning location and methods of presentation are acceptable, providing the objection is accomplished.

13.0 GLOSSARY

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air Purifying Respirators
CAAA	Crane Army Ammunition Activity
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CLEAN	Comprehensive Long-Term Environmental Action Navy
CSP	Certified Safety Professional
CTO	Contract Task Order
DRI	Direct Reading Instruments
eV	electron Volts
FID	Flame Ionization Detector
FOL	Field Operations Leader
HSGM	Health and Safety Guidance Manual
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HSM	Health and Safety Manager
IDLH	Immediately Dangerous to Life and Health
NAD	Naval Ammunition Depot
N/A	Not Available
NIOSH	National Institute Occupational Safety and Health
NSWC	Naval Surface Warfare Center
OB/OD	Open Burning/Open Detonation
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Manager
PID	Photo Ionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
PPM	Parts Per Million
PVC	Poly Vinyl Chloride
RCRA	Resource Conservation and Recovery Act

SCBA	Self Contained Breathing Apparatus
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
SWMU	Solid Waste Management Unit
TBD	To Be Determined
TOM	Task Order Manager
TWA	Time Weighted Average
UV	Ultra Violet
WP	Work Plan

ATTACHMENT I

INJURY/ILLNESS PROCEDURE AND REPORT FORM

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:

- Stop work as needed to ensure no further harm is done.
- 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. Check with your office location or project health and safety plan for specific instructions.
- If incident involves an injury, illness, or 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 Duffy at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours of the injury. You will be required to complete an Injury/Illness Report. You may also be required to participate in a more detailed investigation with the Health Sciences Department.
- In the event of a serious near-miss incident, a "Serious Near Miss Report" (Form AR-2, available online at https://go2.tetratech.com under "Departments", "Health and Safety", "Accident Reporting Procedures", hyperlink for "Serious Near Miss Report") must be completed and faxed to the Corporate Health and Safety Manager within 48 hours.
- If further medical treatment is needed, our insurance carrier, ACE, will provide information on the authorized providers customized to the location of the injured employee. You can find this information by accessing the website of ACE's claims handler, ESIS, at : **www.esis.com**. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local Human Resources representative (Marilyn Duffy), Corporate Health and Safety Manager (Matt Soltis), 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 pay premiums on behalf of their employees. This program is based on a no-fault system, and benefits are provided for covered events as an exclusive remedy to the injured employee regardless of fault. The types 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 from the first day of work. All employees must follow the above injury/illness reporting procedures. If you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

Consultants, independent contractors, and employees of subcontractors and employees from temporary employment agencies are not covered by Tetra Tech's Worker's Compensation plan.

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.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT

To: _____
Subsidiary Health and Safety Representative

cc: _____
Workers Compensation Administrator

Project name: _____

Project number: _____

Prepared by: _____

Position: _____

Office: _____

Telephone number: _____

Fax number: _____

Information Regarding Injured or Ill Employee

Name: _____

Office: _____

Home address: _____

Gender: M ☐ F ☐ No. of dependents: _____

_____

Marital status: _____

Home telephone number: _____

Date of birth: _____

Occupation (regular job title): _____

Social security number: _____

Department: _____

Date of Accident: _____

Time of Accident: _____ a.m. ☐ p.m. ☐

Time Employee Began Work: _____

☐ Check if time cannot be determined

Location of Incident

Street address: _____

City, state, and zip code: _____

County: _____

Was place of accident or exposure on employer's premises? Yes ☐ No ☐

Information About the Incident

What was the employee doing just before the incident occurred? Describe the activity as well as the tools, equipment, or material the employee was using. Be specific. Examples: "Climbing a ladder while carrying roofing materials"; "Spraying chlorine from hand sprayer"; "Daily computer key-entry"

What Happened? Describe how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time"

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Information About the Incident (Continued)

What was the injury or illness? Describe the part(s) of the body affected and how it was affected. Be more specific than "hurt," "pain," or "sore." Examples "Strained back"; "Chemical burn, right hand"; "Carpal tunnel syndrome, left wrist"

Describe the Object or Substance that Directly Harmed the Employee: Examples: "Concrete floor"; "Chlorine"; "Radial arm saw." If this question does not apply to the incident, write "Not applicable."

Did the employee die? Yes ☐ No ☐ Date of death: _____

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 report.

Witness (Attach additional sheets for other witnesses.)

Name: _____

Company: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Medical Treatment Required? ☐ Yes ☐ No ☐ First aid only

Name of physician or health care professional: _____

If treatment was provided away from the work site, provide the information below.

Facility name: _____

Street address: _____

City: _____ State: _____ Zip code: _____

Telephone number: _____

Was the employee treated in an emergency room? ☐ Yes ☐ No

Was the employee hospitalized over night as an in-patient? ☐ Yes ☐ No

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

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:** _____

I have reviewed this investigation report and agree, to the best of my recollection, with its contents.

_____ _____
Printed Name of Injured Employee Telephone Number

_____ _____
Signature of Injured Employee Date

The signatures provided below indicate that appropriate personnel have been notified of the incident.

Title	Printed Name	Signature	Telephone Number	Date
Office Manager				
Project Manager				
Site Safety Coordinator or Office Health and Safety Representative				

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

To Be Completed by the Subsidiary Health and Safety Representative

Classification of Incident:

☐ Injury ☐ Illness

Result of Incident:

☐ First aid only

☐ Days away from work

☐ Remained at work but incident resulted in job transfer or work restriction

☐ Incident involved days away and job transfer or work restriction

☐ Medical treatment only

No. of days away from work _____

Date employee left work _____

Date employee returned to work _____

No. of days placed on restriction or job transfer: _____

OSHA Recordable Case Number _____

To Be Completed by Human Resources

Social security number: _____

Date of hire: _____ Hire date for current job: _____

Wage information: $ _____ per ☐ Hour ☐ Day ☐ Week ☐ Month

Position at time of hire: _____

Current position: _____ 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 Carrier

Date reported: _____ Reported by: _____

Confirmation number: _____

Name of contact: _____

Field office of claims adjuster: _____

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

ATTACHMENT II
MEDICAL DATA SHEET

MEDICAL DATA SHEET

This Medical Data Sheet must be completed by all on-site personnel and kept in the command post during the conduct of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project _____

Name _____ Home Telephone _____

Address _____

Age _____ Height _____ Weight _____

Name of Next Kin _____

Drug or other Allergies _____

Particular Sensitivities _____

Do You Wear Contacts? _____

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals _____

_____

_____

What medications are you presently using? _____

_____

_____

Do you have any medical restrictions? _____

_____

_____

Name, Address, and Phone Number of personal physician: _____

_____

_____

I am the individual described above. I have read and understand this HASP.

_____ _____

Signature Date

ATTACHMENT III

EQUIPMENT INSPECTION CHECKLIST

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)	❒	❒	❒

Saf ty 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 IV

UTILITY LOCATING
AND
EXCAVATION CLEARANCE

TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE **2**

2.0 SCOPE **2**

3.0 GLOSSARY **2**

4.0 RESPONSIBILITIES **3**

5.0 PROCEDURES **3**

5.1 BURIED UTILITIES 3
5.2 OVERHEAD POWER LINES 5

6.0 UNDERGROUND LOCATING TECHNIQUES **5**

6.1 GEOPHYSICAL METHODS 5
6.2 PASSIVE DETECTION SURVEYS 6
6.3 INTRUSIVE DETECTION SURVEYS 6

7.0 INTRUSIVE ACTIVITIES SUMMARY **7**

8.0 REFERENCES **8**

ATTACHMENTS

1 Listing of Underground Utility Clearance Resources 9
2 Frost Line Penetration Depths by Geographic Location 11
3 Utility Clearance Form 12
4 OSHA Letter of Interpretation 13

1.0 PURPOSE

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations. Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility locating services. It is the policy of Tetra Tech NUS, Inc. (TtNUS) to provide a safe and healthful work environment for the protection of our employees. The purpose of this Standard Operating Procedure (SOP) is to aid in achieving the objectives of this policy, to present the acceptable procedures pertaining to utility locating and excavation clearance activities, and to present requirements and restrictions relevant to these types of activities. This SOP must be reviewed by any employee potentially involved with underground or overhead utility locating and avoidance activities.

2.0 SCOPE

This procedure applies to all TtNUS field activities where there may be potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of typical methods used to determine the presence and avoidance of contact with utility services. This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to the initiation of any such activities on a specific project. This SOP is not intended to provide a detailed description of methodology and instrument operation. Specialized expertise during both planning and execution of several of the methods presented may also be required.

3.0 GLOSSARY

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Magnetometer – A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey – A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal Detection – A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

Vertical Gradiometer – A magnetometer equipped with two sensors that are vertically separated by a fixed distance. It is best suited to map near surface features and is less susceptible to deep geologic features.

Ground Penetrating Radar – Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture.

4.0 RESPONSIBILITIES

Project Manager (PM)/Task Order Manager (TOM) - Responsible for ensuring that all field activities are conducted in accordance with this procedure.

Site Manager (SM)/Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Site Health & Safety Officer (SHSO) – Responsible to provide technical assistance and verify full compliance with this SOP. The SHSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager (HSM) and to the PM/TOM.

Health & Safety Manager (HSM) – Responsible for preparing, implementing, and modifying corporate health and safety policy and this SOP.

Site Personnel – Responsible for performing their work activities in accordance with this SOP and the TtNUS Health and Safety Policy.

5.0 PROCEDURES

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed individually from a buried and overhead standpoint.

5.1 Buried Utilities

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown or incorrectly known on client properties. This procedure must be followed prior to beginning any subsurface probing or excavation that might potentially be in the vicinity of underground utility services. In addition, the Utility Clearance Form (Attachment 3) must be completed for every location or cluster of locations where intrusive activities will occur.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM/TOM is responsible for arranging for the procurement of a qualified, experienced, utility locating subcontractor who will accomplish the utility location and demarcation duties specified herein.

1. A comprehensive review must be made of any available property maps, blue lines, or as-builts prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities. Information regarding utility locations shall be added to project maps upon completion of this exercise.

2., A visual site inspection must be performed to compare the site plan information to actual field conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation or other subsurface activities must be marked at the site in white paint or pin flags to identify those locations of the proposed intrusive activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, electrical service vaults/panels, asphalt/concrete scares and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information regarding utility

locations shall be added to project maps upon completion of this exercise and returned to the PM/TOM.

3. If the planned work is to be conducted on private property (e.g., military installations, manufacturing facilities, etc.) the FOL must identify and contact appropriate facility personnel (e.g., public works or facility engineering) before any intrusive work begins to inquire about (and comply with) property owner requirements. It is important to note that private property owners may require several days to several weeks advance notice prior to locating utilities.

4. If the work location is on public property, the state agency that performs utility clearances must be notified (see Attachment 1). State "one-call" services must be notified prior to commencing fieldwork per their requirements. Most one-call services require, by law, 48- to 72-hour advance notice prior to beginning any excavation. Such services typically assign a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again. The utility service will notify utility representatives who then mark their respective lines within the specified time frame. It should be noted that most military installations own their own utilities but may lease service and maintenance from area providers. Given this situation, "one call" systems may still be required to provide location services on military installations.

5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other accepted means. The location of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code:

white	excavation/subsurface investigation location
red	electrical
yellow	gas, oil, steam
orange	telephone, communications
blue	water, irrigation, slurry
green	sewer, drain

6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., the work area must be thoroughly investigated prior to beginning the excavation. In these situations, utilities must be identified using safe and effective methods such as passive and intrusive surveys, or the use of non-conductive hand tools. Also, in situations where such hand tools are used, they should always be used in conjunction with suitable detection equipment, such as the items described in Section 6.0 of this SOP. Each method has advantages and disadvantages including complexity, applicability, and price. It also should be noted that in some states, initial excavation is required by hand to a specified depth.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment, and where utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed using a device such as a tile probe which is made of non-conductive material such as fiberglass. If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.

8. All utilities uncovered or undermined during excavation must be structurally supported to prevent potential damage. Unless necessary as an emergency corrective measure, TtNUS shall not make any repairs or modifications to existing utility lines without prior permission of the utility owner, property owner, and Corporate HSM. All repairs require that the line be locked-out/tagged-out prior to work.

5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be adequate to prevent employees from contacting such lines directly with any part of their body or indirectly though conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

Nominal Voltage	Minimum Clearance
0 -50 kV	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

6.0 UNDERGROUND LOCATING TECHNIQUES

A variety of supplemental utility locating approaches are available and can be applied when additional assurance is needed. The selection of the appropriate method(s) to employ is site-specific and should be tailored to the anticipated conditions, site and project constraints, and personnel capabilities.

6.1 Geophysical Methods

Geophysical methods include electromagnetic induction, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic induction, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References (Section 8.0).

El ctromagnetic Induction

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is an EM-61.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

Magnetics

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

Ground Penetrating Radar

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

6.2 Passive Detection Surveys

Acoustic Surveys

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

Th rmal Imaging

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting

debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

Hand Excavation

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other methods, borings and excavations may be cleared via the use of non-conductive hand tools. This should always be done in conjunction with the use of detection equipment. This would be required for all locations where there is a potential to impact buried utilities. The minimum hand-excavation depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the placement of buried utilities is influenced by frost line depths that vary by geographical region. Attachment 2 presents frost line depths for the regions of the contiguous United States. At a minimum, hand excavation depths must be at least to the frost line depth (see Attachment 2) plus two (2) feet, but never less than 4 feet below ground surface (bgs). For hand excavation, the hole created must be reamed large enough to be 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 excavation. It is important to note that a post-hole digger must not be used in this type of hand excavation activity.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, non-conductive tile probes may be used. A tile probe is a "T"-handled rod of varying lengths that can be pushed into the soil to determine if any obstructions exist at that location. Tile probes constructed of fiberglass or other nonconductive material are readily-available from numerous vendors. Tile probes must be performed to the same depth requirements as previously specified. As with other types of hand excavating activities, the use of a non-conductive tile probe, should always be in conjunction with suitable utility locating detection equipment.

7.0 INTRUSIVE ACTIVITIES SUMMARY

The following list summarizes the activities that must be performed prior to beginning subsurface activities:

1. Map and mark all subsurface locations and excavation boundaries using white paint or markers specified by the client or property owner.

2. Notify the property owner and/or client that the locations are marked. At this point, drawings of locations or excavation boundaries shall be provided to the property owner and/or client so they may initiate (if applicable) utility clearance.

   Note: Drawings with confirmed locations should be provided to the property owner and/or client as soon as possible to reduce potential time delays.

3. Notify "One Call" service. If possible, arrange for an appointment to show the One Call representative the surface locations or excavation boundaries in person. This will provide a better location designation to the utilities they represent. You should have additional drawings should you need to provide plot plans to the One Call service.

4. Implement supplemental utility detection techniques as necessary and appropriate to conform utility locations or the absence thereof.

5. Complete Attachment 3, Utility Clearance Form. This form should be completed for each excavation location. In situations where multiple subsurface locations exist within the close proximity of one another, one form may be used for multiple locations provided those locations are noted on the Utility Clearance Form. Upon completion, the Utility Clearance Form and revised/annotated utility location map becomes part of the project file.

8.0 REFERENCES

OSHA Letter of Interpretation, Mr. Joseph Caldwell, Attachment 4
OSHA 29 CFR 1926(b)(2)
OSHA 29 CFR 1926(b)(3)
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

American Public Works Association
2345 Grand Boulevard, Suite 500, Kansas City, MO 64108-2625
Phone (816) 472-6100 • Fax (816) 472-1610
Web www.apwa.net • E-mail apwa@apwa.net

ONE-CALL SYSTEMS INTERNATIONAL CONDENSED DIRECTORY

Alabama
Alabama One-Call
1-800-292-8525

Alaska
Locate Call Center of Alaska, Inc.
1-800-478-3121

Arizona
Arizona Blue Stake
1-800-782-5348

Arkansas
Arkansas One Call System, Inc.
1-800-482-8998

California
Underground Service Alert North
1-800-227-2600
Underground Service Alert of Southern California
1-800-227-2600

Colorado
Utility Notification Center of Colorado
1-800-922-1987

Connecticut
Call Before You Dig
1-800-922-4455

Delaware
Miss Utility of Delmarva
1-800-282-8555

Florida
Sunshine State One-Call of Florida, Inc.
1-800-432-4770

Georgia
Underground Protection Center, Inc.
1-800-282-7411

Hawaii
Underground Service Alert North
1-800-227-2600

Idaho
Dig Line Inc.
1-800-342-1585
Kootenai County One-Call
1-800-428-4950
Shoshone - Benewah One-Call
1-800-398-3285

Illinois
JULIE, Inc.
1-800-892-0123
Digger (Chicago Utility Alert Network)
312-744-7000

Indiana
Indiana Underground Plant Protection Service
1-800-382-5544

Iowa
Iowa One-Call
1-800-292-8989

Kansas
Kansas One-Call System, Inc.
1-800-344-7233

Kentucky
Kentucky Underground Protection Inc.
1-800-752-6007

Louisiana
Louisiana One Call System, Inc.
1-800-272-3020

Maine
Dig Safe System, Inc.
1-888-344-7233

Maryland
Miss Utility
1-800-257-7777
Miss Utility of Delmarva
1-800-282-8555

Massachusetts
Dig Safe System, Inc.
1-888-344-7233

Michigan
Miss Dig System, Inc.
1-800-482-7171

Minnesota
Gopher State One Call
1-800-252-1166

Mississippi
Mississippi One-Call System, Inc
1-800-227-6477

Missouri
Missouri One-Call System, Inc.
1-800-344-7483

Montana
Utilities Underground Protection Center
1-800-424-5555
Montana One Call Center
1-800-551-8344

Nebraska
Diggers Hotline of Nebraska
1-800-331-5666

Nevada
Underground Service Alert North
1-800-227-2600

New Hampshire
Dig Safe System, Inc.
1-888-344-7233

New Jersey
New Jersey One Call
1-800-272-1000

New Mexico
New Mexico One Call System, Inc.
1-800-321-2537
Las Cruces- Dona Ana Blue Stakes
1-888-526-0400

New York
Dig Safely New York
1-800-962-7962
New York City- Long Island One Call Center
1-800-272-4480

North Carolina
The North Carolina One-Call Center, Inc.
1-800-632-4949

North Dakota
North Dakota One-Call
1-800-795-0555

Ohio
Ohio Utilities Protection Service
1-800-362-2764
Oil & Gas Producers Underground Protect'n Svc
1-800-925-0988

Oklahoma
Call Okie
1-800-522-6543

Oregon
Oregon Utility Notification Center/One Call Concepts
1-800-332-2344

Pennsylvania
Pennsylvania One Call System, Inc.
1-800-242-1776

Rhode Island
Dig Safe System, Inc.
1-888-344-7233

South Carolina
Palmetto Utility Protection Service Inc.
1-888-721-7877

South Dakota
South Dakota One Call
1-800-781-7474

Tennessee
Tennessee One-Call System, Inc.
1-800-351-1111

ATTACHMENT 1 (Continued)

Texas
Texas One Call System
1-800-245-4545
Texas Excavation Safety System, Inc.
1-800-344-8377
Lone Star Notification Center
1-800-669-8344

Utah
Blue Stakes of Utah
1-800-662-4111

Vermont
Dig Safe System, Inc.
1-888-344-7233

Virginia
Miss Utility of Virginia
1-800-552-7001
Miss Utility (Northern Virginia)
1-800-257-7777

Washington
Utilities Underground Location Center
1-800-424-5555
Northwest Utility Notification Center
1-800-553-4344
Inland Empire Utility Coordinating Council
509-456-8000

West Virginia
Miss Utility of West Virginia, Inc.
1-800-245-4848

Wisconsin
Diggers Hotline, Inc.
1-800-242-8511

Wyoming
Wyoming One-Call System, Inc.
1-800-348-1030
Call Before You Dig of Wyoming
1-800-849-2476

District of Columbia
Miss Utility
1-800-257-7777

Alberta
Alberta One-Call Corporation
1-800-242-3447

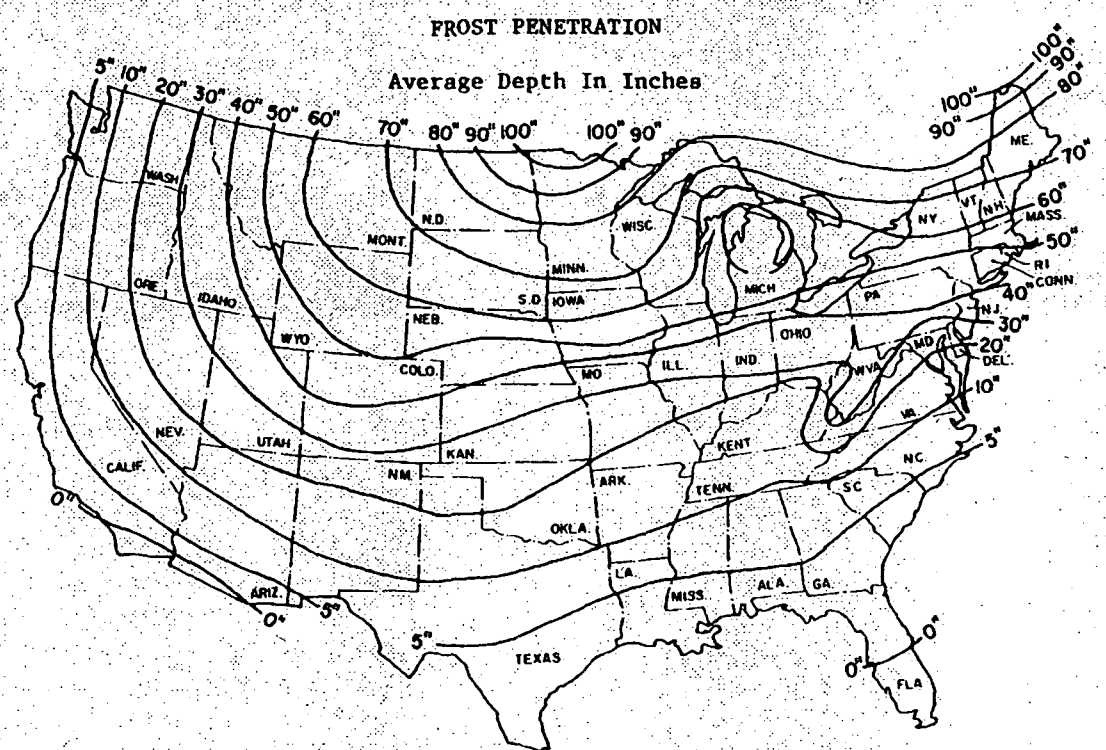
British Columbia
BC One Call
1-800-474-6886

Ontario
Ontario One-Call System
1-800-400-2255

Quebec
Info-Excavation
1-800-663-9228

ATTACHMENT 2

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



Courtesy U.S. Department Of Commerce

ATTACHMENT 3
UTILITY CLEARANCE FORM

Client: _____ Project Name: _____

Project No.: _____ Completed By: _____

Location Name: _____ Work Date: _____

Excavation Method/Overhead Equipment: _____

1. Underground Utilities — Circle One

a)	Review of existing maps?	yes no N/A
b)	Interview local personnel?	yes no N/A
c)	Site visit and inspection?	yes no N/A
d)	Excavation areas marked in the field?	yes no N/A
e)	Utilities located in the field?	yes no N/A
f)	Located utilities marked/added to site maps?	yes no N/A
g)	Client contact notified Name _____ Telephone: _____ Date: _____	yes no N/A
g)	State One-Call agency called? Caller: _____ Ticket Number: _____ Date: _____	yes no N/A
h)	Geophysical survey performed? Survey performed by: _____ Method: _____ Date: _____	yes no N/A
i)	Hand excavation performed (with concurrent use of utility detection device)? Completed by: _____ Total depth: _____ feet Date: _____	yes no N/A
j)	Trench/excavation probed? Probing completed by: _____ Depth/frequency: _____ Date: _____	yes no N/A

2. Overhead Utilities — Present Absent

a)	Determination of nominal voltage	yes no N/A
b)	Marked on site maps	yes no N/A
c)	Necessary to lockout/insulate/re-route	yes no N/A
d)	Document procedures used to lockout/insulate/re-route	yes no N/A
e)	Minimum acceptable clearance (SOP Section 5.2): _____	

3. Notes:

_____

_____

_____

Approval:

_____ _____

Site Manager/Field Operations Leader Date

c: PM/Project File
Program File

ATTACHMENT 4
OSHA LETTER OF INTERPRETATION

Mr. Joseph Caldwell
Consultant
Governmental Liaison
Pipeline Safety Regulations
211 Wilson Boulevard
Suite 700
Arlington, Virginia 22201

Re: Use of hydro-vacuum or non-conductive hand tools to locate underground utilities.

Dear Mr. Caldwell:

In a letter dated July 7, 2003, we responded to your inquiry of September 18, 2002, regarding the use of hydro-vacuum equipment to locate underground utilities by excavation. After our letter to you was posted on the OSHA website, we received numerous inquiries that make it apparent that aspects of our July 7 letter are being misunderstood. In addition, a number of industry stakeholders, including the National Utility Contractors Association (NUCA), have provided new information regarding equipment that is available for this work.

To clarify these issues, we are withdrawing our July 7 letter and issuing this replacement response to your inquiry.

Question: Section 1926.651 contains several requirements that relate to the safety of employees engaged in excavation work. Specifically, paragraphs (b)(2) and (b)(3) relate in part to the safety of the means used to locate underground utility installations that, if damaged during an uncovering operation, could pose serious hazards to employees.

Under these provisions, what constitutes an acceptable method of uncovering underground utility lines, and further, would the use of hydro-vacuum excavation be acceptable under the standard?

Answer

Background

Two sections of 29 CFR 1926 Subpart P (Excavations), 1926.651(Specific excavation requirements), govern methods for uncovering underground utility installations. Specifically, paragraph (b)(2) states:

> When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours * * * or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used. (emphasis added).

Paragraph (b)(3) provides:

ATTACHMENT 4 (Continued)

> When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means. (emphasis added).

Therefore, "acceptable means" must be used where the location of the underground utilities have not been identified by the utility companies and detection equipment is not used.

Subpart P does not contain a definition of either "other acceptable means" or "safe and acceptable means." The preambles to both the proposed rule and the final rule discussed the rationale behind the wording at issue. For example, the preamble to the proposed rule, 52 Fed. Reg. 12301 (April 15, 1987), noted that a 1972 version of this standard contained language that specified "careful probing or hand digging" as the means to uncover utilities. The preamble then noted that an amendment to the 1972 standard later deleted that language "to allow other, *equally effective means* of locating such installations." The preamble continued that in the 1987 proposed rule, OSHA again proposed using language in section (b)(3) that would provide another example of an acceptable method of uncovering utilities that could be used *where the utilities have not been marked and detection equipment is not being used* – "probing with hand-held tools." This method was rejected in the final version of 29 CFR 1926. As OSHA explained in the preamble to the final rule, 54 Fed. Reg. 45916 (October 31, 1989):

> OSHA received two comments * * * and input from ACCSH [OSHA's Advisory Committee on Construction Safety and Health] * * * on this provision. All commenters recommended dropping 'such as probing with hand-held tools' from the proposed provision, because this could create a hazard to employees by damaging the installation or its insulation.

In other words, the commenters objected to the use of hand tools being used unless detection equipment was used in conjunction with them. OSHA then concluded its discussion relative to this provision by agreeing with the commentators and ultimately not including any examples of "acceptable means" in the final provision.

Non-conductive hand tools are permitted

This raises the question of whether the standard permits the use of hand tools alone -- without also using detection equipment. NUCA and other industry stakeholders have recently informed us that non-conductive hand tools that are appropriate to be used to locate underground utilities are now commonly available.

Such tools, such as a "shooter" (which has a non-conductive handle and a snub nose) and non-conductive or insulated probes were not discussed in the rulemaking. Since they were not considered at that time, they were not part of the class of equipment that was thought to be unsafe for this purpose. Therefore, we conclude that the use of these types of hand tools, when used with appropriate caution, is an "acceptable means" for locating underground utilities.

ATTACHMENT 4 (Continued)

Hydro-vacuum excavation

It is our understanding that some hydro-vacuum excavation equipment can be adjusted to use a minimum amount of water and suction pressure. When appropriately adjusted so that the equipment will not damage underground utilities (especially utilities that are particularly vulnerable to damage, such as electrical lines), use of such equipment would be considered a "acceptable means" of locating underground utilities. However, if the equipment cannot be sufficiently adjusted, then this method would not be acceptable under the standard.

Other technologies

We are not suggesting that these are the only devices that would be "acceptable means" under the standard. Industry stakeholders have informed us that there are other types of special excavation equipment designed for safely locating utilities as well.

We apologize for any confusion our July 7 letter may have caused. If you have further concerns or questions, please feel free to contact us again by fax at: U.S. Department of Labor, OSHA, Directorate of Construction, Office of Construction Standards and Compliance Assistance, fax # 202-693-1689. You can also contact us by mail at the above office, Room N3468, 200 Constitution Avenue, N.W., Washington, D.C. 20210, although there will be a delay in our receiving correspondence by mail.

Sincerely,

Russell B. Swanson, Director
Directorate of Construction

NOTE: OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA=s interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov.

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:

- Stop work as needed to ensure no further harm is done.
- 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. Check with your office location or project health and safety plan for specific instructions.
- If incident involves an injury, illness, or 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 Duffy at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours of the injury. You will be required to complete an Injury/Illness Report. You may also be required to participate in a more detailed investigation with the Health Sciences Department.
- In the event of a serious near-miss incident, a "Serious Near Miss Report" (Form AR-2, available online at https://go2.tetratech.com under "Departments", "Health and Safety", "Accident Reporting Procedures", hyperlink for "Serious Near Miss Report") must be completed and faxed to the Corporate Health and Safety Manager within 48 hours.
- If further medical treatment is needed, our insurance carrier, ACE, will provide information on the authorized providers customized to the location of the injured employee. You can find this information by accessing the website of ACE's claims handler, ESIS, at : **www.esis.com**. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local Human Resources representative (Marilyn Duffy), Corporate Health and Safety Manager (Matt Soltis), 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 pay premiums on behalf of their employees. This program is based on a no-fault system, and benefits are provided for covered events as an exclusive remedy to the injured employee regardless of fault. The types 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 from the first day of work. All employees must follow the above injury/illness reporting procedures. If you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

Consultants, independent contractors, and employees of subcontractors and employees from temporary employment agencies are not covered by Tetra Tech's Worker's Compensation plan.

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.

ATTACHMENT V

SAFE WORK PERMITS

SAFE WORK PERMIT FOR

MOBILIZATION AND DEMOBILIZATION

NSWC, CRANE INDIANA

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** Mob and Demob activities at SWMU 17

II. **Primary Hazards:** Lifting, pinches and compressions, slips, trip and falls, heavy equipment, vehicular and foot traffic, ambient temperature extremes, insect/animal bites and stings, poisonous plants, and inclement weather.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
None expected during this Task.			

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

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/cellular phone	☐ Yes	☐ No
Splash shield	☐ Yes	☒ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type – work)	☐ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☒ No
Steel toe work shoes or boots	☒ Yes	☐ No	Chemical resistant boot covers	☐ Yes	☒ No
High visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First aid kit	☐ Yes	☐ No	Fire extinguisher	☐ Yes	☐ No
Safety shower/Eyewash	☐ Yes	☒ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** _____

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT FOR
SOIL BORING
NSWC, CRANE INDIANA

Permit No. _____ Date: _____ Time: From _____ to _____

I. Work limited to the following (description, area, equipment used): DPT operations at SWMU 17

II. Primary Hazards: Chemical contamination, transfer contamination, pinch/compression, noise, energized systems, lifting, slips, trips and falls, vehicular and foot traffic, ambient temperature extremes, insect/animal bites, stings, poisonous plants, and inclement weather

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
PCBs and Creosote	PID with 10.6 eV lamp or FID (precautionary)	Any sustained readings in worker breathing zone	Suspend work and retreat to unaffected area until readings return to background levels
	Dust	visible dust	Use area wetting techniques

Primary Route(s) of Exposure/Hazard: inhalation

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

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/cellular phone	☐ Yes	☐ No
Splash shield	☐ Yes	☐ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – nitrile)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☐ No
Steel toe work shoes or boots	☒ Yes	☐ No	Chemical resistant boot covers	☐ Yes	☐ No
High visibility vest	☐ Yes	☒ No	Tape up/use insect repellent	☐ Yes	☐ No
First aid kit	☐ Yes	☐ No	Fire extinguisher	☒ Yes	☐ No
Safety shower/eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: _____

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT FOR

MULTIMEDIA SAMPLING

NSWC, CRANE INDIANA

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** Multimedia sampling including surface and groundwater sediment, surface and subsurface soils at SWMU 17

II. **Primary Hazards:** Chemical contamination, transfer contamination, pinch/compression, noise, lifting, slips, trips and falls, vehicular and foot traffic, ambient temperature extremes, insect/animal bites, stings, poisonous plants, and inclement weather

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: _____

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
PCBs and Creosote	PID with 10.6 eV lamp or FID (precautionary)	Any sustained readings in worker breathing zone	Suspend work and retreat to unaffected area until readings return to background levels
	Dust	visible dust	Use area wetting techniques

Primary Route(s) of Exposure/Hazard: inhalation

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

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/cellular phone	☐ Yes	☐ No
Splash shield	☐ Yes	☒ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – surgical style)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☐ No
Steel toe work shoes or boots	☒ Yes	☐ No	Chemical resistant boot covers	☐ Yes	☒ No
High visibility vest	☐ Yes	☒ No	Tape up/use insect repellent	☐ Yes	☐ No
First aid kit	☐ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety shower/eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** _____

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT FOR
DECONTAMINATION
NSWC, CRANE INDIANA

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** Decontamination activities at SWMU 17

II. **Primary Hazards:** Chemical contamination, decontamination fluids, noise, lifting, flying projectiles, slips, trips and falls, vehicular and foot traffic, ambient temperature extremes, and inclement weather

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: _____

VI.

Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

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/cellular phone	☐ Yes	☐ No
Splash shield	☒ Yes	☐ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☒ Yes	☐ No	Gloves (Type – nitrile)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No
Steel toe work shoes or boots	☒ Yes	☐ No	Chemical resistant boot covers	☐ Yes	☐ No
High visibility vest	☐ Yes	☒ No	Tape up/use insect repellent	☐ Yes	☐ No
First aid kit	☐ Yes	☐ No	Fire extinguisher	☐ Yes	☐ No
Safety shower/eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** _____

Permit Issued by: _____ Permit Accepted by: _____

SAFE WORK PERMIT FOR
GEOGRAPHIC SURVEYING
NSWC, CRANE INDIANA

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** SWMU 17

II. **Primary Hazards:** Slips, trips and falls, ambient temperature extremes, inclement weather, insect/animal bites or stings, poisonous plants.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☐

Modifications/Exceptions: _____

VI.

Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

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/cellular phone	☐ Yes	☐ No
Splash shield	☐ Yes	☒ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type – _____)	☐ Yes	☒ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☐ No
Steel toe work shoes or boots	☒ Yes	☐ No	Chemical resistant boot covers	☐ Yes	☒ No
High visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First aid kit	☐ Yes	☐ No	Fire extinguisher	☐ Yes	☐ No
Safety shower/eyewash	☐ Yes	☒ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** _____

Permit Issued by: _____ Permit Accepted by: _____