

**DRAFT**

**Technical Memorandum  
Record Review and Field Sampling Plan**

**for**

**Coddington Cove Rubble Fill Area  
(Study Area 04)**

**Naval Station Newport  
Newport, Rhode Island**



**Engineering Field Activity Northeast  
Naval Facility Engineering Command**

**Contract Number N62467-94-D-0888**

**Contract Task Order 0842**

1288

**May 2004**



**TETRA TECH NUS, INC.**

**TECHNICAL MEMORANDUM  
RECORD REVIEW AND FIELD SAMPLING PLAN**

**FOR**

**CODDINGTON COVE RUBBLE FILL AREA  
(STUDY AREA 04)**

**NAVAL STATION NEWPORT  
NEWPORT, RHODE ISLAND**

**COMPREHENSIVE LONG-TERM  
ENVIRONMENTAL ACTION - NAVY (CLEAN) CONTRACT**

**Submitted to:**

**Engineering Field Activity Northeast  
Environmental Branch (Code EV2)  
Naval Facilities Engineering Command  
10 Industrial Highway, Mail Stop #82  
Lester, Pennsylvania 19113-2090**

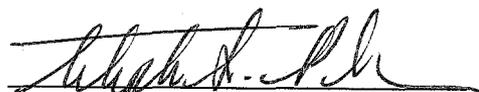
**Submitted by:**

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

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

**May 2004**

**PREPARED UNDER THE DIRECTION OF:**



**STEPHEN PARKER, LSP  
PROJECT MANAGER  
TETRA TECH NUS, INC.  
WILMINGTON, MASSACHUSETTS**

**APPROVED FOR SUBMISSION BY:**



**JOHN J. TREPANOWSKI, P.E.  
PROGRAM MANAGER  
TETRA TECH NUS, INC.  
KING OF PRUSSIA, PENNSYLVANIA**



**TETRA TECH NUS, INC.**

55 Jonspin Road • Wilmington, MA 01887-1020  
Tel 978.658.7899 • Fax 978.658.7870 • www.tetrattech.com

C-NAVY-05-04-1710W

May 11, 2004

Project Number N5152

**COPY**

Mr. Curtis Frye  
Remedial Project Manager  
EFA Northeast, Naval Facilities Engineering Command  
10 Industrial Highway, Mail Stop 82  
Lester, Pennsylvania 19113

Reference: CLEAN Contract No. N62467-94-D-0888  
Contract Task Order No. 0842

Subject: Technical Memorandum – Records Review and Field Sampling Plan  
Coddington Cove Rubble Fill Area, SA-04  
Naval Station Newport, Newport Rhode Island

Dear Mr. Frye:

Enclosed for your information, you will find four copies of the Technical Memorandum for the site referenced above. The sampling effort described within this document is intended to be an accelerated "first look" at this site, being conducted to prioritize work at NAVSTA sites.

As noted by the distribution list below, this document has been provided to the IR Program group for their information as well. Although it is provided as a "Draft", we do not anticipate a technical review or comments at this time, as discussed at the RPMs meeting on January 21, 2004.

Please be advised that we have scheduled field investigations at the site for the week of May 17-21, 2004. If you have any questions regarding this material, please do not hesitate to contact myself or Deb Chisholm, here in this office.

Very truly yours,

Stephen S. Parker, LSP  
Project Manager

SSP/rp

Attachment

- c: K. Keckler, USEPA (w/attach. - 3)
- P. Kulpa, RIDEM (w/attach. - 4)
- S. McFadden, TAG (w/attach. - 1)
- C. Mueller, NAVSTA (w/attach. - 2)
- J. Stump, Gannett Fleming (w/attach. - 2)
- Public Repositories c/o K. Marley, NAVSTA (w/attach. - 3)
- NAVSTA RAB, c/o K. Marley, NAVSTA (w/attach. - 4 CD ROM)
- J. Trepanowski/G. Glenn, TtNUS (w/o attach.)
- D. Chisholm, TtNUS (w/attach. - 2)
- File N5152-3.2 (w/o attach.) File N5152-8.0 (w/attach.)

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 INTRODUCTION .....	1-1
1.1 SITE-SPECIFIC INVESTIGATION OBJECTIVES .....	1-1
1.2 PROJECT DELIVERABLES .....	1-1
2.0 BACKGROUND INFORMATION .....	2-1
2.1 SITE DETAILS .....	2-1
2.2 RECORDS SEARCH .....	2-1
3.0 FIELD SAMPLING PLAN .....	3-1
3.1 MOBILIZATION/DEMobilIZATION .....	3-1
3.2 TEST PIT EXCAVATION .....	3-1
3.3 SAMPLE COLLECTION .....	3-3
3.3.1 Groundwater Sampling .....	3-6
3.4 DECONTAMINATION PROCEDURES .....	3-7
3.5 LAND SURVEYING .....	3-7
3.6 INVESTIGATION-DERIVED WASTE (IDW) DISPOSAL .....	3-7
3.7 CHANGES TO THE FIELD SAMPLING PLAN .....	3-8
3.8 SCHEDULE AND REGULATORY OVERSIGHT .....	3-8
4.0 QUALITY ASSURANCE PLAN .....	4-1
4.1 QUALITY CONTROL SAMPLES .....	4-1
4.2 SAMPLE NUMBERING .....	4-1
4.3 CALIBRATION PROCEDURES .....	4-2
4.4 ANALYTICAL DATA VALIDATION .....	4-2
4.5 DOCUMENTATION .....	4-3
5.0 REPORTING .....	5-1
6.0 REFERENCES .....	6-1

TABLES

<u>NUMBER</u>	<u>PAGE</u>
3-1 Estimated Number of Field and Quality Control Samples .....	3-4
3-2 Sample Container, Preservative, and Holding Time Requirements .....	3-5

FIGURES

<u>NUMBER</u>	<u>PAGE</u>
2-1 Site Locus .....	2-2
2-2 Site Plan with Test Pit Locations .....	2-3
2-3 Aerial Photo - 1951 – 1952 .....	2-5
2-4 Aerial Photo - 1965 .....	2-6
2-5 Aerial Photo - 1981 .....	2-7
2-6 Aerial Photo - 1997 .....	2-8

**TABLE OF CONTENTS (cont.)**

**APPENDICES**

- A Standard Operating Procedures
- B Field Documentation Forms
- C Field Modification Form

## **1.0 INTRODUCTION**

This Technical Memorandum has been prepared under the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract No. N62467-94-D-0888, Contract Task Order (CTO) 842. Under this CTO, a Record Review and Field Sampling Plan for the Coddington Cove Rubble Fill Area (CCRF) Area (Study Area 04), located at Naval Station Newport (NAVSTA Newport) in Middletown, Rhode Island are to be conducted by Tetra Tech NUS, Inc. (TtNUS) on behalf of the Navy. This document has been prepared to fulfill this requirement.

### **1.1 SITE-SPECIFIC INVESTIGATION OBJECTIVES**

The project objective will address the initial characterization of waste materials and investigate the nature and extent of contaminants (if any) that are present on the CCRF Area by gathering preliminary information on the soil and groundwater conditions through a focused investigation program. To date, analytical data have not been collected for this site. According to the Initial Assessment Study (IAS) (Envirodyne, 1983) the site was a disposal area for inert rubble materials including concrete, asphalt, metal, slate, wood, brush and a small amount of ash from 1978 to 1982. The findings of this field investigation will assist in determining whether further action is required at the CCRF Area and prioritize this site with the other NAVSTA Newport Installation Restoration program sites accordingly.

### **1.2 PROJECT DELIVERABLES**

Project deliverables to be submitted during this project will include:

- Technical Memorandum: Record Review and Field Sampling Plan.
- Technical Memorandum: Sampling Results and Recommendations.

## **2.0 BACKGROUND INFORMATION**

### **2.1 SITE DETAILS**

The CCRF Area covers an area less than eight acres and is located approximately 25 miles south of Providence, Rhode Island on Aquidneck Island at Naval Station Newport (NAVSTA Newport). The site bisects the Newport/Middletown, Rhode Island town line and is located on the north and west side of Coddington Highway. Figure 2-1 presents the location of the CCRF Area. A map of the site is provided as Figure 2-2.

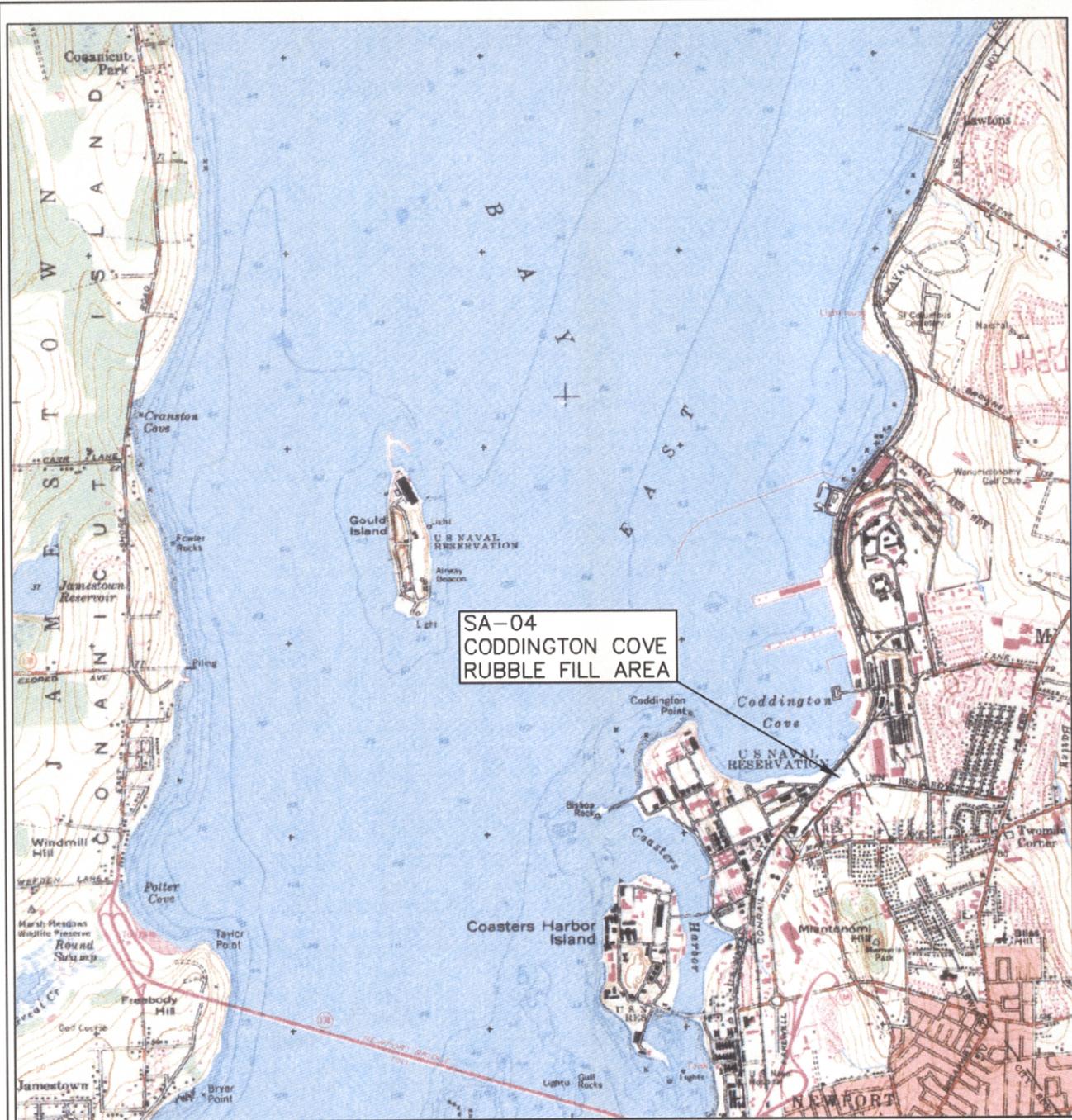
As depicted on Figure 2-2, CCRF Area is located between Coddington Highway to the south and east and a railroad track running parallel to Defense Highway to the west. Derecktor Shipyard (Study Area 19) is just northwest of the site and beyond which is Coddington Cove and Narragansett Bay. A secure, fenced storage area is located directly north of the site and the Defense Automated Printing Service/Supply Department (Building 47) is to the east. A Navy housing development abuts the south and west boundary of the CCRF Area.

According to a site reconnaissance conducted in March 2004, the site is completely vegetated and ranges from grass to thornscrub in the south and western sections of the site, to light wooded vegetation in the north and east. Along the stream is a low-lying wet area with vegetation typical of a stream environment. A fence borders the site to the north, east, west, and south-east. Access to the site is not restricted from the south-west (Figure 2-2).

### **2.2 RECORDS SEARCH**

A preliminary records search to further identify materials that may have been disposed in the CCRF Area, the amount and location of the disposed materials, and potential up-gradient sources to the site has been conducted to direct initial fieldwork. The records search included a search and review of Navy and TtNUS data sources. Aerial photographs obtained from the Rhode Island Department of Administration, Division of Planning were reviewed in an effort to determine where fill was disposed so test pit locations can target these areas. Review of Rhode Island Department of Environmental Management (RIDEM) data sources will be conducted as part of field investigation activities.

Limited information is available regarding the land use record of the CCRF Area. According to the Initial Assessment Study (IAS) (Envirodyne, 1983), the site was a disposal area for inert rubble materials including concrete, asphalt, metal, slate, wood, brush and a small amount of ash from 1978 to 1982. Reviewed records do not indicate additional land use practices.



SA-04  
CODDINGTON COVE  
RUBBLE FILL AREA

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



QUADRANGLE LOCATION

SITE LOCUS

FIGURE 2-1

CCRF AREA – TECHNICAL MEMORANDUM:  
RECORD REVIEW AND FIELD SAMPLING PLAN

NAVSTA NEWPORT – NEWPORT, RHODE ISLAND



TETRA TECH NUS, INC.

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	MAY 3, 2004
SCALE:	AS NOTED	ACAD NAME:	DWG\5152\0471\FIG_2-1.DWG

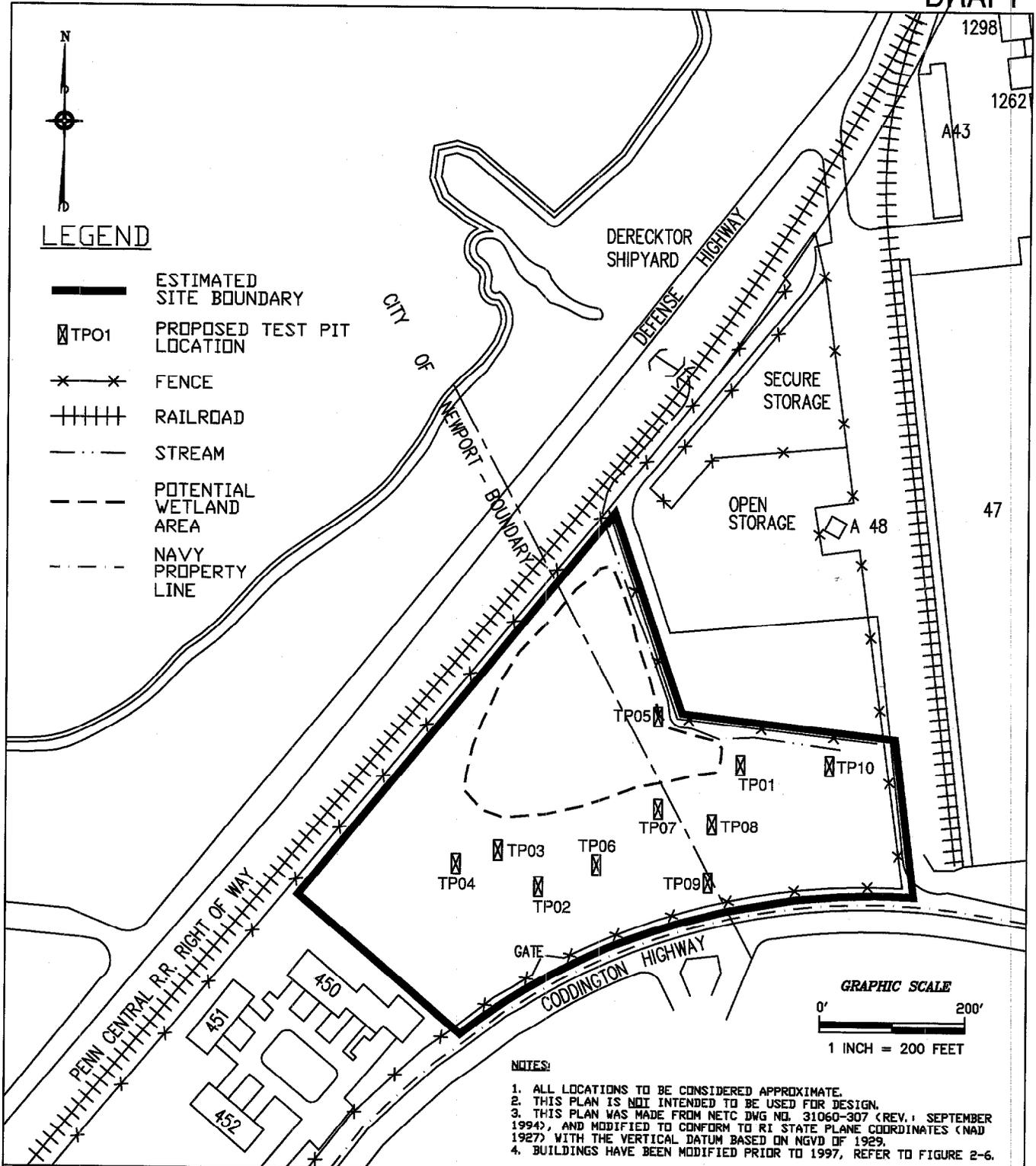
55 Jonspin Road  
Wilmington, MA 01887  
(978)658-7899

DRAFT



LEGEND

- ESTIMATED SITE BOUNDARY
- TPO1 PROPOSED TEST PIT LOCATION
- FENCE
- RAILROAD
- STREAM
- POTENTIAL WETLAND AREA
- NAVY PROPERTY LINE



NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. THIS PLAN IS NOT INTENDED TO BE USED FOR DESIGN.
3. THIS PLAN WAS MADE FROM NETC DWG NO. 31060-307 (REV. 1 SEPTEMBER 1994), AND MODIFIED TO CONFORM TO RI STATE PLANE COORDINATES (NAD 1927) WITH THE VERTICAL DATUM BASED ON NGVD OF 1929.
4. BUILDINGS HAVE BEEN MODIFIED PRIOR TO 1997, REFER TO FIGURE 2-6.

SITE PLAN WITH TEST PIT LOCATIONS

FIGURE 2-2

CCRF AREA - TECHNICAL MEMORANDUM:  
RECORD REVIEW AND FIELD SAMPLING PLAN

NAVSTA NEWPORT - NEWPORT, RHODE ISLAND



TETRA TECH NUS, INC.

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	MAY 10, 2004
SCALE:	AS NOTED	ACAD NAME:	DWG\5152\0471\FIG_2-2.DWG

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

W5204310D

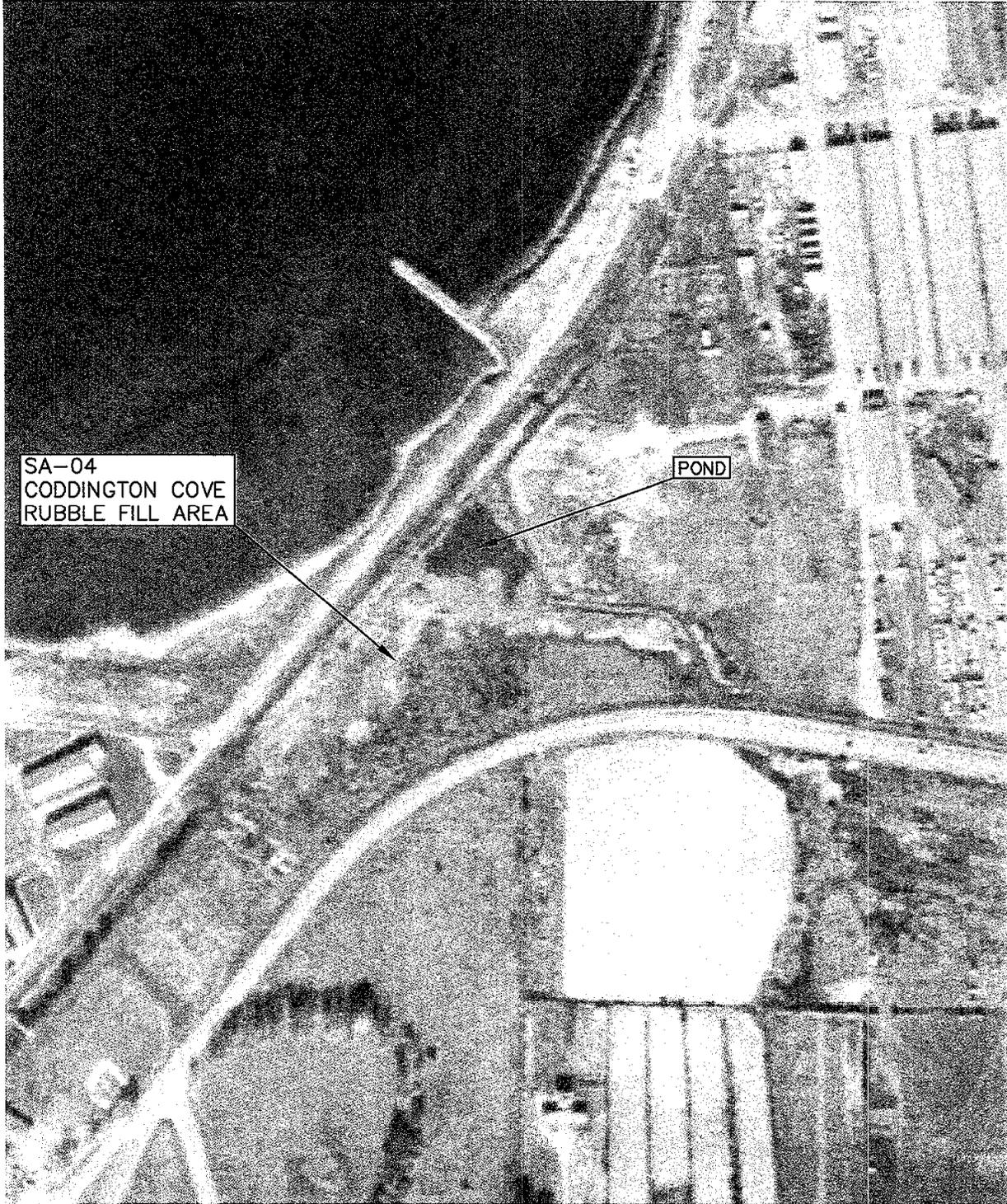
In an aerial photograph dated 1951-1952, provided by the Rhode Island Department of Administration, Division of Planning, a stream appears to flow from the southeast to the northwest end of the site before pooling along the northern corner, adjacent to the railroad track. The western half of the site is densely vegetated in this photograph. The area bordering the railroad track and the pond appear to be less vegetated. Due to the clarity of the photograph, it is difficult to determine what activities, if any, may have occurred in this area. Figure 2-3 presents the 1951-1952 aerial photograph.

The aerial photograph from 1965, presented as Figure 2-4, shows two possible fill areas which are identified on the figure. A visible dirt drive extends from Coddington Highway to each suspected fill area. The fill areas are located adjacent to each other, in the center of the site and are approximately the same size. The areas encompass an estimated 900 square feet. Distinct mounds are visible in the northeast fill area along the northern edge. The remainder of the site appears to be vegetated in this photograph. The pond is present though noticeably smaller, and there are fewer visible tributaries transecting the site.

According to the aerial photograph from 1981, presented as Figure 2-5, the southern fill area identified in the 1965 photograph is no longer visible, as vegetation covers this area. The fill area to the north is still evident, though the extent has shifted further north. This fill area, identified on Figure 2-5, has an estimated size of 500 square feet. The pond is not present in this photograph and minimal vegetation is evident in the vicinity to the north of the fill area. Grass appears to cover the southern side of the site. Development along the southern boundary of CCRF Area and the southeastern side of Coddington Highway across from the site is evident in this photograph.

Minimal changes to the site are evident in the 1992, 1996 and 1997 aerial photographs. The aerial photograph from 1997 is presented as Figure 2-6. These views show the entire site to be vegetated. Grass covers the southern third of the site while larger more dense vegetation is evident in the north. The pond is not visible in any of these photographs. The pond area in the 1951-1952 photograph and the area directly adjacent to the railroad track have a noticeably different vegetation coloring. This coloring and the absence of the pond indicate that this area may have been filled in with the aforementioned demolition type materials from 1978 through 1982, though this is unconfirmed in available aerial photographs.

Three structures which were part of the Navy housing development immediately abutting the CCRF Area to the south are no longer present in the 1997 aerial photograph. These structures were present in the 1992 and 1996 photographs. Minimal changes in development of the area southeast of Coddington Highway and across from the site are evident.



SA-04  
CODDINGTON COVE  
RUBBLE FILL AREA

POND

AERIAL PHOTO - 1951-1952

FIGURE 2-3

CCRF AREA - TECHNICAL MEMORANDUM:  
RECORD REVIEW AND FIELD SAMPLING PLAN

NAVSTA NEWPORT - NEWPORT, RHODE ISLAND



TETRA TECH NUS, INC.

DRAWN BY: D.W. MACDOUGALL

REV.: 0

CHECKED BY: L. SEYDEWITZ

DATE: MAY 3, 2004

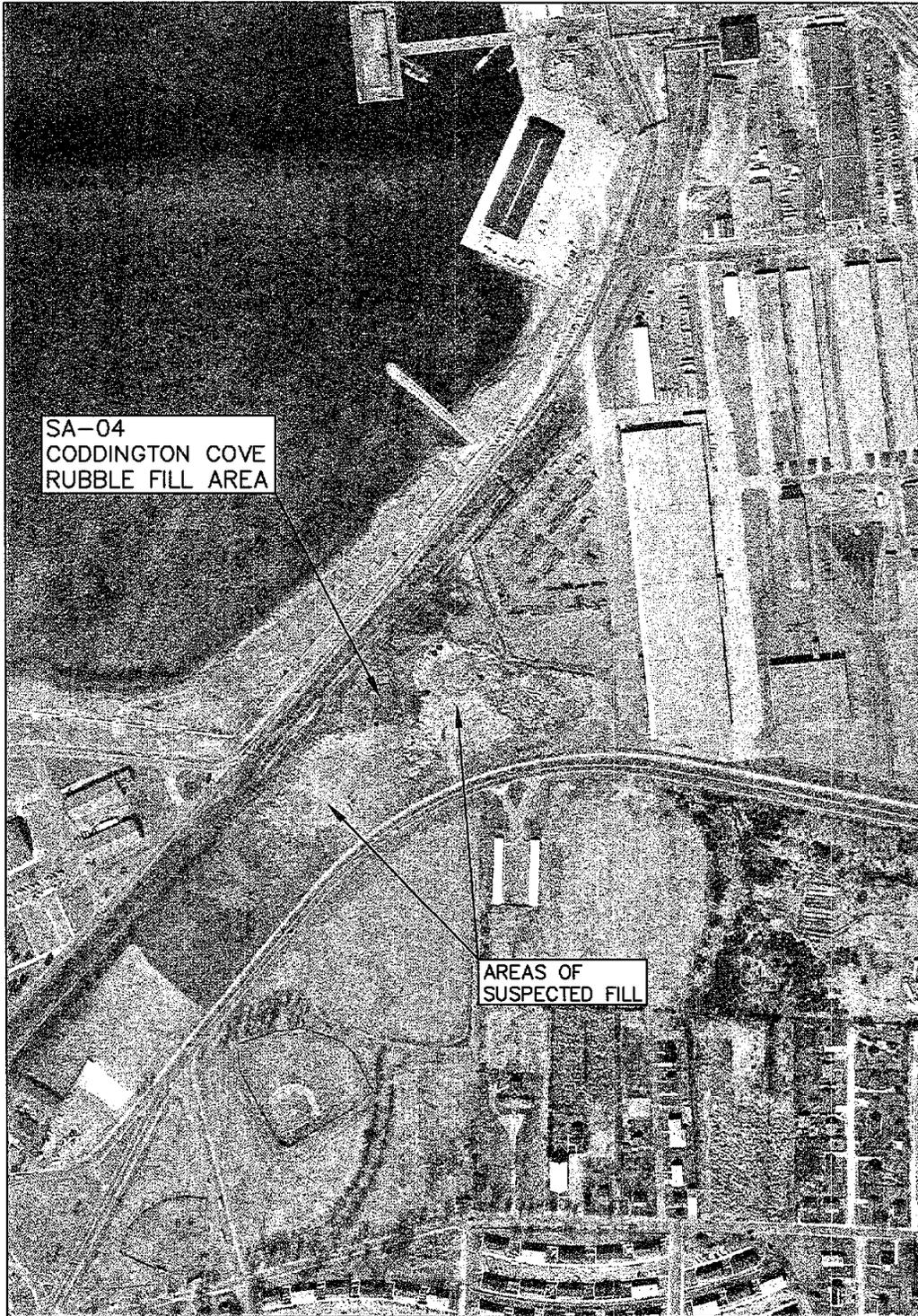
SCALE: NONE

ACAD NAME: DWG\5152\0471\FIG\_2-3.DWG

55 Jonspin Road

Wilmington, MA 01887

(978)658-7899



AERIAL PHOTO - 1965

FIGURE 2-4

CCRF AREA - TECHNICAL MEMORANDUM:  
RECORD REVIEW AND FIELD SAMPLING PLAN

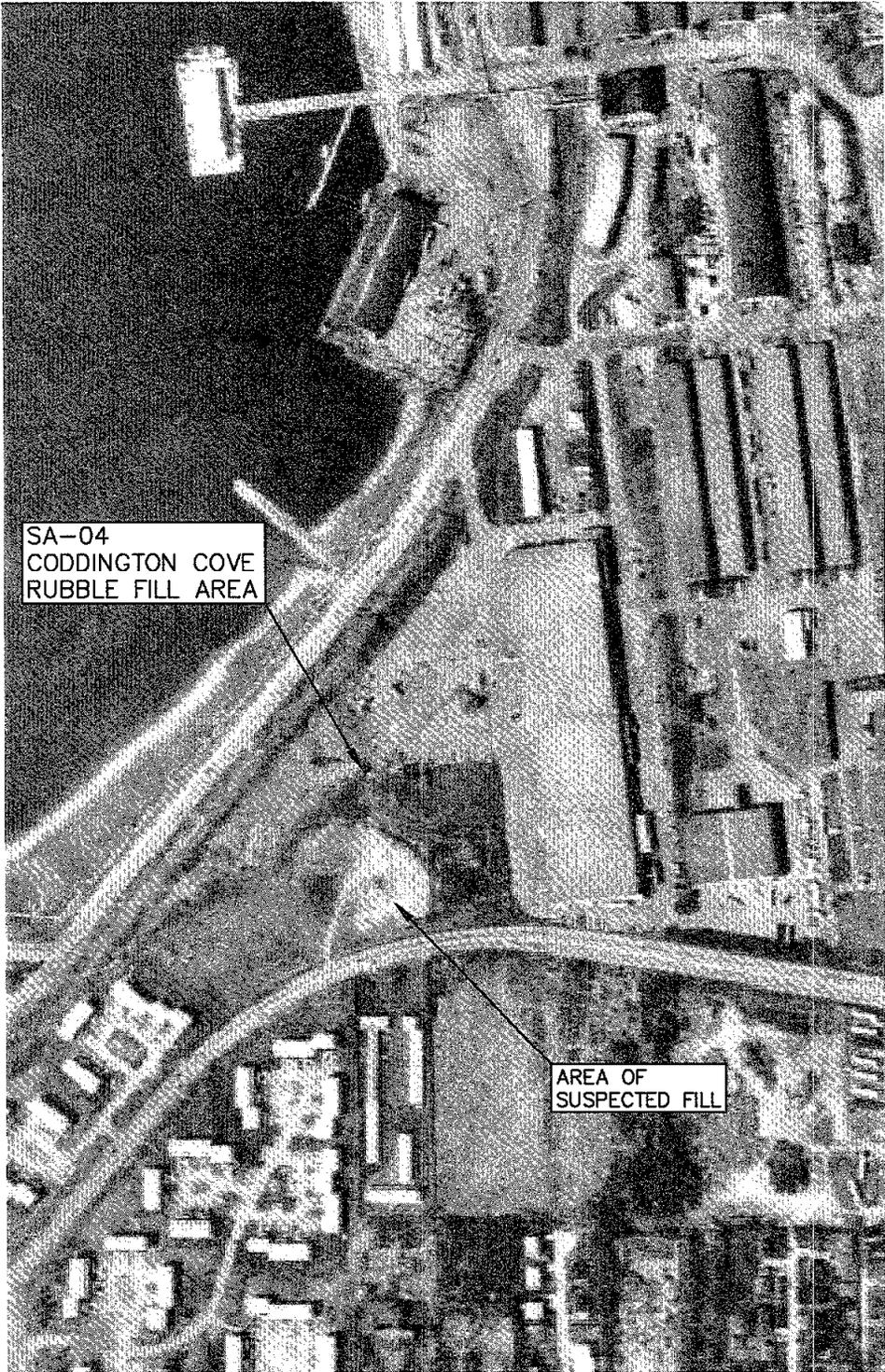
NAVSTA NEWPORT - NEWPORT, RHODE ISLAND

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	MAY 3, 2004
SCALE:	AS NOTED	ACAD NAME:	DWG\5152\0471\FIG_2-4.DWG



TETRA TECH NUS, INC.

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



SA-04  
 CODDINGTON COVE  
 RUBBLE FILL AREA

AREA OF  
 SUSPECTED FILL

AERIAL PHOTO - 1981

FIGURE 2-5

CCRF AREA - TECHNICAL MEMORANDUM:  
 RECORD REVIEW AND FIELD SAMPLING PLAN

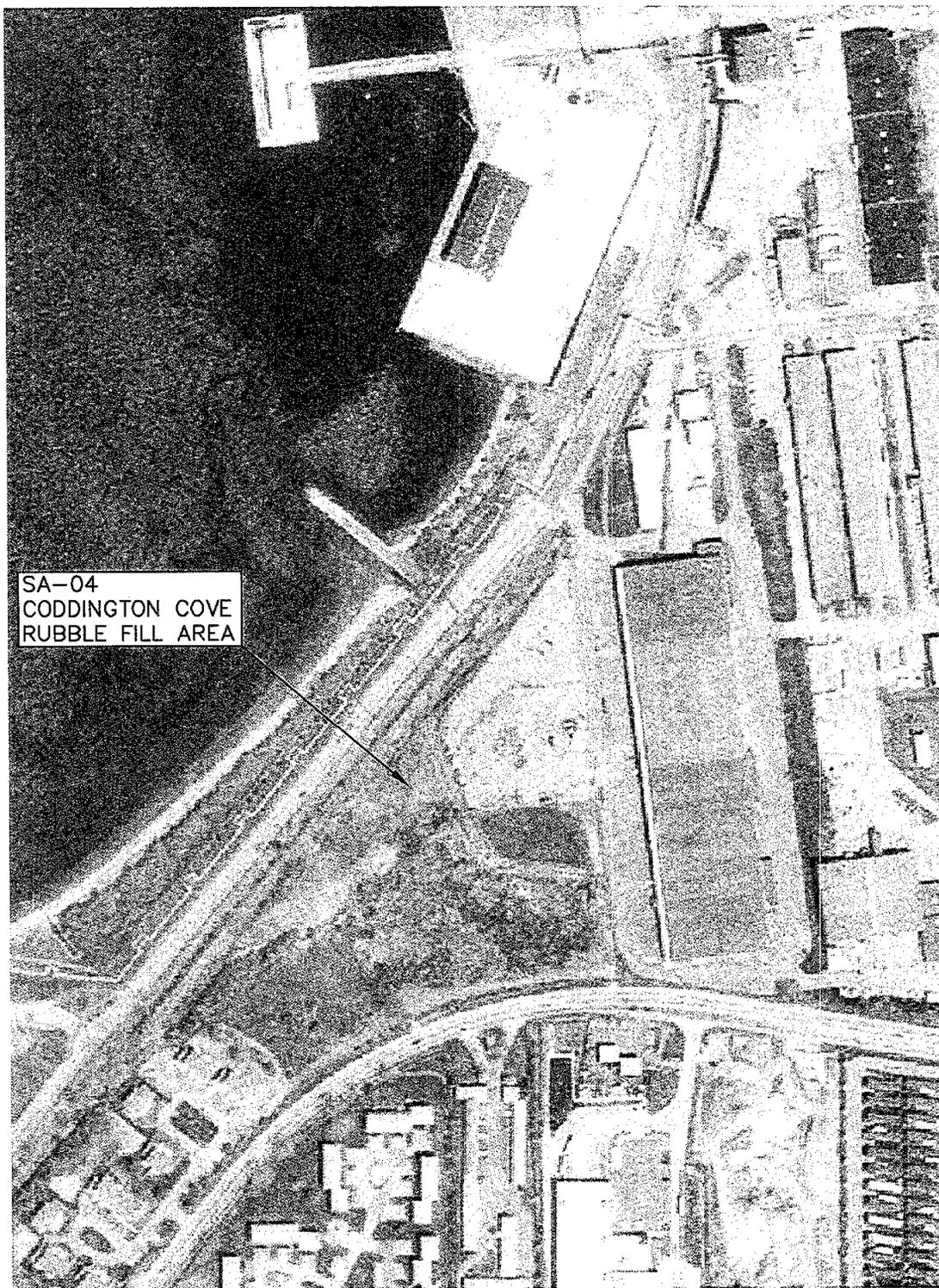
NAVSTA NEWPORT - NEWPORT, RHODE ISLAND



TETRA TECH NUS, INC.

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	MAY 3, 2004
SCALE:	AS NOTED	ACAD NAME:	DWG\5152\0471\FIG_2-5.DWG

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



SA-04  
 CODDINGTON COVE  
 RUBBLE FILL AREA



AERIAL PHOTO - 1997

FIGURE 2-6

CCRF AREA - TECHNICAL MEMORANDUM:  
 RECORD REVIEW AND FIELD SAMPLING PLAN

NAVSTA NEWPORT - NEWPORT, RHODE ISLAND



TETRA TECH NUS, INC.

DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	L. SEYDEWITZ	DATE:	MAY 3, 2004
SCALE:	AS NOTED	ACAD NAME:	DWG\5152\0471\FIG_2-6.DWG

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

### **3.0 FIELD SAMPLING PLAN**

The objective of this initial investigation is to characterize the waste materials disposed of at the CCRF Area and determine if hazardous materials may have been released to the environment. The analytical data generated from this sampling effort will be used by the Navy to determine whether further study is necessary at this site and if so, the priority it has with the other NAVSTA Newport sites.

The sampling activities are detailed in the following sections.

#### **3.1 MOBILIZATION/DEMOBILIZATION**

As part of mobilization activities, technical specifications for brush clearing, excavating test pits, disposing of investigation-derived waste (IDW) and laboratory analysis subcontracts will be prepared and issued. Required field equipment and supplies will be ordered and mobilized to the site. Field team members will review this Field Sampling Plan (FSP), the Health and Safety Plan (provided under separate cover), applicable Standard Operating Procedures (SOPs, included as Appendix A), and applicable subcontract specifications. A field team orientation meeting will be conducted prior to initiating the fieldwork to familiarize personnel with site health and safety requirements and the scope of the field activities. The mobilization date will be coordinated with NAVSTA Newport personnel a minimum of one week in advance of the proposed mobilization date. Upon completion of field activities, demobilization activities will be conducted, including disposing of IDW, finalization of field documentation and submittal of all field documents to the project file.

#### **3.2 TEST PIT EXCAVATION**

A total of 10 test pits will be excavated in areas of suspected fill, as determined in the review of records and aerial photographs. Prior to excavation, the identified locations will be inspected for evidence of waste materials including, soil mounds, stressed vegetation and visible rubble. Test pits will be located at these areas, if identified. If no such areas are determined during the initial inspection, the 10 originally planned test pits will be excavated in their proposed locations. Figure 2-2 presents the proposed locations of test pits.

A significant amount of small wooded vegetation exists on the CCRF Area. Any vegetation preventing physical access to each test pit location will be cut level with the ground surface, and chipped or removed from the CCRF Area by a TiNUS subcontractor. In addition, pertinent features, such as any overhead and subsurface utilities, and other potential hazards will be reviewed with Navy personnel with respect to planned excavation activities.

Test pits will be excavated using either a back-hoe or excavator to identify the presence and extent of wastes and other debris, and to collect soil and/or groundwater samples for laboratory analysis. Test pits will be excavated by a subcontractor to TtNUS operating under the site-specific Health and Safety Plan and supervised by a TtNUS representative.

Excavated material will be returned to the pits as backfill. Obvious forms of contamination (drums, sludges, etc.) will be separated out, if found, and disposed of appropriately.

All test pits will be excavated to a depth of the reach of the excavator (approximately 15 to 18 feet below grade), the top of bedrock, top of groundwater, or until the excavation begins to collapse, as determined by the TtNUS engineer/geologist supervising the excavation. Since the fill reportedly consists of material containing concrete, asphalt, metal, slate, wood, brush and a small amount of ash, it is anticipated that natural soils should be visually identifiable. The depth of fill from the ground surface is unknown. After samples have been collected, and the pit has been photographed and videotaped, the pit will be backfilled to the original grade. If a large quantity of foreign material (drums, tanks, etc) are encountered that cannot be replaced into the test pit, clean fill will be provided for make-up material, and the foreign material will be removed from the site in accordance with local, state, and federal regulations.

A log of each test pit will be maintained by the field geologist to describe lithologies encountered, characterize soil utilizing the Unified Soil Classification System (USCS), identify depth of geologic contacts, water levels, sample depths, bedrock characteristics, and any other pertinent observations made during excavation. Test pit logs will also include information on sample number, type, and depth and headspace screening results. An example of a test pit log is included in Appendix B.

Some of the test pit activities may be proximal to streams and wetland areas, and may fall under the Rhode Island Freshwater Wetlands Act jurisdiction. The RIDEM Department of Water Resources will be notified of the work to be performed, and their concerns will be addressed prior to initiation of this work. Any impacts to these sensitive areas will be minimized to the greatest extent possible. Test pit excavation subcontractors will be required to install erosion and sedimentation control measures at each test pit location which may impact the sensitive environments. Any work activities which may impact these areas will fall under Sections 6.01 (Exempt Activities) and 6.14 (Monitoring and Research Activities) of the Rhode Island Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act (RIDEM, 1998, amended 2001).

### 3.3 SAMPLE COLLECTION

The objective of the sample collection is to characterize the waste materials disposed at the CCRF Area and determine if hazardous materials may have been released to the environment. Samples will be collected from 10 test pits and analyzed for Target Compound List (TCL) organics (including volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), gas range organics/diesel range organics (GRO/DRO) and Target Analyte List (TAL) metals analyses. Table 3-1 presents a summary of Field and Quality Control (QC) samples, and Table 3-2 presents the analytical methods, volume and preservatives required. Samples will be containerized in the following order: VOCs/GRO/percent moisture, SVOCs, TAL metals, and DRO.

An estimated two (soil or groundwater) samples will be collected from each test pit at depths to be determined based on field observations after the excavation has been completed. Location of samples within test pits will be selected from suspected impacted areas, based on visual observations such as staining and/or VOC/SVOC screening readings, etc. Specifically, if visual or screening evidence of contamination is encountered, a soil sample will be collected from within the suspected fill in addition to a groundwater sample (if groundwater is encountered). If there is observed potential contamination to the groundwater (e.g., a sheen), a groundwater sample will be collected in addition to a soil sample from soils directly above the depth of groundwater saturation.

If no visual or screening evidence of potential areas of contamination are observed, then only one soil sample will be collected from the test pit such that the sample will be a composite from each wall of the pit. All soils will be collected from the center of the excavator bucket using hand tools. With the exception of soil samples for VOC and GRO analysis, soils will be placed in a stainless steel bowl and homogenized prior to being split into the appropriate sample containers for laboratory analyses.

Soil samples for VOC and GRO analysis will be collected using an EnCore™ sample device in accordance with the manufacturers' instructions, and the SW846 Method 5035A, July 2002. The following procedure should be followed:

1. Label four EnCore™ samplers (two for the VOC analysis and two for the GRO analysis).
2. Attach a reusable T-handle that serves to assist in pushing the sampler into the soil to the EnCore™ sample device. Once the soil sample is collected, attach an airtight sealing cap, creating a self-contained package.
3. Pack the samples with ice and ship to the laboratory.

**TABLE 3-1  
ESTIMATED NUMBER OF FIELD AND QUALITY CONTROL SAMPLES  
TECHNICAL MEMORANDUM: RECORD REVIEW AND FIELD SAMPLING PLAN  
CODDINGTON COVE RUBBLE FILL AREA  
NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND**

SAMPLE TYPE	MEDIA	ANALYSIS	FIELD SAMPLES	FIELD DUPLICATES (1 PER 10 FIELD SAMPLES)	RINSATE BLANKS <sup>(1)</sup>	SOURCE BLANKS (1 PER WATER SOURCE PER EVENT)	TRIP BLANKS (1 PER SHIPMENT)	TOTAL QUANTITY <sup>(2)</sup>
Test Pit Excavation	Soils (minimum number of samples)	TCL VOCs	10	1	1	1	1	14
		TCL SVOCs	10	1	1	1	0	13
		TAL Metals	10	1	1	1	0	13
		GRO/DRO	10	1	1	1	0	13
		Pest/PCB	10	1	1	1	0	13
	Groundwater (maximum number of samples)	TCL VOCs	10	1	1	0	1	13
		TCL SVOCs	10	1	1	0	0	12
		TAL Metals	10	1	1	0	0	12
		GRO/DRO	10	1	1	0	0	12
		Pest/PCB	10	1	1	0	0	12

(1) One rinsate blank per type of tool or sampling procedure used.

(2) In order to accommodate laboratory quality control analyses (i.e., matrix spike, matrix spike duplicate, laboratory duplicate) the field crew will provide multiple aliquots of samples (as applicable) with a frequency of one per 20 samples of similar matrix.

**TABLE 3-2  
 SAMPLE CONTAINER, PRESERVATIVE, AND HOLDING TIME REQUIREMENTS  
 TECHNICAL MEMORANDUM: RECORD REVIEW AND FIELD SAMPLING PLAN  
 CODDINGTON COVE RUBBLE FILL AREA  
 NAVAL STATION NEWPORT, NEWPORT, RHODE ISLAND**

SAMPLE MEDIUM	ANALYSIS	SAMPLE CONTAINER	PRESERVATIVE	HOLDING TIME	USEPA/NFESCDQO LEVEL <sup>(1)</sup>
Soils	TCL VOCs (SW 836-5035A, 8260B) and GRO	EnCore™ sample device	Cool to 4°C	48 Hours Unpreserved/14 Days (Analysis)	IV
	TCL SVOCs (SW846 8270)	8 oz wide mouth jar	Cool to 4°C	7 Days (Extraction)	IV
	TAL Metals (SW846, 6010B)	4 oz wide mouth jar	Cool to 4°C	Hg 28 Days, Others 6 months	IV
	DRO (SW846 8015B modified)	8 oz wide mouth jar	Cool to 4°C	28 days	III
	Percent Moisture	2-oz glass jar	Cool to 4°C	14 days analysis	III
Pest/PCB (SW846 8081/8082)	8 oz wide mouth jar	Cool to 4°C	7 Days (Extraction)	IV	
Groundwater	TCL VOCs (SW846, 8260B)	2 - 40 ml VOA vials	HCl to pH <2/Cool to 4°C	14 Days (Analysis)	IV
	TCL SVOCs (SW846-8270)	80 oz amber bottle	Cool to 4°C	7 Days (Extraction)	IV
	TAL Metals (SW846-6010B)	1 liter PE bottle/ 1 liter PE bottle	HNO <sub>3</sub> to pH <2/HNO <sub>3</sub> to pH <2	Hg 28 Days, Others, 6 months/ Hg 28 Days, Others, 6 months	IV
	DRO/GRO (SW846 8015B modified)	2-40 ml VOA vials	HCl to pH <2/Cool to 4°C	14 Days (Analysis)	IV
	Pest/PCB (SW846 8081A/8082)	80 oz amber bottle	Cool to 4°C	7 Days (Extraction)	IV

(1) USEPA and Naval Facilities Engineering Service Center Data Quality Objectives for laboratory data deliverables (see text)

Headspace screening for VOC compounds will be conducted using both a flame ionization detector (FID) monitoring instrument and a photoionization detector (PID). The jar headspace screening method is presented in Appendix A.

### **3.3.1 Groundwater Sampling**

Grab groundwater sample collection procedures will be followed for each test pit sampled. The groundwater sampling procedure is similar to the surface water sampling procedure. As such, the TtNUS SOP No. SA-1.2, Revision 5 for surface water sample collection is to be used. A typical remote sampler used to collect groundwater samples from the bottom of a test pit is presented in Attachment D of TtNUS SOP No. SA-1.3, Revision 7, for soil sampling. All SOPs are presented in Appendix A.

The following steps provide a general guideline for the grab (or dip) sample collection:

1. If floating product is observed in the test pit, the presence of product will be noted, and if appropriate, the thickness measured with the use of an immiscible liquid interface probe (or equivalent) and sampled. The depth to water in the test pit will be measured and recorded to the nearest 0.1 feet, minimizing immersion of the meter within the standing water to avoid disturbance of colloidal particles.
2. The remote sampler will be lowered into the test pit to just beneath the surface of the water and the container filled.
3. The sampler will be brought to the surface and sample bottles filled.

The sample aliquot for VOC analysis shall be collected directly into pre-preserved 40-mL amber vials containing hydrochloric acid (HCL) with minimal disturbance. An extra vial shall be collected initially to check the pH of the sample. If the desired pH is not obtained, five drops of HCl shall be placed into new 40-mL vials and the sample will be recollected. The process is repeated until pH < 2 is achieved. If effervescence is noted when the samples are collected, the samples shall be recollected without preservative and shipped to the laboratory as soon as possible. All samples will be labeled, packaged, and shipped according to TtNUS SOP No. SA-6.1.

**3.3.1.1 Non-Aqueous Phase Liquids (NAPL) Sampling**

If light or dense non-aqueous phase liquids (LNAPL or DNAPL) are determined to be present in the test pits, samples are to be collected to avoid disruption of the NAPL layer. The collection of the free phase samples will be the same as a regular groundwater sample.

**3.4 DECONTAMINATION PROCEDURES**

All non-disposable sampling equipment that comes into contact with the sample medium will be decontaminated to prevent cross-contamination between sampling points. This includes equipment such as stainless steel bowls, scoops, the excavator bucket, etc. The following decontamination sequence will be employed:

- remove gross contamination by scrubbing with potable water
- scrub with potable water/liquinox
- rinse with potable water
- rinse with dionized water
- rinse with 2-propanol
- air dry (to extent possible)
- wrap with aluminum foil, dull side toward equipment.

The excavator bucket and any part of the excavator that comes into contact with the sample medium will be steam cleaned prior to the start of the excavation program, and after the completion of each test pit. Heavy equipment decontamination will be performed at a temporary, centrally located decontamination pad constructed specifically for this purpose. The decontamination pad will be large enough to capture all wash water and channel it into a sump. The fluids in the sump will be containerized after each use.

**3.5 LAND SURVEYING**

The horizontal location of each test pit will be surveyed using a portable global positioning unit (GPS) tied to local control. Opposing corners of each test pit will be marked (with stakes) and the coordinates recorded.

**3.6 INVESTIGATION-DERIVED WASTE (IDW) DISPOSAL**

Any soil IDW generated during excavation or sampling will be backfilled in the test pit where it originated. Liquid IDW (e.g. water used to decontaminate equipment) and solid IDW (e.g. contaminated personal

protection equipment (PPE) and plastic sheeting) will be placed in drums and containerized before being shipped off site in bulk for disposal at an approved disposal facility. Laboratory analysis of samples collected during the investigation program will be used to further characterize the waste materials, as required by state and federal disposal requirements. Additional samples for other parameters may also be required. Analysis of representative samples of waste materials for disposal parameters will be the responsibility of an outside disposal subcontractor. All IDW will be shipped off site by this same subcontractor.

Any PPE waste generated during work will be decontaminated and stored in plastic bags for disposal at the end of each work day. The bags will be placed in an industrial dumpster at a location to be determined by the Navy.

Containers of IDW will be labeled as to their point of origin, and date collected. Samples of these materials will be labeled with the information on the containers. Containers of IDW that are found to be hazardous will be characterized and disposed of within 90 days.

### **3.7 CHANGES TO THE FIELD SAMPLING PLAN**

If, during the field investigation, the plan for collection of data needs to be altered, the FSP may be amended through the use of a Field Modification Request (FMR). This form will be prepared by the TtNUS Field Operations Leader (FOL) and forwarded to the TtNUS Project Manager (PM). The TtNUS PM makes a recommendation to the Navy Regional Project Manager (RPM), who (if necessary) will forward the FMR to the regulatory oversight RPMs. Time limits on acceptance of, or comment to, the FMR will be stated. An example of this form is presented in Appendix B.

### **3.8 SCHEDULE AND REGULATORY OVERSIGHT**

A schedule for field investigations has not been prepared at this time. However, test pit excavation may warrant regulatory oversight. A schedule will be prepared and submitted to United States Environmental Protection Agency (USEPA) and RIDEM a minimum of one week prior to initiation of the field work. This schedule will be updated as necessary to inform oversight personnel when different tasks and activities are scheduled to occur.

Following completion of the analysis of data from each task, the data will be presented to the oversight parties and an agreement will be reached on the sample stations for the next phase of investigation. In addition, any changes in the number or location of proposed test pits will be discussed with RIDEM and EPA prior to initiation of the associated phase of fieldwork.

A 24-hour advance notification of changes in scheduled field activities will be given to the regulatory agencies.

## 4.0 QUALITY ASSURANCE PLAN

The quality assurance and quality control (QA/QC) sample collection procedures and frequencies, data quality protocols, and analytic data validation requirements are stated below. Applicable SOPs including chain-of-custody procedures are located in Appendix A.

Sampling objectives are to provide representative concentrations of TCL VOCs, SVOCs, pesticides, PCBs, and TAL metals in soil and groundwater relative to the CCRF Area. Achieving these objectives requires that the data collected from the field conform to an appropriate level of quality. The quality of a data set is measured by the precision and accuracy, representativeness, completeness, and comparability (PARCC) parameters. Some parameters are expressed quantitatively, and others qualitatively. The PARCC goals for this project are determined by the intended use of the data.

The environmental samples collected for laboratory analysis during the field investigation will be analyzed by a Naval Facilities Engineering Service Center (NFESC) approved laboratory. Standard EPA analytical methods will be employed.

Sample concentrations will be compared to EPA screening numbers for soil and groundwater.

### 4.1 QUALITY CONTROL SAMPLES

The number and frequency of quality control samples are presented in Table 3-1. All quality control samples and field samples will be collected and preserved following the same procedures.

### 4.2 SAMPLE NUMBERING

Soil and groundwater samples will be labeled as soon as they are collected. Sample numbers will reflect the source, medium, and location. An alpha numeric numbering system will be used to describe this information. This system is detailed below:

AAAA - A - AANN - NNNN  
(Site Identifier) - (Medium) - (Sample Location) - (Depth)

The site identifier for the CCRF Area is CCRF. "Medium" indicates solid (S) or aqueous (A). Sample locations will be noted as TP for test pit samples. Sample depth for soil samples will be identified in feet such as CCRF-S-TP01-0204; groundwater sample identification will not specify depth.

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

Duplicates: CCRF-S-TP-DUP##

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

Source Blanks: CCRF-A-DIUF-TP##

Rinsate blanks will be identified using the code for the sample for which the equipment was last used, the identifier (RB), and its chronological number.

Rinsate Blanks: CCRF-A-TP01-0204-RB##

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

Trip Blanks: CCRF-A-TB##

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

#### **4.3 CALIBRATION PROCEDURES**

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

Calibration procedures for laboratory equipment used in the analysis of environmental samples will be performed in accordance with laboratory SOP and the analytical methods required.

#### **4.4 ANALYTICAL DATA VALIDATION**

Samples will be analyzed for the parameters listed on Table 3-2. The VOC, SVOC, pesticides, and PCB sample data will be validated using EPA Region 1 Tier I validation protocol in accordance with the "Data

Functional Guidelines for Evaluating Environmental Analyses" (USEPA, December 1996). TAL metals sample data will be validated in accordance with "Region I, EPA-Region I Laboratory Data Validation Functional Guideline for Evaluating Inorganic Analyses" (modified February 1989). Use of these validation protocols is allowed under the NFESC (formerly NEESA) guidelines and is described in the Navy Installation Restoration Laboratory Quality Assurance Guide, Interim Document (revised February 1996), and the NEESA 20.2047B; June 1988 guidelines.

This level of validation is limited to a check on completeness of the laboratory report/deliverable to assure all samples delivered are reported and lab Quality Control results are within normal parameters.

#### **4.5 DOCUMENTATION**

A bound/weatherproof field logbook will be maintained by the FOL. The FOL or designee will record all information related to sampling or field activities. Some field documentation will be recorded on sample chains of custody, sample collection log sheets, site entry logs, and other field forms. Examples of these forms are provided in Appendix B. At completion of the field work, this information will be bound and incorporated into the project files.

## **5.0 REPORTING**

Following the completion of the field sampling, laboratory analysis, data validation, and data evaluation, the results will be described in a Technical Memorandum. The memorandum will report the results of the excavation effort as well as historical data from the additional review of records. Sample concentrations compared to EPA screening numbers will be presented and a recommendation will be made as to what action will need to be taken at CCRF Area in the next phase of work.

## 6.0 REFERENCES

Envirodyne Engineers, Inc. (EEI). 1983. Initial Assessment Study of the Naval Education and Training Center, Newport, Rhode Island. Contract No. N62474-82-C-8262. Naval Energy and Environmental Support Activity (NEESA) 13-024. March.

Massachusetts Institute of Technology. 2001. RIDOT 1997 Aerial Orthophotos Black and White 1:5,000. <http://ortho.edc.uri.edu>.

**APPENDIX A**  
**STANDARD OPERATING PROCEDURES**



TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

Number	SA-1.3	Page	1 of 20
Effective Date	09/03	Revision	7
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>DS</i>		

Subject  
SOIL SAMPLING

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 PURPOSE.....	2
2.0 SCOPE.....	2
3.0 GLOSSARY .....	2
4.0 RESPONSIBILITIES.....	3
5.0 PROCEDURES.....	3
5.1 OVERVIEW.....	3
5.2 SOIL SAMPLE COLLECTION.....	4
5.2.1 Procedure for Collecting Soil Samples for Volatile Organic Compounds.....	4
5.2.2 Procedure for Collecting Non-Volatile Soil Samples .....	6
5.2.3 Procedure for Collecting Undisturbed Soil Samples (ASTM D1587-83).....	6
5.3 SURFACE SOIL SAMPLING .....	7
5.4 NEAR-SURFACE SOIL SAMPLING .....	7
5.5 SUBSURFACE SOIL SAMPLING WITH A HAND AUGER .....	8
5.6 SUBSURFACE SOIL SAMPLING WITH A SPLIT-BARREL SAMPLER (ASTM D1586-84).....	9
5.7 SUBSURFACE SOL SAMPLING USING DIRECT PUSH TECHNOLOGY.....	10
5.8 EXCAVATION AND SAMPLING OF TEST PITS AND TRENCHES .....	10
5.8.1 Applicability.....	10
5.8.2 Test Pit and Trench Excavation .....	10
5.8.3 Sampling in Test Pits and Trenches .....	12
5.8.4 Backfilling of Trenches and Test Pits.....	15
5.9 RECORDS .....	15
6.0 REFERENCES.....	16
 <u>ATTACHMENTS</u>	
A SOIL & SEDIMENT SAMPLE LOG SHEET.....	17
B SPLIT-SPOON SAMPLER.....	18
C TEST PIT LOG.....	19
D REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING .....	20

Subject  SOIL SAMPLING	Number SA-1.3	Page 2 of 20
	Revision 7	Effective Date 09/03

## 1.0 PURPOSE

This procedure discusses the methods used to collect surface, near surface, and subsurface soil samples. Additionally, it describes the method for sampling of test pits and trenches to determine subsurface soil and rock conditions, and recover small-volume or bulk samples.

## 2.0 SCOPE

This procedure is applicable to the collection of surface, near surface and subsurface soils for laboratory testing, which are exposed through hand digging, hand augering, drilling, or machine excavating at hazardous substance sites.

## 3.0 GLOSSARY

Composite Sample - A composite sample exists as a combination of more than one sample at various locations and/or depths and times, which is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples are not to be collected for volatile organics analysis.

Grab Sample - One sample collected at one location and at one specific time.

Non-Volatile Sample - A non-volatile sample includes all other chemical parameters (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

Hand Auger - A sampling device used to extract soil from the ground in a relatively undisturbed form.

Thin-Walled Tube Sampler - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches outside diameter (OD) and from 18 to 54 inches in length.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2-inch OD to 3-1/2 inch OD. The larger sizes are commonly used when a larger volume of sample material is required.

Test Pit and Trench - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine the shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher excavator, or bulldozer).

Confined Space - As stipulated in 29 CFR 1910.146, a confined space means a space that: 1) is large enough and so configured that an employee can bodily enter and perform assigned work; 2) has limited or restricted means for entry or exit (for example tanks, vessels, silos, storage bins, hoppers, vaults, pits, and excavations); and 3) is not designed for continuous employee occupancy. TtNUS considers all confined space as permit-required confined spaces.

Subject  SOIL SAMPLING	Number SA-1.3	Page 3 of 20
	Revision 7	Effective Date 09/03

#### 4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for determining sampling objectives, as well as, the field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches, and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan. This will include (but not be limited to) performing air quality monitoring during sampling, boring and excavation activities, and to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the FOL on other safety-related matters regarding boring, excavation and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - The FOL is responsible for finalizing the location of surface, near surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits and trenches, and for adherence to OSHA regulations during these operations.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of soil samples and the completion of all required paperwork (i.e., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms).

Competent Person - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

#### 5.0 PROCEDURES

##### 5.1 Overview

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they have migrated into the water table, and can establish the amount of contamination sorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during the sampling operations, particularly noting the location, depth, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. As a result, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. Often this information on soil properties can be obtained from published soil surveys available through the U.S. Geological Surveys and other government or farm agencies. It is the

Subject  SOIL SAMPLING	Number SA-1.3	Page 4 of 20
	Revision 7	Effective Date 09/03

intent of this procedure to present the most commonly employed soil sampling methods used at hazardous waste sites.

## 5.2 Soil Sample Collection

### 5.2.1 Procedure for Collecting Soil Samples for Volatile Organic Compounds

The above described traditional sampling techniques, used for the collection of soil samples for volatile organic analysis, have recently been evaluated by the scientific community and determined to be ineffective in producing accurate results (biased low) due to the loss of volatile organics in the sampling stages and microbial degradation of aromatic volatiles. One of the newly adopted sampling procedures for collecting soil samples includes the field preservation of samples with methanol or sodium bisulfate to minimize volatilization and biodegradation. These preservation methods may be performed either in the field or laboratory, depending on the sampling methodology employed.

Soil samples to be preserved by the laboratory are currently being performed using method SW-846, 5035. Laboratories are currently performing low level analyses (sodium bisulfate preservation) and high level analyses (methanol preservation) depending on the end users needs.

It should be noted that a major disadvantage of the methanol preservation method is that the laboratory reporting limits will be higher than conventional testing. The reporting levels using the new method for most analytes are 0.5 µg/g for GC/MS and 0.05 µg/g for GC methods.

The alternative preservation method for collecting soil samples is with sodium bisulfate. This method is more complex to perform in the field and therefore is not preferred for field crews. It should also be noted that currently, not all laboratories have the capabilities to perform this analysis. The advantage to this method is that the reporting limits ( 0.001 µg/g for GC/PID or GC/ELCD, or 0.010 for GC/MS) are lower than those described above.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

#### 5.2.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for volatile organics that are to be preserved at the laboratory will be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample will be obtained using a reusable sampling handle provided with the EnCore™ sampler. The sample is collected by pushing the EnCore™ sampler directly into the soil, ensuring that the sampler is packed tight with soil, leaving zero headspace. Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore™ sampler shipment by the manufacturer.

Once the sample is collected, it should be placed on ice immediately and shipped to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

If the lower detection limits are necessary, an option would be to collect several EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

Subject  SOIL SAMPLING	Number SA-1.3	Page 5 of 20
	Revision 7	Effective Date 09/03

#### 5.2.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) method and medium-level (methanol preservation) method.

##### Methanol Preservation (Medium Level):

Soil samples to be preserved in the field with methanol will utilize 40-60 mL glass vials with septum lids. Each sample bottle will be filled with 25 mL of demonstrated analyte-free purge and trap grade methanol. Bottles may be prespiked with methanol in the laboratory or prepared in the field.

Soil will be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol preserved sample bottle. Calibration of the scale should be performed prior to use and intermittently throughout the day according to the manufacturers requirements.

The sample should be collected by pulling the plunger back and inserting the syringe into the soil to be sampled. The top several inches of soil should be removed before collecting the sample. Approximately 10 grams  $\pm 2g$  (8-12 grams) of soil should be collected. The sample should be weighed and adjusted until obtaining the required amount of sample. The sample weight should be recorded to the nearest 0.01 gram in the field logbook and/or sample log sheet. The soil should then be extruded into the methanol preserved sample bottle taking care not to contact the sample container with the syringe. The threads of the bottle and cap must be free of soil particles.

After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

##### Sodium Bisulfate Preservation (Low Level):

Samples to be preserved using the sodium bisulfate method are to be prepared as follows:

Add 1 gram of sodium bisulfate to 5 mL of laboratory grade deionized water in a 40-60 mL glass vial with septum lid. Bottles may be prespiked in the laboratory or prepared in the field. The soil sample should be collected in a manner as described above and added to the sample container. The sample should be weighed to the nearest 0.01 gram as described above and recorded in the field logbook or sample log sheet.

Care should be taken when adding the soil to the sodium bisulfate solution. A chemical reaction of soils containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode.

When preparing samples using the sodium bisulfate preservation method, duplicate samples must be collected using the methanol preservation method on a one for one sample basis. The reason for this is because it is necessary for the laboratory to perform both the low level and medium level analyses. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

If the lower detection limits are necessary, an option to field preserving with sodium bisulfate would be to collect 3 EnCore™ samplers at a given sample location. Send all samplers to the laboratory and the laboratory can perform the required preservation and analyses.

Subject  SOIL SAMPLING	Number SA-1.3	Page 6 of 20
	Revision 7	Effective Date 09/03

### 5.2.2 Procedure for Collecting Non-Volatile Soil Samples

Non-volatile soil samples may be collected as either grab or composite samples. The non-volatile soil sample is thoroughly mixed in a stainless steel or disposable, inert plastic tray, using a stainless steel trowel or other approved tool, then transferred into the appropriate sample container(s). Head space is permitted in a non-volatile soil sample container to allow for sample expansion.

### 5.2.3 Procedure for Collecting Undisturbed Soil Samples (ASTM D1587-83)

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) will be employed. The following method will be used:

1. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and clean out the borehole to the sampling depth, being careful to minimize the chance for disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.
2. The use of bottom discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Use of any side-discharge bits is permitted.
3. A stationary piston-type sampler may be required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.
4. To minimize chemical reaction between the sample and the sampling tube, brass tubes may be required, especially if the tube is stored for an extended time prior to testing. While steel tubes coated with shellac are less expensive than brass, they're more reactive, and shall only be used when the sample will be tested within a few days after sampling or if chemical reaction is not anticipated. With the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.
5. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material in the upper end of the tube and measure the length of sample again. After removing at least an inch of soil from the lower end and after inserting an impervious disk, seal both ends of the tube with at least a 1/2-inch thickness of wax applied in a way that will prevent the wax from entering the sample. Clean filler must be placed in voids at either end of the tube prior to sealing with wax. Place plastic caps on the ends of the sample tube, tape the caps in place, and dip the ends in wax.
6. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label. Mark the "up" direction on the side of the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody (see SOP SA-6.3) and other required forms (including Attachment A of this SOP). Do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the ground, (i.e., top of sample is up) in a cool place out of the sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

Subject  SOIL SAMPLING	Number SA-1.3	Page 7 of 20
	Revision 7	Effective Date 09/03

Thin-walled undisturbed tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs, and therefore their use shall be weighed against the need for acquiring an undisturbed sample.

### 5.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples (most commonly collected to a depth of 6 inches) for subsequent analysis is by use of a stainless steel trowel. Surface soils are considered 0-12 inches bgs.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Real-time air monitoring instrument (e.g., PID, FID, etc.).
- Latex gloves.
- Required Personal Protective Equipment (PPE).
- Required paperwork (see SOP SA-6.3 and Attachment A of this SOP).
- Required decontamination equipment.
- Required sample container(s).
- Wooden stakes or pin flags.
- Sealable polyethylene bags (i.e., Ziploc® baggies).
- Heavy duty cooler.
- Ice.
- Chain-of-custody records and custody seals.

When acquiring surface soil samples, the following procedure shall be used:

1. Carefully remove vegetation, roots, twigs, litter, etc., to expose an adequate soil surface area to accommodate sample volume requirements.
2. Using a decontaminated stainless steel trowel, follow the procedure cited in Section 5.2.1 for collecting a volatile soil sample. Surface soil samples for volatile organic analysis should be collected from 6-12 inches bgs only.
3. Thoroughly mix (in-situ) a sufficient amount of soil to fill the remaining sample containers and transfer the sample into those containers utilizing the same stainless steel trowel employed above. Cap and securely tighten all sample containers.
4. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.
5. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

### 5.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6-18 inches) can be accomplished with tools such as shovels and stainless steel or pre-cleaned disposable trowels.

Subject  SOIL SAMPLING	Number SA-1.3	Page 8 of 20
	Revision 7	Effective Date 09/03

The following equipment is necessary to collect near surface soil samples:

- Clean shovel.
- The equipment listed under Section 5.3 of this procedure.
- Hand auger.

To obtain near-surface soil samples, the following protocol shall be observed:

1. With a clean shovel, make a series of vertical cuts to the depth required in the soil to form a square approximately 1 foot by 1 foot.
2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.
3. Follow steps 2 through 5 listed under Section 5.3 of this procedure.

#### **5.5 Subsurface Soil Sampling With a Hand Auger**

A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e., cylinders 6-1/2" long, and 2-3/4", 3-1/4", and 4" in diameter), a series of extension rods (available in 2', 3', 4' and 5' lengths), and a cross handle. A larger diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then withdrawn. In turn, the larger diameter bit is replaced with a smaller diameter bit, lowered down the hole, and slowly turned into the soil at the completion depth (approximately 6 inches). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil both from the surface, or to depths in excess of 12 feet. However, the presence of rock layers and the collapse of the borehole normally contribute to its limiting factors.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes).
- Stainless steel mixing bowls.
- The equipment listed under Section 5.3 of this procedure.

To obtain soil samples using a hand auger, the following procedure shall be followed:

1. Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.
2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).
3. Begin augering (periodically removing accumulated soils from the bucket bit) and add additional rod extensions as necessary. Also, note (in a field notebook, boring log, and/or on standardized data sheets) any changes in the color, texture or odor of the soil.
4. After reaching the desired depth, slowly and carefully withdraw the apparatus from the borehole.
5. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is commonly smaller in diameter than the bucket bit employed to initiate the borehole.

Subject  SOIL SAMPLING	Number SA-1.3	Page 9 of 20
	Revision 7	Effective Date 09/03

6. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.
7. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.
8. Discard the top of the core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the sample material.
9. Fill volatile sample container(s), using a properly decontaminated stainless steel trowel, with sample material directly from the bucket bit. Refer to Section 5.2.1 of this procedure.
10. Utilizing the above trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl and thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.
11. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

#### **5.6 Subsurface Soil Sampling With a Split-Barrel Sampler (ASTM D1586-84)**

Split-barrel (split-spoon) samplers consist of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment B). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-lb. or larger casing driver.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (O.D. 2 inches, I.D. 1-3/8 inches, either 20 inches or 26 inches long); Larger O.D. samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-lb. weight, driving head and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls.
- Equipment listed under Section 5.3 of this procedure.

The following steps shall be followed to obtain split-barrel samples:

1. Remove the drive head and nosepiece, and open the sampler to reveal the soil sample. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.). Carefully separate the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.
2. Collect the volatile sample from the center of the core where elevated readings occurred. If no elevated readings were encountered the sample material should still be collected from the core's

Subject  SOIL SAMPLING	Number SA-1.3	Page 10 of 20
	Revision 7	Effective Date 09/03

center (this area represents the least disturbed area with minimal atmospheric contact). Refer to Section 5.2.1 of this procedure.

3. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl. Thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.
4. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

#### **5.7 Subsurface Sol Sampling Using Direct Push Technology**

Subsurface soil samples can be collected to depths of 40+ feet using direct push technology (DPT). DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

#### **5.8 Excavation and Sampling of Test Pits and Trenches**

##### **5.8.1 Applicability**

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise which control the method of excavation. No personnel shall enter any test pit or excavation over 4 feet deep except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P - Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is still required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden or steel support structures. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments. Any entry may constitute a Confined Space and must be done in conformance with all applicable regulations. In these cases, substantial air monitoring is required before entry, and appropriate respiratory gear and protective clothing is mandatory. There must be at least two persons present at the immediate site before entry by one of the investigators. The reader shall refer to OSHA regulations 29 CFR 1926, 29 CFR 1910.120, 29 CFR 1910.134, and 29 CFR 1910.146.

Excavations are generally not practical where a depth of more than about 15 feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If data on soils at depths greater than 15 feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

##### **5.8.2 Test Pit and Trench Excavation**

These procedures describe the methods for excavating and logging test pits and trenches excavated to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented (see Attachment C).

Subject  SOIL SAMPLING	Number SA-1.3	Page 11 of 20
	Revision 7	Effective Date 09/03

Test pits and trenches may be excavated by hand or by power equipment to permit detailed description of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration.
- The space required for efficient excavation.
- The chemicals of concern.
- The economics and efficiency of available equipment.

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table, which is based on equipment efficiencies, gives a rough guide for design consideration:

Equipment	Typical Widths, in Feet
Trenching machine	2
Backhoe	2-6
Track dozer	10
Track loader	10
Excavator	10
Scraper	20

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous waste materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, field conditions may necessitate revisions to the initial plans. The final depth and construction method shall be determined by the field geologist. The actual layout of each test pit, temporary staging area, and spoils pile will be predicated based on site conditions and wind direction at the time the test pit is made. Prior to excavation, the area can be surveyed by magnetometer or metal detector to identify the presence of underground utilities or drums.

As mentioned previously, no personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is still required, Occupational Safety and Health Administration (OSHA) requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be in the hole at all times, and a temporary guardrail must be placed along the surface of the hole before entry). It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example, samples of leachate, groundwater, or sidewall soils can be taken with telescoping poles, etc.

Dewatering may be required to assure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation dry. This is an important consideration for excavations in cohesionless material below the groundwater table. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

Subject  SOIL SAMPLING	Number SA-1.3	Page 12 of 20
	Revision 7	Effective Date 09/03

### 5.8.3 Sampling in Test Pits and Trenches

#### 5.8.3.1 General

Test pits and trenches are usually logged as they are excavated. Records of each test pit/trench will be made as presented in Attachment C. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable Health and Safety and OSHA requirements have been met.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information would include soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples, which can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

#### 5.8.3.2 Sampling Equipment

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

- Backhoe or other excavating machinery.
- Shovels, picks, hand augers, and stainless steel trowels/disposable trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottleware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.
- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps and right angle adapter for conduit (see Attachment D).

#### 5.8.3.3 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 5.8.3.4.

- Excavate trench or pit in several depth increments. After each increment, the operator will wait while the sampler inspects the test pit from grade level to decide if conditions are appropriate for sampling. (Monitoring of volatiles by the SSO will also be used to evaluate the need for sampling.) Practical depth increments range from 2 to 4 feet.

Subject  SOIL SAMPLING	Number SA-1.3	Page 13 of 20
	Revision 7	Effective Date 09/03

- The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:
  - Any fluid phase or groundwater seepage is encountered in the test pit.
  - Any drums, other potential waste containers, obstructions or utility lines are encountered.
  - Distinct changes of material are encountered.

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending upon the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Remove loose material to the greatest extent possible with backhoe.
- Secure walls of pit if necessary. (There is seldom any need to enter a pit or trench which would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)
- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material once it has been deposited on the ground. The sampler or Field Operations Leader directs the backhoe operator to remove material from the selected depth or location within the test pit/trench. The bucket is brought to the surface and moved away from the pit. The sampler and/or SSO then approaches the bucket and monitors its contents with a photoionization or flame ionization detector. The sample is collected from the center of the bucket or pile and placed in sample containers using a decontaminated stainless steel trowel or disposable spatula.
- If a composite sample is desired, several depths or locations within the pit/trench are selected and a bucket is filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.
- Using the remote sampler shown in Attachment D, samples can be taken at the desired depth from the side wall or bottom of the pit. The face of the pit/trench shall first be scraped (using a long-handled shovel or hoe) to remove the smeared zone that has contacted the backhoe bucket. The sample shall then be collected directly into the sample jar, by scraping with the jar edge, eliminating the need to utilize samplers and minimizing the likelihood of cross-contamination. The sample jar is then capped, removed from the assembly, and packaged for shipment.
- Complete documentation as described in SOP SA-6.3 and Attachment C of this SOP.

#### 5.8.3.4 In-Pit Sampling

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soils or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

Subject  SOIL SAMPLING	Number SA-1.3	Page 14 of 20
	Revision 7	Effective Date 09/03

- There is no practical alternative means of obtaining such data.
- The Site Safety Officer and Competent Person determines that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of volatile organics, explosive gases and available oxygen).
- A Company-designated Competent Person determines that the pit/trench is stable or is made stable (by grading the sidewalls or using shoring) prior to entrance of any personnel. OSHA requirements must be strictly observed.

If these conditions are satisfied, one person will enter the pit/trench. On potentially hazardous waste sites, this individual will be dressed in safety gear as required by the conditions in the pit. He/she will be affixed to a safety rope and continuously monitored while in the pit.

A second individual will be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations. The individual entering the pit will remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon. As an added precaution, it is advisable to keep the backhoe bucket in the test pit when personnel are working below grade. Such personnel can either stand in or near the bucket while performing sample operations. In the event of a cave-in they can either be lifted clear in the bucket, or at least climb up on the backhoe arm to reach safety.

#### 5.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 5.8.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., open tube samplers), which can be pushed or driven into the floor of the test pit.
- Suitable driving (i.e., a sledge hammer) or pushing (i.e., the backhoe bucket) equipment which is used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

Disturbed grab or bulk geotechnical soil samples may be collected for most soils in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification, while larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soils using open tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe,

Subject  SOIL SAMPLING	Number SA-1.3	Page 15 of 20
	Revision 7	Effective Date 09/03

rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the sampler when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 5.8.3.4 of this procedure must be followed. The open tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate, because the sample will not have the correct orientation.

A sledge hammer or the backhoe may be used to drive or push the sampler or tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry of the test pit, the requirements in Section 5.8.3.4 of this procedure must be followed. Prepare, label, pack and transport the sample in the required manner, as described in SOP SA-6.3 and SA-6.1.

#### **5.8.4 Backfilling of Trenches and Test Pits**

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew shall photograph all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL.

If a low permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

#### **5.9 Records**

The appropriate sample log sheet (see Attachment A of this SOP) must be completed by the site geologist/sampler. All soil sampling locations should be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) or obtaining GPS coordinates; and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see Attachment C of this SOP) shall contain a sketch of pit conditions. In addition, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

Other data to be recorded in the field logbook include the following:

- Name and location of job.
- Date of boring and excavation.

Subject  SOIL SAMPLING	Number SA-1.3	Page 16 of 20
	Revision 7	Effective Date 09/03

- Approximate surface elevation.
- Total depth of boring and excavation.
- Dimensions of pit.
- Method of sample acquisition.
- Type and size of samples.
- Soil and rock descriptions.
- Photographs.
- Groundwater levels.
- Organic gas or methane levels.
- Other pertinent information, such as waste material encountered.

**6.0 REFERENCES**

American Society for Testing and Materials, 1987. ASTM Standards D1587-83 and D1586-84. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

OSHA, Confined Space Entry 29 CFR 1910.146.

Subject  SOIL SAMPLING	Number SA-1.3	Page 17 of 20
	Revision 7	Effective Date 09/03

**ATTACHMENT A  
SOIL & SEDIMENT SAMPLE LOG SHEET**



Tetra Tech NUS, Inc.

**SOIL & SEDIMENT SAMPLE LOG SHEET**

Page      of     

Project Site Name: _____		Sample ID No.: _____		
Project No.: _____		Sample Location: _____		
<input type="checkbox"/> Surface Soil		Sampled By: _____		
<input type="checkbox"/> Subsurface Soil		C.O.C. No.: _____		
<input type="checkbox"/> Sediment		Type of Sample:		
<input type="checkbox"/> Other: _____		<input type="checkbox"/> Low Concentration		
<input type="checkbox"/> QA Sample Type: _____		<input type="checkbox"/> 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:		Signature(s):		
MS/MSD	Duplicate ID No.:			

Subject

SOIL SAMPLING

Number

SA-1.3

Page

18 of 20

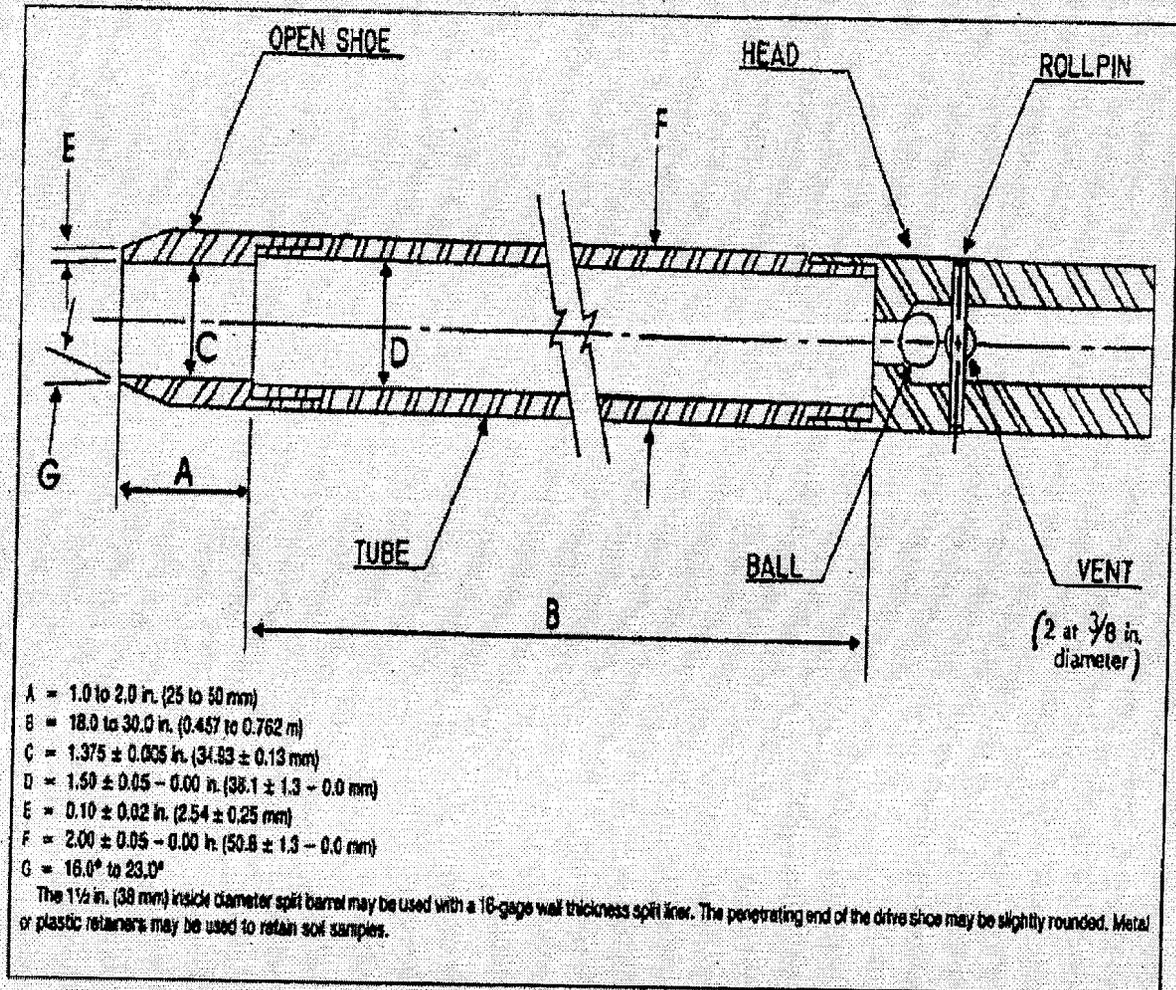
Revision

7

Effective Date

09/03

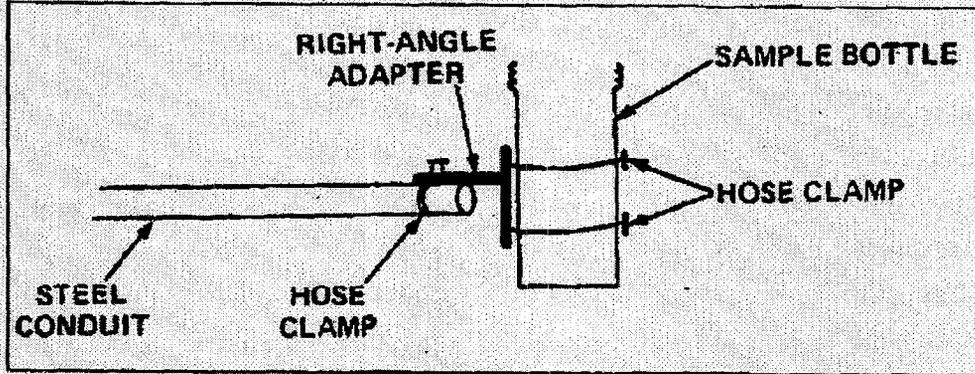
ATTACHMENT B  
SPLIT-SPOON SAMPLER

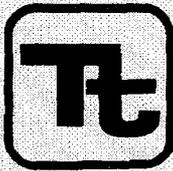




Subject SOIL SAMPLING	Number SA-1.3	Page 20 of 20
	Revision 7	Effective Date 09/03

**ATTACHMENT D  
REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING**





TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

Number	SA-1.2	Page	1 of 12
Effective Date	09/03	Revision	5
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>ds</i>		

Subject SURFACE WATER AND SEDIMENT SAMPLING

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 PURPOSE.....	2
2.0 SCOPE.....	2
3.0 GLOSSARY.....	2
4.0 RESPONSIBILITIES.....	2
5.0 PROCEDURES.....	2
5.1 INTRODUCTION.....	2
5.2 DEFINING THE SAMPLING PROGRAM.....	3
5.2.1 Sampling Program Objectives.....	3
5.2.2 Location of Sampling Stations.....	3
5.2.3 Frequency of Sampling.....	4
5.3 SURFACE WATER SAMPLE COLLECTION.....	4
5.3.1 Streams, Rivers, Outfalls and Drainage Features (Ditches, Culverts).....	4
5.3.2 Lakes, Ponds and Reservoirs.....	5
5.3.3 Estuaries.....	5
5.3.4 Surface Water Sampling Equipment.....	6
5.3.5 Surface Water Sampling Techniques.....	7
5.4 ONSITE WATER QUALITY TESTING.....	8
5.5 SEDIMENT SAMPLING.....	8
5.5.1 General.....	8
5.5.2 Sampling Equipment and Techniques.....	9
6.0 REFERENCES.....	10
 <u>ATTACHMENTS</u>	
A SURFACE WATER SAMPLE LOG SHEET.....	11
B SOIL & SEDIMENT SAMPLE LOG SHEET.....	12

Subject <b>SURFACE WATER AND SEDIMENT SAMPLING</b>	Number SA-1.2	Page 2 of 12
	Revision 5	Effective Date 09/03

## 1.0 PURPOSE

This procedure describes methods and equipment commonly used for collecting environmental samples of surface water and aquatic sediment for either onsite examination and chemical testing, or for subsequent laboratory analysis.

## 2.0 SCOPE

The information presented in this guideline is generally applicable to all environmental sampling of surface waters (Section 5.3) and aquatic sediments (Section 5.5), except where the analyte(s) may interact with the sampling equipment. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions and equipment different from those described herein.

## 3.0 GLOSSARY

Environmental Sample - a sample containing (or suspected to contain) low-level concentrations of contaminants, which does not require special handling or transport considerations as detailed in SOP SA-6.1.

Hazardous Waste Sample - a sample containing (or suspected to contain) higher concentrations of contaminants thus requiring special handling and/or transport considerations per SOP SA-6.1.

## 4.0 RESPONSIBILITIES

Project Manager - The Project Manager has the overall responsibility for seeing that all surface water and sediment sampling activities are properly conducted by appropriately trained personnel.

Field Operations Leader - The Field Operations Leader (FOL) is responsible for the supervision of onsite water quality analyses, ensuring proper sample collection, handling, and the completion and accuracy of all field documentation, and making sure that custody of all samples obtained is maintained according to proper procedures.

## 5.0 PROCEDURES

### 5.1 Introduction

Collecting a representative sample from surface water or sediments is difficult because of water movement, stratification, or patchiness. To collect representative samples, one must standardize sampling bias related to site selection, sampling frequency, sample collection, sampling devices, and sample handling, preservation, and identification.

Representativeness is a qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been taken. Regardless of quality control applied during laboratory analyses and subsequent scrutiny of analytical data packages, reported data are no better than the confidence that can be placed in the representativeness of the samples.

Subject <b>SURFACE WATER AND SEDIMENT SAMPLING</b>	Number <b>SA-1.2</b>	Page <b>3 of 12</b>
	Revision <b>5</b>	Effective Date <b>09/03</b>

## **5.2 Defining the Sampling Program**

Many factors must be considered in developing a sampling program for surface water or sediments including study objectives, accessibility, site topography, physical characteristics of the water body (such as flow and mixing), point and diffuse sources of contamination, and personnel and equipment available to conduct the study. For waterborne constituents, dispersion depends on the vertical and lateral mixing within the body of water. For sediments, dispersion depends on bottom current or flow characteristics, sediment characteristics (density, size) and geochemical properties (which affect adsorption/desorption). The hydrogeologist developing the sampling plan must therefore know not only the mixing characteristics of streams and lakes, but also must understand the role of fluvial-sediment transport, deposition, and chemical sorption.

### **5.2.1 Sampling Program Objectives**

The objective of surface water sampling is to determine the surface water quality entering, leaving or remaining within the site. The scope of the sampling program must consider the sources and potential pathways for transport of contamination to or within a surface water body. Sources may include point sources (leaky tanks, outfalls, etc.) or nonpoint sources (e.g., spills). The major pathways for surface water contamination (not including airborne deposition) are overland runoff, leachate influx to the waterbody, direct waste disposal (solid or liquid) into the water body; and groundwater flow influx from upgradient. The relative importance of these pathways, and therefore the design of the sampling program, is controlled by the physiographic and hydrologic features of the site, the drainage basin(s) which encompass the site, and the history of site activities.

Physiographic and hydrologic features to be considered include slopes and runoff direction, areas of temporary flooding or pooling, tidal effects, artificial surface runoff controls such as berms or drainage ditches (and when they were constructed relative to site operation), and locations of springs, seeps, marshes, etc. In addition, the obvious considerations such as the location of man-made discharge points to the nearest stream (intermittent or flowing), pond, lake, estuary, etc., shall be considered.

A more subtle consideration in designing the sampling program is the potential for dispersion of dissolved or sediment-associated contaminants away from the source. The dispersion could lead to a more homogeneous distribution of contamination at low or possibly non-detectable concentrations. Such dispersion does not, however, always readily occur. For example, obtaining a representative sample of contamination from a main stream immediately below an outfall or a tributary is difficult because the inflow frequently follows a stream bank with little lateral mixing for some distance. Sampling alternatives to overcome this situation are: (1) move the site far enough downstream to allow for adequate mixing, or (2) collect integrated samples in a cross section. Also, nonhomogeneous distribution is a particular problem with regard to sediment-associated contaminants, which may accumulate in low-energy environments (coves, river bends, deep spots, or even behind boulders) near or distant from the source while higher-energy areas (main stream channels) near the source may show no contaminant accumulation.

The distribution of particulates within a sample itself is an important consideration. Many organic compounds are only slightly water soluble and tend to adsorb onto particulate matter. Nitrogen, phosphorus, and the heavy metals may also be transported by particulates. Samples must be collected with a representative amount of suspended material; transfer from the sampling device shall include transferring a proportionate amount of the suspended material.

### **5.2.2 Location of Sampling Stations**

Accessibility is the primary factor affecting sampling costs. The desirability and utility of a sample for analysis and consideration of site conditions must be balanced against the costs of collection as controlled

Subject <b>SURFACE WATER AND SEDIMENT SAMPLING</b>	Number SA-1.2	Page 4 of 12
	Revision 5	Effective Date 09/03

by accessibility. Bridges or piers are the first choice for locating a sampling station on a stream, because bridges provide ready access and also permit the sampling technician to sample any point across the stream. A boat or pontoon (with an associated increase in cost) may be needed to sample locations on lakes and reservoirs, as well as those on larger rivers. Frequently, however, a boat will take longer to cross a water body and will hinder manipulation of the sampling equipment. Wading for samples is not recommended unless it is known that contaminant levels are low so that skin contact will not produce adverse health effects. This provides a built in margin of safety in the event that wading boots or other protective equipment should fail to function properly. If it is necessary to wade into the water body to obtain a sample, the sampler shall be careful to minimize disturbance of bottom sediments and must enter the water body downstream of the sampling location. If necessary, the sampling technician shall wait for the sediments to settle before taking a sample.

Sampling in marshes or tidal areas may require the use of an all-terrain vehicle (ATV). The same precautions mentioned above with regard to sediment disturbance apply.

Under ideal and uniform contaminant dispersion conditions in a flowing stream, the same concentrations of each would occur at all points along the cross section. This situation is most likely downstream of areas of high turbulence. Careful site selection is needed in order to ensure, as nearly as possible, that samples are taken where uniform flow or deposition and good mixing conditions exist.

The availability of streamflow and sediment discharge records can be an important consideration in choosing sampling sites in streams. Streamflow data in association with contaminant concentration data are essential for estimating the total contaminant loads carried by the stream. If a gaging station is not conveniently located on a selected stream, the project hydrogeologist shall explore the possibility of obtaining streamflow data by direct or indirect methods.

### **5.2.3 Frequency of Sampling**

The sampling frequency and the objectives of the sampling event will be defined by the project plan documents. For single-event site or area characterization sampling, both bottom material and overlying water samples shall be collected at the specified sampling stations. If valid data are available on the distribution of the contaminant between the solid and aqueous phases, it may be appropriate to sample only one phase, although this is not often recommended. If samples are collected primarily for monitoring purposes (i.e., consisting of repetitive, continuing measurements to define variations and trends at a given location), water samples shall be collected at a pre-established and constant interval as specified in the project plans (often monthly or quarterly, and during droughts and floods). Samples of bottom material shall be collected from fresh deposits at least yearly, and preferably seasonally, during both spring and fall.

The variability in available water-quality data shall be evaluated before determining the number and collection frequency of samples required to maintain an effective monitoring program.

## **5.3 Surface Water Sample Collection**

### **5.3.1 Streams, Rivers, Outfalls and Drainage Features (Ditches, Culverts)**

Methods for sampling streams, rivers, outfalls, and drainage features at a single point vary from the simplest of hand-sampling procedures to the more sophisticated multi-point sampling techniques known as the equal-width-increment (EWI) method or the equal-discharge-increment (EDI) methods (see below).

Samples from different depths or cross-sectional locations in the watercourse taken during the same sampling episode, shall be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore shall not be composited.

Subject <b>SURFACE WATER AND SEDIMENT SAMPLING</b>	Number <b>SA-1.2</b>	Page <b>5 of 12</b>
	Revision <b>5</b>	Effective Date <b>09/03</b>

Generally, the number and type of samples to be taken depend on the river's width, depth, discharge and on the suspended sediment the stream or river transports. The greater the number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

In small streams less than about 20 feet wide, a sampling site can generally be found where the water is well mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross section.

For larger streams, at least one vertical composite shall be taken with one sample each from just below the surface, at mid-depth, and just above the bottom. The measurement of DO, pH, temperature, conductivity, etc., shall be made on each aliquot of the vertical composite and on the composite itself. For rivers, several vertical composites shall be collected, as directed in the project plan documents.

### **5.3.2 Lakes, Ponds and Reservoirs**

Lakes, ponds, and reservoirs have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained.

The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small lakes, a single vertical composite at the deepest point may be sufficient. Similarly, the measurement of DO, pH, temperature, etc., is to be conducted on each aliquot of the vertical composite and on the composite itself. In naturally-formed ponds, the deepest point may have to be determined empirically; in impoundments, the deepest point is usually near the dam.

In lakes and larger reservoirs, several vertical composites shall be composited to form a single sample. These verticals are often taken along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones. In a stratified lake, the epilimnion is the thermocline which is exposed to the atmosphere. The hypolimnion is the lower, "confined" layer which is only mixed with the epilimnion and vented to the atmosphere during seasonal "overturn" (when density stratification disappears). These two zones may thus have very different concentrations of contaminants if input is only to one zone, if the contaminants are volatile (and therefore vented from the epilimnion but not the hypolimnion), or if the epilimnion only is involved in short-term flushing (i.e., inflow from or outflow to shallow streams). Normally, however, a composite consists of several verticals with samples collected at various depths.

In lakes with irregular shape and with bays and coves that are protected from the wind, separate composite samples may be needed to adequately represent water quality since it is likely that only poor mixing will occur. Similarly, additional samples are recommended where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

Many lake measurements are now made in-situ using sensors and automatic readout or recording devices. Single and multi-parameter instruments are available for measuring temperature, depth, pH, oxidation-reduction potential (ORP), specific conductance, dissolved oxygen, some cations and anions, and light penetration.

### **5.3.3 Estuaries**

Estuarine areas are by definition, zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Estuaries are generally categorized into three types dependent upon freshwater inflow and mixing properties. Knowledge of the estuary type is necessary to determine sampling locations. Each type of estuarine area is described below:

Subject SURFACE WATER AND SEDIMENT SAMPLING	Number SA-1.2	Page 6 of 12
	Revision 5	Effective Date 09/03

- Mixed Estuary - characterized by the absence of a vertical halocline (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically this type of estuary is shallow and is found in major freshwater sheetflow areas. Being well mixed, the sampling locations are not critical in this type of estuary.
- Salt Wedge Estuary - characterized by a sharp vertical increase in salinity and stratified freshwater flow along the surface. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally, back and forth, with the tidal phase. If contamination is being introduced into the estuary from upstream, water sampling from the salt wedge may miss it entirely.
- Oceanic Estuary - characterized by salinities approaching full-strength oceanic waters. Seasonally, freshwater inflow is small with the preponderance of the fresh-saline water mixing occurring near, or at, the shore line.

Sampling in estuarine areas is normally based upon the tidal phases, with samples collected on successive slack tides (i.e., when the tide turns). Estuarine sampling programs shall include vertical salinity measurements at 1- to 5-foot increments, coupled with vertical dissolved oxygen and temperature profiles.

#### 5.3.4 Surface Water Sampling Equipment

The selection of sampling equipment depends on the site conditions and sample type to be acquired. The most frequently used samplers are:

- Open tube.
- Dip sampler.
- Weighted bottle.
- Hand pump.
- Kemmerer.
- Depth-Integrating Sampler.

The dip sampler and the weighted bottle sampler are used most often, and detailed discussions for these devices only (and the Kemmerer sampler) are addressed subsequently in this section.

The criteria for selecting a sampler include:

1. Disposability and/or easy decontamination.
2. Inexpensive cost (if the item is to be disposed).
3. Ease of operation.
4. Nonreactive/noncontaminating properties - Teflon-coated, glass, stainless-steel or PVC sample chambers are preferred (in that order).

As specified above, each sample (grab or each aliquot collected for compositing) shall be measured for but not limited to:

- Specific conductance.
- Temperature.
- pH.
- Dissolved oxygen (optional).

Sample measurements shall be conducted as soon as the sample is acquired. Measurement techniques described in SOP SA-1.1 shall be followed. All pertinent data and results shall be recorded in a field

Subject SURFACE WATER AND SEDIMENT SAMPLING	Number SA-1.2	Page 7 of 12
	Revision 5	Effective Date 09/03

notebook or on sample logsheets (see Attachment A). These analyses will provide information on water mixing/stratification and potential contamination.

#### Dip Sampling

Water is often sampled by filling a container either attached to a pole or held directly, from just beneath the surface of the water (a dip or grab sample). Constituents measured in grab samples are only indicative of conditions near the surface of the water and may not be a true representation of the total concentration that is distributed throughout the water column and in the cross section. Therefore, whenever possible, it is recommended to augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

#### Weighted Bottle Sampling

A grab sample can also be taken using a weighted holder that allows a bottle to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects sample throughout the total depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach what is known as a depth-integrated sample.

A closed weighted bottle sampler consists of a stopped glass or plastic bottle, a weight and/or holding device, and lines to open the stopper and lower or raise the bottle. The procedure for sampling with this device is:

- Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).
- Pull out the stopper with a sharp jerk of the stopper line.
- Allow the bottle to fill completely, as evidenced by the absence of air bubbles.
- Raise the sampler and cap the bottle.
- Decontaminate the outside of the bottle. This bottle can be used as the sample container as long as the bottle is an approved container type.

#### Kemmerer

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon coated sampler, a standard Kemmerer sampler may be used. The Kemmerer sampler is a brass, stainless-steel or acrylic cylinder, with rubber stoppers that leave the ends open while being lowered in a vertical position (thus allowing free passage of water through the cylinder). A "messenger" is sent down the line when the sampler is at the designated depth, to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill sample bottles.

#### **5.3.5 Surface Water Sampling Techniques**

Most samples taken during site investigations are grab samples. Typically, surface water sampling involves immersing the sample container in the body of water; however, the following suggestions are made to help ensure that the samples obtained are representative of site conditions:

Subject <b>SURFACE WATER AND SEDIMENT SAMPLING</b>	Number <b>SA-1.2</b>	Page <b>8 of 12</b>
	Revision <b>5</b>	Effective Date <b>09/03</b>

- The most representative samples are obtained from mid-channel at a 0.6 foot stream depth in a well-mixed stream.
- Even though the containers used to obtain the samples are previously laboratory cleaned, it is suggested that the sample container be rinsed at least once with the water to be sampled before the sample is taken. This is not applicable when sample containers are provided "pre-preserved."
- For sampling moving water, it is suggested that the farthest downstream sample be obtained first, and that subsequent samples be taken as one works upstream. In general, work from zones suspected of low contamination to zones of high contamination.
- To sample a pond or other standing body of water, the surface area may be divided into grids. A series of samples taken from each grid node is combined into one sample, or several grid nodes are selected at random.
- Care should be taken to avoid excessive agitation of the water, as loss of volatile constituents could result.
- When obtaining samples in 40 mL septum vials for volatile organics analysis, it is important to exclude any air space in the top of the bottle and to be sure that the Teflon liner of the septum faces in after the vial is filled and capped. The vial can be turned upside down to check for air bubbles.
- Do not sample at the surface, unless sampling specifically for a known constituent which is immiscible and on top of the water. Instead, the sample container should be inverted, lowered to the approximate depth, and held at about a 45-degree angle with the mouth of the bottle facing upstream. When sample containers are provided "pre-preserved," use a dedicated, clean, un-preserved bottle for sampling and transfer to an appropriately-preserved container.

#### **5.4      Onsite Water Quality Testing**

Onsite water quality testing shall be conducted as described in SOP SA-1.1.

#### **5.5      Sediment Sampling**

##### **5.5.1      General**

Sediment samples are usually collected at the same verticals at which water samples were collected. If only one sediment sample is to be collected, the sampling location shall be approximately at the center of the water body.

Generally, the coarser grained sediments are deposited near the headwaters of the reservoir. Bed sediments near the center of a water body will be composed of fine-grained materials which may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations of contaminants. The shape, flow pattern, bathymetry (i.e., depth distribution), and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (e.g., bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) shall be sampled while areas likely to show net erosion (i.e., high-velocity, turbulent areas) and suspension of fine solid materials, shall be avoided.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments (especially fine-grained material) may act as a sink or reservoir for adsorbed heavy metals and organic contaminants (even if

Subject SURFACE WATER AND SEDIMENT SAMPLING	Number SA-1.2	Page 9 of 12
	Revision 5	Effective Date 09/03

water column concentrations are below detection limits). Therefore, it is important to minimize the loss of low-density "fines" during any sampling process.

All relevant information pertaining to sediment sampling shall be documented as applicably described in SOP SA-6.3 and Attachment B.

### 5.5.2 Sampling Equipment and Techniques

A bottom-material sample may consist of a single scoop or core, or may be a composite of several individual samples in the cross section. Sediment samples may be obtained using onshore or offshore techniques.

The following health and safety provisions apply when working on/over/near water.

Size of Work Team:

- 1) Never less than 2 persons [who are wearing USCG approved Personal Flotation Devices (PFDs)]
- 2) A minimum of 3 persons if any of the following conditions are anticipated or observed:
  - Depth is greater than 3 feet
  - Involves a waterway that is turbulent or swift
  - The underwater walking surface (e.g., stream/river bed) is suspected or observed to involve conditions that increase the potential for a worker to fall into the water. Examples would include large/uneven rocks or boulders, dense mud or sediment that could entrap worker's feet, etc.)
  - Waterway is tidal, and conditions such as those listed above could change

The third person in the above condition must be equipped and prepared to render emergency support [e.g., lifeline, tethered PFD (life saver), skiff, means to contact external emergency response support, etc.]

The following samplers may be used to collect bottom materials:

- Scoop sampler.
- Dredge samplers.

Each type of sampler is discussed subsequently.

#### Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood, PVC, or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if it can be waded, the easiest and best way to collect a sediment sample is to use a scoop sampler. This reduces the potential for cross-contamination. This method is accomplished by reaching over or wading into the water body and, while facing upstream (into the current), scooping the sampler along the bottom in an upstream direction. It is very difficult not to disturb fine-grained materials of the sediment-water interface when using this method.

Subject SURFACE WATER AND SEDIMENT SAMPLING	Number SA-1.2	Page 10 of 12
	Revision 5	Effective Date 09/03

### Dredges

Dredges are generally used to sample sediments which cannot easily be obtained using coring devices (i.e., coarse-grained or partially-cemented materials) or when large quantities of sample are required. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a "messenger". Some dredges are heavy and may require use of a winch and crane assembly for sample retrieval. There are three major types of dredges: Peterson, Eckman and Ponar dredges.

The Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The Peterson dredge shall be lowered very slowly as it approaches bottom, because it can force out and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high flow velocities.

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave". The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

### **6.0 REFERENCES**

American Public Health Association, 1980. Standard Methods for the Examination of Water and Wastewater, 15th Edition, APHA, Washington, D.C.

Feltz, H. R., 1980. Significance of Bottom Material Data in Evaluating Water Quality in Contaminants and Sediments. Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., V. 1, p. 271-287.

Kittrell, F. W., 1969. A Practical Guide to Water Quality Studies of Streams. U.S. Federal Water Pollution Control Administration, Washington, D.C., 135 p.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020.

U.S. EPA, 1980. Standard Operating Procedures and Quality Assurance Manual. Water Surveillance Branch, USEPA Surveillance and Analytical Division, Athens, Georgia.

U.S. Geological Survey, 1977. National Handbook of Recommended Methods for Water-Data Acquisition. Office of Water Data Coordination, USGS, Reston, Virginia.

Subject SURFACE WATER AND SEDIMENT SAMPLING	Number SA-1.2	Page 11 of 12
	Revision 5	Effective Date 09/03

**ATTACHMENT A  
SURFACE WATER SAMPLE LOG SHEET**



Tetra Tech NUS, Inc.

**SURFACE WATER SAMPLE LOG SHEET**

Page \_\_\_ of \_\_\_

Project Site Name: _____	Sample ID No.: _____
Project No.: _____	Sample Location: _____
<input type="checkbox"/> Stream	Sampled By: _____
<input type="checkbox"/> Spring	C.O.C. No.: _____
<input type="checkbox"/> Pond	Type of Sample:
<input type="checkbox"/> Lake	<input type="checkbox"/> Low Concentration
<input type="checkbox"/> Other: _____	<input type="checkbox"/> High Concentration
<input type="checkbox"/> QA Sample Type: _____	

SAMPLING DATA								
Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION			
Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS/NOTES	INITIALS

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	





TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

Number	SA-6.3	Page	1 of 12
Effective Date	09/03	Revision	2
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>DS</i>		

Subject  
FIELD DOCUMENTATION

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 PURPOSE.....	2
2.0 SCOPE.....	2
3.0 GLOSSARY.....	2
4.0 RESPONSIBILITIES.....	2
5.0 PROCEDURES.....	2
5.1 SITE LOGBOOK.....	2
5.1.1 General.....	2
5.1.2 Photographs.....	3
5.2 FIELD NOTEBOOKS.....	3
5.3 FIELD FORMS.....	4
5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results.....	4
5.3.2 Hydrogeological and Geotechnical Forms.....	5
5.3.3 Equipment Calibration and Maintenance Form.....	6
5.4 FIELD REPORTS.....	6
5.4.1 Daily Activities Report.....	6
5.4.2 Weekly Status Reports.....	7
6.0 LISTING OF TETRA TECH NUS FIELD FORMS FOUND ON THE TTNUS INTRANET SITE. <a href="http://intranet.ttnus.com">HTTP://INTRANET.TTNUS.COM</a> CLICK ON FIELD LOG SHEETS.....	7
 <u>ATTACHMENTS</u>	
A TYPICAL SITE LOGBOOK ENTRY.....	9
B SAMPLE LABEL.....	10
C CHAIN-OF-CUSTODY RECORD FORM.....	11
D CHAIN-OF-CUSTODY SEAL.....	12

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 2 of 12
	Revision 2	Effective Date 09/03

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs and reports generally initiated and maintained for documenting Tetra Tech NUS field activities.

## 2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Tetra Tech NUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

## 3.0 GLOSSARY

None

## 4.0 RESPONSIBILITIES

Project Manager (PM) - The Project Manager is responsible for obtaining hardbound, controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports illustrated in this guideline (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time-frame.

## 5.0 PROCEDURES

### 5.1 Site Logbook

#### 5.1.1 General

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

- All field personnel present
- Arrival/departure of site visitors
- Time and date of H&S training
- Arrival/departure of equipment
- Time and date of equipment calibration
- Start and/or completion of borehole, trench, monitoring well installation, etc.
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues (level of protection observed, etc.)
- Weather conditions

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 3 of 12
	Revision 2	Effective Date 09/03

that onsite activities take place which involve Tetra Tech NUS or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

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

- Project name
- Tetra Tech NUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2), but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the field notebook in which the measurements are recorded (see Attachment A).

All logbook, notebook, and log sheet entries shall be made in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, the entry shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used must be signed and dated. The site logbook must also be signed by the Field Operations Leader at the end of each day.

### 5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook/notebook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided, since they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend upon the subject matter, type of camera (digital or film), and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Once processed, the slides or photographic prints shall be consecutively numbered and labeled according to the logbook/notebook descriptions. The site photographs and associated negatives and/or digitally saved images to compact disks must be docketed into the project's central file.

### 5.2 Field Notebooks

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 4 of 12
	Revision 2	Effective Date 09/03

### 5.3 Field Forms

All Tetra Tech NUS field forms (see list in Section 6.0 of this SOP) can be found on the company's intranet site (<http://intranet.ttnus.com>) under Field Log Sheets. Forms may be altered or revised for project-specific needs contingent upon client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOP.

#### 5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

##### 5.3.1.1 Sample Log Sheet

Sample Log Sheets are used to record specified types of data while sampling. The data recorded on these sheets are useful in describing the sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. A log sheet must be completed for each sample obtained, including field quality control (QC) samples.

##### 5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B. Adhesive labels must be completed and applied to every sample container. Sample labels can usually be obtained from the appropriate Program source electronically generated in-house, or are supplied from the laboratory subcontractor.

##### 5.3.1.3 Chain-of-Custody Record Form

The Chain-of-Custody (COC) Record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site. One carbonless copy of the completed COC form is retained by the field crew, one copy is sent to the Project Manager (or designee), while the original is sent to the laboratory. The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing vials for VOC analysis or the cooler with the air bill attached. The air bill should then state how many coolers are included with that shipment. An example of a Chain-of-Custody Record form is provided as Attachment C. Once the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed COC form (any discrepancies between the sample labels and COC form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the Tetra Tech NUS Project Manager). The COC form is signed and copied. The laboratory will retain the copy while the original becomes part of the samples' corresponding analytical data package.

##### 5.3.1.4 Chain-of-Custody Seal

Attachment D is an example of a custody seal. The Custody seal is an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. The COC seals are signed and dated by the sampler(s) and affixed across the lid and body of each cooler (front and back) containing environmental samples (see SOP SA-6.1). COC seals may be available from the laboratory; these seals may also be purchased from a supplier.

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 5 of 12
	Revision 2	Effective Date 09/03

5.3.1.5 Geochemical Parameters Log Sheets

Field Analytical Log Sheets are used to record geochemical and/or natural attenuation field test results.

5.3.2 **Hydrogeological and Geotechnical Forms**

5.3.2.1 Groundwater Level Measurement Sheet

A Groundwater Level Measurement Sheet must be filled out for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The Pumping Test Data Sheet facilitates this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be laid out in advance.

5.3.2.3 Packer Test Report Form

A Packer Test Report Form must be completed for each well upon which a packer test is conducted.

5.3.2.4 Boring Log

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring, or Boring Log is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a PID or FID), these readings must be entered on the boring log at the appropriate depth. The "Remarks" column can be used to subsequently enter the laboratory sample number, the concentration of key analytical results, or other pertinent information. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock, stick-up or flush mount), different forms are used.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible field geologist or sampling technician.

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 6 of 12
	Revision 2	Effective Date 09/03

#### 5.3.2.7 Miscellaneous Monitoring Well Forms

Monitoring Well Materials Certificate of Conformance should be used as the project directs to document all materials utilized during each monitoring well installation.

The Monitoring Well Development Record should be used as the project directs to document all well development activities.

#### 5.3.2.8 Miscellaneous Field Forms - QA and Checklists

Container Sample and Inspection Sheet should be used as the project directs each time a container (drum, tank, etc.) is sampled and/or inspected.

QA Sample Log Sheet should be used at the project directs each time a QA sample is collected, such as Rinsate Blank, Source Blank, etc.

Field Task Modification Request (FTMR) will be prepared for all deviations from the project planning documents. The FOL is responsible for initiating the FTMRs. Copies of all FTMRs will be maintained with the onsite planning documents and originals will be placed in the final evidence file.

The Field Project Daily Activities Check List and Field Project Pre-Mobilization Checklist should be used during both the planning and field effort to assure that all necessary tasks are planned for and completed. These two forms are not a requirement but a useful tool for most field work.

#### 5.3.3 **Equipment Calibration and Maintenance Form**

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device used in the field; entries must be made for each day the equipment is used or in accordance with the manufacturer's recommendations.

#### 5.4 Field Reports

The primary means of recording onsite activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation, but are not easily useful for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain onsite for extended periods of time and are thus not accessible for timely review by project management.

##### 5.4.1 **Daily Activities Report**

To provide timely oversight of onsite contractors, Daily Activities Reports are completed and submitted as described below.

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 7 of 12
	Revision 2	Effective Date 09/03

#### 5.4.1.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. This report must be filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors. The DAR form can be found on the TtNUS intranet site.

#### 5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

#### 5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DAR reports are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the Project Manager.

### 5.4.2 **Weekly Status Reports**

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

It should be noted that in addition to summaries described herein, other summary reports may also be contractually required.

All Tetra Tech NUS field forms can be found on the company's intranet site at <http://intranet.ttnus.com> under Field Log Sheets.

### 6.0 **LISTING OF TETRA TECH NUS FIELD FORMS FOUND ON THE TTNUS INTRANET SITE. HTTP://INTRANET.TTNUS.COM CLICK ON FIELD LOG SHEETS**

- Groundwater Sample Log Sheet
- Surface Water Sample Log Sheet
- Soil/Sediment Sample Log Sheet
- Container Sample and Inspection Sheet
- Geochemical Parameters (Natural Attenuation)
- Groundwater Level Measurement Sheet
- Pumping Test Data Sheet
- Packer Test Report Form
- Boring Log
- Monitoring Well Construction Bedrock Flush Mount
- Monitoring Well Construction Bedrock Open Hole
- Monitoring Well Construction Bedrock Stick Up
- Monitoring Well Construction Confining Layer
- Monitoring Well Construction Overburden Flush Mount
- Monitoring Well Construction Overburden Stick Up
- Test Pit Log
- Monitoring Well Materials Certificate of Conformance
- Monitoring Well Development Record

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 8 of 12
	Revision 2	Effective Date 09/03

Daily Activities Record  
Field Task Modification Request  
Hydraulic Conductivity Test Data Sheet  
Low Flow Purge Data Sheet  
QA Sample Log Sheet  
Equipment Calibration Log  
Field Project Daily Activities Checklist  
Field Project Pre-Mobilization Checklist

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 9 of 12
	Revision 2	Effective Date 09/03

**ATTACHMENT A  
TYPICAL SITE LOGBOOK ENTRY**

START TIME: \_\_\_\_\_ DATE: \_\_\_\_\_

SITE LEADER: \_\_\_\_\_

PERSONNEL: \_\_\_\_\_

TtNUS

DRILLER

SITE VISITORS

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

WEATHER: Clear, 68°F, 2-5 mph wind from SE

**ACTIVITIES:**

1. Steam jenny and fire hoses were set up.
2. Drilling activities at well \_\_\_\_\_ resumes. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well \_\_\_\_\_.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well \_\_\_\_\_.
4. Well \_\_\_\_\_ drilled. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 2, page \_\_\_\_\_ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well \_\_\_\_\_ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit \_\_\_\_\_.
8. Test pit \_\_\_\_\_ dug with cuttings placed in dump truck. Rig geologist was \_\_\_\_\_. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit \_\_\_\_\_ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

\_\_\_\_\_  
Field Operations Leader

Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 10 of 12
	Revision 2	Effective Date 09/03

**ATTACHMENT B**

	Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		Project:
			Site:
		Location:	
Sample No:		Matrix:	
Date:	Time:	Preserve:	
Analysis:			
Sampled by:		Laboratory:	

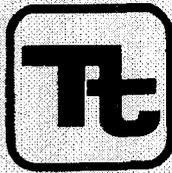


Subject  FIELD DOCUMENTATION	Number SA-6.3	Page 12 of 12
	Revision 2	Effective Date 09/03

ATTACHMENT D

CHAIN-OF-CUSTODY SEAL

<b>Signature</b> <hr/>		<b>CUSTODY SEAL</b>
<b>Date</b> <hr/>		<b>Date</b> <hr/>
<b>CUSTODY SEAL</b>		<b>Signature</b> <hr/>



TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

Number	SA-6.1	Page	1 of 11
Effective Date	02/04	Revision	3
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>[Signature]</i>		

Subject  
NON-RADIOLOGICAL SAMPLE HANDLING

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 PURPOSE.....	2
2.0 SCOPE.....	2
3.0 GLOSSARY.....	2
4.0 RESPONSIBILITIES.....	3
5.0 PROCEDURES.....	3
5.1 SAMPLE CONTAINERS.....	3
5.2 SAMPLE PRESERVATION.....	3
5.2.1 Overview.....	4
5.2.2 Preparation and Addition of Reagents.....	4
5.3 FIELD FILTRATION.....	5
5.4 SAMPLE PACKAGING AND SHIPPING.....	6
5.4.1 Environmental Samples.....	6
6.0 REFERENCES.....	7
 <u>ATTACHMENTS</u>	
A GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS.....	8
B ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES.....	9

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 2 of 11
	Revision 3	Effective Date 02/04

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

## 2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

## 3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (y261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (y261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

### Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H<sub>2</sub>SO<sub>4</sub>
- Nitric Acid - HNO<sub>3</sub>
- Sodium Hydroxide - NaOH

Subject <b>NON-RADIOLOGICAL SAMPLE HANDLING</b>	Number <b>SA-6.1</b>	Page <b>3 of 11</b>
	Revision <b>3</b>	Effective Date <b>02/04</b>

Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

**4.0 RESPONSIBILITIES**

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

**5.0 PROCEDURES**

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

**5.1 Sample Containers**

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

**5.2 Sample Preservation**

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 4 of 11
	Revision 3	Effective Date 02/04

changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

### 5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO<sub>3</sub>, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TtNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

### 5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H <sub>2</sub> SO <sub>4</sub> )	1 part concentrated H <sub>2</sub> SO <sub>4</sub> : 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO <sub>3</sub> )	Undiluted concentrated HNO <sub>3</sub>	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 5 of 11
	Revision 3	Effective Date 02/04

- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.
- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).
- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

### 5.3 Field Filtration

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 6 of 11
	Revision 3	Effective Date 02/04

- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.
- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

#### 5.4 Sample Packaging and Shipping

Only employees who have successfully completed the TtNUS "Shipping Hazardous Materials" training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)
- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

##### 5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.
- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.
- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.
- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).
- Seal (i.e., tape or tie top in knot) large liner bag.
- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.
- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 7 of 11
	Revision 3	Effective Date 02/04

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

## 6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

Subject <b>NON-RADIOLOGICAL SAMPLE HANDLING</b>	Number <b>SA-6.1</b>	Page <b>8 of 11</b>
	Revision <b>3</b>	Effective Date <b>02/04</b>

**ATTACHMENT A**

**GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS**

Sample Type and Concentration	Container <sup>(1)</sup>	Sample Size	Preservation <sup>(2)</sup>	Holding Time <sup>(2)</sup>
-------------------------------	--------------------------	-------------	-----------------------------	-----------------------------

**WATER**

Organics (GC&GC/MS)	VOC	Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to ≤ 2	14 days <sup>(9)</sup>
	Extractables SVOCs and pesticide/PCBs)	(Low	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals	Low	High-density polyethylene	1 L	HNO <sub>3</sub> to pH ≤ 2	6 months (Hg-28 days)
		Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide	Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
		Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	14 days

**SOIL**

Organics (GC&GC/MS)	VOC		EnCore Sampler	(3) 5 g Samplers	Cool to 4°C	48 hours to lab preservation
	Extractables SVOCs and pesticides/PCBs)	(Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	35 days until extraction; 40 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction

**AIR**

Volatile Organics	Low/Medium		Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended
----------------------	------------	--	---	-----------	-------------	--------------------

- 1 All glass containers should have Teflon cap liners or septa.
- 2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

Subject <b>NON-RADIOLOGICAL SAMPLE HANDLING</b>	Number <b>SA-6.1</b>	Page <b>9 of 11</b>
	Revision <b>3</b>	Effective Date <b>02/04</b>

**ATTACHMENT B**

**ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,  
AND HOLDING TIMES**

Parameter Number/Name	Container <sup>(1)</sup>	Preservation <sup>(2)(3)</sup>	Maximum Holding Time <sup>(4)</sup>
-----------------------	--------------------------	--------------------------------	-------------------------------------

**INORGANIC TESTS:**

Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid <sup>(5)</sup>	14 days <sup>(6)</sup>
Fluoride	P	None required	28 days
Hardness	P, G	HNO <sub>3</sub> to pH 2; H <sub>2</sub> SO <sub>4</sub> to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H <sub>2</sub> SO <sub>4</sub> to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 10 of 11
	Revision 3	Effective Date 02/04

**ATTACHMENT B  
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,  
AND HOLDING TIMES  
PAGE TWO**

Parameter Number/Name	Container <sup>(1)</sup>	Preservation <sup>(2)(3)</sup>	Maximum Holding Time <sup>(4)</sup>
-----------------------	--------------------------	--------------------------------	-------------------------------------

**INORGANIC TESTS (Cont'd):**

Sulfide	P, G	Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4°C	48 hours

**METALS:<sup>(7)</sup>**

Chromium VI (Hexachrome)	P, G	Cool, 4°C	24 hours
Mercury (Hg)	P, G	HNO <sub>3</sub> to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO <sub>3</sub> to pH 2	6 months

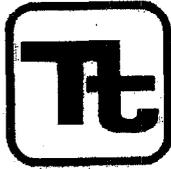
**ORGANIC TESTS:<sup>(8)</sup>**

Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> HCl to pH 2 <sup>(9)</sup>	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> adjust pH to 4-5 <sup>(10)</sup>	14 days
Phenols <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
Benzidines <sup>(11), (12)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction <sup>(13)</sup>
Phthalate esters <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitrosamines <sup>(11), (14)</sup>	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
PCBs <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> ; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs) <sup>(11), (14)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup> ; store in dark	7 days until extraction; 40 days after extraction
Haloethers <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF) <sup>(11)</sup>	G, Teflon-lined cap	Cool, 4°C; 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>(5)</sup>	7 days until extraction; 40 days after extraction

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 11 of 11
	Revision 3	Effective Date 02/04

**ATTACHMENT B  
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,  
AND HOLDING TIMES  
PAGE THREE**

- (1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
- (2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
- (3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
- (4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
- (5) Should only be used in the presence of residual chlorine.
- (6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
- (7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
- (8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
- (9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
- (10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
- (11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
- (12) If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.
- (13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
- (14) For the analysis of diphenylnitrosamine, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> and adjust pH to 7-10 with NaOH within 24 hours of sampling.
- (15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.



TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

Number	ME-12	Page	1 of 26
Effective Date	06/99	Revision	1
Applicability	Tetra Tech NUS, Inc.		
Prepared	Health Sciences Department		
Approved	D. Senovich		

Subject  
PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 PURPOSE .....	3
2.0 SCOPE .....	3
3.0 GLOSSARY .....	3
4.0 RESPONSIBILITIES .....	3
5.0 PROCEDURES .....	4
5.1 PRINCIPLE OF OPERATION .....	4
5.1.1 Displays .....	5
5.1.2 Keys .....	5
5.2 DEFAULT DISPLAY .....	6
5.3 MONITORING .....	6
5.3.1 Use and Documentation of Results .....	6
5.3.2 Instrument Status .....	7
5.3.3 Alarms .....	7
5.4 STEL, TWA, MAX, AND PEAK OPERATION .....	13
5.4.1 Short-term Exposure Limit (STEL) Mode .....	13
5.4.2 Time-weighted Average (TWA) Mode .....	13
5.4.3 MAX Mode .....	13
5.4.4 PEAK Mode .....	14
5.5 SET FUNCTIONS .....	14
5.5.1 Pump .....	14
5.5.2 Clock .....	14
5.5.3 Calibration (Cal) .....	15
5.5.4 Library (Lib) .....	15
5.6 PREPARING FOR FIELD OPERATION OF THE PHOTOVAC 2020 .....	15
5.7 MAINTENANCE AND CALIBRATION SCHEDULE .....	16
5.7.1 Cleaning the UV Light Source Window .....	16
5.7.2 Cleaning the Ionization Chamber .....	17
5.8 INSTRUMENT ADVANTAGES .....	17
5.9 LIMITATIONS OF THE PHOTOVAC 2020 PHOTOIONIZATION MONITOR .....	17
5.9.1 Variables Affecting Monitoring Data .....	18
6.0 TROUBLESHOOTING .....	18
6.1 FAULT MESSAGES .....	18
6.2 SPECIFIC PROBLEMS .....	20

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 2 of 26
	Revision 1	Effective Date 06/99

**TABLE OF CONTENTS (Continued)**

<u>SECTION</u>	<u>PAGE</u>
7.0 SHIPPING.....	25
8.0 REFERENCES.....	25

**FIGURES**

<u>NUMBER</u>	<u>PAGE</u>
5-1 DOCUMENTATION OF FIELD CALIBRATION .....	8
5-2 DIRECT-READING INSTRUMENT RESPONSE DATA .....	9
5-3 BORING LOG.....	11
5-4 TEST PIT LOG .....	12
5-5 DANGEROUS GOODS AIRBILL.....	26

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 3 of 26
	Revision 1	Effective Date 06/99

## 1.0 PURPOSE

To establish procedures for the use, maintenance, and calibration of the Photovac 2020 Photoionization Air Monitor.

## 2.0 SCOPE

Applies to each usage of the Photovac 2020 Photoionization Air Monitor by TtNUS personnel.

## 3.0 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. It is equal to  $1.602192 \pm 0.000007 \times 10^{-19}$  volts.

Intrinsically Safe (I.S.) - Based on wiring, configuration, design, operation, gasketing, construction, this instrument may be employed within locations in which 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) - Photoionization detector employed as general reference to air monitors of this type. PIDs detection method employs ultraviolet (UV) radiation as an energy source. As air and contaminant 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) - 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.

## 4.0 RESPONSIBILITIES

Office Managers – Office Managers are responsible for ensuring that personnel under their direction who may use this device are first provided with adequate training and information.

Project Managers – Project Managers are responsible for ensuring that appropriate health and safety requirements and resources are addressed for their assigned projects.

Health and Safety Manager (HSM) - The HSM shall ensure that appropriate training is available to users of the Photovac 2020 instrument.

Equipment Manager - The Equipment Manager shall ensure all air monitoring instrumentation slated for field activities has been operationally checked out, fully charged, and calibrated prior to issuing any instrument for field service. Maintenance deficiencies identified by the Equipment Manager will require those instruments to be pulled from service until repairs can be facilitated.

Field Operations Leader (FOL)/Field Team Leader (FTL) - The FOL/FTL shall ensure all field team members employing the monitoring instruments as part of their assigned duties are adequately trained in

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 4 of 26
	Revision 1	Effective Date 06/99

the operation and limitations of this instrument. The FOL/FTL shall ensure that the air monitoring instruments are employed as directed by site guidance documents (i.e., Work Plan, Health and Safety Plan, etc.). Additionally, the FOL/FTL shall ensure that the appropriate documentation and recordkeeping requirements are fulfilled including Documentation of Calibration and Direct Reading Instrument Response Data Sheets for air monitoring activities. On projects where a dedicated SSO is not assigned, the FOL/FTL is responsible for assuming the duties of that position.

Health and Safety Officer (HSO) - The HSO is responsible for determining air monitoring requirements for the site activities, and providing direction for air monitoring during specific site activities. This identification of types of air monitoring and direction for use are indicated within the Site-Specific Health and Safety Plan (HASP).

Site Safety Officer (SSO) - The SSO shall ensure the instruments identified are employed in the manner directed by the HSO, and that any action levels specified are observed for the application of engineering controls, personal protective equipment (PPE) use, and administrative controls. Additionally, he/she shall ensure the instruments are properly maintained and calibrated prior to use in the field. The SSO, during specific air monitoring applications including STEL and TWA mode measurements, will be responsible for the operation and application of this specialty air monitoring device. The SSO is also responsible for addressing relevant Hazard Communication requirements (e.g., MSDS, chemical inventories, labeling, training, etc.) on each assigned project.

## 5.0 PROCEDURES

### 5.1 Principle of Operation

Direct-reading instruments such as a photoionization detector are typically used to monitor for airborne releases that could present an inhalation threat to personnel, and to screen and bias environmental samples. Proper use of these instruments by trained, qualified personnel is essential to the validity of any acquired results. Also essential is that the devices are properly calibrated according to manufacturers instructions (and the specifications of this SOP), and that users of the instrument properly document results.

The Photovac portable photoionizer detects many organic (and a few inorganic) vapors. The basis for detection of this instrument is the ionization of components of captured gaseous streams. The incoming gas molecules are subjected to ultraviolet (UV) radiation, which is energetic enough to ionize many gaseous compounds. 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 the 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 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<sup>3</sup>.

The 2020 instrument is easy to operate. The meter display updates itself once per second. Concentrations are directly displayed on the readout.

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

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 5 of 26
	Revision 1	Effective Date 06/99

2020 has 6 keys for alphanumeric entry and for accessing multiple functions. The keys are used to set up and calibrate the 2020 instrument. They allow for the manipulation of the data in various ways.

All information entered with the keys and stored in the instrument's memory. This 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 instrument is turned on.

### 5.1.1 Displays

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

#### 5.1.1.1 Meter Display

The meter has a 4-digit display. It will always be used for reporting detected concentrations. When the detector and pump are off, the meter display will be blank.

In order to accommodate the entire range of concentrations the 2020 can detect, the instrument has 2 resolution settings. The 0.1 resolution setting should be used for concentrations below 100 ppm, and the 1 resolution setting should be used for concentrations above 100 ppm.

#### 5.1.1.2 Status Display

The status display is a 2 line by 16 character display. The top line is used to display status information and prompts the user for information. The bottom line is used for soft key names. Up to 3 names can be displayed for the 3 soft keys. If a name does not appear for a soft key, then the soft key has no associated function.

### 5.1.2 Keys

#### 5.1.2.1 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 both to turn power on to the 2020 as well as to turn the power off. To turn on 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 an 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. At the initial entry of the menu, EXIT will return the user 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.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 6 of 26
	Revision 1	Effective Date 06/99

### 5.1.2.2 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. Since only three soft keys are available, each function is broken down into a path.

### 5.1.2.3 Entering Text With the Soft Keys

For all information that must be entered, 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 to 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 the EXIT key.

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 8 characters long, which is displayed on the right side of the status display line. The prompt, describing the input, occupies the left side of the top line. The soft keys are defined on the bottom line of the status display.

## 5.2 Default Display

The meter display shows the detected concentration. The resolution of the display automatically changes with the magnitude of the reading. A reading of 0 to 99.9 will be displayed with a resolution of 0.1 ppm or mg/m<sup>3</sup>. A reading greater than 99.9 will be shown with a resolution of 1 ppm or mg/m<sup>3</sup>. The meter will display concentrations up to 2000 ppm or 2(XX) mg/m<sup>3</sup>.

The status display is used to indicate 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.

## 5.3 Monitoring

### 5.3.1 Use and Documentation of Results

As with any direct-reading instrument, understanding not only how – but when to use this instrument is essential to gathering relevant and valid data. This device will only respond to volatile substances in sampled air that have ionization potentials below the UV lamp strength. Inappropriate instrument selection, or use/interpretation of instrument results by an unqualified user not only can yield inaccurate

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 7 of 26
	Revision 1	Effective Date 06/99

results, but could place personnel at risk of exposure to hazardous agents. Only personnel who are properly trained and authorized to use this device will be permitted to operate it.

It is essential that instrument operators understand and comply with the requirements to document results. This includes the need to document calibration results as well as operational readings. Calibration results must be recorded using Figure 5-1. Operational results can be recorded in several ways, including:

- Direct-Reading Instrument Response Data (Figure 5-2) – preferred method
- Boring Log Forms (Figure 5-3)
- Test Pit Log Forms (Figure 5-4)
- Log book entries

When using direct-reading instruments, it is important to monitor the air near the source of potential releases (e.g., drilling boreholes, tank entrances, drum openings, etc.) and at worker breathing zone areas. All readings should be recorded, including readings noted where background levels were not exceeded.

### 5.3.2 Instrument Status

The instrument status is shown on the left side of the first line of the status display and on the Table and Graph outputs. Each status has an assigned 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.

### 5.3.3 Alarms

While operating the instrument, any one of three audible alarm conditions can occur. To accurately identify the source of the alarm, each type of alarm has been given a unique 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 alarm conditions, and is named "Ack." If no alarm conditions exist, then the "Ack" key is not shown. To clear an 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 the 15 minute average exceeds the selected STEL, a STEL alarm is generated.

The TWA alarm is generated when the current average of concentration, since the TWA was last cleared, has exceeded the TWA exposure limit.











Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 13 of 26
	Revision 1	Effective Date 06/99

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

#### **5.4 STEL, TWA, MAX, and PEAK Operation**

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

##### **5.4.1 Short-term Exposure Limit (STEL) Mode**

The Short-term Exposure Limit (STEL) mode displays the concentration as a 15 minute moving average. The 2020 maintains 15 samples, each representing a one-minute averaging interval.

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

STEL is set to zero each time the instrument is turned on. Since 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 results of the calculations can be displayed by selecting STEL as the Display mode.

##### **5.4.2 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 the TWA mode, the time on the status display will show the number of minutes and hours of data that TWA data has been accumulated. When the sample time reaches 8 hours, the 2020 stops accumulating data and the TWA is complete.

TWA calculations are always being performed by the 2020. The results of the calculations can be displayed by selecting TWA as the Display mode. When the sampling period is less than 8 hours, record the TWA readout along with the sampling duration displayed on the meter.

##### **5.4.3 MAX Mode**

The MAX mode displays the maximum signal, with the date and time that it was recorded. 2020 continues to log data according to the selected averaging interval, but only the maximum detected concentration is shown 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 you press "Clr," only the MAX value is cleared. The TWA is still accumulating in the background.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 14 of 26
	Revision 1	Effective Date 06/99

#### 5.4.4 PEAK Mode

The PEAK mode displays the current detected concentration. The reading is updated every 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. Typically, the instrument is operated in the PEAK mode. Operation within the other specialized modes are the responsibility of the SSO.

#### 5.5 Set Functions

Pre-set functions are used to setup the 2020. There are three functions which can be used: Calibration, Pump and Clock.

##### 5.5.1 Pump

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

The detector is also turned off when turning the pump 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. Operating the instrument with the pump and detector turned off will conserve the lives of the battery and ultraviolet (UV) lamp.

1. Press the ENTER key. The top line of the status display changes to "Select?". The bottom line displays 3 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 3 devices which can be set: "Clock," "Pump," and "Cal." Press the "Pump" key.
4. If the pump is off, pressing the "Pump" key will turn the pump on.
5. A message will be displayed showing the status of the pump. The display reverts back to the previous menu after a few seconds.
6. To return to the default display, press the ENTER key.

##### 5.5.2 Clock

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

1. Press the ENTER key.
2. Press the "Set" key.
3. When the names of the soft keys change, press the "Clock" key.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 15 of 26
	Revision 1	Effective Date 06/99

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 to 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 the user to input 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.

### 5.5.3 Calibration (Cal)

The Cal function allows the user to setup and calibrate the 2020. Three options are available 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 the user with two new soft keys: "User" and "Lib."

### 5.5.4 Library (Lib)

Library selections simplify Cal Memory programming, and provide standard response factors for approximately 70 applications. "Lib" allows you 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 for a list of the library entries.

## 5.6 Preparing for Field Operation of the Photovac 2020

### Turning 2020 On

1. Turn the 2020 on by pressing the ON/OFF key.
2. The instrument will display the software version number. Wait for the 2020 to proceed to the default display.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 16 of 26
	Revision 1	Effective Date 06/99

3. Allow 10 minutes for the instrument to warm up and stabilize.
4. Press the "Enter" Key. The default display will provide 3 soft key selections: "Set," "Log," and "Display."
5. Press "Set." From this option 3 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 is for Span determination. Press "Enter" and 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 or 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" 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 Documentation of Calibration form as illustrated in Figure 5-1.

This instrument is ready for use.

Calibration is to be performed daily or prior to each use in accordance with Sections 5.6 and 5.7 of this SOP, and with manufacturer's recommendations.

#### 5.7 Maintenance and Calibration Schedule

Function	Frequency
Routine Calibration	Prior to each use. Complete Figure 5-4 for each calibration.
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

##### 5.7.1 Cleaning the UV Light Source Window

1. Turn the FUNCTION switch to the OFF position. Use the instrument's multi-tool and remove lamp housing cover.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 17 of 26
	Revision 1	Effective Date 06/99

2. Tilt the lamp housing with one hand over the opening, 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

Observe manufacturer's MSDS requirements when handling these substances.

4. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace o-ring as necessary, reinstall lamp housing cover, tighten using the multi-tool. (Do not over tighten).
5. Recalibrate as per Section 5.6.

#### **5.7.2 Cleaning the Ionization Chamber**

1. Turn the FUNCTION switch to the OFF position and remove the lamp housing cover and lamp as per Section 5.7.1.
2. Using a gentle jet of compressed air, gently blow out any dust or debris.
3. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace o-ring as necessary, reinstall lamp housing cover, tighten using the multi-tool. (Do not over tighten).
4. Recalibrate as per Sections 5.6 and 5.7.

#### **5.8 Instrument Advantages**

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

#### **5.9 Limitations of the Photovac 2020 Photoionization Monitor**

- Since 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, a background or zero reading on this instrument does not necessarily signify the absence of air contaminants.
- The 2020 instrument can monitor only certain vapors and gases in air. Many nonvolatile liquids, toxic solids, particulates, and other toxic gases and vapors cannot be detected.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 18 of 26
	Revision 1	Effective Date 06/99

- PID's are generally not compound-specific. Their response to different compounds is relative to the calibration gas used. This is generally referred to as the relative response ratio. Instrument readings may be higher or lower than the true concentration. This can be especially serious when monitoring for total contaminant concentrations if several different compounds are being detected at once.
- The 2020 is a small, portable instrument which cannot be expected to yield results as accurately as laboratory instruments.

#### 5.9.1 Variables Affecting Monitoring Data

Monitoring hazardous waste site environments 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 Pressure - changes in temperature and/or pressure will influence volatilization, and effect airborne concentrations. Additionally, an increase or decrease in temperature ranges may have an adverse effect on the instrument's ability to detect airborne concentrations. Significant changes in temperature or pressure from the time of calibration to the time of sample measurement may result in erroneous results.
- Humidity - excessive levels of humidity may interfere with the accuracy of monitoring results.
- Rainfall - through increased barometric pressure and water may influence dispersion pathways effecting airborne emissions.
- Electromagnetic interference - high voltage sources, generators, other electrical equipment may interfere with the operation and accuracy of direct-reading monitoring instruments.

### 6.0 TROUBLESHOOTING

#### 6.1 Fault Messages

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

##### **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: Contamination of sample line, sample probe or fittings before the detector.

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

Cause: Span gas and zero air are mixed up.

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

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 19 of 26
	Revision 1	Effective Date 06/99

Cause: Ambient air is contaminated.

Action: If the quality of ambient air is unknown, use a supply of commercial zero grade air.

**Fault 2: Signal from span gas is too small.**

Cause: Operator may have incorrectly used the span gas for the zero air source.

Action: Ensure clean air is used to zero the 2020. If you are using Tedlar bags, mark the calibration and zero gas Tedlar 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: UV lamp has not started immediately.

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

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

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

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

Cause: UV lamp not installed.

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

Action: Install a UV lamp.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 20 of 26
	Revision 1	Effective Date 06/99

Cause: UV lamp has failed.

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

Action: Install a new UV lamp.

Cause: 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: 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 the UV lamp has a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the 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 Equipment Manager.

Cause: The pump has failed.

Action: Contact the Equipment Manager.

**6.2 Specific Problems**

**Problem: Very low or no instrument response detected, yet compounds are suspected 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 the User's Manual.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 21 of 26
	Revision 1	Effective Date 06/99

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 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 intended application. You must use the correct calibration gas and concentration for each Cal Memory.

Cause: Response factor has been set to zero.

Action: Enter the correct response factor. Refer to the list of response factors. If the compound is not listed or you are measuring gas mixtures, then enter a value of 1.0. See User's Manual.

Cause: Not using the correct Cal Memory.

Action: Select the correct Cal Memory for the intended 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. Do not overtighten the cover.

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

Cause: 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 the UV lamp has a white serial number label, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the 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 the UV lamp has a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the Equipment Manager.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 22 of 26
	Revision 1	Effective Date 06/99

Cause: 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 humidity conditions, there may be a decreased response.

Cause: UV lamp is failing.

Action: Replace UV lamp.

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

Cause: High concentration of non-ionizable compounds suspected.

Action: 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 conduct 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 ground water investigations in areas where the water 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 Sections 5.6 and 5.7.

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 Equipment Manager.

Cause: Cal Memories have not been programmed correctly.

Action: Program all the Cal Memories required for the intended application. The correct calibration gas and concentration must be used for each Cal Memory. See the User's Manual.

Cause: Not using the correct Cal Memory.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 23 of 26
	Revision 1	Effective Date 06/99

Action: Select the correct Cal Memory for the intended application. See 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: 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 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 instrument 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.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 24 of 26
	Revision 1	Effective Date 06/99

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 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 disconnecting 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.

Action: Contact the Equipment Manager.

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

Cause: Inlet filter is plugged.

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

Action: Replace inlet filter.

Cause: Inlet filter has not been installed properly.

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

Cause: 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 the UV lamp has a white serial number label, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the Equipment Manager.

Subject PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR	Number ME-12	Page 25 of 26
	Revision 1	Effective Date 06/99

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

Action: If the UV lamp has a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the 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 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 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 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 Equipment Manager.

## 7.0 SHIPPING

- The Photovac may be shipped as cargo or carried on as luggage provided that there is no calibration gas cylinder accompanying the kit. When shipping or transporting the calibration gas, a Hazardous Materials (Dangerous Good) Airbill, including the information as stipulated in Figure 5-5 will be prepared. **Only personnel who have been properly trained are permitted to offer a hazardous material for shipment.** The "Shipping Hazardous Materials" course offered by Tetra Tech NUS is considered acceptable training for this purpose. Specific instructions on packaging, labeling, and otherwise preparing a hazardous material shipment are presented in the Student Manual that accompanies the course.

## 8.0 REFERENCES

Photovac 2020 Photoionization Monitor User's Manual, 1995.

Student Manual from "Shipping Hazardous Materials" course, Tetra Tech NUS, 1999.

FIGURE 5-5



**Dangerous Goods**  
*Airbill*

**Sender's Copy**  
RETAIN FOR 1 YEAR  
RETAIN THIS COPY FOR YOUR RECORDS

*The World On Time*

---

**1 From** (please print and press hard)  
Date \_\_\_\_\_ Sender's FedEx Account Number \_\_\_\_\_  
Sender's Name \_\_\_\_\_ Phone \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_ Dept./Floor/Suite/Room \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

**2 Your Internal Billing Reference Information**  
(Optional) (Print 24 characters with spaces or hyphens)

**3 To** (please print and press hard)  
Receiver's Name Tom Patton Phone (412) 262-4583  
Company Tetra Tech NUS  
Address Spring Run Road Extension, Suite 140  Check here if residence (We Cannot Deliver to P.O. Boxes or P.O. ZIP Codes) (Home charges apply for FedEx Express Saver)  
City Coraopolis State PA ZIP 15108

**For HOLD at FedEx Location check here** **For WEEKEND Delivery check here** (Days Change (See instructions on reverse))  
 Hold Monday  Hold Saturday (Not available at all locations)  Saturday Delivery (Available for FedEx Priority Overnight and FedEx 2Day only)  Sunday Delivery (Available for FedEx Priority Overnight and FedEx 2Day only)

**4a Express Package Service Packages under 150 lbs.** Delivery commitment may be later in some areas.  
 FedEx Priority Overnight (Next business morning)  FedEx Standard Overnight (Next business afternoon)  
 FedEx 2Day (Second business day)  FedEx Express Saver (Third business day)

**4b Express Freight Service Packages over 150 lbs.** Delivery commitment may be later in some areas.  
 FedEx Overnight Freight (Next business day)  FedEx 2Day Freight (Second business day)  FedEx Express Saver Freight (Third business day)  
 (Call for delivery schedule. Some restrictions apply. See back for detailed descriptions of freight services.)

**5 Packaging**  
 Other Packaging  
Dangerous Goods cannot be shipped in FedEx packaging.

**6 Special Handling**  
 Dangerous Goods as per attached Shipper's Declaration  Cargo Aircraft Only

**7 Payment**  
 Sender  Recipient  Third Party  Credit Card  Cash/Check  
 (Enter FedEx Account No. or Credit Card No. below)  
 FedEx Account No. \_\_\_\_\_  
 Credit Card No. \_\_\_\_\_ Exp. Date \_\_\_\_\_  
 Total Packages \_\_\_\_\_ Total Weight \_\_\_\_\_ Total Declared Value \$ \_\_\_\_\_  
 \*When declaring a value higher than \$100 per shipment, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE, AND LIMIT OF LIABILITY section for further information.

**Signature Release Unavailable** PART #154751 Rev. Date 4/98 C1184-09 FedEx® PRINTED IN U.S.A.

FedEx Tracking Number **807286974806** Form I.D. No. **0204** 355

---

Page 1 of 1 Pages

Two completed and signed copies of this Declaration must be handed to the operator.

**TRANSPORT DETAILS**  
This shipment is within the limitations prescribed for (unless non-applicable)  
PASSENGER AND CARGO AIRCRAFT  
Airport of Departure: \_\_\_\_\_  
Airport of Destination: \_\_\_\_\_

**WARNING**  
Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

Shipment type: (delete non-applicable)  
 NON-RADIOACTIVE  RADIOACTIVE

**NATURE AND QUANTITY OF DANGEROUS GOODS**

Dangerous Goods Identification					Quantity and Type of Packaging	Packing Inst.	Authorization
Proper Shipping Name	Class or Division	UN or LD No.	Packing Group	Subsidiary Risk			
Compressed Gas N.O.S. (mixture Nitrogen and Oxygen)	2.2	UN 1956			1 Plastic box x 0.56 Kg	200	

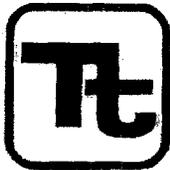
Additional Handling Information \_\_\_\_\_

Prepared for AIR TRANSPORT according to: (Customer MUST check one)  
 49 CFR  ICAO / IATA

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked, and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.  
 Emergency Telephone Number (Required for US Origin or Destination Shipments) **1-800-535-5053 InfoTRAC**

Name/Title of Signatory \_\_\_\_\_  
 Place and Date \_\_\_\_\_  
 Signature (see warning above) \_\_\_\_\_

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.



TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

Number ME-15	Page 1 of 20
Effective Date 06/99	Revision 1
Applicability Tetra Tech NUS, Inc.	
Prepared Health Sciences Department	
Approved D. Senovich <i>DS</i>	

Subject PHOTOVAC MICROFID HANDHELD  
FLAME IONIZATION DETECTOR

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 PURPOSE .....	2
2.0 SCOPE .....	2
3.0 GLOSSARY .....	2
4.0 RESPONSIBILITIES .....	2
5.0 PROCEDURES .....	3
5.1 GENERAL .....	3
5.2 USE AND DOCUMENTATION OF RESULTS .....	3
5.3 PRINCIPLES OF OPERATION .....	3
5.4 CALIBRATION .....	10
5.5 ROUTINE MAINTENANCE .....	11
5.5.1 Battery Charging .....	11
5.5.2 Emptying the Hydrogen Cylinder .....	12
5.5.3 Replacing the Sample Inlet Filter .....	12
5.6 TROUBLESHOOTING .....	13
5.6.1 MicroFID Fault Messages .....	13
5.7 TRANSPORTING MICROFID .....	18
6.0 SHIPPING .....	18
7.0 REFERENCES .....	18

## FIGURES

<u>NUMBER</u>	<u>PAGE</u>
5-1 DOCUMENTATION OF FIELD CALIBRATION .....	4
5-2 DIRECT-READING INSTRUMENT RESPONSE DATA .....	5
5-3 BORING LOG .....	7
5-4 TEST PIT LOG .....	8
6-1 EXAMPLE OF A HAZARDOUS AIRBILL FOR HYDROGEN .....	19
6-2 EXAMPLE OF A HAZARDOUS AIRBILL FOR METHANE IN AIR .....	20

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 2 of 20
	Revision 1	Effective Date 06/99

## 1.0 PURPOSE

To establish procedures for the use, calibration, maintenance, troubleshooting, and shipment of the Photovac MicroFID handheld flame ionization detector.

## 2.0 SCOPE

Applies to all Brown & Root Environmental personnel who operate the MicroFID instrument during the performance of their work.

## 3.0 GLOSSARY

None.

## 4.0 RESPONSIBILITIES

Office Managers - Office Managers are responsible for ensuring that personnel under their direction who may use this device are first provided with adequate training and information.

Project Managers - Project Managers are responsible for ensuring that appropriate health and safety requirements and resources are addressed for their assigned projects.

Health and Safety Manager (HSM) - The HSM shall ensure that appropriate training is available to users of the Photovac MicroFID instrument.

Equipment Manager - The Equipment Manager shall ensure that all air monitoring instrumentation slated for field activities has been operationally checked out, fully charged, and calibrated prior to issuance for field service. Maintenance deficiencies identified by the Equipment Manager will require those instruments to be pulled from service until repairs can be facilitated.

Field Operations Leader (FOL)/Field Team Leader (FTL) - The FOL/FTL shall ensure all field team members using monitoring instruments as part of their assigned duties are adequately trained in their proper operation and limitations. The FOL/FTL shall ensure that the air monitoring instruments are employed as directed by site guidance documents (i.e., Work Plan, Health and Safety Plan, etc.). Additionally, the FOL/FTL shall ensure that the appropriate documentation and recordkeeping requirements are fulfilled including Documentation of Calibration and Direct Reading Instrument Response Data Sheets for air monitoring activities. On projects where a dedicated SSO is not assigned, the FOL/FTL is responsible for assuming the duties of that position.

Health and Safety Officer (HSO) - The HSO is responsible for determining air monitoring requirements for the site activities, and providing direction for air monitoring during specific site activities. This identification of types of air monitoring and direction for use are indicated within the Site-Specific Health and Safety Plan (HASP).

Site Safety Officer (SSO) - The SSO shall ensure the instruments identified are employed in the manner directed by the HSO and action levels employed as contingencies marks for the application of engineering controls, personal protective equipment (PPE) use, and administrative controls are employed as directed. Additionally, he/she shall ensure the instruments are properly maintained and calibrated prior to use in the field. The SSO during specific air monitoring applications including STEL and TWA mode measurements will be responsible for operation and application of this specialty air monitoring employment duty. The

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 3 of 20
	Revision 1	Effective Date 06/99

SSO is also responsible for addressing relevant Hazard Communication requirements (e.g., MSDS, chemical inventories, labeling, training, etc.) on each assigned project.

## 5.0 PROCEDURES

### 5.1 General

Direct-reading instruments such as a flame ionization detector are typically used to monitor for airborne releases that could present an inhalation threat to personnel, and to screen and bias environmental samples. Proper use of these instruments by trained, qualified personnel is essential to the validity of any acquired results. Also essential is that the devices are properly calibrated according to manufacturers instructions (and the specifications of this SOP), and that users of the instrument properly document results.

### 5.2 Use and Documentation of Results

As with any direct-reading instrument, understanding not only how - but when to use this instrument is essential to gathering relevant and valid data. This device will only respond to volatile organics in air that are combustible. Inappropriate instrument selection, use, or interpretation of instrument results by an unqualified user not only can yield inaccurate results, but could place personnel at risk of exposure to hazardous agents. Only personnel who are properly trained and authorized to use this device will be permitted to operate it.

It is essential that instrument operators understand and comply with the requirements to document results. This includes the need to document calibration results as well as operational readings. Calibration results must be recorded using Figure 5-1. Operational results can be recorded in several ways, including:

- Direct-Reading Instrument Response Data (Figure 5-2) - preferred method
- Boring Log Forms (Figure 5-3)
- Test Pit Log Forms (Figure 5-4)
- Log book entries

When using direct-reading instruments, it is important to monitor the air near the source of potential releases (e.g., drilling boreholes, tank entrances, drum openings, etc.) and at worker breathing zone areas. All readings should be recorded, including readings noted where background levels were not exceeded.

### 5.3 Principles of Operation

The MicroFID is a flame ionization detector used for the measurement of combustible organic compounds in air at parts per million levels. Permanent air gases (argon, carbon dioxide, nitrogen, oxygen, water vapor, etc.) are not ionized by the flame.

When the MicroFID is turned on, the display prompts you to turn on the hydrogen. The internal pump draws sample air in through MicroFID's inlet. This sample air provides the oxygen necessary for combustion in the hydrogen-fueled flame. When the proper ratio of hydrogen to air is present in the combustion chamber, the flame is automatically started with a glow plug. A thermocouple is used to monitor the status of the flame. When the sample passes through the flame the combustible organic compounds in the sample will be ionized. After the compounds have been ionized, they are subjected to











Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 9 of 20
	Revision 1	Effective Date 06/99

a continuous electric field between the repeller electrode at the jet and the collector electrode. The ions in the electric field generate a current which is proportional to the concentration of the ionized molecules in the ionization chamber. An electrometer circuit converts the current to a voltage that is then fed to the microprocessor which interprets the current in units of ppm. After the sample passes through the flame and has become ionized, it is vented from the detector through a flame arrestor. The flame arrestor prevents the flame from igniting any flammable gases present in the working atmosphere.

MicroFID is strictly an organic compound detector. It does not respond to inorganic compounds. MicroFID's sensitivity is highly dependent on chemical structure and bonding characteristics. The combustion efficiency of a compound determines its sensitivity. Simple saturated hydrocarbons (methane, ethane, etc.) possess high combustion efficiencies and are among the compounds that produce the highest MicroFID response. Organic fuels (acetylene, refined petroleum products), burn easily and are also extremely well detected.

The presence of substituted functional groups (amino, hydroxyl, halogens) on a simple hydrocarbon reduces its combustion efficiency and the MicroFID's sensitivity to the compound. For example, methanol and chloromethane are detectable with MicroFID, but not at the same sensitivity as methane. The number of carbon atoms can also affect the instrument's sensitivity due to substitution. For example, MicroFID is more sensitive to n-butanol than it is to methanol. For additional information regarding response factors of the MicroFID, consult the manufacturer's of the User's Manual.

### Beginning Operation

The MicroFID can be operated without the activation of the flame to print or review logged data. In this way, the hydrogen fuel is conserved.

MicroFID will attempt to ignite the flame once the flow of hydrogen gas has been started. If the MicroFID has not been used for a while, it is possible that the gas supply lines are filled with air. If the flame cannot be started, MicroFID will begin a 30 second purge cycle. During the purge cycle it will flush the gas supply lines with hydrogen. After the purge cycle, it will attempt to light the flame again. If it fails again, another purge cycle will be performed and MicroFID will try a third time to ignite the flame. The following steps summarize proper start-up procedures.

1. Turn the instrument on by pressing the front of the On/Off switch. When the instrument is powered up, the version number and creation date of the instrument software are displayed. Press ENTER.
2. You will be prompted to start the flame. If you do not want to start the flame, use the ARROW keys to select "No Flame Needed" and press ENTER. To start the flame, use the ARROW keys to select Start Flame and press ENTER.
3. If you selected "Start Flame," MicroFID will prompt you to turn on the hydrogen. Turn the shut-off valve counterclockwise to start the flow of hydrogen and press ENTER.
4. The pump will start and MicroFID will then ignite the flame. You will hear a small pop when the flame has been ignited. Once the flame has been started the message "Detector flame has been started OK" will be displayed followed by the default display.

The default display provides the following information: instrument status, current detected concentration, event name (if the datalogger is on), time, and date. If an event name is longer than three characters, the bottom line of the display will scroll through the information.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 10 of 20
	Revision 1	Effective Date 06/99

The instrument status appears at the left of the upper line of the display and on the Print 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.

#### 5.4 Calibration

The calibration (CAL) key is used to calibrate MicroFID. Before beginning calibration, ensure that you have a reliable source of both zero air and calibration gas. To document calibration efforts, field personnel will record information on the Documentation of Field Calibration Form (Figure 5-1), or the same information in the calibration/maintenance log book assigned to an instrument. A brief description of the functions under the CAL key are as follows:

1. When you press the CAL key you will first be prompted to select a Cal Memory. Each Cal Memory stores a unique zero point, sensitivity setting, response factor and alarm level.
2. You will then be prompted to enter a response factor. Refer to the manufacturer's User's Manual for a list of response factors. If the compound is not listed in that reference, or if you are measuring gas mixtures, enter a value of 1.00. The concentration detected by MicroFID will be multiplied by the response factor before it is displayed and logged.
3. Next select Low Range or High Range operation. Use Low Range if you are sampling concentrations between 0.5 and 2000 ppm (methane equivalents). Use High Range if you are sampling concentrations between 10 and 50,000 ppm (methane equivalents).
4. You will now be prompted to connect a supply of zero air. You may use ambient air or, for best results, use a clean Tedlar bag filled with zero grade air. In most cases, ambient air will be used provided calibration is performed in an area in which interfering airborne contaminants are not present. If using ambient air, press <ENTER> to begin zeroing.
5. If you are using a charcoal filter to clean ambient air, connect the filter by loading the Teflon ferrules into the nut (the ferrules and the nut are supplied with the filter). Connect the nut to MicroFID's inlet. Do not tighten the nut. Remove the charcoal filter from its plastic bag and insert it into the nut. Finger tighten the nut onto the inlet. If the filter is not secure, ensure you have inserted the tube far enough into the nut. Do not over-tighten the fitting. Press <ENTER> and the MicroFID will set its zero point. NOTE: The charcoal filter does not filter methane or ethane. If these compounds are present, use a gas bag with a supply of commercial zero air.
6. If you are using a Tedlar bag filled with zero air, connect the bag to the inlet. Open the bag and press <ENTER>. MicroFID will set its zero point.
7. After MicroFID has set its zero point, you can then enter the concentration of the calibration gas (span gas), and then connect the Tedlar bag adapter to the inlet. Open the bag and press <ENTER>. MicroFID sets its sensitivity. Note: You must have a supply of calibration gas ready before calibrating MicroFID. When calibrating MicroFID, ensure the instrument is level. If MicroFID is tilted from side to side, gravity will affect the flame height and cause erroneous readings.
8. When MicroFID's display reverts to normal, it is calibrated and ready for use. Remove the Tedlar bag from the inlet.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 11 of 20
	Revision 1	Effective Date 06/99

9. Press the ALARM key and enter the alarm level for the selected CAL memory.

## 5.5 Routine Maintenance

### 5.5.1 Battery Charging

A fully charged battery will power the MicroFID for approximately 15 hours. If the instrument is to be used for more than 15 hours, carry a spare battery pack. Battery life is reduced if the instrument is turned off and then on again repeatedly.

When the instrument status displays "LoBat," the battery pack requires changing. When the "LoBat" status is displayed, you have a few minutes of operation left. MicroFID will turn itself off before the battery pack becomes critically low.

To remove the battery pack:

1. Stop the flow of hydrogen gas by turning the hydrogen shut-off valve fully clockwise. Turn the instrument off by pressing the On/Off switch twice.
2. Use the MicroFID multi-tool to loosen the two captive screws in the bottom of the battery pack.
3. A retainer at the rear of the instrument helps secure the battery pack to the instrument. Free the battery pack from the instrument.
4. Connect the charged battery pack to the retainer at the rear of the instrument.
5. Retighten the two captive screws and the bottom of the battery pack.

To charge the battery pack:

1. Ensure the correct plug is installed on the line cord of the battery charger.
2. Plug the charger into the jack located on the front of the battery pack.
3. Plug the charger into an AC outlet. The LED, on the battery pack indicates the charge state. Red indicates the battery is being charged. Green indicates the battery is fully charged and ready for use. It is normal for a fully charged battery to indicate it is charging (red light) when first plugged in. The LED will turn green as the battery charges.
4. When the battery pack is charged remove the charger, first from the wall outlet then from the battery pack.

Charging a fully discharged battery pack will take approximately 8 hours. Leaving the charger connected to a charged battery pack will not harm the battery or the charger in any way. If a battery pack is to be left indefinitely, leave it connected to the charger so that it will be fully charged and ready for operation.

### 5.5.2 Emptying the Hydrogen Cylinder

When you transport the MicroFID, you should empty the internal hydrogen cylinder and then refill it when you arrive at your destination.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 12 of 20
	Revision 1	Effective Date 06/99

To empty the cylinder:

1. Take the instrument outdoors, or to a well-ventilated area, at least 25 feet from any potential sources of ignition.
2. Turn the MicroFID off and open the hydrogen shut-off valve.
3. Remove the battery pack as described above.
4. Locate the purge outlet. It is located on the underside of the instrument.
5. Use the MicroFID multi-tool to turn the screws counterclockwise. Loosen the screw but do not remove it.
6. Leave the instrument so that the purge outlet is facing up. If the purge outlet is facing down, hydrogen will vent into MicroFID's case.
7. If the cylinder is full, it will take approximately 15 minutes to empty.
8. Watch the Contents gauge. When the cylinder is empty, close the purge outlet. Use the MicroFID multi-tool to turn the screw clockwise.
9. Replace the battery pack as discussed above.

### 5.5.3 Replacing the Sample Inlet Filter

MicroFID is equipped with a combined dust and water filter to reduce detector contamination. As the filter collects dust, MicroFID's inlet flow rate and sensitivity decrease. The filter will not allow water to pass through, but the filter will not stop gases and vapors.

Replace the filter on a weekly basis, or more frequently if MicroFID is used in a dusty or wet environment. You must replace the filter if MicroFID has been exposed to liquid water. The pump will sound labored when the filter requires replacement.

1. Turn off the instrument and unscrew the filter housing from the detector housing. Be careful not to lose the o-ring seal.
2. Remove the Teflon/Polypropylene filter and install the new filter. Place the filter in the filter housing with the Teflon side facing down into the filter housing and the mesh side facing the MicroFID. Handle the filter disk only by the edges. The mesh may be damaged or contaminated by excessive handling. Use forceps if possible.
3. Replace the filter housing.
4. Calibrate the CAL Memories that you are using before continuing operation.

### 5.6 Troubleshooting

This section provides guidance for troubleshooting the MicroFID. If problems are not corrected through these troubleshooting methods, contact the Photovac Service Department.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 13 of 20
	Revision 1	Effective Date 06/99

### 5.6.1 MicroFID Fault Messages

When the "Check" status is displayed, MicroFID's operation is compromised. Press the <TUTOR> key for a two-line description of the fault. One exception is the flame out fault. When a flame out fault occurs, the instrument status changes to "NoFlm."

**Fault:** Detector flame has gone out.

**Cause:** The hydrogen gas has run out.

**Action:** Ensure the shut-off valve is open. Check the hydrogen contents gauge on the side of the instrument and refill the hydrogen cylinder if necessary. Ensure the cylinder purge outlet has been closed.

**Cause:** Oxygen supply is deficient (Note: This is a Level B PPE condition).

**Action:** Ensure there is an adequate supply of oxygen. If you are sampling very high concentrations it is possible you are sampling above the flame out concentration. The flame out concentration for methane is approximately 52,000 ppm (5.2 percent methane in air).

A minimum of 17 percent oxygen is required to start the hydrogen flame. The oxygen is supplied from the sample as it is drawn in by the pump. A minimum of 10 percent oxygen is required to maintain the hydrogen flame.

Flame out also may occur when sampling enclosed or confined spaces where vapors and gases cannot escape. Watch for indications of increased flame height such as erratic readings or sudden high concentrations followed by a flame out fault.

If you will be using the MicroFID in a highly contaminated area where it is possible that the oxygen content will fall below 10 percent, watch for indication of reduced flame height such as lowered detection limits or a flame out fault.

**Cause:** High concentrations of flammable gases (gases within their flammable range) are present. High concentrations of flammable gases can act as an additional fuel source. When this happens, the flame height may increase beyond the confines of the combustion chamber. The hydrogen supply will then be cut-off and the flame will go out. Monitor LEL conditions and observe action levels specified in the Health and Safety Plan.

**Action:** Move to a location where there is an adequate supply of air and restart the flame. See the information above. Watch for indications of increased flame height such as erratic readings or sudden height concentrations followed by a flame out fault.

**Cause:** Exhaust port is blocked.

**Action:** At low temperatures, water vapor, a by-product of the hydrogen flame, may condense at the exhaust port. At sub-zero temperatures the water will freeze and obstruct the exhaust port. If the exhaust port becomes obstructed, pump operation will be inhibited. Flame out may also result. Operate the MicroFID within the operating temperature range 41 to 105 degrees Fahrenheit. In the event that the flame arrestor becomes clogged, contact the Photovac Service Department.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 14 of 20
	Revision 1	Effective Date 06/99

**Cause:** Sample line is blocked.

**Action:** Ensure the sample line is not obstructed in any way. If you are using the long sample probe, ensure flow is maintained through the entire length of tubing.

**Cause:** Inlet filter is plugged.

**Action:** Replace the inlet filter.

**Fault: Signal from zero gas is too high.**

**Cause:** Contamination of sample line or fittings before the detector.

**Action:** Clean or replace the sample line of the inlet filter.

**Cause:** Span gas is used instead of zero gas.

**Action:** Ensure clean gas is used to zero the MicroFID. Mark the calibration and zero gas Tedlar bags clearly.

**Cause:** Ambient air is contaminated.

**Action:** If you are unsure about the quality of the ambient air, use a charcoal filter or a supply of commercial zero grade air.

**Cause:** Hydrogen supply is contaminated.

**Action:** Hydrogen may react with the carbon element of the steel tank to produce methane. This will only occur if the cylinder is in poor condition and if the hydrogen has a high moisture content. Replace the hydrogen tank. Empty and refill the MicroFID internal cylinder with fresh hydrogen.

**Fault: Signal from the calibration gas is too small**

**Cause:** Calibration gas and zero air are switched.

**Action:** Ensure calibration gas is used to calibrate the MicroFID. Mark the calibration and zero gas Tedlar bags clearly. Ensure the calibration gas is of a reliable concentration.

**Fault: Detector field voltage is low.**

**Cause:** Internal fault in electronics.

**Action:** Contact the Photovac Service Department.

**Problem: No instrument response detected, yet compounds are known to be present.**

**Cause:** MicroFID has not been calibrated properly.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 15 of 20
	Revision 1	Effective Date 06/99

**Action:** Ensure calibration gas is of a reliable concentration and then calibrate the instrument. After the instrument has been calibrated, sample the Tedlar bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the Photovac Service Department.

**Action:** When calibrating the MicroFID, ensure the instrument is level. If the MicroFID is tilted side to side, gravity can affect the flame height and cause erroneous readings. If the sampling location is difficult to reach without tilting the instrument, use the long sample probe.

**Cause:** Background contamination from the hydrogen.

**Action:** It is possible that the hydrogen has become contaminated and is contributing a high background signal. If the hydrogen supply tank is more than 6 months old it should be replaced with a new cylinder. When ordering hydrogen, specify ultra-high purity (99.999 percent pure). Empty the MicroFID hydrogen cylinder (as described in Section 5.5.2 of this SOP) and then refill with hydrogen from the new cylinder.

**Problem:      Date and time settings are not retained.**

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

**Action:** Turn MicroFID on and allow it to run until a "LoBat" status appears. This will take approximately 15 hours. Remove the battery pack and recharge it overnight. Repeat this procedure for 3 or 4 days. While MicroFID is running the internal battery is charging.

**Problem:      Cannot fill the internal hydrogen cylinder to 1800 psi.**

**Cause:** Supply tank has less than 1800 psi of pressure. You can only fill the internal cylinder to a pressure of less than or equal to the tank pressure.

**Action:** Fill the internal cylinder to the pressure of the tank or replace the tank with a full one.

**Cause:** The hydrogen purge outlet is open.

**Action:** Close the outlet and fill the cylinder.

**Cause:** There is a problem with the refill adapter.

**Action:** Contact the Photovac Service Department

**Problem:      Instrument status shows "Over."**

**Cause:** Rapid change in signal level. The detector electronics have been momentarily saturated.

**Action:** Wait a few seconds for the status to return to "Ready."

**Cause:** The detector has become saturated.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 16 of 20
	Revision 1	Effective Date 06/99

**Action:** Move the MicroFID to a location where it can sample clean air. Sample zero air until the reading stabilizes around "0." If you were using Low Range, switch to High Range. Calibrate the CAL Memory you were using when the "Over" status appeared.

**Problem:** Display contrast bars are on or display is blank.

**Cause:** Battery pack is critically low.

**Action:** Recharge the battery pack or connect the MicroFID to the battery charger.

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

**Action:** Ensure the battery pack has been aligned correctly. Ensure the battery pack is secured by the retainer at the rear of the instrument.

**Problem:** Sample flow rate varies from 600 ml/min. +/-10 percent.

**Cause:** Inlet filter has not been installed.

**Action:** Install an inlet filter.

**Cause:** Inlet filter has not been properly tightened onto the detector cap.

**Action:** Finger-tighten the filter cap.

**Cause:** Inlet filter is plugged.

**Action:** Replace the inlet filter.

**Cause:** Pump has been damaged.

**Action:** Contact the Photovac Service Department

**Cause:** Exhaust port is blocked.

**Action:** At low temperatures, water vapor (a by-product of the hydrogen flame) may condense at the exhaust port. At sub-zero temperatures the water will freeze and obstruct the exhaust port. If the exhaust port becomes obstructed, pump operation will be inhibited. Flame out may also result. Operate the MicroFID within the operating temperature range 41 to 105 degrees Fahrenheit. In the event that the flame arrestor becomes clogged, contact the Photovac Service Department.

**Problem:** Flame will not ignite.

**Cause:** The hydrogen gas has run out.

**Action:** Ensure the shut-off valve is open. Check the hydrogen contents gauge on the side of the instrument and refill the hydrogen cylinder if necessary. Ensure the hydrogen purge outlet is closed.

**Cause:** Oxygen supply is deficient.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 17 of 20
	Revision 1	Effective Date 06/99

**Action:** Ensure there is an adequate supply of oxygen. Do not attempt to ignite the flame in a location where there is the suspicion of encountering greater than 10,000 ppm methane or the equivalent concentration of a flammable gas. Move to a location where there are lower concentrations, start the flame and then begin sampling higher concentrations. Monitor for LEL conditions, following action levels specified in the Health and Safety Plan. If the flame goes out while you are sampling very high concentrations, it is possible you are sampling above the flame out concentration. The flame out concentration of methane is approximately 52,000 ppm (5.2 percent methane in air). A minimum of 17 percent oxygen is required to start the hydrogen flame. Oxygen is supplied from the sample as it is drawn in by the pump. A minimum of 10 percent oxygen is required to maintain the hydrogen flame.

**Cause:** Exhaust port is blocked.

**Action:** At low temperatures, water vapor (a by-product of the hydrogen flame) may condense at the exhaust port. At sub-zero temperatures the water will freeze and obstruct the exhaust port. If the exhaust port becomes obstructed, pump operation will be inhibited. Flame out may also result. Operate the MicroFID within the operating temperature range 41 to 105 degrees Fahrenheit. In the event that the flame arrestor becomes clogged, contact the Photovac Service Department.

**Cause:** Hydrogen supply lines are full of air.

**Action:** If MicroFID has not been operated for some time, it is possible that the hydrogen supply lines contain air. Fill the hydrogen cylinder and then open the hydrogen shut-off valve. Allow the hydrogen to purge the system for about 5 minutes and then turn MicroFID on and start the flame.

**Cause:** Hydrogen lines are blocked.

**Action:** Contact the Photovac Service Department.

**Problem:** Liquid has been aspirated.

**Cause:** MicroFID has been exposed to a solvent that can pass through the Teflon/Polypropylene filter.

**Action:** Contact the Photovac Service Department.

#### 5.7 Transporting MicroFID

When you transport MicroFID, you should empty the internal hydrogen cylinder and then refill it when you arrive at your destination (see Section 5.5.2 of this SOP). If you are traveling by passenger aircraft, you **must** empty the hydrogen cylinder. You cannot transport MicroFID by passenger aircraft with hydrogen in the cylinder.

The MicroFID can be shipped to sites. However, if shipment is to be performed while the cylinder still contains hydrogen, a Hazardous Materials Airbill must be filled out and the package must be properly marked and labeled. Examples of various completed forms are provided as Figures 6-1 and 6-2.

Subject PHOTOVAC MICROFID HANDHELD FLAME IONIZATION DETECTOR	Number ME-15	Page 18 of 20
	Revision 1	Effective Date 06/99

## 6.0 SHIPPING

The Photovac may be shipped as cargo or carried on as luggage providing there is no hydrogen fuel source or calibration gas cylinder accompanying the kit. **Only personnel who have been properly trained are permitted to offer a hazardous material for shipment.** The "Shipping Hazardous Materials" course offered by Tetra Tech NUS is considered acceptable training for this purpose. Specific instructions on packaging, labeling, and otherwise preparing a hazardous material shipment are presented in the Student Manual that accompanies the course. If shipping or transporting the hydrogen fuel source, a Hazardous Materials (or Dangerous Goods) Airbill such as the example in Figure 6-1 must be completed. When shipping or transporting the calibration gas, a separate Airbill (such as the one illustrated in Figure 6-2) must be prepared.

## 7.0 REFERENCES

MicroFID Handheld Flame Ionization Detector User's Manual, 1995.

Student Manual from "Shipping Hazardous Materials" course, Tetra Tech NUS, 1999.

FIGURE 6-1

EXAMPLE HAZARDOUS AIRBILL FOR HYDROGEN

**FedEx** *Dangerous Goods*  
2887300  
7180827

**Sender's Copy**  
RETAIN FOR 1 YEAR  
RETAIN THIS COPY FOR YOUR RECORDS

*The World On Time.*

Service Conditions, Declared Value, and Limit of Liability - By using this Airbill, you agree to the service conditions in our current Service Guide or U.S. Government Service Guide. Both are available on request. SEE BACK OF SENDER'S COPY OF THIS AIRBILL FOR INFORMATION AND ADDITIONAL TERMS. We will not be responsible for any claim in excess of \$100 per package unless the manifest, invoice, or other document reflects a higher value, and you agree to pay an additional charge, and document your actual loss in a timely manner. Your right to recover from us for any loss includes actual value of the package, loss of sales, interest, profit, attorney's fees, costs, litigation costs of damage, whether direct, indirect, consequential, or special, and is limited to the greater of \$100 or the declared value but cannot exceed actual declared value. The maximum declared value for any FedEx Letter and FedEx Air is \$500. Federal Government may require receipt, and with some exceptions, refund all transportation charges paid.

See the FedEx Service Guide for further details.

---

**1 From (please print and press hard)**

Date \_\_\_\_\_ Sender's FedEx Account Number \_\_\_\_\_

Sender's Name \_\_\_\_\_ Phone (\_\_\_\_) \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_ Dept./Floor/Suite/Room \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

**2 Your Internal Billing Reference Information**  
(Optional) (First 20 characters will appear on invoice)

**3 To (please print and press hard)**

Recipient's Name **TBM PATTON** Phone **(412) 262 4583**

Company **TETRA TECH NUS**

Address **SPRING RUN RD EXT STE 140 B 1**  Check here if residence (For those using FedEx Express Service)

City **CORAOPOLIS** State **PA** ZIP **15108**

**4a Express Package Service Packages under 100 lbs.**

Hold Overnight (Next business morning)  FedEx Standard Overnight (Next business afternoon)

FedEx 2Day (Second business day)  FedEx Express Saver (Third business day)

**4b Express Freight Service Packages over 150 lbs.**

FedEx Overnight Freight (Next business day)  FedEx 2Day Freight (Second business day)  FedEx Express Saver Freight (Up to 3 business days)

(Call for delivery schedule. Service restrictions apply. See back for detailed descriptions of freight services.)

**5 Packaging**

Other Packaging  
Dangerous Goods cannot be shipped in FedEx packaging.

**6 Special Handling**

Dangerous Goods as per attached Shipper's Declaration  Cargo Aircraft Only

**7 Payment**

Bill to:  Sender (Account No. to be printed)  Recipient  Third Party  Credit Card  Cash/Check

FedEx Account No. \_\_\_\_\_

Credit Card No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

Total Packages \_\_\_\_\_ Total Weight \_\_\_\_\_ Total Declared Value \$ \_\_\_\_\_ Total Charges \$ \_\_\_\_\_

Signature Release Unavailable PART #15191 - Rev. Date 4/98 0199-36 FedEx - PRINTED IN U.S.A.

FedEx Tracking Number **807286973876** Firm I.D. No. **0204** 355

---

Page 1 of 1 Pages

**TRANSPORT DETAILS**

This shipment is within the limitations prescribed here (where applicable):

PASSENGER AIRCRAFT ONLY  CARGO AIRCRAFT ONLY

Airport of Departure: \_\_\_\_\_

Airport of Destination: \_\_\_\_\_

**WARNING**

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

Shipment type: (Select non-applicable)

NON-RADIOACTIVE  RADIOACTIVE  OTHER

---

NATURE AND QUANTITY OF DANGEROUS GOODS						Quantity and Type of Packaging	Packing Inst.	Authorization
Dangerous Goods Identification								
Proper Shipping Name	Class or Division	UN or I.D. No.	Packing Group	Subsidiary Risk				
Hydrogen Compressed	2.1	UN 1049			1 Plastic Box 1.0 Kg	200		
Additional Handling Information								

Prepared for AIR TRANSPORT according to: (Customer MUST check one)

49 CFR  ICAO/IATA

---

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked, and labeled/placarded, and are in all respects in proper condition for transport according to applicable International and national governmental regulations.

Emergency Telephone Number (Regional for US Origin or Destination Shipments)  
**1-800-535-5053 InforTrac**

Name/Title of Signatory \_\_\_\_\_  
Place and Date \_\_\_\_\_  
Signature (see warning above) \_\_\_\_\_

---

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.

Subject  
**PHOTOVAC MICROFID HANDHELD  
 FLAME IONIZATION DETECTOR**

Number  
**ME-15**

Revision  
**1**

Page  
**20 of 20**

Effective Date  
**06/99**

**FIGURE 6-2**

**EXAMPLE HAZARDOUS AIRBILL FOR METHANE IN AIR**

**FedEx** 67300  
**7181180**

**Dangerous Goods  
 Airbill**

**Sender's Copy**  
 RETAIN FOR 1 YEAR  
 RETAIN THIS COPY FOR YOUR RECORDS

*The World On Time*

---

**1 From (please print and press hard)**

Date \_\_\_\_\_ Sender's FedEx Account Number \_\_\_\_\_

Sender's Name \_\_\_\_\_ Phone (\_\_\_\_) \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_ Dept./Floor/Suite/Room \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

**2 Your Internal Billing Reference Information**  
 (Optional; first 24 characters will appear on invoice)

\_\_\_\_\_

**3 To (please print and press hard)**

Recipient's Name **Tom Patton** Phone **(412) 262-4583**

Company **Tetra Tech NUS**

Address **Spring Run Road Extension, Suite 140** Dept./Floor/Suite/Room \_\_\_\_\_  
(We Cannot Deliver to P.O. Boxes or P.O. ZIP Codes)

City **Coraopolis** State **PA** ZIP **15108**

**4a Express Package Service Packages under 150 lbs.**

FedEx Priority Overnight (Next business morning)  FedEx Standard Overnight (Next business day)

FedEx 2Day (Second business day)  FedEx Express Saver (Third business day)

**4b Express Freight Service Packages over 150 lbs.**

FedEx Overnight Freight (Next business day)  FedEx 2Day Freight (Two business days)

FedEx Express Saver Freight (Three business days)

(Call for delivery schedule. Some restrictions apply. See back for detailed descriptions of freight services.)

**5 Packaging**

Other Packaging  
Dangerous Goods cannot be shipped in FedEx packaging.

**6 Special Handling**

Dangerous Goods as per attached Shipper's Declaration  Cargo Aircraft Only

**7 Payment**

BIN/EC  Sender (Account No. is required if bill to be billed)  Recipient  Third Party  Credit Card  Cash/Check

FedEx Account No. \_\_\_\_\_

Credit Card No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

Total Packages \_\_\_\_\_ Total Weight \_\_\_\_\_ Total Declared Value \$ **.00** Total Charges \_\_\_\_\_

**Signature Release Unavailable** PART 154231 Rev. Date 4/99 01/94-99 FedEx • PRINTED IN U.S.A.

FedEx Tracking Number **807286974806** Form I.D. No. **0204**

---

Page **1** of **1** Pages

**TRANSPORT DETAILS**

This shipment is within the limitations prescribed for:

(Select one - applicable)

PASSENGER AND CARGO AIRCRAFT  AIRCRAFT ONLY

Alport of Departure: \_\_\_\_\_

Alport of Destination: \_\_\_\_\_

**WARNING**

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

Shipment type: (select non-applicable)

NON-RADIOACTIVE  RADIOACTIVE

---

DANGEROUS GOODS IDENTIFICATION					Quantity and Type of Packaging	Packing Inst.	Authorization
Proper Shipping Name	Class of Division	UN of I.D. No.	Packing Group	Subsidiary Risk			
Compressed Gas N.O.S. (mixture Nitrogen and Oxygen)	2.2	UN 1956			1 Plastic box x 0.56 Kg	200	

---

Additional Handling Information \_\_\_\_\_

Prepared for AIR TRANSPORT according to:  
 (Customer MUST check one)  
 49 CFR  ICAO / IATA

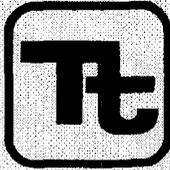
---

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked, and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Emergency Telephone Number (Required for US Origin or Destination Shipments) **1-800-535-5053 InfoTRAC**

Name/Title of Signatory \_\_\_\_\_  
 Place and Date \_\_\_\_\_  
 Signature (Date warning above) \_\_\_\_\_

**IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.**



TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

Number	HS-1.0	Page	1 of 15
Effective Date	12/03	Revision	2
Applicability	Tetra Tech NUS, Inc.		
Prepared	Health & Safety		
Approved	D. Senovich <i>DS</i>		

Subject  
UTILITY LOCATING AND EXCAVATION CLEARANCE

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
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
 <u>ATTACHMENTS</u>	
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

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 2 of 15
	Revision 2	Effective Date 12/03

## 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.

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 3 of 15
	Revision 2	Effective Date 12/03

#### 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 TiNUS 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 scars and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information regarding utility

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 4 of 15
	Revision 2	Effective Date 12/03

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.

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 5 of 15
	Revision 2	Effective Date 12/03

## 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 through conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

<u>Nominal Voltage</u>	<u>Minimum Clearance</u>
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 TiNUS SOPs included in the References (Section 8.0).

#### **Electromagnetic Induction**

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is an EM-61.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

Subject <b>UTILITY LOCATING AND EXCAVATION CLEARANCE</b>	Number HS-1.0	Page 6 of 15
	Revision 2	Effective Date 12/03

### **Magnetics**

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

### **Ground Penetrating Radar**

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

## **6.2 Passive Detection Surveys**

### **Acoustic Surveys**

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

### **Thermal Imaging**

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

## **6.3 Intrusive Detection Surveys**

### **Vacuum Excavation**

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 7 of 15
	Revision 2	Effective Date 12/03

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.

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 8 of 15
	Revision 2	Effective Date 12/03

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

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 9 of 15
	Revision 2	Effective Date 12/03

**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**

- |  |   |  |
|--|---|--|
| <p><b>Alabama</b><br/>Alabama One-Call<br/>1-800-292-8525</p> <p><b>Alaska</b><br/>Locate Call Center of Alaska, Inc.<br/>1-800-478-3121</p> <p><b>Arizona</b><br/>Arizona Blue Stake<br/>1-800-782-5348</p> <p><b>Arkansas</b><br/>Arkansas One Call System, Inc.<br/>1-800-482-8998</p> <p><b>California</b><br/>Underground Service Alert North<br/>1-800-227-2600<br/>Underground Service Alert of Southern<br/>California<br/>1-800-227-2600</p> <p><b>Colorado</b><br/>Utility Notification Center of Colorado<br/>1-800-922-1987</p> <p><b>Connecticut</b><br/>Call Before You Dig<br/>1-800-922-4456</p> <p><b>Delaware</b><br/>Miss Utility of Delmarva<br/>1-800-282-8555</p> <p><b>Florida</b><br/>Sunshine State One-Call of Florida, Inc.<br/>1-800-432-4770</p> <p><b>Georgia</b><br/>Underground Protection Center, Inc.<br/>1-800-282-7411</p> <p><b>Hawaii</b><br/>Underground Service Alert North<br/>1-800-227-2600</p> <p><b>Idaho</b><br/>Dig Line Inc.<br/>1-800-342-1585<br/>Kootenai County One-Call<br/>1-800-428-4950<br/>Shoshone - Benewah One-Call<br/>1-800-396-3285</p> <p><b>Illinois</b><br/>JULIE, Inc.<br/>1-800-892-0123<br/>Digger (Chicago Utility Alert Network)<br/>312-744-7000</p> <p><b>Indiana</b><br/>Indiana Underground Plant Protection<br/>Service<br/>1-800-382-5544</p> | <p><b>Iowa</b><br/>Iowa One-Call<br/>1-800-292-8989</p> <p><b>Kansas</b><br/>Kansas One-Call System, Inc.<br/>1-800-344-7233</p> <p><b>Kentucky</b><br/>Kentucky Underground Protection Inc.<br/>1-600-752-6007</p> <p><b>Louisiana</b><br/>Louisiana One Call System, Inc.<br/>1-600-272-3020</p> <p><b>Maine</b><br/>Dig Safe System, Inc.<br/>1-888-344-7233</p> <p><b>Maryland</b><br/>Miss Utility<br/>1-800-257-7777<br/>Miss Utility of Delmarva<br/>1-800-282-8555</p> <p><b>Massachusetts</b><br/>Dig Safe System, Inc.<br/>1-888-344-7233</p> <p><b>Michigan</b><br/>Miss Dig System, Inc.<br/>1-800-482-7171</p> <p><b>Minnesota</b><br/>Gopher State One Call<br/>1-800-252-1166</p> <p><b>Mississippi</b><br/>Mississippi One-Call System, Inc.<br/>1-800-227-6477</p> <p><b>Missouri</b><br/>Missouri One-Call System, Inc.<br/>1-800-344-7483</p> <p><b>Montana</b><br/>Utilities Underground Protection Center<br/>1-800-424-5555<br/>Montana One Call Center<br/>1-800-551-8344</p> <p><b>Nebraska</b><br/>Diggers Hotline of Nebraska<br/>1-800-331-5688</p> <p><b>Nevada</b><br/>Underground Service Alert North<br/>1-800-227-2600</p> <p><b>New Hampshire</b><br/>Dig Safe System, Inc.<br/>1-888-344-7233</p> | <p><b>New Jersey</b><br/>New Jersey One Call<br/>1-800-272-1000</p> <p><b>New Mexico</b><br/>New Mexico One Call System, Inc.<br/>1-800-321-2537<br/>Las Cruces- Dona Ana Blue Stakes<br/>1-888-526-0400</p> <p><b>New York</b><br/>Dig Safely New York<br/>1-800-962-7962<br/>New York City- Long Island One Call<br/>Center<br/>1-800-272-4480</p> <p><b>North Carolina</b><br/>The North Carolina One-Call Center,<br/>Inc.<br/>1-800-632-4949</p> <p><b>North Dakota</b><br/>North Dakota One-Call<br/>1-800-795-0555</p> <p><b>Ohio</b><br/>Ohio Utilities Protection Service<br/>1-800-362-2764<br/>Oil &amp; Gas Producers Underground<br/>Protect'n Svc<br/>1-800-925-0988</p> <p><b>Oklahoma</b><br/>Call Okie<br/>1-800-522-6543</p> <p><b>Oregon</b><br/>Oregon Utility Notification Center/One<br/>Call Concepts<br/>1-800-332-2344</p> <p><b>Pennsylvania</b><br/>Pennsylvania One Call System, Inc.<br/>1-800-242-1776</p> <p><b>Rhode Island</b><br/>Dig Safe System, Inc.<br/>1-888-344-7233</p> <p><b>South Carolina</b><br/>Palmetto Utility Protection Service Inc.<br/>1-888-721-7877</p> <p><b>South Dakota</b><br/>South Dakota One Call<br/>1-800-781-7474</p> <p><b>Tennessee</b><br/>Tennessee One-Call System, Inc.<br/>1-800-351-1111</p> |
|--|---|--|

Subject <b>UTILITY LOCATING AND EXCAVATION CLEARANCE</b>	Number HS-1.0	Page 10 of 15
	Revision 2	Effective Date 12/03

**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  
1-800-682-4111

**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  
1-800-474-6888

**Ontario**

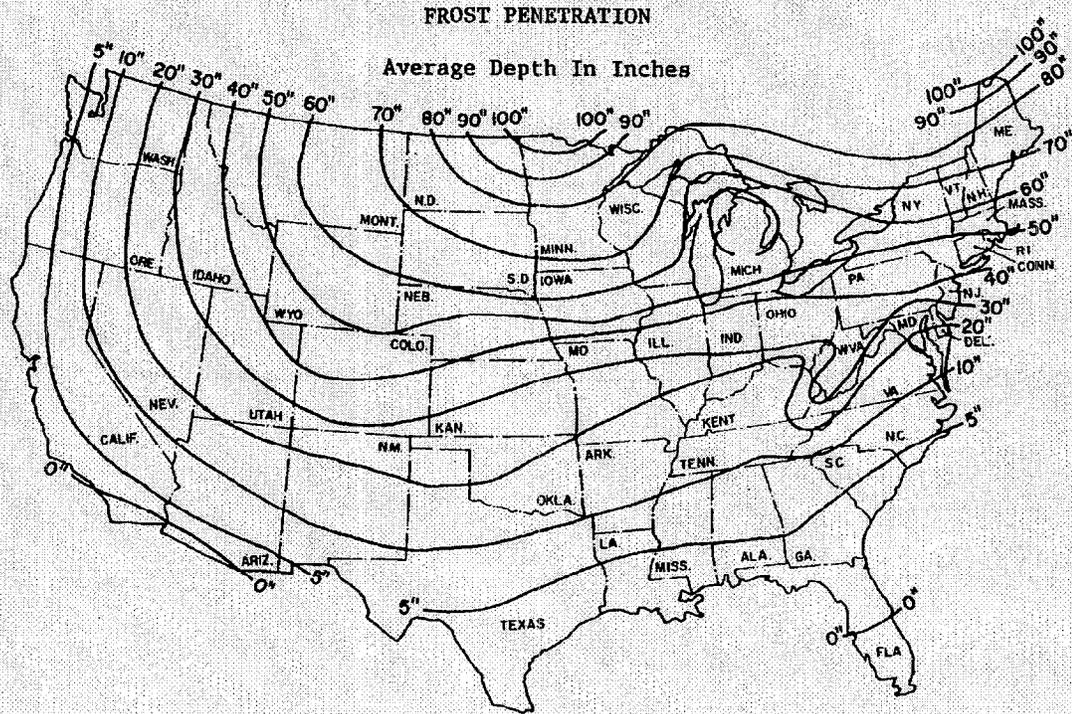
Ontario One-Call System  
1-800-400-2255

**Quebec**

Info-Excavation  
1-800-663-9228

ATTACHMENT 2

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



Courtesy U.S. Department Of Commerce

Subject <b>UTILITY LOCATING AND EXCAVATION CLEARANCE</b>	Number HS-1.0	Page 12 of 15
	Revision 2	Effective Date 12/03

**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 yes no N/A  
 Name \_\_\_\_\_ Telephone: \_\_\_\_\_ Date: \_\_\_\_\_
  - g) State One-Call agency called? yes no N/A  
 Caller: \_\_\_\_\_  
 Ticket Number: \_\_\_\_\_ Date: \_\_\_\_\_
  - h) Geophysical survey performed? yes no N/A  
 Survey performed by: \_\_\_\_\_  
 Method: \_\_\_\_\_ Date: \_\_\_\_\_
  - i) Hand excavation performed (with concurrent use of utility  
 detection device)? yes no N/A  
 Completed by: \_\_\_\_\_  
 Total depth: \_\_\_\_\_ feet Date: \_\_\_\_\_
  - j) Trench/excavation probed? yes no N/A  
 Probing completed by: \_\_\_\_\_  
 Depth/frequency: \_\_\_\_\_ Date: \_\_\_\_\_

2. **Overhead Utilities** Present Absent
- a) Determination of nominal voltage yes no N/A
  - b) Marked on site maps yes no N/A
  - c) Necessary to lockout/insulate/re-route yes no N/A
  - d) Document procedures used to lockout/insulate/re-route yes no N/A
  - e) Minimum acceptable clearance (SOP Section 5.2): \_\_\_\_\_

3. Notes:  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Approval: \_\_\_\_\_  
 Site Manager/Field Operations Leader Date \_\_\_\_\_

c: PM/Project File  
 Program File

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 13 of 15
	Revision 2	Effective Date 12/03

**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:

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 14 of 15
	Revision 2	Effective Date 12/03

#### 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.

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 15 of 15
	Revision 2	Effective Date 12/03

**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>.

## TOTAL VOLATILE ORGANIC COMPOUNDS JAR HEADSPACE SCREENING

The samples will be logged by the rig geologist, and standard headspace analysis will be performed using a flame ionization detector (FID) or photoionization detector (PID) field survey instrument as described below:

1. Half-fill one clean glass jar with the sample to be analyzed. Quickly cover each open jar top with one sheet of clean aluminum foil and subsequently apply the jar screw cap to tightly seal the jar. The jar must have a volume of 8 ounces or greater .
2. Shake the jar vigorously for 15 to 30 seconds and then allow the headspace to equilibrate for at least 10 minutes. When ambient temperatures are below 32 degrees F, the headspace equilibration should occur within a heated vehicle or building.
3. After headspace equilibration, remove the jar lid to expose the foil seal. Quickly puncture the foil seal with the FID probe tip, to a point approximately one-half of the available headspace depth. Exercise care when penetrating the foil seal in order to avoid uptake of water droplets or soil particulates.
4. Following the probe insertion through the foil seal, record the highest meter response as the total VOC headspace concentration. The maximum response should occur between 2 to 5 seconds after the insertion of the probe tip. Longer periods may create a vacuum inside the sample jar. Erratic meter response may occur at high VOC concentrations or conditions of elevated headspace water vapor in which case the headspace data should be considered suspect for that sample.

NOTE: The presence of methane can also interfere with the response of a FID instrument. FIDs have a very sensitive response to methane and which can mistakenly be considered as a high total VOC concentration. If methane is potentially present (e.g., landfill or wetland), a PID instrument may be substituted or used in unison with the FID. The PID instrument does not respond to methane, however high humidity can result in a poor VOC response.

**APPENDIX B**  
**FIELD DOCUMENTATION FORMS**



TETRA TECH NUS, INC.

TEST PIT LOG

Site Name: \_\_\_\_\_ Test Pit No.: \_\_\_\_\_  
 Project Number: \_\_\_\_\_ Date: \_\_\_\_\_  
 Location: \_\_\_\_\_ Field Geologist: \_\_\_\_\_

DEPTH (feet)	LITHOLOGY CHANGE (Depth, feet)	MATERIAL DESCRIPTION (Soil Density/Consistency, Color)	USCS	REMARKS

Test Pit Cross Section and/or Plan View

REMARKS: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

PHOTO LOG: \_\_\_\_\_

TEST PIT: \_\_\_\_\_

PAGE \_\_\_\_\_ OF \_\_\_\_\_





TETRA TECH NUS, INC.

SAMPLE LOG SHEET - LIQUID PHASE

Site Name: \_\_\_\_\_  
Sample ID: \_\_\_\_\_

Tetra Tech NUS Charge No. \_\_\_\_\_  
QC Information: \_\_\_\_\_ (if applicable)

Sample Method/Device: \_\_\_\_\_  
Depth Sampled: \_\_\_\_\_ feet Total Depth \_\_\_\_\_ feet (SW Only)  
Sample Date & Time: \_\_\_\_/\_\_\_\_/\_\_\_\_ \_\_\_\_\_ hours  
Sampler(s): \_\_\_\_\_

Recorded By: \_\_\_\_\_  
Signature

TYPE OF SAMPLE: (Check all that apply)

- Groundwater
- Surface Water
- Residential Supply
- Grab
- Composite
- Trip Blank\*
- Rinsate Blank\*
- Field Duplicate Collected
- Other (Specify): \_\_\_\_\_

\*include sample source & lot No.

WELL PURGE DATA:

Micro Tip/OVA Monitor Reading: \_\_\_\_\_ ppm

Well Depth	feet	Purge Start	hrs
Inside Diameter	Inches	Purge Stop Time	hrs
Water Level	feet	Total Gallons Purged	
Well Volume	gal.	Purge Method	

Sampling/Purge Data:

Vol. #	Temp ? C	pH	Spec. Cond.	DO
0	_____	_____	_____	_____
1	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____

Color: \_\_\_\_\_ Turbidity: CLR/SL CLDY/CLDY/OPAQ

ANALYSIS	BOTTLE LOT NO.	TRAFFIC REPORT NO.		COMMENTS
		ORGANIC	INORGANIC	









TETRA TECH NUS, INC.

# PHOTOIONIZATION DETECTOR FIELD CALIBRATION LOG

Serial No.: \_\_\_\_\_ Model No.: \_\_\_\_\_ Decal No.: \_\_\_\_\_

Site Name/Location: \_\_\_\_\_ Tetra Tech NUS Charge No.: \_\_\_\_\_

CALIBRATION DATE	STANDARD GAS- ISOBUTYLENE	CALIBRATION READING Isobutylene Equiv. (ppm)	CALIBRATION CHECK Isobutylene Equiv. (ppm)	SIGNATURE	COMMENTS
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				

**APPENDIX C**  
**FIELD MODIFICATION FORM**



TETRA TECH NUS, INC.

FIELD MODIFICATION RECORD

Site Name: \_\_\_\_\_ Location: \_\_\_\_\_

Project Number: \_\_\_\_\_ Task Assignment: \_\_\_\_\_

To: \_\_\_\_\_ Location: \_\_\_\_\_ Date: \_\_\_\_\_

Description: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reason for Change: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Recommended Action: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Field Operations Leader (Signature): \_\_\_\_\_ Date: \_\_\_\_\_

Disposition/Action: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Project Manager (Signature): \_\_\_\_\_ Date: \_\_\_\_\_

Distribution: Program Manager: \_\_\_\_\_ Others as Required: \_\_\_\_\_

Project Manager: \_\_\_\_\_

Quality Assurance Officer: \_\_\_\_\_

Field Operations Leader: \_\_\_\_\_

Project File: \_\_\_\_\_