

**SAMPLING AND ANALYSIS PLAN
WOONASQUATUCKET RIVER SEDIMENT
INVESTIGATION**

**CENTREDALE MANOR SITE
NORTH PROVIDENCE, RHODE ISLAND**

RESPONSE ACTION CONTRACT (RAC), REGION I

**For
U.S. Environmental Protection Agency**

**By
Tetra Tech NUS, Inc.**

**EPA Contract No. 68-W6-0045
EPA Work Assignment No. 043-ANLA-016P
TtNUS Project No. N0400**

September 1999



TETRA TECH NUS, INC.



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Tetra Tech NUS, Inc.

RACI
SAMPLING AND ANALYSIS PLAN
CENTREDALE MANOR
NORTH PROVIDENCE, RHODE ISLAND

Number: RI99347	Page 1 of 1
Date: October 1999	Revision: 1
Applicability: Project Specific	
Prepared by: S. Parker	
Approved by: G. D. Gardner, P.E.	

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CENTREDALE MANOR SITE
NORTH PROVIDENCE, RHODE ISLAND

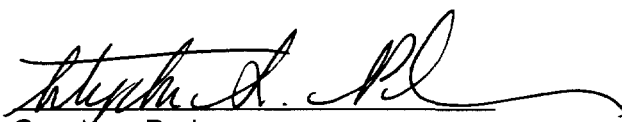
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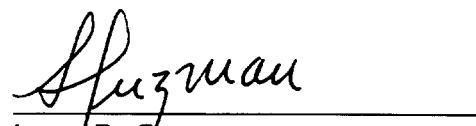
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Stephen Parker
Project Manager


Lucy B. Guzman
Quality Assurance Officer

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REVISED

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1.0 PROJECT INTRODUCTION

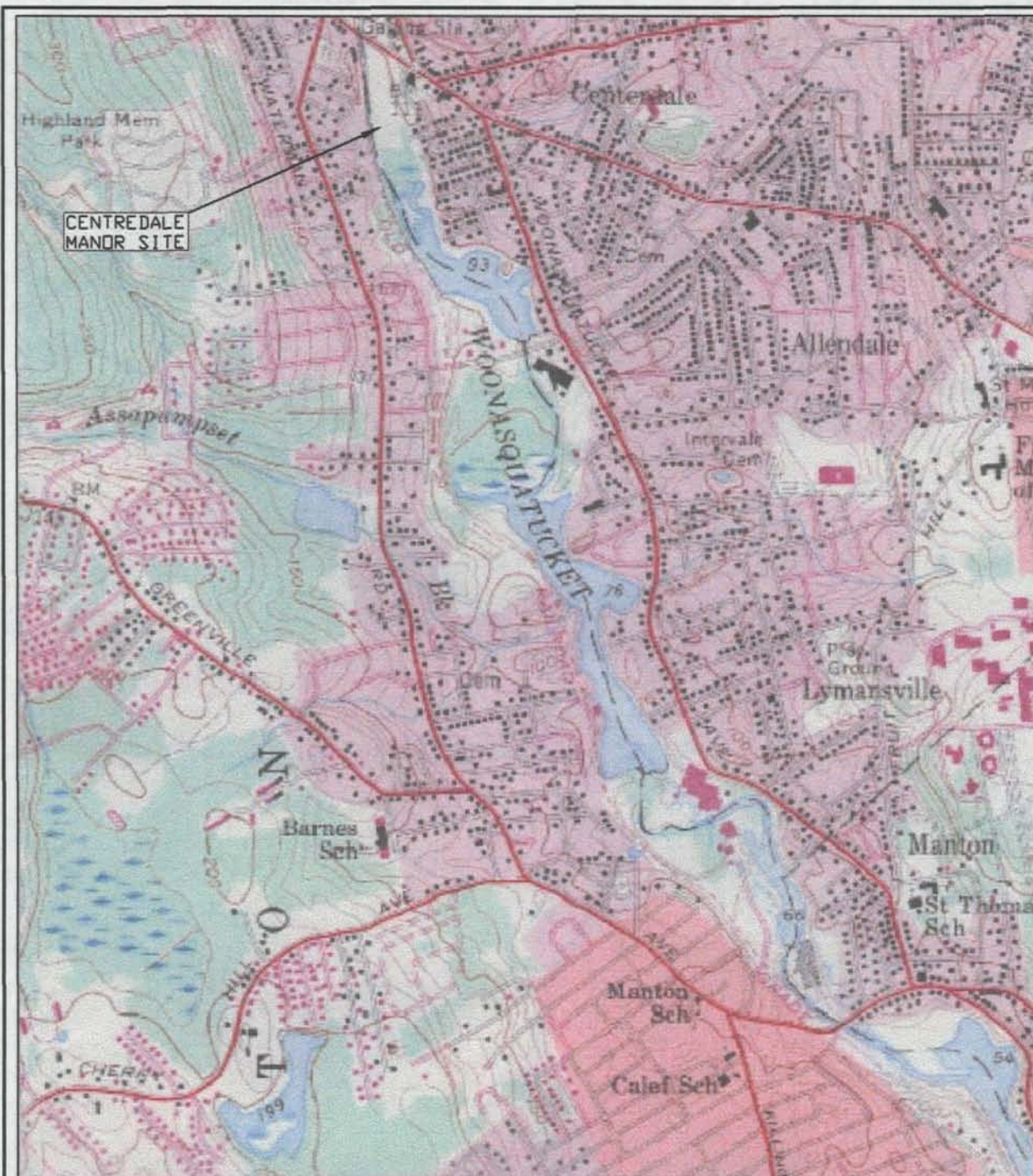
At the request of the U.S. Environmental Protection Agency (EPA), Region I, Tetra Tech NUS, Inc. (TtNUS) will provide Technical Assistance (TA) support for the Centredale Manor Site located in North Providence, Rhode Island. This work is authorized under Work Assignment Number 043-ANLA-016P, Contract No. 68-W6-0045.

The scope of work for this technical assistance involves collection and analysis of sediment, soil, and surface water samples from five specific areas within and adjacent to the Woonasquatucket River. The samples will be collected adjacent to and downstream of the Centredale Manor Site where dioxin, polychlorinated biphenyls (PCBs), metals, and other contaminants have been detected. The data generated by this work will be used for ecological and human health risk assessment and other engineering evaluations. The scope also includes collection and compilation of analytical data generated by previous investigations into a database for future evaluation purposes. The Centredale Manor Site and the study area defined for this investigation is depicted in Figure 1-1.

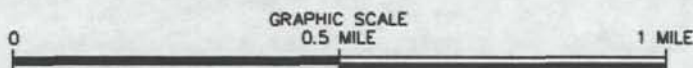
Under this work assignment, TtNUS will be responsible for performing the following activities: mobilizing and demobilizing for field investigations; locating sample sites; collecting and analyzing soils, sediment, and surface water samples, disposing of investigation-derived waste (if necessary), compilation of a database of analytical data from this and previous investigations, and preparation of a Technical Memorandum.

This Sampling and Analysis Plan (SAP) for the Woonasquatucket River Sediment Investigation is divided into three sections as described below.

Section 1.0 describes the site location and history, and other on-going site activities, and provides an overview of the field activities.



BASEMAP: PORTION OF THE FOLLOWING U.S.G.S. QUADRANGLE MAP: PROVIDENCE, RI, 1957, PHOTOREVISED 1970 AND 1975.



SITE LOCUS FIGURE

CENTREDALE MANOR

PROVIDENCE, RHODE ISLAND

FIGURE 1-1



TETRA TECH NUS, INC.

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Section 2.0 presents the Site Management Plan and Field Sampling Plan (plan) as one integrated approach for conducting fieldwork activities. The plan addresses the project organization and responsibilities of personnel engaged in performing field investigation activities; the projected field operations schedule; and site access and security. The plan also provides detailed guidance on how activities will be performed to meet the objectives of the work assignment. This guidance includes sampling and analytical objectives; the number, type, and location of all samples to be collected during the field investigation; detailed procedures for field activities; and data management elements. The plan will be used by TtNUS field personnel as a guide for performing all field activities and analytical procedures according to designated, accepted protocols.

Section 3.0 presents the Quality Assurance Project Plan (QAPP). The QAPP discusses project objectives, and quality assurance/quality control QA/QC protocols to be used to achieve the Data Quality Objectives (DQOs). The QA/QC requirements outline procedures and methodologies to be employed by TtNUS to ensure the technical integrity of analytical data, evaluation procedures, sampling and analytical procedures, and site records.

Appendix A contains the HASP which details site-specific health and safety information, including a hazard assessment, personnel training, site operations monitoring procedures, safe operating procedures, health and safety equipment, disposal procedures, and other health and safety requirements. Appendix B contains the field forms that will be used during the field investigation task. Appendix C contains the completed DQO Summary Forms. Appendix D contains Standard Operating Procedures (SOPs) that will be used during the field investigation task.

1.1 Site Background Information

This SAP is based on EPA Work Assignment Form (WAF) Revision 0 dated July 21, 1999, the associated statement of work, and results of a scoping meeting held between EPA and TtNUS on August 4, 1999. The SAP is also based, in part, on information previously obtained from the study area by EPA during the Woonsocket River Sediment/Water Quality

Analysis (EPA, July 1998). Also from an ESI of the Centredale Manor Site, North Providence, Rhode Island, performed by Roy F. Weston, Inc. (Weston, March 1999), as well as other data collected by the EPA Emergency Response Program.

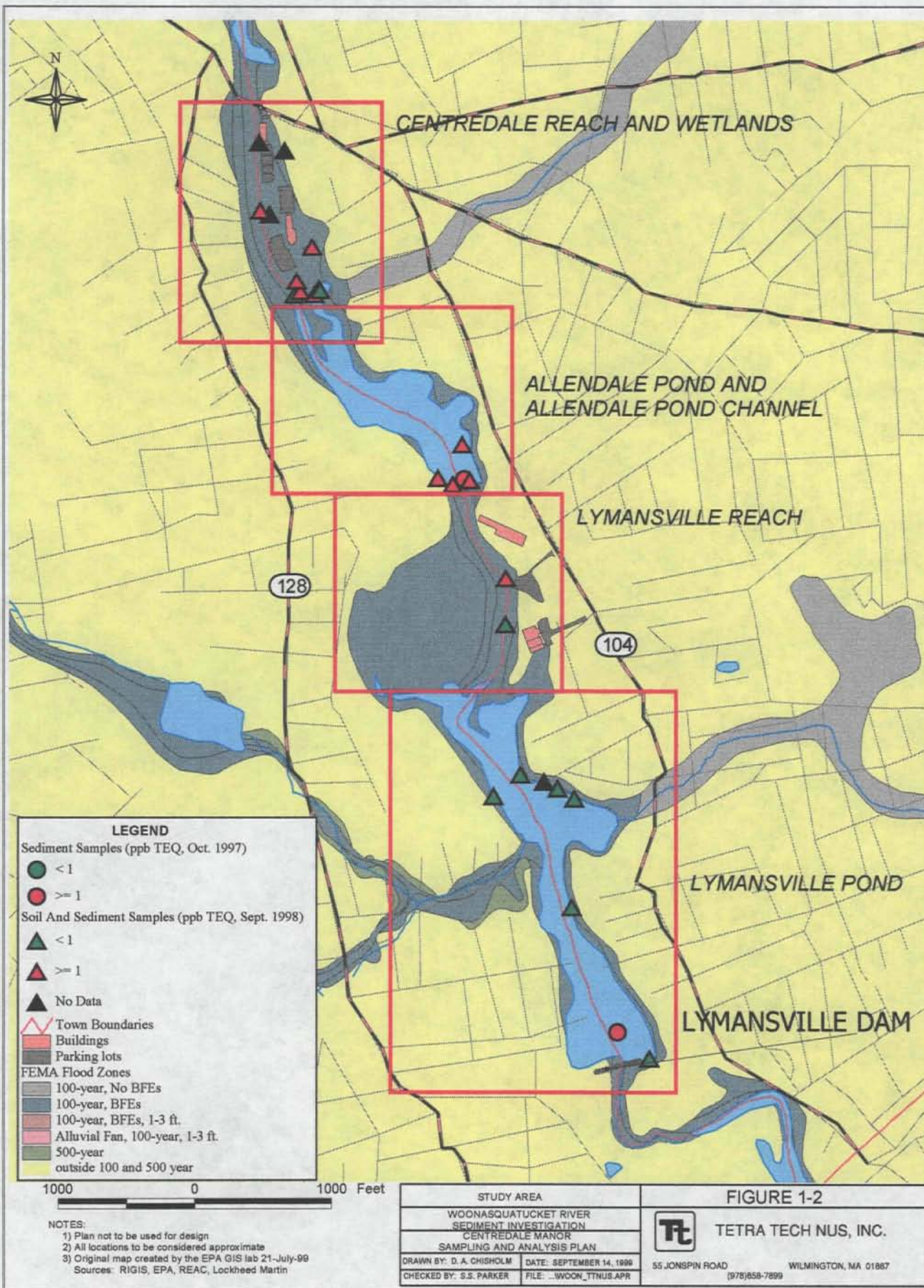
The purpose of this work assignment is to conduct additional sampling in areas that may have been impacted by contaminants released from the former Metro-Atlantic Chemical property and transported and deposited by the waters of the Woonasquatucket River. The goal of the investigation is to identify the extent to which these have contaminated the soils, sediments, and surface water of specific portions of the river. This data will be used to perform human health and ecological risk assessments and engineering evaluations.

The investigation area includes an 1.4-mile section of the Woonasquatucket River located between Smith Street (Route 44) and the Lymanville Dam that is adjacent to, and downstream of, the Centredale Manor Site. Specific areas that will be sampled in this the investigation are identified as follows: the Woonasquatucket River - Centredale Reach, Centredale wetlands, Allendale Pond channel, Allendale Pond bottom (exposed) and the Woonasquatucket River - Lymanville Reach. The location of these areas is depicted in Figure 1-2.

1.1.1 Site Description

This section presents a description of the Centredale Manor Site and the areas within and adjacent to the Woonasquatucket River proposed for sample collection activities.

The Centredale Manor Site is a multi-unit apartment complex that houses elderly and handicapped adults. It is located at 2074 Smith Street (Route 44) in Centredale, a village of North Providence, Rhode Island. Figure 1-1 depicts the location of the site. The Centredale Manor apartment building and the adjacent apartment building known as "Brook Village", are located on the site of the former Metro-Atlantic Chemical Corporation, which operated from the 1940s to the 1970s in a former mill complex on the site. The



Woonasquatucket River follows the west boundary of the site. The remains of a raceway for the former mill complex are present on the eastern boundary of the site.

Historical records of Metro Atlantic Chemical researched by Weston (March 1999) indicate that the site manufactured hexachlorophene and that there were shipments of trichlorophenols to the site. The mill complex was destroyed by fire in the late 1970's and the apartment buildings were constructed in 1982. During construction of the apartment buildings 400 drums and 6,000 cubic yards of contaminated soil were removed from the site. Labels indicated that the drums contained caustics, halogenated solvents, PCBs, and inks.

A study conducted in June 1996 by the EPA Narragansett Laboratories and the Providence Urban Initiative Program (EPA, 1996) determined that elevated levels of dioxin were present in fish collected from the River. A subsequent study of the Woonasquatucket River conducted by the USEPA OEME in June 1998 found elevated concentrations of dioxin and PCBs in sediments in portions of the river and impoundments adjacent to and downstream of Centredale Manor (EPA, July 1998). Soil and sediment sampling conducted by EPA START personnel in September 1998 found dioxin at concentrations up to 10.1 ppb in sediments collected directly behind the Allendale dam that had a water depth of at least 6 feet (Weston, March, 1999). Allendale Pond was an impoundment located immediately downstream of the Centredale Manor Site. The impoundments dam breached in 1991 exposing the sediments. Further sampling conducted in February 1999 on the Centredale Manor property also found elevated concentrations of dioxin in soils and sediment. Additional historical information on the Centredale Manor Site is available in the Expanded Site Inspection Report, prepared by Weston (March, 1999).

1.1.2 Previous Environmental Investigations

CERCLA-related investigations performed on the Centredale Manor Site included a Preliminary Assessment (PA) performed in August 1986 by NUS/FIT (NUS/FIT, August, 1986), a Screening Site investigation (SSI) performed in March 1990 by NUS/FIT

(NUS/FIT, March 1990) and a Site Inspection Prioritization (SIP) performed by Weston in October of 1995 (Weston, 1995). These investigations concluded that soils, sediment, surface water, and groundwater had been impacted by hazardous waste disposal activities at the site. These investigations also identified heavy metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and PCBs in soil and sediment. Dioxin analysis was not performed on samples collected during these investigations.

In May 1996, EPA Narragansett Laboratory and Providence Urban Initiative personnel (EPA, July 1998) collected fish tissue samples from the Woonasquatucket River. This effort is detailed in Section 1.1.2.1.

Two subsequent investigations conducted sampling and analysis of soils and sediments in the vicinity of Centredale Manor. The first investigation was the Woonasquatucket River Sediment/Water Quality Analysis conducted by the OEME performed in July 1998 (OEME, July 1998). The second investigation was an Expanded Site Inspection (ESI) of the Centredale Manor conducted by Weston (Weston, March, 1999). These investigations are summarized in sections 1.1.2.2 and 1.1.2.3, respectively.

1.1.2.1 Human Health Risk Screens

As part of its Urban Initiative Effort, EPA has sought to address the immediate environmental concerns of several New England urban communities. As a result of this effort, EPA has conducted investigations of the sediment and fish of the Woonasquatucket River in Providence, Rhode Island. In May, 1996. The EPA collected and analyzed a limited number of fish samples from two locations on the Woonasquatucket River; Valley Street and Smith Street. The samples were analyzed for 15 contaminants which included metals, PCBs, pesticides and dioxins. Since there was very little data collected, EPA was only able to conduct a risk screen of the potential human health effects resulting from the ingestion of contaminated fish. A risk screen is usually performed when there is limited information about environmental concentrations, (e.g. in fish), or limited information about exposure, (e.g. who fishes in the river, how much fish do they eat, etc). A risk screen

usually results in a conservative estimate of the potential human health risks which could occur.

The risk screen for the Woonasquatucket River evaluated the potential risks to a hypothetical fisherman who would utilize the fish caught from the river as a major food source. It was also assumed that this fisherman would consume the fillet, skin and organs of the fish. Results of the risk screen indicate that this type of exposure would result in a high likelihood of cancer occurring, especially if this activity occurred over a lifetime. In addition, several noncancer effects would be expected to be elevated, such as; adverse effects to the immune and reproductive systems, damage to the liver, kidney, thyroid and adrenal glands, and damage to the brain, kidneys and nervous system of the developing fetus. Although EPA did not evaluate the potential health effects to a fisherman who would consume only the fillet of fish caught on a less frequent basis, there would be a similar concern for adverse cancer and noncancer effects. Based on the EPA's risk screen, the RI Department of Health issued a health advisory in 1996, for the Woonasquatucket River. The health advisory prohibited the ingestion of any fish in the river below the Smithfield Treatment plant.

1.1.2.2 Woonasquatucket River Sediment/Water Quality Analysis – OEME,
July 1998

This investigation involved collection and analysis of sediments, one sediment sample behind each impoundment. The sediment samples were analyzed for dioxin, 1,2,4,5,7,8-hexachloro(9H)xanthene (HCX), polycyclic aromatic hydrocarbons (PAHs), PCBs, pesticides, total organic carbon (TOC), total metals, and acid volatile sulfide/simultaneous extracted metal analysis (AVS/SEM) of copper, zinc, lead, cadmium, nickel, and mercury. Surface water was analyzed for dissolved oxygen, temperature, conductivity and pH. The purpose of the investigation was to determine whether sediments contained equally high contaminant concentrations as had been detected in onsite soils and thus might be a potential source for contamination to fish. One sediment and one surface water samples were collected from each of seven impoundments of the Woonasquatucket River formed by the Esmond,

Allendale, Lymanville, Manton, Dyerville, Olneyville, and the Lonigan dams. The samples were collected in depositional areas of the impoundments that had silt or clay bottoms (sediments in the Allendale Pond impoundments were exposed at the time since the dam had breached in 1991).

Dioxins and HCX were detected at all seven sample locations. The highest dioxin concentrations were detected in the sediments of the Allendale Pond and Lymanville Pond impoundments that are located adjacent to and downstream of the Centredale Manor Site, respectively. Metals were detected at all sites in varying concentrations and frequencies. The greatest cyanide concentrations (in descending order of concentration) were detected at the Esmond, Lymanville, and Allendale Pond impoundments. The highest concentrations of PAHs were detected in the Allendale Pond impoundment. The highest concentrations of PCBs were detected (in descending order of concentration) at the Dyerville, Lymanville, and Allendale dams.

The investigation report concluded that there might be multiple sources for the dioxin detected in the Woonasquatucket River. Distributions of high molecular weight dibenzo-*p*-dioxins (PCDDs) and dibenzofurans (PCDFs) indicate multiple sources associated with the use of pentachlorophenol in the wood preservative and textile industry. The presence of 2,3,7,8-tetrachloro-*p*-dioxin indicated the presence of an additional source between the Esmond and Allendale dams that was involved in the manufacturing of 2,4,5-trichlorophenol and hexachlorophene. Historical records indicate that the former Metro Atlantic Chemical Company received shipments of trichlorophenol and manufactured hexachlorophene at the Centredale Manor Site.

Human health and ecological risk screens were performed using the analytical results of the OEME sediment sample analysis. Constituents of Concern (COCs) identified in the sediment samples included PCBs, PAHs, and dioxins.

The human health risk screen evaluated exposure to an older child and adult, ages 7-31, who might occasionally utilize areas along the river to picnic, wade or walk. This analysis

did not evaluate exposure to a child, (young or older), who might have more frequent exposures to the river, (for instance if a beach or home existed along the river.) The risk screen indicates that adverse health effects from direct contact to sediments in the river during recreational exposures is unlikely for an older child or adult. Risks are expected to be low due to the low frequency of exposure assumed for this type of a scenario, (i.e. visits of 2 days/wk during the summer months of June through August, and 1 day/wk in May, September, and October). This is not the same type of exposure that would occur under a residential setting in which the existing level of contamination would be considered to be a health hazard.

The results of the preliminary ecological risk screening indicated that the greatest risk to the benthic community of acute toxicity from metals in sediment is least likely to be found at those locations sampled with the exception of Dyerville Dam. Furthermore, this does not exclude the threat of chronic effects nor does it exclude impacts from other metals at these locations.

The report indicated that based on exceedances of selected sediment quality guidelines, detrimental impacts to the benthic community from both PAHs and PCBs is possible. There is a stronger probability associated with PAH contamination. Based on equilibrium partitioning and sample specific organic carbon normalization, dioxin at those concentrations detected would not appear to pose an acute risk to the benthic community. Chronic impacts are more likely to occur.

1.1.2.3 Expanded Site Inspection Centredale Manor - Weston, March 1999

The ESI performed by Weston (Weston, March 1999) for the Centredale Manor Site reviewed the history of environmental contamination at the Centredale Manor Site. The report stated that the Site was the former location of the Atlantic Chemical Company and the New England Container, Inc., which was a drum recycling facility. Over 400 drums were identified on the site during the period from 1977 through 1981. Approximately 60 drums were re-located in a wetland adjacent to the Woonasquatucket River and

approximately 150 drums were observed along the bank of the river. Approximately 10 open drums containing sulfuric acid were removed during this period.

During construction of the Centredale Manor apartment complex in 1982, approximately 400 drums and 6,000 yards of contaminated soil were removed from the Site for disposal. Additional suspected buried drums were identified in the western portion of the property during a ground-penetrating radar survey of the Site performed in 1986. A PA performed on the site in August 1986, by NUS/FIT determined that surface water, soil, and sediment at the Site were potentially impacted. Performance of a SSI was recommended. The SSI was performed by NUS/FIT in 1990, and detected elevated concentrations of VOCs, SVOCs, pesticides/PCBs, and metals in 10 soil samples collected from the Site. Weston found additional rusted empty drums on the Site near the Woonasquatucket River in October 1995, while performing a Site Inspection Prioritization (SIP) investigation of the property.

Weston collected nine sediment samples as part of the SIP, including three from the river and six from the wetland area. Analytical results indicated the presence of elevated concentrations of VOCs, SVOCs, and metals at concentrations greater to or equal to three times the reference sample concentrations. No pesticides or PCBs were detected in these samples.

Subsequent discovery of dioxin in fish tissue samples, and the OEME sediment and water quality investigation is discussed in the Section 1.1.2 of this SAP. In response to these findings, START initiated an ESI of the Centredale Manor Site under the direction of EPA. The ESI was initiated in June 1998, to address the presence of dioxin/furan and hexachloroxanthene (HCX) contamination on the Site, the extent of contamination in areas of potential human exposure, and potential source areas located upstream of the Site. This was the first investigation to analyze for the presence of dioxin and HCX on the Centredale Manor Site.

On September 5, 1998 START personnel collected five soil samples from the Centredale Manor Property, one soil sample from the Brook Village property, 35 sediment samples from the Woonasquatucket River, and four sediment samples from the former drainage canal. The soil and sediment samples were analyzed for dioxin, HCH, SVOCs, pesticides/PCBs, and TOC.

Analysis of these samples indicated that 12 SVOCs, 12 pesticides, one PCB (Aroclor 1254), dioxins, and HCH were detected at concentrations exceeding reference values in various sediment samples collected along the Woonasquatucket River downstream of the Centredale Manor property. Five pesticides, one PCB, dioxins, and HCH were detected at concentrations exceeding reference values in the drainage channel and downstream sediment samples.

Dioxin concentrations were highest near the Centredale Manor property and attenuated to less than one part per billion (ppb) at downstream locations. The highest concentration of dioxins was identified along the drainage channel adjacent to the Centredale Manor property. The maximum dioxin concentration detected in the Woonasquatucket River was found in a sample collected from the sediments of Allendale Pond (10.1 ppb). Dioxin concentrations detected in sediment samples collected upstream from the Centredale Manor Site were significantly lower than those collected adjacent to and downstream of the Site.

The greatest number and highest concentration of SVOCs were detected in the sample collected farthest downstream, whereas elevated concentrations of PCBs were detected only in samples collected from Allendale Pond. Two pesticide compounds, one PCB, and various dioxin compounds were detected at concentrations exceeding three times the reference values in sediment samples collected along the Woonasquatucket River upstream of the Centredale Manor property. Seventeen of the SVOCs were detected at the highest concentrations in sample SD-37, which was collected approximately 1.8 miles upstream of the Centredale Manor property. The highest PCB concentration (7,800 ppb) was detected in one sample collected upstream of the Centredale Manor Site.

On January 15, 1999 START personnel collected 17 soil samples from the Centredale Manor and Brook Village properties, the Lee Romano Little league field, and the Boys and Girls club property. The soil samples with the highest dioxin concentration were those collected from the Centredale Manor property, where dioxin concentrations exceeded the 1 ppb action limit for residential properties. A geophysical study was also conducted at this time on the Centredale Manor and Brook Village properties to determine if there were any buried objects that may be contributing to the on-site contamination.

1.1.3 Woonasquatucket River Study Area

Currently, USEPA Emergency and Rapid Response Service Region I (ERRS-I) is conducting an evaluation of the Centredale Manor and Brook Village properties for possible source control actions. Part of this evaluation is an extensive sampling program for soils and sediment from the occupied portions of the Centredale Manor and floodplain wetlands to the south. This sampling action is anticipated to be completed by September 30, 1999.

As described in Section 1.1.2 of this SAP, dioxin and other contaminants may have been transported from the Centredale Manor Site by the Woonasquatucket River and deposited in adjacent and downstream areas. RIDOH placed a consumption advisory on all fish caught from the River due to high dioxin concentrations.

Existing information on downstream contamination is insufficient to adequately characterize the risks to human health and the environment from dioxin, HCX, and other contaminants (metals, PCBs, cyanide, and PAHs) in the rivers sediments, river banks, and adjacent floodplain areas.

Supplemental information on the nature and extent of contamination in river sediments, frequently used river bank areas, and portions of riverside residential properties within the 100-year flood plain is required to conduct a comprehensive evaluation of human health risks associated with deposition of dioxin and other contaminants from the Centredale Manor Site. Additional sampling of sediment and surface water is also necessary to expand information available on the lateral and vertical extent of dioxin and other

contaminants within the river. This information is required to adequately assess ecological risks to benthic and pelagic aquatic communities, associated mammalian and avian piscivores, and human fish consumers.

The purpose of this work assignment is to provide information on contaminant distribution adjacent to and downstream of the Centredale Manor Site to support EPA's assessment of human health and ecological risks associated with contaminants in the sediment of the Woonasquatucket River. The specific areas selected for sample collection and analysis include areas of the Woonasquatucket River and associated wetlands that previous investigations identified as areas of concern due to the presence of dioxin and reference areas. Primary areas of concern are reaches of the River where sediment concentrations of dioxin exceeded the 1 ppb residential action limit. These include:

- Woonasquatucket River, Centredale Reach; this is a fast moving shallow river area with high banks and a stony bottom. During flood periods, the pond downstream backs up and causes the river at this location to overflow the east bank and flood the Centredale Manor Property and parking areas.
- Centredale Wetlands; this is a swampy area vegetated with red maple, wild cherry, and various scrub vegetation including loosestrife and fern. This area has several ditches running through it and appears to flood regularly. Drum carcasses are still present in this area.
- Allendale Pond Bottoms (exposed); this is the bottom of the former Allendale Mill Pond. This pond was created by the dam at the Allendale Mill which breached in approximately 1991. Since that time, the pond bottoms flood occasionally, but are currently vegetated with terrestrial wetland plants, indicating that this area is only inundated with water during flood conditions. It appears that when the dam was intact, flood stage may have caused waters to overflow the east bank of the pond onto residential properties in this neighborhood. The west bank is high and consists of a former railroad bed.

- Allendale Pond Channel; this is a small meandering channel passing through the former Allendale pond. This channel is shallow and would be difficult to locate if the pond was restored to its former depth.
- Woonasquatucket River, Lymansville Reach; this is a fast moving shallow river area with high banks and a stony bottom. During flood periods, the pond downstream could back up and cause the river at this location to overflow the east bank and flood residential properties. A large floodplain is present on the west side of this reach of the river, which has not been inspected or sampled to date.

Previous investigations identified dioxin contamination in the sediments of the Allendale and Lymansville ponds. As noted above, the dam creating the Allendale Pond has breached, resulting in exposure of contaminated sediments to erosion. Lymansville Pond is the first impoundment downstream of the former Allendale Pond, and is likely to serve as the primary depositional area for material eroded from the exposed Allendale Pond sediments. Only one sediment sample has been collected and analyzed for dioxin at Lymansville Pond and had a result of dioxin concentrations in excess of 1 ppb. This ponds current function as the primary downstream area for accumulation of contaminated sediments from Allendale Pond and the Centredale Manor Site warrants its inclusion in the study area as a secondary area of concern.

Four upgradient locations have been identified as potential reference areas to determine background concentrations of contaminants, and to determine the degree to which other contamination sources may have contributed to contamination identified in the River and adjacent areas. Reference sample collection areas include:

- Woonasquatucket River (Upstream of the Site, and Esmond Dam)
- Centredale Brook

- Assapumpsett Brook, and
- Cranberry Brook.

Sediment and surface samples will be collected from specified areas within the River to obtain information sufficient to assess the ecological risks associated with the presence of dioxin and other contaminants. Surface water, sediment and soil samples will be collected in order to provide information to assess human health risks associated with contaminants in these media. The soil samples are being collected to obtain potential impacts resulting from deposition of contaminants beyond the Rivers channel. The soil samples will be collected from the banks of the Woonasquatucket River that appear to be frequented by recreational fishermen. Samples will also be collected from portions of residential properties adjacent to the River that are within the 100-year floodplain.

1.2 Overview of Field Activities

The investigation field activities scoped under this SAP include the following:

- Mobilization
- Collection of surface water samples
- Collection of sediment and soil samples
- Investigation-derived waste characterization and disposal (if necessary); and Demobilization.

The soil, sediment, and surface water sample locations are described in Section 2.0.

2.0 SITE MANAGEMENT/FIELD SAMPLING PLAN

This section presents the project organization, personnel responsibilities, schedule, and site control for the Woonasquatucket River Sediment Investigation. This section also presents the field sampling activities and analytical objectives, locations, and methods, as well as Quality Assurance/Quality Control (QA/QC) requirements.

2.1 Project Organization and Schedule

This section describes the project organization and schedule, including responsibilities of the personnel involved in performing the work assignment. Key project personnel and their responsibilities are outlined below.

2.1.1 Personnel Responsibilities

TtNUS field personnel conducting the work outlined in this SAP will consist of a Field Operations Leader (FOL), Site Safety Officer (SSO), and field scientists. Field work will be performed by the team under the direction of the FOL. The FOL will report directly to the TtNUS Project Manager. The TtNUS Project Manager reports to the EPA Remedial Project Manager (RPM) and the TtNUS Program Manager on a regular basis.

Responsibilities of the FOL include supervising field operations and coordinating daily with the various subcontractors; ensuring the procedures specified in the Work Plan and SAP are properly implemented, maintaining daily sampling and shipping schedules; and reporting to the Project Manager on a regular basis regarding sampling status and progress of the field activities.

The SSO will be appointed from the TtNUS field team personnel. The SSO will assist in implementing the Health and Safety Plan attached as Appendix A. The SSO will report directly to the TtNUS Health and Safety Officer on any health and safety issues. The SSO

will also report any hazards, injuries, or decisions to stop work to the FOL whom, in turn, will contact the TtNUS Project Manager.

Unless otherwise noted, the overall TtNUS project organization and responsibilities of key management personnel are discussed in Section 5.0 of the Draft Work Plan, dated September 1999.

2.1.2 Schedule

All fieldwork and sample analysis is separated by task. The estimated schedule for the investigation is shown on Figure 2-1.

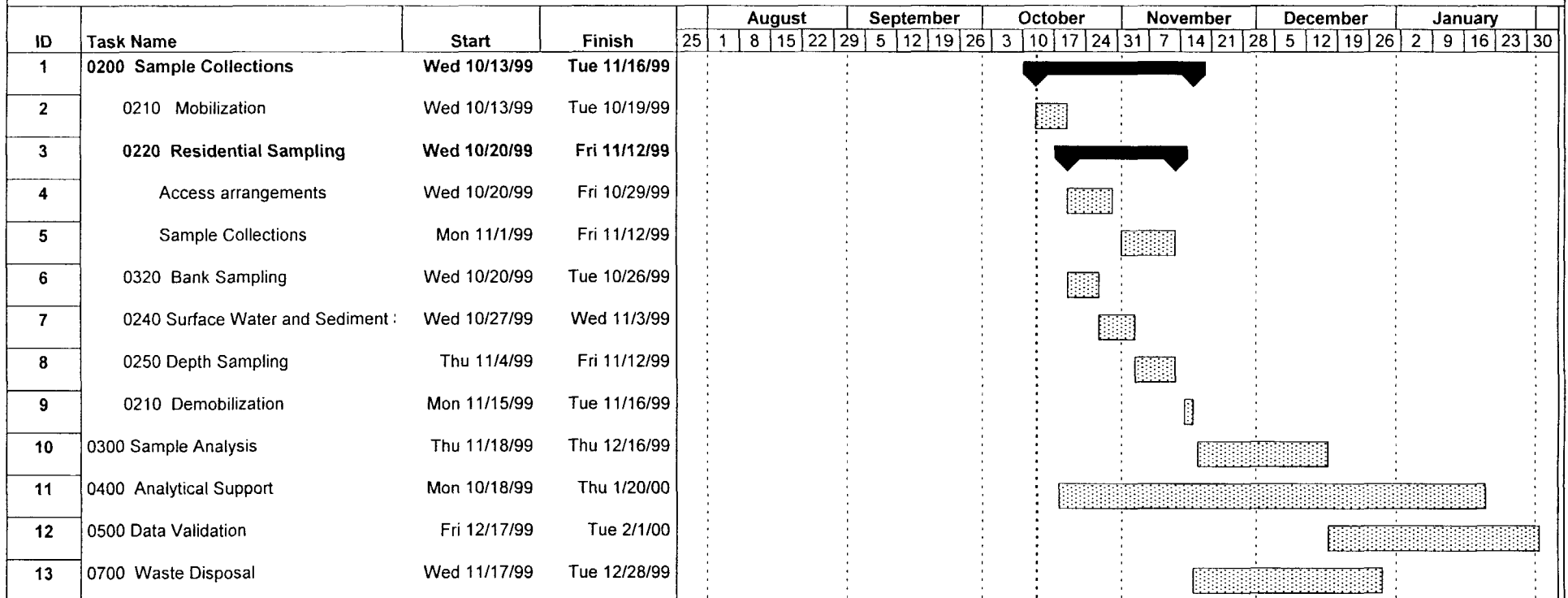
2.2 Site Control

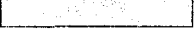
The following subsections contain information regarding the control of activities at the site.

2.2.1 Site Access

Access will be acquired for up to 30 residential properties along the east shore of Allendale Pond and the Lymanville Reach of the river. TtNUS, on behalf of EPA, will request access using the following procedure: TtNUS will find the owners address through tax records at the town hall. Property owners who already have access agreements with EPA from emergency response actions will be sent a letter confirming access arrangements. TtNUS will send a letter and agreement form to each of the other owners of the properties listed in Table 2-1B. TtNUS personnel will call to schedule a time for the sampling crew to visit a week after the letter is mailed. Three attempts will be made to contact the owner by phone at different times of the day. All conditions of access requested by the owners will be recorded by the contact person and documented in field logs. If a property owner cannot be contacted, a final attempt will be made to visit the owner at the property itself, but if no contact can be made, the property will not be accessed or sampled.

FIGURE 2-1 PROPOSED SCHEDULE WOONASQUATUCKET RIVER SEDIMENT INVESTIGATION FIELD ACTIVITIES CENTREDALE MANOR SITE



Project: Centredale Manor (Metro Atla Date: Wed 10/13/99)	Task		Rolled Up Task		Project Summary	
	Progress		Rolled Up Milestone		Split	
	Milestone		Rolled Up Progress		Rolled Up Split	
	Summary		External Tasks			

All other areas are within the river boundaries and do not require special access.

2.2.2 Utility Clearance and Other Permits

No utility clearances are required for surface water and sediment collection.

2.2.3 Field Office/Command Post

No single field support location will be established for this investigation. Field crews will operate out of support vehicles. The support vehicles will be located in non-obtrusive areas near to the locations being sampled on any given day.

2.2.4 Site Security/Control

TtNUS will not control access to the study area. Most of the area is state-owned land, the remaining area is privately owned and TtNUS will only control access to active sampling locations. As directed by the FOL, all removable TtNUS or EPA equipment will be returned to the TtNUS field crews hotel rooms or locked in vehicles and secured at the end of each working day.

2.3 Field Sampling Activities

The field sampling activities consist of the following subtasks:

- Mobilization
- Residential Soil Sampling
- Bank Soil Sampling
- Aquatic Sediment and Surface Water Sampling
- Deep Sediment Sampling
- Investigative Derived Waste (IDW) characterization and disposal (if necessary)
- Demobilization

2.3.1 Mobilization/Demobilization

This section describes the mobilization of both TtNUS personnel and TtNUS subcontractor personnel.

2.3.1.1 TtNUS Mobilization/Demobilization

Prior to beginning any fieldwork, all field team members will review the Statement of Work (SOW), Work Plan, this SAP, the HASP, and all applicable Standard Operating Guidelines (SOGs) and Standard Operating Procedures (SOPs) identified in Section 3.0 and contained in Appendix D of this SAP. In addition, the Project Manager, Lead Chemist, Office Health and Safety Manager, SSO, FOL, and field scientists will hold a field team orientation meeting prior to beginning the fieldwork to familiarize personnel with the scope of the field activities. All field team members (as listed above), will receive a copy of the SAP prior to the orientation meeting. A record of the field work orientation meeting is maintained in the project file. An example of the Record of Field Work Orientation form is presented in Appendix B.

Equipment mobilization may include, but will not be limited to, transporting and preparing the following equipment:

- Sampling and shipping equipment
- Health and safety equipment
- Decontamination equipment
- Subcontractor equipment (to be conducted by the subcontractor).

The FOL will coordinate the TtNUS mobilization. The FOL will also coordinate any equipment purchases necessary to conduct the field investigation. The equipment for the sampling and health and safety activities will be transported to the site as needed.

2.3.1.2 Subcontractor Mobilization/Demobilization

Subcontractors will be procured for IDW characterization and disposal. Once the procurement process has been completed, a "Notice to Proceed" will be issued by the TtNUS RAC I Program Management office to the selected subcontractor to initiate mobilization for each service.

The IDW disposal subcontractor will be responsible for mobilizing and demobilizing the equipment and personnel necessary to perform the work outlined in the specification, including obtaining utility clearance and any other permits required by federal, state, and local authorities.

2.3.2 **Residential and Bank Soil Sampling**

A total of 88 surface soil grab samples will be collected from the residential areas and 24 from the bank areas. Residential soil samples will be collected from a depth interval of 0 to 1 foot below ground surface (bgs). Bank soil samples will be collected from a depth interval of 0 to 0.5 foot bgs. Locations of residential samples are described on Table 2-1A and bank soil samples are described on Table 2-2, and are presented on Figures 2-2 and 2-3. Soil samples collected from residential areas will be analyzed for metals, SVOCs, pesticides/PCBs, dioxin, and HCX. All selected residential properties will be sampled to assure there is a minimum of one sample for pesticides/PCB, SVOCs, and metals, and a minimum of three samples for dioxin and HCX for each property. The selection of a minimum number of three dioxin/HCX samples is based on a property lot size of approximately one-quarter acre. Larger parcels may require additional dioxin/HCX samples (to a maximum of 5).

Table 2-1(A)
Summary of Residential Sampling - Proposed Sample Collections
Centredale Manor/Woonasquatucket River Sediment Investigation
North Providence Rhode Island

Plat #	Lot #	Owner	Owners Address	# samples collected to date	Within 100 year flood?	Adjacent to Pond or River?	Potential for Deposition	Selected for Sampling?	
								Dioxin	CLP
14	268	Scott, Nina A.	2 Mill Street	none	Yes	Raceway	Med	3	1
14	271	Serio, Anthony	41 Steere Ave.	4 samples, 0.002 - 0.047	Yes	Wetlands	High	0	1
14	272	Naber, Charles	36 Steer Ave.	4 samples, 0.013 - 0.120	Yes	Wetlands	High	0	1
14	302	Grenier, Antoniette	45 Grover St.	4 samples, 0.023 - 0.098	Yes	Wetlands	High	0	1
14	303	Rotella, Flora E	42 Redfern St.	1 sample, 0.113	Yes	Wetlands	High	2	1
14	333	Rotella, Flora E	42 Redfern St.	none	Yes	Wetlands	High	3	1
14	334	Rotella, Flora E	42 Redfern St.	5 samples, 0.011 - 2.7	Yes	Wetlands	High	0	1
14	365	Luca, Jon W	43 George St.	none	Yes	Wetlands	High	3	1
14	366	Rehel, Jacqueline G	46 George St.	none	Yes	Wetlands	High	3	1
14	398	Fitzgerald, Virginia M	41 Stevens St.	4 samples, 0.082 to 1.99	Yes	Pond	High	0	1
14	399	Peloquin, Josephore	44 Stevens St.	1 sample, 1.510	Yes	Pond	High	2	1
14	418	Asaante, Debra R	21 Aldrich St.	none	Yes	Pond	High	3	1
14	419	Asselin, Donald A	22 Aldrich St.	2 samples, 0.006 - 0.032	Yes	Pond	High	0	1
14	420	Asselin, Donald A	22 Aldrich St.	none	Yes	Pond	High	0	1
14	421	Asselin, Donald A	22 Aldrich St.	2	Yes	Pond	High	0	1
14	422	Vitullo, Joseph A	16 Aldrich St.	none	Yes	Pond	High	3	1
14	424	Vitullo, Joseph A	16 Aldrich St.	none	Yes	Pond	High	3	1
14	425	Vitullo, Joseph A	16 Aldrich St.	none	Yes	Pond	High	3	1
14	430	Sgambato, Frank P	15 Centredale Ave.	3 samples, 0.001 - 0.138	Yes	Pond	High	0	1
14	448	Saravo, Ettore	34 Centredale Ave.	2 samples, 0.094 - 2.74	Yes	Pond	High	1	1
14	449	DiLazzaro, Vincenza	578 Woonasquatucket Ave.	none	Yes	Pond	High	3	1
14	210	Cimorelli, Elsie A	566 1/2 Woonasquatucket Ave.	none	Yes	Pond	High	3	1
12	239	Cusson, Eva I	562 Woonasquatucket Ave.	8 samples, 0.005 - 45.1	Yes	Pond	High	0	1
12	240	Cusson, Eva I	562 Woonasquatucket Ave.	1 sample, 10.5	Yes	Pond	High	2	1
12	550	Allendale Baptist Church	Woonasquatucket Ave.	5 samples, 0.010 - 27.8	Yes	Pond	High	0	1
12	551	Lewis, Harold E	542 Woonasquatucket Ave.	3 samples, 0.602 - 7.63	Yes	Pond	High	0	1
12	552	McCurdy, Ross KJ	530 Woonasquatucket Ave.	3 samples, 0.002 - 16.4	Yes	Pond	High	0	1
12	553	Davidow, Mary Jane	524 Woonasquatucket Ave.	5 samples, 0.010 - 1.39	Yes	Pond	High	0	1
12	554	Carcone, Hilda E	518 Woonasquatucket Ave.	3 samples, 0.007 - 5.220	Yes	Pond	High	0	1
12	555	Richardson, Alice I	512 Woonasquatucket Ave.	2 samples, 0.007 - 0.077	Yes	Pond	High	1	1
12	556	Dionne, Joseph	500 Woonasquatucket Ave.	1 sample, 0.015	Yes	Pond	High	2	1
12	560	ANPC Associates & Allendale M	Apts: Woonasquatucket Ave.	none	Yes	River	Med	5	2
12	669	Town of North Providence	Woonasquatucket Ave./LL Field	10 + samples	Yes	River	High	5	2
12	320	Providence Boys Club	Maple Ave. Boys Club	none	Yes	River	High	5	2
12	323	Parcaro, Felix Jr.	Maple Ave.	none	Yes	Pond	Commercial	0	0
12	324	Parcaro, Felix Jr.	Maple Ave.	none	Yes	Pond	Commercial	0	0

Table 2-1(A)
 Summary of Residential Sampling - Proposed Sample Collections
 Centredale Manor/Woonasquatucket River Sediment Investigation
 North Providence Rhode Island
 Page 2 of 2

Plat #	Lot #	Owner	Owners Address	# samples collected to date	Within 100 year flood?	Adjacent to Pond or River?	Potential for Deposition	Selected for Sampling?	
								Dioxin	CLP
11	11	Parcaro, Felix Jr.	Maple Ave.	none	Yes	Pond	Commercial	0	0
11	12	Parcaro, Felix Jr.	Maple Ave.	none	Yes	Pond	Commercial	0	0
11	13	Cerce, Gerald F	4 Warren Ave.	none	Yes	Pond	Commercial	0	0
11	556	Cerce, Gerald F	4 Warren Ave.	none	Yes	Pond	Commercial	0	0
11	20	Cerce, Gerald F	4 Warren Ave.	none	Yes	Pond	Commercial	0	0
11	21	M & L Realty	1 Warren Ave.	none	Yes	Pond	Commercial	0	0
11	419	Muscatelli, Thomas	36 Zambarano Ave.	none	Yes	Pond	High	3	1
11	420	Depetrillo, Aleck J	37 Zambarano Ave.	none	Yes	Pond	Med	0	0
11	422	Cornachione, Frank	35 Zambarano Ave.	none	Yes	Pond	Med	0	0
11	423	McCoy, Richard J	18 Falco Ave.	none	Yes	Pond	Med	0	0
11	424	McCoy, Richard J	18 Falco Ave.	none	Yes	Pond	Med	0	0
11	425	Campanelli, Anthony J	16 Falco Ave.	none	Yes	Pond	Med	0	0
11	426	Campanelli, Anthony J	16 Falco Ave.	none	Yes	Pond	Med	0	0
11	427	Cinquegrana, Lorenzo	14 Falco Ave.	none	Yes	Pond	High	3	1
11	428	Cinquegrana, Lorenzo	14 Falco Ave.	none	Yes	Pond	High	3	1
11	429	Cinquegrana, Lorenzo	14 Falco Ave.	none	Yes	Pond	High	3	1
11	430	Rapone, Frank	12 Falco Ave.	none	Yes	Pond	High	3	1
11	431	Rapone, Frank	12 Falco Ave.	none	Yes	Pond	High	3	1
11	432	Simmons, Raymond	10 Falco Ave.	none	Yes	Pond	High	3	1
11	433	Simmons, Raymond	10 Falco Ave.	none	Yes	Pond	High	3	1
11	434	Casinelli, Steven	330 Woonasquatucket Ave.	none	Yes	Pond	Commercial	0	0
11	435	Casinelli, Steven	330 Woonasquatucket Ave.	none	Yes	Pond	Commercial	0	0
11	436	Casinelli, Steven	330 Woonasquatucket Ave.	none	Yes	Pond	Commercial	0	0
11	437	Casinelli, Steven	330 Woonasquatucket Ave.	none	Yes	Pond	Commercial	0	0
11	439	Casinelli, Steven	330 Woonasquatucket Ave.	none	Yes	Pond	Commercial	0	0
11	438	Casinelli, Steven	330 Woonasquatucket Ave.	none	Yes	Pond	Commercial	0	0
11	486	Defelice, Frank	318 Woonasquatucket Ave.	none	Yes	Pond	High	3	1
11	328	Graham, John Lawrence	316 Woonasquatucket Ave.	none	Yes	Pond	Med	0	0
11	497	Velleco, Frank C	306 Woonasquatucket Ave.	none	Yes	Pond	Med	0	0
11	396	Eastland Park Corporation	296 Woonasquatucket Ave.	none	Yes	Pond	High	3	1
11	577	Cassisi, Denise	33 Oak St.	none	Yes	Pond	Med	0	0
10	4	Pellegrino, Raymond G	28 Oak Street	none	Yes	Pond	Med	0	0
10	5	Pellegrino, Raymond G	28 Oak Street	none	Yes	Pond	Med	0	0
10	42	Testa, John J	5 Testa Drive	none	Yes	Pond	Low	0	0
10	604	Furtado, Louise	36 Allendale Avenue	none	Yes	Pond	Med	0	0
10	44	Furtado, Louise	36 Allendale Avenue	none	Yes	Pond	High	3	1
10	53	Deluca, Joseph	191 Carleton Street	none	Yes	Pond	Med	0	0
10	68	Deluca, Joseph	191 Carleton Street	none	Yes	Pond	Med	0	0
10	74	Laurie, Duane	18 Water Street	none	Yes	Pond	Med	0	0
10	75	Laurie, Duane	18 Water Street	none	Yes	Pond	Med	0	0
10	632	State of Rhode Island	220 Woonasquatucket Ave	none	Yes	Pond	Not Residential	0	0
TOTALS:								88	48

Notes: (1) - The access info is listed for another person than who is listed on the Tax records.

TABLE 2-1(B)
 SUMMARY OF RESIDENTIAL SAMPLING - SUMMARY OF ACCESS AGREEMENTS
 CENTREDALE MANOR/WOONASQUATUCKET RIVER SEDIMENT INVESTIGATION
 NORTH PROVIDENCE, RHODE ISLAND

Plat #	Lot #	Owner	Owners Address	# samples collected to date	Selected for Sampling?		Agreement in place	Send Letter	Send Agreement
					Dioxin	CLP			
14	268	Scott, Nina A.	2 Mill Street	none	3	1			Yes
14	271	Serio, Anthony	41 Steere Ave.	4 samples, 0.002 - 0.047	0	1	Yes	Yes	
14	272	Naber, Charles	36 Steer Ave.	4 samples, 0.013 - 0.120	0	1	Yes	Yes	
14	302	Grenier, Antoniette	45 Grover St.	4 samples, 0.023 - 0.098	0	1	Yes	Yes	
14	303	Rotella, Flora E	42 Redfern St.	1 sample, 0.113	2	1			Yes
14	333	Rotella, Flora E	42 Redfern St.	none	3	1			Yes
14	334	Rotella, Flora E	42 Redfern St.	5 samples, 0.011 - 2.7	0	1	yes	yes	
14	365	Luca, Jon W	43 George St.	none	3	1	yes	yes	
14	366	Rehel, Jacqueline G	46 George St.	none	3	1	yes	yes	
14	398	Fitzgerald, Virginia M	41 Stevens St.	4 samples, 0.082 to 1.99	0	1	yes	yes	
14	399	Peloquin, Josephore	44 Stevens St.	1 sample, 1.510	2	1	Yes	Yes	
14	418	Assante, Debra R	21 Aldrich St.	none	3	1	Tennant? (1)		Yes
14	419	Asselin, Donald A	22 Aldrich St.	2 samples, 0.006 - 0.032	0	1	Yes	Yes	
14	420	Asselin, Donald A	22 Aldrich St.	none	0	1	No	Yes	
14	421	Asselin, Donald A	22 Aldrich St.	2	0	1	No	Yes	
14	422	Vitullo, Joseph A	16 Aldrich St.	none	3	1	yes	yes	
14	424	Vitullo, Joseph A	16 Aldrich St.	none	3	1	No		Yes
14	425	Vitullo, Joseph A	16 Aldrich St.	none	3	1	No		Yes
14	430	Sgambato, Frank P	15 Centredale Ave.	3 samples, 0.001 - 0.138	0	1	No		Yes
14	448	Saravo, Ettore	34 Centredale Ave.	2 samples, 0.094 - 2.74	1	1	Yes	Yes	
14	449	DiLazzaro, Vincenza	578 Woonasquatucket Ave.	none	3	1	No		Yes
14	210	Cimorelli, Elsie A	566 1/2 Woonasquatucket Ave.	none	3	1	Tennant? (1)	Yes	
12	239	Cusson, Eva I	562 Woonasquatucket Ave.	8 samples, 0.005 - 45.1	0	1	No		Yes
12	240	Cusson, Eva I	562 Woonasquatucket Ave.	1 sample, 10.5	2	1	No		Yes
12	550	Allendale Baptist Church	Woonasquatucket Ave.	5 samples, 0.010 - 27.8	0	1	yes	yes	
12	551	Lewis, Harold E	542 Woonasquatucket Ave.	3 samples, 0.602 - 7.63	0	1	No		Yes
12	552	McCurdy, Ross KJ	530 Woonasquatucket Ave.	3 samples, 0.002 - 16.4	0	1	No		Yes
12	553	Davidow, Mary Jane	524 Woonasquatucket Ave.	5 samples, 0.010 - 1.39	0	1	Yes	Yes	
12	554	Carcone, Hilda E	518 Woonasquatucket Ave.	3 samples, 0.007 - 5.220	0	1	Yes	Yes	
12	555	Richardson, Alice I	512 Woonasquatucket Ave.	2 samples, 0.007 - 0.077	1	1	Yes	Yes	
12	556	Dionne, Joseph	500 Woonasquatucket Ave.	1 sample, 0.015	2	1	Yes	Yes	
12	560	ANPC Associates & Allendale M	Apts: Woonasquatucket Ave.	none	5	2	No		Yes
12	669	Town of North Providence	Woonasquatucket Ave./LL Field	10 + samples	5	2	Presumed	Yes	
12	320	Providence Boys Club	Maple Ave. Boys Club	none	5	2	No		
12	321	Porcaro, Felix Jr.	Maple Ave.	none	0	0	No		
12	322	Cobble Hill Development	23 Maple Ave.	none	0	0	No		
12	323	Parcaro, Felix Jr.	Maple Ave.	none	0	0	No		
12	324	Parcaro, Felix Jr.	Maple Ave.	none	0	0	No		
11	11	Parcaro, Felix Jr.	Maple Ave.	none	0	0	No		
11	12	Parcaro, Felix Jr.	Maple Ave.	none	0	0	No		
11	13	Cerce, Gerald F	4 Warren Ave.	none	0	0	No		
11	556	Cerce, Gerald F	4 Warren Ave.	none	0	0	No		
11	20	Cerce, Gerald F	4 Warren Ave.	none	0	0	No		

Table 2-1(B)
 Summary of Residential Sampling - Summary of Access Agreements
 Centredale Manor/Woonasquatucket River Sediment Investigation
 North Providence, Rhode Island
 Page 2 of 2

Plat #	Lot #	Owner	Owners Address	# samples collected to date	Selected for Sampling?		Agreement in place	Send Letter	Send Agreement
					Dioxin	CLP			
11	556	Cerce, Gerald F	4 Warren Ave.	none	0	0	No		
11	20	Cerce, Gerald F	4 Warren Ave.	none	0	0	No		
11	21	M & L Realty	1 Warren Ave.	none	0	0	No		
11	419	Muscatelli, Thomas	36 Zambarano Ave.	none	3	1			Yes
11	420	Depetrillo, Aleck J	37 Zambarano Ave.	none	0	0	No		
11	422	Cornachione, Frank	35 Zambarano Ave.	none	0	0	No		
11	423	McCoy, Richard J	18 Falco Ave.	none	0	0	No		
11	424	McCoy, Richard J	18 Falco Ave.	none	0	0	No		
11	425	Campanelli, Anthony J	16 Falco Ave.	none	0	0	No		
11	426	Campanelli, Anthony J	16 Falco Ave.	none	0	0	No		
11	427	Cinquegrana, Lorenzo	14 Falco Ave.	none	3	1			Yes
11	428	Cinquegrana, Lorenzo	14 Falco Ave.	none	3	1			Yes
11	429	Cinquegrana, Lorenzo	14 Falco Ave.	none	3	1			Yes
11	430	Rapone, Frank	12 Falco Ave.	none	3	1			Yes
11	431	Rapone, Frank	12 Falco Ave.	none	3	1			Yes
11	432	Simmons, Raymond	10 Falco Ave.	none	3	1			Yes
11	433	Simmons, Raymond	10 Falco Ave.	none	3	1			Yes
11	434	Casinelli, Steven	330 Woonasquatucket Ave.	none	0	0	No		
11	435	Casinelli, Steven	330 Woonasquatucket Ave.	none	0	0	No		
11	436	Casinelli, Steven	330 Woonasquatucket Ave.	none	0	0	No		
11	437	Casinelli, Steven	330 Woonasquatucket Ave.	none	0	0	No		
11	439	Casinelli, Steven	330 Woonasquatucket Ave.	none	0	0	No		
11	438	Casinelli, Steven	330 Woonasquatucket Ave.	none	0	0	No		
11	486	Defelice, Frank	318 Woonasquatucket Ave.	none	3	1			Yes
11	328	Graham, John Lawrence	316 Woonasquatucket Ave.	none	0	0	No		
11	497	Velleco, Frank C	306 Woonasquatucket Ave.	none	0	0	No		
11	396	Eastlande Park Corporation	296 Woonasquatucket Ave.	none	3	1			Yes
11	577	Cassisi, Denise	33 Oak St.	none	0	0			Yes
10	4	Pellegrino, Raymond G	28 Oak Street	none	0	0	No		
10	5	Pellegrino, Raymond G	28 Oak Street	none	0	0	No		
10	42	Testa, John J	5 Teeta Drive	none	0	0	No		
10	604	Furtado, Louise	36 Allendale Avenue	none	0	0	No		
10	44	Furtado, Louise	36 Allendale Avenue	none	3	1			Yes
10	53	Deluca, Joseph	191 Carleton Street	none	0	0	No		
10	68	Deluca, Joseph	191 Carleton Street	none	0	0	No		
10	74	Laurie, Duane	18 Water Street	none	0	0	No		
10	75	Laurie, Duane	18 Water Street	none	0	0	No		
10	632	State of Rhode Island	220 Woonasquatucket Ave	none	0	0	No		
TOTAL:					88	48			

Notes: (1) - The access info is listed for another person than who is listed on the Tax records.

TABLE 2-2
SELECTION OF BANK SURFACE SOIL SAMPLING LOCATIONS
SAMPLING AND ANALYSIS PLAN
CENTREDALE MANOR SITE
NORTH PROVIDENCE , RHODE ISLAND

STATION ID	LOCATION	SELECTION RATIONALE	SAMPLING RATIONALE
CMS-RWR-BK-2001	Upstream of Route 44	Bank of river upstream of site	Bank reference location
CMS-RWR-BK-2002	Upstream of Route 44	Bank of river upstream of site	Bank reference location
NOT ASSIGNED	West river bank along abandoned railway bed, south of Rt. 44 near USGS gauging station	Observed short trail from railway bed to riverbank, possible fishing location	Not selected for sampling, upstream of site
NOT ASSIGNED	West river bank along abandoned railway bed, near culvert discharge point	Observed trail leading down slope to river shoreline, area is clear for fishing, etc.	Not selected for sampling, trail does not have regular use, current sample station located nearby
CMS-APB-BK-2003	Immediately east of Allendale Pond Dam	Observed trail from Allendale Ave to east side of dam, probable fishing location	Selected as sampling station, trail appears to be regularly used
NOT ASSIGNED	Downstream of Allendale Ave bridge on west bank of river	Observed steep trail down to rivers edge just downstream of bridge crossing	Not selected for sampling , trail is not regularly used
CMS-WRL-BK-2004	Downstream of Allendale Ave bridge on west side of river	Observed trail along west side of river used by ATVs and bicycles. Noted clearing at riverbank that is suitable for fishing	Selected as sampling station, trail and access point to river appears regularly used
CMS-WRL-BK-2005	Downstream of Allendale Ave bridge on west side of river	Observed trail along west side of river used by ATVs and bicycles. Noted clearing at riverbank that is suitable for fishing (approx. 250ft downstream of 2004)	Selected as sampling station, trail and access point to river appears regularly used

TABLE 2-2
SELECTION OF BANK SURFACE SOIL SAMPLING LOCATIONS
SAMPLING AND ANALYSIS PLAN
CENTREDALE MANOR SITE
NORTH PROVIDENCE , RHODE ISLAND
PAGE 2 OF 2

STATION ID	LOCATION	SELECTION RATIONALE	SAMPLING RATIONALE
NOT ASSIGNED	On soil dam at Lymansville Dam, on west side of river/pond	Observed trail from Lyman Ave that crosses Lymansville Dam. Location is a clearing that is probable fishing location	Not selected for sampling, station is located near CMS-LPX-BK-2008 station
NOT ASSIGNED	Downstream of Allendale Ave bridge, on east side of river	Observed small clearing to river in rear of Mill apartment building complex	Not selected as a sampling station, not regularly used
NOT ASSIGNED	Near intersection of Allendale Dam raceway and river	Observed trail to river	Trail is situated on boulder wall used to deflect raceway and river current, not a depositional area
NOT ASSIGNED	West of Warren Ave/Willows Ave dead end, on Lymansville Pond	Observed clearing and potential fishing location near residential property line/fence	Not selected as a sampling station. Will be addressed under residential sampling program: adjacent to home at 2 Amborano Avenue: See Table 2-1
CMS-LPX-BK-2006	Located at the end of the Eric Lanne cul-de-sac	Observed trail to pond from dead end street	Selected as sampling station. Trail appears to have regular use
CMS-LPX-BK-2007	Located at southwest corner of parking lot of DiPanni LTD and Aztec Industries which are near intersection of Woonquatucket Ave and Packard Ave	Observed clearing and trail from parking lot that leads to edge of pond	Selected as sampling station. Trail appears to have regular use
CMS-LPX-BK-2008	On soil dam at Lymansville Dam, on west side of river/pond	Observed trail from Lyman Ave that crosses Lymansville Dam. Location is a clearing that is probable fishing location	Selected as sampling station, trail and access point to pond appear to have regular use

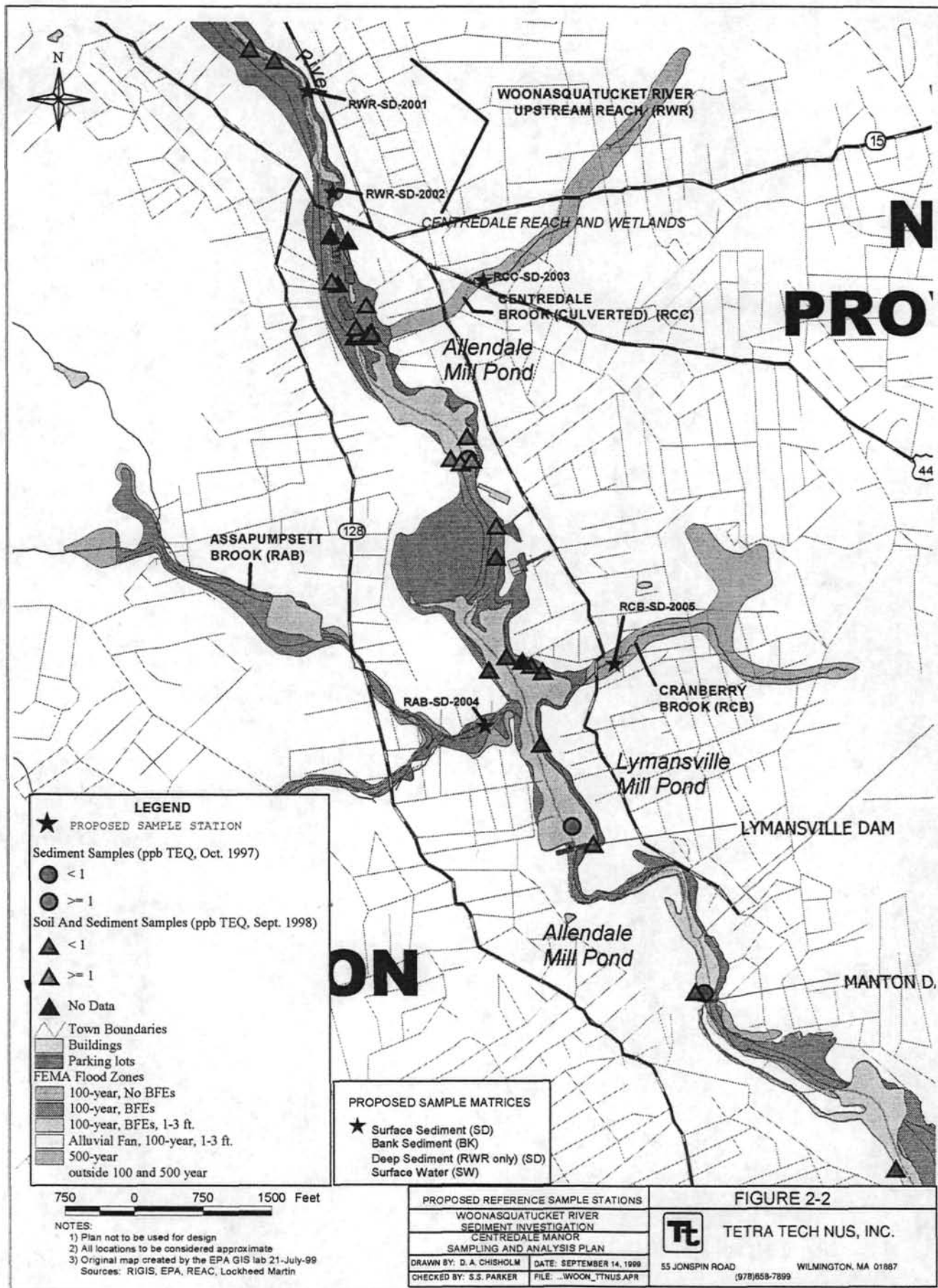


Table 2-1A describes criteria for selection of residential locations: distance of the property from the site; if it is within the 100-year flood zone; and the potential for sediment deposition on these properties during flood periods. Only locations that are within the 100-year flood zone and those that abut the ponds or river are included in the residential sampling program. Bank soil sampling locations were selected during a September 22, 1999 site visit by TtNUS and were based on visual evidence of recreational use (Table 2-2). The bank soil sample locations will focus on areas that are frequently used for recreational activities, primarily fishing and boating.

For residential areas where the lawn area slopes continuously down to the river or pond, three grab samples will be collected in line between the downgradient end of the property (typically nearest the water) and then towards the upgradient end (presumably nearest the house). The three dioxin/HCH samples will be positioned at the top, middle, and bottom of the slope, but within the 100-year flood plain as determined by the field scientist. One grab sample for SVOCs, metals, and pesticides/PCBs will be collected from the station closest to the water body on these properties.

For residential properties where the lawn area is level and does not slope down appreciably to the water, three samples will be collected along the edge of the lawn area nearest to the river or pond. The mid-point sample of the three samples will be collected approximately 5 feet further away from this property line and from the other two samples, so that the three points form a wide triangle. Further, if the bank of the river is identifiable, samples will be collected at the toe, mid-point, and top of the bank. The single sample for SVOCs, metals, and pesticide/PCB will be collected from the station closest to the water on the properties.

Residential properties upstream of the Allendale Pond dam that meet the criteria described above and in Table 2-1A, will all be sampled. Residents abutting the Lymanville Pond dam will be sampled if access is acquired prior to the initiation of the sampling event.

Bank soil samples will be analyzed for SVOCs, pesticides/PCBs, dioxin, and HCX (see Table 2-3). Three bank soil samples (~~grabs~~) will be collected at each station for all the above parameters. Sampling locations descriptions and rationale are presented in Table 2-2.

All soil samples will be collected using hand tools according to Sections 5.2 and 5.5 of TtNUS SOP SA-1.3, using decontaminated bucket augers or stainless steel trowels. All sampling devices shall be decontaminated prior to use following the procedures specified in Section 2.5. The soil sample collection procedure is summarized below:

- Repeated grabs of the soil from the appropriate depth interval are collected and placed in a decontaminated stainless steel mixing bowl. The soil is then monitored for VOCs using a portable FID or PID. VOC field screening results and a soil description are recorded on the field data collection form.
- The soil sample is thoroughly mixed and homogenized and transferred to the appropriate sample containers as identified in Table 2-4.
- Stake and survey the soil location using GPS (as described in Section 2.3.6 and 2.3.7)
- All non-disposable equipment is decontaminated after use as described in Section 2.5 of this SAP.

Sample areas on residential properties will be repaired with sod or topsoil to match the surrounding grade. Table 2-4 summarizes the sample container types, preservative requirements, and maximum holding times for each analyses.

All sampling stations will be surveyed during the sampling program using GPS (Global Positioning System) survey equipment with sub-meter accuracy. In addition to the GPS

TABLE 2-3
SOIL AND SEDIMENT SAMPLE SUMMARY
SAMPLING AND ANALYSIS PLAN
WOONASQUATACHET RIVER SEDIMENT INVESTIGATION
CENTREDALE MANOR SITE
NORTH PROVIDENCE, RHODE ISLAND

Sample Type	Analysis	Method	Matrix	Field Samples	Field Duplicates ⁽¹⁾	Rinsate Blanks ⁽²⁾	PE Samples ⁽³⁾	Total Samples	Lab QC Samples ⁽⁴⁾
Residential Soils	Pesticides/PCBs	OLM3.2 ⁽¹⁾	Soil	48	5	5	3	61	3
	SVOCs	OLM03.2 ⁽¹⁾	Soil	48	5	5	3	61	3
	Metals	ILM04.0 ⁽²⁾	Soil	48	5	5	3	61	3
	Dioxin and HCX	8290 ⁽³⁾	Soil	88	9	9	12	118	6
Bank Soil (Recreational) <i>meadow</i>	Pesticides/PCBs	OLM3.2 ⁽⁴⁾	Sed	24	3	3	2	32	2
	SVOCs	OLM03.2 ⁽⁴⁾	Sed	24	3	3	2	32	2
	Dioxin and HCX	8290 ⁽³⁾	Sed	24	3	3	2	32	2
Surface Aquatic Sediment Samples	Pesticides/PCBs	OLM3.2 ⁽⁴⁾	Sed	50	5	5	3	63	3
	SVOCs	OLM03.2 ⁽⁴⁾	Sed	50	5	5	3	63	3
	Metals	ILM04.0 ⁽⁵⁾	Sed	50	5	5	3	63	3
	TOC	Lloyd Kahn ⁽⁶⁾	Sed	50	5	0	0	55	3
	Grain Size	ASTM D422-63 ⁽⁷⁾	Sed	50	5	0	0	55	3
	Dioxin and HCX	8290 ⁽³⁾	Sed	50	5	5	6	66	3
	SEM and AVS	Allen & Fu ⁽⁸⁾	Sed	50	5	0	0	55	3
Deep Sediment Samples	Pesticides/PCBs	OLM3.2 ⁽⁴⁾	Sed	45	5	5	3	58	3
	SVOCs	OLM03.2 ⁽⁴⁾	Sed	45	5	5	3	58	3
	Metals	ILM04.0 ⁽⁵⁾	Sed	45	5	5	3	58	3
	Dioxin and HCX	8290 ⁽³⁾	Sed	45	5	5	6	58	3

Notes:

1. U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis Multi-Media, Multi-Concentration. OLM03.2.
2. U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis Multi-Media, Multi-Concentration. ILM04.0.
3. Dioxin and hexachloroxanthene analysis by USEPA SW-846 Method 8290 modified according to TtNUS Technical Specification No. S99-RACI-117.
4. U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis Multi-Media, Multi-Concentration. OLM03.2 modified according to TtNUS Technical Specification No. S99-RACI-118.
5. U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis Multi-Media, Multi-Concentration. ILM04.0 modified according to TtNUS Technical Specification No. S99-RACI-118.
6. "Lloyd Kahn Method for Determination of Total Organic Carbon in Sediments," U.S. EPA Region II, July 1986. According to the Technical Specification No. S99-RACI-118.
7. Grain size distribution by ASTM D422-63 November 1963 (Re-approved 1990). Modified according to TtNUS Technical Specification No. S99-RACI-118.
8. Acid volatile sulfide by the H.E. Allen and G. Fu Method, December 1991, modified according to TtNUS Technical Specification No. S99-RACI-118.

TABLE 2-4
SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIME REQUIREMENTS
SAMPLING AND ANALYSIS PLAN
WOONASQUATACHET RIVER SEDIMENT INVESTIGATION
CENTREDALE MANOR SITE
NORTH PROVIDENCE, RHODE ISLAND

MATRIX	ANALYSIS	CONTAINERS PER SAMPLE ⁽³⁾	CONTAINER TYPE ⁽¹⁾	PRESERVATIVE	MAX. HOLDING TIME ⁽²⁾
Surface Water	SVOCs	2	80 oz amber	4°C	7 days extraction 40 days analysis
	Pesticides/PCB				
	TAL Metals	1	1-liter polyethylene	HNO ₃ to pH < 2 4°C	28 days
	Dioxin & HCX	2	1-liter amber	4°C	30 days extraction 45 day analysis
Soil/Sediment ⁽⁴⁾	SVOCs/Pest/PCBs	1	8 oz. Amber jar	4°C	14 days extraction 40 days analysis
	TAL Metals	1	8 oz. jar	4°C	28 days
	TOC	1	2-oz. VOC jar	4°C	28 days
	Grain Size	1	16-oz. jar	4°C	None
	Dioxin & HCX	1	4-oz. amber jar	4°C	30 days extraction 45 day analysis
	SEM and AVS	1	8-oz. jar	4°C	14 days AVS 28 days SEM

NOTES:

- (1) Sample containers shall meet specifications delineated in EPA OSWER Directive No. 9240.0-05A.
- (2) Maximum holding time from date of sample collection to date of sample extraction or analysis is based on analyte with shortest holding time.
- (3) Triple volume of groundwater samples should be collected for organic analysis and double volume of groundwater samples for metal analysis as per section 2.4.
- (4) Double volume of sediment samples should be collected for laboratory QC. If sediment samples have low solid content, two sample containers per analysis may need to be collected.

survey, the sample station that is nearest the water body will be identified by a single wooden stake in order to avoid multiple stakes on private property. The stake will be labeled with the sample identification number. The remaining sample locations at the residential location will be located by measuring the distance from the single stake and using a magnetic compass heading. In addition, a description of the sample location and setting will be recorded. This information will be recorded in the field logbook.

2.3.3 Surface Water Sampling

Surface water samples will be collected from up to 40 stations (which correspond to 40 out of the 50 sediment stations) as presented in Figures 2-2 and 2-3. Surface water grab samples are to be collected from stations, co-located with the aquatic sediment samples. Of these, five will be "reference" locations, two up-stream in the Woonasquatucket and one in each of the three tributaries to the river within the study area. Surface water samples will be collected before the sediment samples, starting at the most downstream location and proceeding upstream. Water samples will usually be collected with a Kemmerer sampler. For locations with less than 2 feet of water depth (approximate), direct-dip sampling may be used. Surface water samples will be collected following Section 5.3.5 of SOG SA-1.2 and the following guidelines:

- Measure depth of water at the station, being careful not to disturb the sediment. When possible and when depths appear consistent, take the water depth measurement slightly downstream of the planned surface sample location to avoid disturbing and mixing the sediments. Contamination from sediment mixing will be minimized in the event sediments are accidentally disturbed during this depth measurement.
- All sampling devices shall be decontaminated prior to first use at each station following the procedures specified in Section 2.5.

- For water depth less than 2 feet a sample collection jar held by hand or attached to the end of a pole may be employed. The sample collection bottle should be inverted and lowered to the desired depth (one foot above the bottom sediments) and then slowly turned upright to a 45 degree angle with the mouth of the bottle facing upstream. Fill the sample collection bottle.
- If water depth is greater than 2 feet deep (approximate), then the Kemmerer sampling device shall be used to collect the water sample. The sampler is lowered to 1 foot above the bottom and a weight (messenger) is dropped down the retrieval line. The messenger triggers the closing of the Kemmerer seals allowing retrieval of a water sample from the desired depth.
- Retrieve the sampler and fill the appropriate sample containers as specified in Table 2-4.
- Record the pH, specific conductivity, temperature, salinity, turbidity, dissolved oxygen (DO), sampling device used, date and time, name of samplers, etc. of the sample on the field data sheets (Appendix B).
- Preserve total metal samples as identified in Table 2-4. Dissolved metals samples are filtered in the field as soon after sample collection as practical (maximum of 2 hours) and prior to preservation. Dissolved metals samples will be filtered through a disposable 0.45 micron filter using a peristaltic pump. The filtered samples are transferred into a clean sample container and preserved with nitric acid to pH below 2.
- Stake and GPS survey sample station (as presented below)
- Decontaminate the sampler device before reuse (Refer to Section 2.5 of this SAP).

The surface water samples will be analyzed for pesticides/PCBs, SVOCs, metals (total and dissolved), dioxins and HCX (Table 2-5). Table 2-4 summarizes the sample container types, preservative requirements, and maximum holding times for the proposed analyses.

All sampling stations will be surveyed during the sampling program using GPS (Global Positioning System) survey equipment. In addition, near shore stations will be identified by a wooden stake at the shoreline edge. The stake will be labeled with the sample identification number and the approximate offset from the stake to the "true" location by writing the distance (in feet) and the magnetic compass heading (i.e. 10'@290°) on the stake. Locations at more than 50 feet from the shoreline will be identified by GPS only. No stakes or permanent buoy markers will be set. This information will also be recorded in the field logbook.

2.3.4 Aquatic Surface Sediment and Deep Sediment Samples

Surface aquatic sediment composite samples will be collected from a depth interval of 0 to 0.5-foot below ground surface (bgs) at 50 pre-determined depositional area locations (See Figures 2-2 and 2-3). These samples will be analyzed for pesticides/PCBs, SVOCs, metals, TOC, grain size, acid volatile sulfides (AVS) and simultaneously extracted metals (SEM), dioxin, and HCX. When possible, surface sediment samples will be collected at depositional locations within 10 feet of the historical shoreline. In addition, field scientists will determine, based on available data and professional judgement, if sediment samples are inundated with water or exposed during most of the year.

It is anticipated that most locations can be accessed by personnel in hip length boots. At sediment sample locations determined to be inaccessible by wading (water depth greater than 2 feet), an open workboat will be used.

Deep sediment samples will be collected at 15 locations in historical deposition areas. These locations will be a subset of 15 of the 50 surface sediment locations. Three deep sediment samples will be collected at each of the selected locations, one from the 0.5 to

TABLE 2-5
SURFACE WATER SAMPLE SUMMARY
SAMPLING AND ANALYSIS PLAN
WOONASQUATCHET RIVER SEDIMENT INVESTIGATION
CENTREDALE MANOR SITE
NORTH PROVIDENCE, RHODE ISLAND

	Method	Matrix	Field Samples	Field Duplicates	Rinsate Blanks	PE Samples	Total Samples	Lab QC Samples
Pesticides/PCB	OLM03.2 ⁽¹⁾	SW	40	4	4	3	51	3
SVOCs	OLM03.2 ⁽¹⁾	SW	40	4	4	3	51	3
Total Metals	ILM04.0 ⁽²⁾	SW	40	4	4	3	51	3
Dissolved Metals	ILM04.0 ⁽²⁾	SW	40	4	4	3	51	3
Dioxin & HCX	8290 ⁽³⁾	SW	40	4	4	6	54	3

Notes:

1. U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis Multi-Media, Multi-Concentration. OLM03.2
2. U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis Multi-Media, Multi-Concentration. ILM04.0
3. Dioxin and hexachloroxanthene analysis by USEPA SW-846 Method 8290 modified according to TtNUS Technical Specification No. S99-RACI-117.

2.0-foot interval bgs, one from the 2.0 to 4.0-foot interval bgs and one from the 4.0 to 6.0-foot interval bgs (Figures 2-2 and 2-3). Each sample interval will be considered an individual composite sample of that interval. The deep sediment samples will be analyzed for pesticides/PCBs, SVOCs, metals, dioxin, and HCX. Sediment samples will be collected following the general guidance of Section 5.5 SOP SA-1.2, and the following guidelines:

- Most aquatic sediment samples will be collected using an Eckman dredge (surface sediment) and a 2-inch ID lined direct-push core tube (deep sediment). The core tube will be driven using a slide hammer to 6 feet bgs or refusal. Shallow sediment samples (0-0.5-foot interval) may be collected with a stainless steel scoop if sediments are exposed. If water is present, a dredge sampler will be employed to collect the surface interval. The depth of the water at all sediment sample locations is not expected to be greater than 10 feet. All sampling devices will be decontaminated prior to use as specified in Section 2.5.
- Core Device: Slowly lower the core sampler so as not to disturb (blow off) soft sediments at the surface. Apply force to the core sampler handle and drive the sampler into the sediments. A slide hammer (or equivalent) may be utilized to obtain the desired core sampler penetration.
- Retrieve the core sampler and record depth of penetration and sample recovery within the core tube.
- Remove the core liner and seal ends to avoid loss of sample. The sample core will be sectioned with a stainless steel tool into the required depth interval segments. Additional collocated core grabs may be required to collect an adequate volume of sediment for analysis.
- AVS/SEM samples (surface interval only) will be collected from an undisturbed portion of one of the early grabs at each station immediately after the dredge is opened. Care

will also be taken during the sample container filling to ensure the sediment matrix disturbance is minimized (no mixing or blending). AVS/SEM sample containers will be completely filled, leaving no headspace. After filling the AVS/SEM containers, any remaining soil is placed into a decontaminated stainless steel mixing bowl.

- Subsequent grabs collected for additional volume for the composite sample are placed into the stainless steel mixing bowl and monitored for VOCs using a portable FID or PID. VOC screening results and a sediment description are recorded on the field data collection form. A separate stainless steel bowl is used for each individual sample depth interval.
- The sample is then thoroughly homogenized by hand mixing using a decontaminated scoop or large mixing spoon. After mixing, the sample is transferred to the appropriate sample containers as identified in Table 2-4.
- An additional aliquot (4-8 ounces) is placed into a zip lock bag for the field determination of free water as described below.
- Record the type of sediment sampling device used, penetration depth of sampler, sample recovery, water depth, sediment description, date and time, sampler names, etc., on the sample data form (Appendix B).

Table 2-4 summarizes the sample container types, preservative requirements, and maximum holding times for the sample analyses.

Free Water Content Determination – Field Methodology: Free water content of aquatic sediment will be determined gravimetrically by vacuum filtration.

A separate aliquot of sediment of approximately 100 grams (minimum) is collected for the determination of free water. The weight (wet) of the sample is first determined (to the

nearest 0.1 gram) using an analytical balance and recorded on the Free Water Determination Data Sheet in Appendix B. The sediment is then transferred to a Buchner funnel assembly lined with a glass fiber filter and allowed to drain freely. After 60 seconds, a vacuum pump will be attached to force a faster removal of the free water (vacuum filtration). Glass microfiber filter (Whatman 934-AH or equivalent) with a 1.5 μm pore size will be used.

The weight of the sediment filter cake is determined by subtracting the weight of a clean filter: The weight difference is equivalent to the amount of free water. Assuming a water density equal to 1 g/ml, the volume of free water is calculated by subtracting the dried sediment filter cake weight to the original weight of the sample aliquot. Decontamination of the equipment is not required since the sample is not used for further analysis. The filter support funnel is wiped dry to the best extent possible between sample measurements.

All sampling stations will be surveyed during the sampling program using GPS (Global Positioning System) survey equipment. In addition, near shore stations will be identified by a wooden stake at the shoreline edge. The stake will be labeled with the sample identification number and the approximate offset from the stake to the actual location. The field team will label the stake with the distance (feet) and the magnetic compass heading (i.e. 10'@290°) from the stake to the location. Locations more than 50 feet from the shoreline will not be identified in the field using this method and must rely only on the GPS survey. No permanent buoy markers will be set. This information will be recorded in the field logbook.

2.3.5 Sample Documentation

Solid or liquid phase sample log sheets (Appendix B) will be completed accordingly, for each sample collected. Information recorded will include sample identification, analytes, depth sampled, date and time collected, and other pertinent information. For sediment

depth samples, any changes in the sediment layering will be recorded. For surface water samples, the required parameters (See section 2.3.4) will be recorded.

2.3.6 Sample Location Survey

Horizontal sample stations locations will be surveyed using a Global Positioning System (GPS). All sample site locations will be referenced to the Rhode Island State Plane Coordinate System.

2.3.7 Sample Location Identification System

Each sample taken from the study area will be assigned a unique sample location tracking number. The sample location tracking number will consist of a four- to five-segment, alpha-numeric code that identifies the area, sample medium, specific sample location identifier, and sample event, sample depth or the quality control (QC) sample designation, as appropriate. Any other pertinent information regarding sample identification will be recorded in the field logbooks or on sample log sheets.

The alpha-numeric coding to be used in the sample location numbering system is explained in the following diagram and the subsequent definitions:

AAA	-	AA	-	NNNN	-	NNNN	-	NN
Site	-	Medium	-	Location	-	Depth	-	Event
Identifier				Identifier				

Character type:

A = Alpha

N = Numeric

1. Three Alpha character group identifying the area investigated ("CMS-" for Centredale Manor Site. Lower reaches of the river and tributaries are given other character groups below):

Site Stations:

CMS – Centredale Manor Site (used for site samples only)

River Stations (including floodplain):

WRC – Woonasquatucket River, Centredale Reach

CMW- Centredale Manor Wetlands

APC – Allendale Pond Channel

APB – Allendale Pond Bottoms

WRL – Woonasquatucket River, Lymanville Reach

LPX – Lymanville Pond

Reference Areas:

RWR – Woonasquatucket River, Upstream Reach

RCC – Centredale Brook (Culverted), Reference

RAB – Assapumpsett Brook, Reference

RCB - Cranberry Brook, Reference

2. Two alpha character group identifying the medium sampled
BK - bank surface soils
SS - Surface Soils (all remaining surface soils excluding bank soils)
SB - SuBsurface soils
SD - SeDiment
SW - Surface Water
3. Four numeric character group describing a unique location number identified sequentially. Each group of data collected will probably have a different series. The sediment data will be in the 2000 series, so the first sample would be "2001", and the forty second sample would be "2042".
4. If necessary, a four digit group stating the depth of the sample collected in feet.

5. A two digit round number for that station number "01" for the first sample collected from that location, and 02 for the second sample collected from that location, etc.

Using this approach, the sample with the identification CMS-SS-2034-01 is a surface soil sample collected from the Centredale Manor Site, at location number 2034, no depth is specified, and it was the first surface soil sample collected from that location.

The sample with the identification CMS-SS-2138-0001-02 is a surface soil sample collected from the Centredale Manor Site from a depth of 0-1 foot below ground surface, and it was the second sample collected at that location, indicating to the user that he/she should look at the date of the sample collected, and look at a difference in data from the previous sample collected there.

QC Samples

1. Three Alpha character group identifying the area investigated ("CMS-" for Centredale Manor Site)
2. Two alpha character group identifying the type of sample:
 - DU = Duplicate
 - RB = Rinsate Blank
 - FB = Field Blank
3. Six numeric character group describing the date of sample collection and a letter in sequence (A being the first collected that day, B being the second, etc).

Therefore, the sample with the identification CMS-DU-080399B is a duplicate sample collected on August 3, 1999 and it was the second duplicate collected that day. This indicates to the user that he/she can search for the match for that sample in the date field. In addition, there will be no chance that another sample will be incorrectly matched to that

duplicate. PE samples will be assigned a specific tracking number by the EPA Lexington laboratory.

2.4 Quality Control Samples

The quality control (QC) samples that will be collected or generated during the surface water and soil sampling are described below. A detailed discussion of the objectives, procedures, and collection rates for each type of QC sample is provided in Section 3.2.5.2.

Rinsate Blanks: Rinsate blanks will be collected at the rate of one for ten samples.

Field Duplicates: Field duplicates will be collected at a rate of one for every ten samples per analysis.

Performance Evaluation (PE) Samples: PE samples will be sent to the laboratory at a rate of one for every 20 samples per analysis.

Laboratory Quality Samples: Additional surface water sample volume will be collected at the rate of one in 20 samples per analysis for laboratory quality control.

2.5 Equipment Decontamination

This section provides guidelines for decontamination of equipment used during the field investigation. Personnel decontamination issues will be discussed in the HASP.

2.5.1 Decontamination Procedures During Surface Water, Sediment, and Soil Sampling

All non-disposable sampling and testing equipment that comes in contact with the sample medium (trowels, bowls, shovels, core tubes, etc.) will be decontaminated to prevent cross-contamination between sampling points, as described below:

1. Brush to remove gross contamination
2. Potable water and detergent (Alconox or Liquinox) wash and scrub with brush
3. Rinse with potable water
4. Rinse with DIUF water (analyte free)
5. Rinse with 2-propanol*
6. Rinse with hexane*
7. Air dry (to the extent practical) on aluminum foil or in a strainer
8. Wrap in aluminum foil for transport (or if not being used immediately).

*Reagent Grade Note: collect solvent rinse separate from water rinses to minimize solvent IDW volume

2.6 Control and Disposal of Investigation-Derived Waste (IDW)

Investigation-derived waste generated by the project will be limited to excess sample material and decontamination fluids. All IDW will be stored (on a daily basis) at EPA Centredale Manor Site trailers until disposal. Sample results from associated soil sampling will be used to characterize this waste to the extent possible. However, the IDW contractor may require additional analysis prior to removal off-site and treatment or disposal.

The personal protective equipment (PPE) waste generated during work will be decontaminated, double-bagged in plastic bags, and disposed of as solid waste in an industrial dumpster at the completion of work.

2.6.1 Segregation of Sediments, Liquids, and Drum Labeling

TtNUS will segregate sediments and liquids after each sampling event. Sediments and liquids will be placed in separate labeled drums.

After IDW soil/sediment is drummed and the lid clamped tight, the drum will be marked using a waterproof indelible ink marker; an example follows:

- IDW-CM-01 - (IDW - Centredale Manor - drum #01)
- Date first accumulated: e.g. 9/25/99
- Source(s) of material: Sample ID# (see Section 2.3.5)
- Volume and type of total material

Drum labeling is necessary to identify materials stored in the drums and to evaluate how the drummed material will be sampled for waste characterization.

2.6.2 Transportation and Disposal Subcontractor

If necessary, a licensed hazardous waste transportation and disposal subcontractor will be required to transport and dispose of any non-hazardous and hazardous waste streams generated during the investigation. The subcontractor will be procured to transport and dispose the IDW waste to approved off-site disposal facilities.

2.6.3 Documentation

On a daily basis, the FOL or designee will document the generation of IDW during the investigative activities to ensure that the IDW is properly containerized and stored at the staging area. Information will be recorded in a bound notebook. Daily records of soil stored in drums will include the following information:

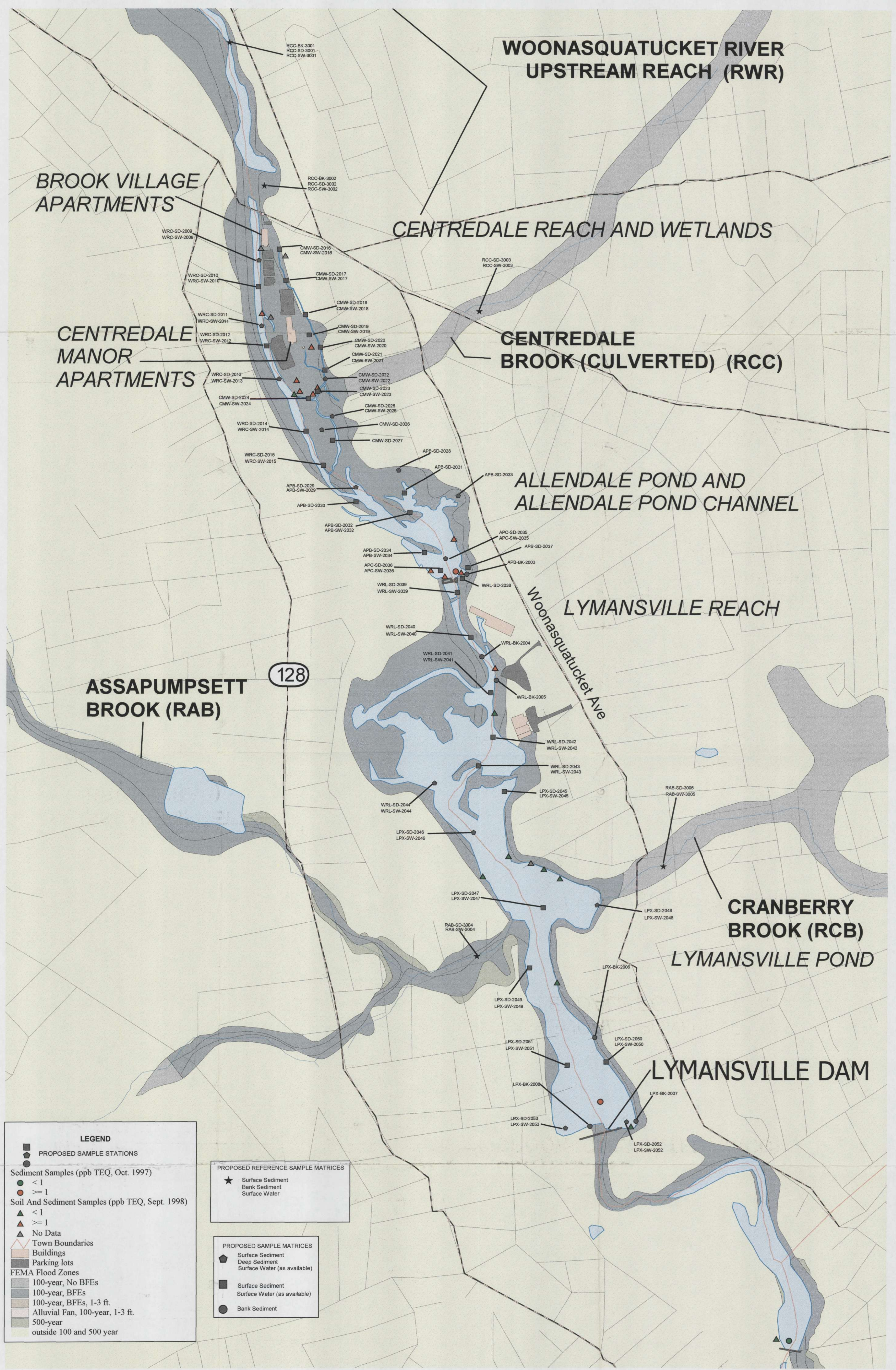
- Drum No. (Unique Identification Number)
- Date first accumulated
- Source of material
- Volume of material
- Sample ID# (consistent with soil sample ID numbers described in Section 2.3.7).

2.6.4 Hazardous Waste Manifesting Compliance

One hazardous waste manifest will be prepared by the transportation and disposal subcontractor for each shipment of IDW leaving the site.

Manifests will be completed for all hazardous wastes disposed off site, and signed by the TtNUS Site Representative "On Behalf of EPA".

Copies of all documentation of control and disposal of IDW generated by the project will be provided to the U.S. EPA. Copies will also be maintained in the project file located at the TtNUS Wilmington office.



NOTES:

- 1) Plan not to be used for design
- 2) All locations to be considered approximate
- 3) Original map created by the EPA GIS lab 21-July-99

Sources: RIGIS, EPA, REAC, Lockheed Martin

PROPOSED SAMPLE STATIONS	
LYMANVILLE REACH	
WOONASQUATUCKET RIVER	
SEDIMENT INVESTIGATION	
CENTREDALE MANOR	
SAMPLING AND ANALYSIS PLAN	
DRAWN BY: J. R. PICCUITO	DATE: OCTOBER 14, 1999
CHECKED BY: S. S. PARKER	FILE: ...WOON_TTNUS.APR

FIGURE 2-3



TETRA TECH NUS, INC.

55 JONSPIN ROAD
(978)658-7899

WILMINGTON, MA 01887

3.0 QUALITY ASSURANCE PROJECT PLAN (QAPP)

The QAPP discusses project objectives and QA/QC protocols to be used to achieve the Data Quality Objectives (DQOs). The QAPP is based on the TtNUS Generic Quality Assurance Plan for the U.S. EPA Contract 68-W6-0045, Work Assignment No. 043-ANLA-016P. This QAPP is organized to parallel the U.S. EPA document QA/R-5, "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations", Draft Final, October 1998.

3.1 Project Management

The overall project management, including responsibilities of the personnel involved in performing this work assignment are described in Section 2.1 - Project Organization.

3.1.1 Project Task/Organization

The overall TtNUS project organization and responsibilities of key management personnel are discussed in Section 5.0 of the Draft Work Plan, dated August 1999.

3.1.2 Problem Definition/Background

As stated in Section 1.0, the purpose of this work assignment is to conduct additional sampling in areas that may have been impacted by contamination released from the Centredale Manor Site that was subsequently transported and deposited in adjacent and downstream areas by the waters of the Woonasquatucket River. The goal of the sampling is to identify the extent to which these releases and their subsequent transport and deposition have contaminated the sediments and surface waters of the Woonasquatucket River and soils of adjacent riverbank and floodplain areas. This data will be used to perform human health and ecological risk assessments, and engineering evaluations.

Historical records of the Centredale Manor Site indicated that it was formerly occupied by the Metro Atlantic Chemical Company. This company manufactured hexachlorophene and received shipments of trichlorophenols. The mill complex was destroyed by fire in the late 1970s. The Centredale Manor apartment buildings were constructed in 1982. During construction of the buildings, 400 drums and 6,000 cubic yards of contaminated soil were removed from the site. Labels indicated that the drums contained caustics, halogenated solvents, PCBs, and inks.

A study conducted in June 1996, by the EPA Narragansett Laboratories and the Providence Urban Initiative Program (EPA, 1996) determined that elevated levels of dioxin were present in fish tissue samples collected from the River. A subsequent study of the Woonasquatucket River conducted by the USEPA (Office of Environmental Measurement and Evaluation (OEME)) in June 1998, found elevated concentrations of dioxin and PCBs in sediments in portions of the river adjacent to, and downstream of, the Centredale Manor Site (EPA, July 1998).

Soil and sediment sampling conducted by EPA START personnel in September 1998 found dioxin present at a concentrations of 10.1 ppb in sediments collected from the exposed bottom of the former Allendale Pond (Weston, March, 1999). Further sampling conducted in February 1999, and again July and August 1999, on the Centredale Manor property and adjacent wetlands also found elevated concentrations of dioxin in soils and sediment.

Under this work assignment, field activities and environmental sampling will be conducted in the Woonasquatucket River sediments adjacent to and downstream of the Centredale Manor Site. The purpose of this investigation is to determine the extent and distribution of dioxin and other contaminants in the rivers sediments, surface water, and in soils located in frequently used riverbank areas, and in residential properties located with the rivers 100-year flood plain. This field investigation will fill existing data gaps, and generate data to support human health and ecological risk assessments and engineering evaluations.

3.1.3 Project/Task Description

The scope of work for this support involves collection and analysis of sediment, soil, and surface water samples from Woonasquatucket River study area. This study focuses on five specific areas that are at and downstream of the Centredale Manor Site where dioxin, PCBs, metals, and other contaminants have been detected. These areas are described in Section 1.1.3 of this SAP. Soil samples will be collected from residential properties located within the 100-year floodplain, and from portions of the riverbank that are frequently used for recreational activities. Shallow and deep sediment samples will be collected from within the river bottom. Surface water samples will be collocated with the sediment samples. The data generated by this work will be used for ecological and human health risk assessment and other engineering evaluations. The scope also includes collection and compilation of analytical data generated by previous investigations into a database for future evaluation purposes.

3.1.4 Data Quality Objectives and Criteria for Measurement Data

DQO development focuses on identifying the end use of the data to be collected and on determining the degree of certainty with respect to precision, accuracy, representativeness, completeness, and comparability (PARCC) necessary to satisfy the intended use of the data. To ensure that analytical data conforms to the specified criteria, TtNUS will conduct Tier II data validation for these sample results. The analytical methods and field QA/QC samples for soil and sediment samples are summarized in Table 2-3. Analytical methods and field QA/QC samples for surface water are summarized in Table 2-5.

3.1.4.1 Residential and Bank Soil Data Quality Objectives

Surficial soil samples from residential areas within the 100-year flood plain and from the frequently used riverbank areas will be collected for laboratory analysis. Data from analysis of these samples will be used to evaluate human health risk and to perform

engineering evaluations for possible remedial actions. Sample analyses for the residential soils will include metals, pesticides/PCBs, HCX, dioxin, and SVOC analyses. Analysis of metals, SVOCs, and pesticides/PCBs will be performed under the CLP. Analysis of dioxin and HCX will be performed by DAS according to the TtNUS technical specification No. S99-RACI-117 (Table 2-3).

Soil samples collected from frequently used riverbank areas will be analyzed for pesticides/PCBs, SVOCs, dioxin, and HCX. These analyses will be performed by DAS according to the TtNUS technical specification (Table 2-3). DAS analysis has been selected for these samples because the percentage of solid may be below 30 percent and because the dioxin contamination may be high in some of these samples.

3.1.4.2 Shallow and Deep Aquatic Sediment Sampling Data Quality Objectives

Shallow sediment samples will be collected at a depth of 0 to 0.5 foot from the river bottom at locations adjacent to and downstream of the Centredale Manor Site. Data from these samples will be used to evaluate human and ecological risks and to support engineering analysis for remedial actions. The sediment samples will be analyzed through DAS for pesticides/PCBs, SVOCs, metal, acid volatile sulfide/simultaneous extracted metal analysis (AVS/SEM), TOC, grain size, dioxin, and HCX. DAS analysis will be performed according to the TtNUS technical specification (Table 2-3).

The deep sediment samples will be collected from three intervals, one at 0.5 to 2.0 foot bgs, one at 2.0 to 4.0, and one at 4.0 to 6.0 feet bgs, at a subset of the shallow sample locations. These samples will be collected to evaluate the vertical extent of contamination in areas favorable to sediment deposition. Evaluation of this data will likely lead to more targeted sample collection in these areas that will be used to support engineering evaluation of sediment removal or other potential corrective actions. The deep sediment samples will be analyzed for pesticides/PCBs, SVOCs, metals, dioxin, and HCX. These samples will be analyzed by DAS according to the TtNUS technical specifications listed in Table 2-3.

3.1.4.3 Surface Water Analyses Data Quality Objectives

Surface water samples are to be collected collocated with the shallow aquatic sediment samples. Data from these samples will be used to identify possible contaminant transfer from sediment to water and to support evaluation of human and ecological risks. The surface water samples will be analyzed under the CLP for pesticides/PCBs, SVOCs, metals and through DAS for dioxin, and HCX (Table 2-5).

3.1.5 Special Training Requirements/Certification

To comply with the OSHA requirements, all TtNUS employees and subcontractors working on site in hazardous waste site investigations will receive the 40-hour health and safety training course prior to beginning work on the Site. Supervisory personnel receive the 8-hour supervisor training.

All field team members will review the associated Work Plan, this SAP; the HASP included as Appendix A of this document, and all applicable SOPs. In addition, a field orientation meeting will be held with the Project Manager, Lead Chemist, and the Office Health and Safety Manager prior to initiating the sampling event to familiarize field team members with the scope of the field activities.

Project team personnel are trained in the specific procedures to be followed during the execution of the work, including but not limited to project QA/QC requirements, soil, sediment and surface water sampling, chain of custody, document control, test and inspection methods, calibration, and in particular the general provisions of this QAPP and its supporting procedures and guidelines.

3.1.6 Documentation and Records

Documentation procedures to be used in the field investigation are described below.

3.1.6.1 Site Log Book

A bound site log book (notebook) will be maintained by the FOL. The FOL or designee will record all information related to sampling or field activities. This information will include field personnel, daily activities and progress, site visitors, field modifications, job related phone calls, daily sample summary, sample shipment information, weather conditions, and unusual events, etc. Additional field logbooks (notebooks) will be used to cover specific tasks (sample time, field measurements, descriptions of photographs); however, the site logbook will contain a summary of each day's activities, and will reference the other field notebooks and field forms when applicable. The requirements of the site logbook are outlined in SOP SA-6.3, Section 5.2.

3.1.6.2 Sample Log Sheets

The field team will complete sample log sheets for the soil, sediment, and aqueous samples collected. The sample log sheets contain information about sample location, date, and time of the sample collection, as well as a sample description, analysis, and sample container lots. Sample logsheets are included in Appendix B.

3.1.6.3 Packing List/Chain-Of-Custody Record and Custody Seal

The original packing list/chain-of-custody (COC) record will be completed by the FOL (or designee). The completed COC will be enclosed in plastic and secured to the inside lid of the sample cooler for shipment to the laboratory. If multiple coolers are required to ship a single set of samples, the chain-of-custody form will be included in the cooler labeled "cooler #1 of X". A copy of the chain of custody form is retained for the project files. An Organic and Inorganic Traffic/Chain-of-Custody form is sent to the CLP laboratories; a DAS Packing List/Chain-of-Custody form is sent to the DAS laboratories. Shipping coolers are sealed with tape and two signed and dated custody seals are placed across the cooler opening. Copies of these chain of custody forms and the custody seals are contained in Appendix B.

The laboratory custodian receiving the samples signs and dates the chain-of-custody records to acknowledge receipt of the samples. The laboratory is then responsible for maintaining sample custody records and returning the original chain-of-custody form with the data analysis results.

3.1.6.4 Field Modification Record

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

1. If a substantial change is required, the FOL or designee notifies the TtNUS Project Manager of the need for the change.
2. If necessary, the Project Manager will discuss the change with pertinent individuals, e.g., the EPA Region I RPM, and will provide verbal approval or denial to the FOL or assistant FOL for the proposed change.
3. The FOL will document the change on a Field Modification Record (FMR) form (see Appendix B) and forward the form to the TtNUS Project Manager at the earliest convenient time.
4. The Project Manager will sign the form and distribute copies to the TtNUS Program Manager, Quality Assurance Officer, FOL, and the project file.
5. A copy of the completed FMR form will also be attached to the field copy of any affected documents, i.e., Sampling and Analysis Plan.

3.2 Measurement/Data Acquisition

This section describes the sampling design selected to achieve the objectives of the investigation. The sampling methods, handling, analytical requirements and methods, and QA/QC requirements are discussed. In addition, information about the instrumentation type, maintenance, calibration, and data management is also described.

3.2.1 Sampling Design

Sampling activities will be carried out in the Woonasquatucket River Sediment Investigation study area to determine the concentration and distribution of dioxin and other contaminants in the soils, sediments and surface water within the portions of the river and selected riverbank, and 100-year floodplain areas that are located adjacent to and downgradient of the Centredale Manor Site. This information will be used to perform human health and ecological risk assessments and engineering evaluations of possible remedial actions.

Three elements were considered during the design of the sampling and analysis program. The first is to have data of high quality that can be used for the objectives of the project. This is achieved using proven collection and analytical procedures, and by performing QC checks of the resulting data through various stages and through validation procedures. The second is to assure the number of samples are adequate for the end use of the data which will include risk assessment and some basic statistical analysis. The third is to assure that the samples are representative of the area of concern, and for this consideration, target sample depths were determined to be representative of the exposures measured. These considerations for each sample group are described below and in the sections that follow.

3.2.1.1 Residential and Bank Soil Sampling

A total of 114 soil samples will be collected, 88 from Residential properties and 24 from the Bank areas will be collected (see Figures 2-2 and 2-3). All soils samples will be collected by hand according to Section 5.3 of TtNUS SOP SA-1.3, using decontaminated bucket augers or stainless steel trowels as described in Section 2.3.2.

The location of soil samples on residential properties was determined using the limits of the 100-year flood plain, distance from the Site, and likelihood of deposition, etc., as a guide (See Table 2-1A). A minimum of three samples (includes only one for analysis only CLP) will be collected for each selected property to provide the most basic evaluation of variation of contaminant concentrations within a small area (each lot is approximately 5,000 square feet). This approach will also provide an adequate sample number for performance of a human health risk assessment for three areas that could be considered separate neighborhoods.

The bank soil sample locations are intended to sample areas that are frequently used for recreational activities, primarily fishing, and boating. The bank sample locations have been determined during a previous site visit and are based on visual evidence of recreational use. A minimum sample size of 24 has been selected for the bank samples, as these will be used for a recreational exposure scenario in the human health risk assessment. Two bank reference stations (three samples each) will also be sampled as described in Section 2.3.2 of this SAP.

Residential soil samples will be collected from a depth of 0 to 1 foot bgs, whereas bank soil samples will be collected from a depth of 0 to 0.5 foot bgs. The 0-1 foot depth interval has been selected for residential exposures based on typical residential activities including gardening, landscaping, etc. The 0 to 0.5 foot interval selected for the recreational exposure has been selected as the depth of sediment likely to be contacted by a person accessing a muddy shoreline for fishing or launching hand-carried boats.

3.2.1.2 Surface and Deep Aquatic Sediment Sampling

Surface sediment samples will be collected from 50 pre-determined locations (see Figures 2-2 and 2-3) at a depth interval of 0 to 0.5 foot bgs. These samples will be analyzed for pesticides/PCBs, SVOCs, metals, TOC, grain size, SEM/AVS, dioxin, and HCX. The TOC and AVS/SEM analytes will help to evaluate the bioavailability of contaminants to receptors that may use or be present in the river. This data will be used for determination of human ecological risks.

The number of samples and their locations as described in Section 2 has been selected as adequate for characterization of two basic types of environments that are present within the study area: fast moving riffle/run (lotic habitat) areas and slow moving river or ponded (lentic habitat) areas. Understanding that different receptors may be present in these two types of areas, these sample groups will allow ecological risk assessors a minimum sample size to provide risk analysis on each of these types of aquatic habitats. This sample depth has been selected as a likely zone of bioturbation of the sediment, and is therefore likely to represent the sediment exposure pathway for most ecological receptors during feeding, breeding or other activities.

Three additional deep sediment samples will be collected if possible at 15 locations in historical deposition areas (Figures 2-2 and 2-3). These locations are a subset of the 50 surficial sample locations. These samples will be used to provide some preliminary information on the deposition of contaminants in different parts of the study area, and to help define volumes of sediment that may be impacted by site contaminants.

These deep samples will be collected from the 0.5 to 2.0-foot, 2.0 to 4.0 foot and 4.0 to 6.0-foot intervals. These intervals have been selected to provide data that would be used to form a preliminary understanding of vertical contaminant distribution in portions of the river with hydrological characteristics that are favorable to deposition. Collection of samples from additional depth intervals may be warranted after the findings of this study are evaluated.

3.2.1.3 Surface Water Sampling

Surface water samples will be collected collocated with the aquatic sediment samples (Figures 2-2 and 2-3) where surface water is present, as well as within the reference areas described in Section 1 of this SAP. Water samples will be collected prior to collection of sediment samples, starting at the most downstream location and proceeding upstream. Water samples will be collected to evaluate the potential for contaminant transfer to surface water from sediment. If contaminants are found in surface water, additional risks could be present to human and ecological receptors and results would be used for risk assessments.

3.2.2 Sampling Methods Requirements

Soil and surface water sample collection, including sampling methods and equipment decontamination procedures is discussed in Sections 2.3.2, 2.3.3, and 2.3.4.

3.2.3 Sample Handling and Custody Requirements

Custody of samples will be maintained at all times and documented in the chain-of-custody forms (Section 3.1.6.3). Chain of custody begins at the time the sample is collected and is maintained by storing the samples on ice in coolers that are locked or are sealed with a custody seal. The chain-of-custody forms are shipped to the laboratory with the samples. Each sample collected will be assigned a unique sampling tracking number. Organic and inorganic CLP sample numbers will be assigned to all samples to be analyzed through the CLP. DAS sample numbers assigned to TtNUS will be assigned to all DAS samples.

Each sample collected will be assigned a unique sample location tracking number. The sample location identification system is described in Section 2.3.2.7. The sample identification system is based on discussions presented in SOP CT-05. The sample location tracking number will consist of a four- to five-segment, alpha-numeric code that identifies the site, sample medium, location, and sample depth (in case of soil samples).

These numbers will be standardized to fit database fields and to for allow simplified data queries and searches.

Serialized EPA sample tags are attached to all samples submitted for CLP analysis. The sample containers, preservatives, maximum allowable sample holding times before sample extraction, digestion, or analysis are presented in Table 2-4.

3.2.4 Analytical Methods Requirements

A summary of analytical methods is presented in Tables 2-3 and 2-5. The soil and surface water samples will be analyzed through the CLP by EPA Methods OLM03.2 and ILM04.0, and sediment will be analyzed as specified through DAS, by TtNUS Technical Specification No. S99-RAC1-117 and S99-RACI-118.

The TtNUS technical specifications contain the method of analysis, instrumentation, detection limits, QC criteria, corrective action measures, sampling schedules, sample numbers, communication contact, and delivery requirements.

3.2.5 Quality Control Requirements

The quality control procedures refer to both field and laboratory control operations. The results from analysis of field and laboratory QC samples are used to document data quality and to control the data acceptance within previously established check limits in order to meet the DQO requirements for the project.

The quality control procedures for CLP analyses are included in the specific CLP statements of work listed in Tables 2-3 and 2-5. The quality control requirements for the DAS analyses are included in the TtNUS technical specifications No. S99-RAC1-117 and S99-RACI-118. Quality control criteria include requirements for laboratory blank acceptance, instrument calibration, initial and continuing calibration, instrument

performance check, reagent standardization checks, matrix spikes recoveries, laboratory precision requirements, and other method-compliant QC results.

3.2.5.1 Standard Operating Procedures

This section describes the applicable TtNUS and U.S. EPA Region I SOPs to be utilized under this SAP. These SOPs are provided in Appendix D.

TtNUS SOPs:

- CT-05 - Database Records and Quality Assurance
- SA-1.2 - Surface Water and Sediment Sampling
- SA-1.3 - Soil Sampling
- SA-6.1 - Non-Radiological Sample Handling
- SA-6.3 - Field Documentation
- SA-7.1 - Decontamination of Field Equipment and Waste Handling

U.S. EPA SOP:

- Calibration of Field Instruments (Draft Copy, June 3, 1998)-no SOP #

3.2.5.2 Field Quality Control

In addition to periodic calibration of field equipment and appropriate documentation, quality control samples will be collected or generated during sampling activities. Quality control samples include field duplicates and blanks. Each type of field quality control sample is defined below.

Rinsate Blank: Rinsate blanks are obtained under representative field conditions by running analyte-free deionized water through sample collection equipment after decontamination and placing it in the appropriate sample containers for analysis. Sample preservatives must be added to the rinsate blanks. These samples are used to assess the effectiveness

of decontamination procedures. Rinsate blanks are required at a rate of one in ten samples, per matrix, or one per sampling event if fewer than ten samples are collected.

Field Duplicates: Field duplicates will be submitted at the rate of one for every ten samples, per matrix. Field duplicates are collected as collocated samples. Collocated samples are collected by filling water sample containers one after the other, rather than by mixing a sample and then dividing it into two containers. Field duplicates provide precision information regarding homogeneity and distribution of the contaminants; they measure the bias of sub-sampling.

Performance Evaluation (PE) Samples: PE samples will be sent to the laboratory at a rate of one for every 20 samples per analysis and per matrix, or one per sampling activity if fewer than 20 samples are collected per analysis. PE samples will be analyzed for the same parameters as the field samples. PE samples are used to assess laboratory accuracy.

Laboratory QC Samples: Additional sample volume will be collected at the rate of one in 20 samples per analysis for laboratory quality control. Triple water volume is required for organic matrix spike and matrix spike duplicate analysis. Double water volume is required for inorganic spike and laboratory duplicate analysis.

3.2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Maintenance and calibration is the process of providing the degree of care necessary to obtain high-quality production, and ensuring the optimum useful life of fieldwork equipment. The process includes determining of the need for and performing preventative maintenance and rehabilitation.

Maintenance can be divided into four types: routine repair and adjustment, preventive maintenance, emergency repair, and calibration.

Within the maintenance function, routine repair and preventative maintenance are designed to reduce emergency repairs. The effectiveness of these two types of maintenance--repair and prevention--is the key to maximizing production by minimizing equipment downtime and wear.

All field instruments will be tested prior to initiation of field work by the TtNUS Equipment Manager. All equipment must be functioning properly and will be calibrated in accordance with EPA SOP Draft Calibration of Field Instruments (June 3, 1998) and following equipment manufacturers instructions.

3.2.7 Instrument Calibration and Frequency

The equipment used for data collection, laboratory analysis, and health and safety monitoring is calibrated and maintained according to EPA SOP Draft Calibration of Field Instruments (June 3, 1998) and following the specific equipment manufacturers instructions.

Monitoring instruments that will be used during the field investigation activities are listed below. The following instruments will be calibrated prior to daily use and calibration will be checked at the end of each day of use:

- Photo-ionization detector (PID)
- Horiba U-10 Water Quality Checker calibrated for
 - Dissolved Oxygen (DO)
 - pH
 - Temperature
 - Conductivity
 - Turbidity.

During calibration, an appropriate maintenance check will be performed on each piece of equipment. If damaged or failed parts are identified during the daily maintenance check

and it is determined that the damage could have an impact on the instruments performance, the instrument will be removed from service until the identified parts are repaired or replaced.

Calibration is documented on an Equipment Calibration Logsheet, which is presented in Appendix B.

3.2.8 Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and consumables will meet the requirements of the specific task. The TtNUS Equipment Manager and the FOL perform the inspection of consumables and supplies for use in the project.

The TtNUS Quality Assurance Manual and the TtNUS Procurement Policies will be applied for procuring, inspecting, and accepting procured supplies and consumables. The Equipment Manager is responsible for inspecting all instrumentation received for RAC support activities. The Equipment Manager will follow the procedures described in the TtNUS Property Management Manual.

3.2.9 Data Management

Chemical/analytical data generated during the study will be reduced to a concise form. The analytical results will be managed using an existing computer program developed by TtNUS specifically for chemical databases. QA/QC procedures will be implemented to ensure that no errors occur during data entry. The computer operator checks the data entered into the program and the printouts are checked against the original laboratory sheets by a chemist.

Analytical data will be received on diskettes. Organic and metals data from the CLP program will be converted from EPA Agency Standard Electronic Deliverables to Microsoft

Access format using an existing conversion program. DAS analytical data is received in electronic format in Dbase files.

After the data is converted to Microsoft Access format, the data will be checked against the chain of custody for consistency and corrections will be made as necessary. Analytical parameter names will be checked against an existing library table. Laboratory QC sample results will be sequestered in a separate table.

Draft data validation tables will be printed. During data validation the tables will be marked up. The marked-up tables will be used to edit the database. Final data validation tables will be printed and submitted to the project files with accompanying memoranda.

Data will be retained in a database by Tetra Tech NUS, Inc. This database will be updated at each step of the process described above, and either transferred electronically to the users or maintained at a secure website developed by the EPA or their contractors. The data collected prior to this study will also be included in this database so that GIS queries can be made of the entire dataset, and other users can acquire data as needed for risk assessment and other evaluations.

3.3 Assessment/Oversight

The activities for assessing the project implementation and the associated QA/QC are described in this section.

3.3.1 Assessments and Response Actions

The assessment actions needed to satisfy the project requirements will include the following activities:

3.3.1.1 Field Audits

Quality assurance audits will be performed by the Quality Assurance Officer (QAO) or QA Representative during field investigations. The audits will include checks on adherence to the QAPP, this SAP, and all applicable SOPs.

The QAO will prepare audit checklists or audit guidelines. The depth and scope of the audit will be determined and incorporated into the checklist or guidelines. At a minimum the audit will cover the following items:

- Adherence to sample collection QAPP and SOPs
- Chain of custody
- Documentation of field activities consistent with the SOP
- Equipment maintenance and calibration
- Training requirements for site workers
- Documentation of variances from field activities and corrective actions.

The QAO will record each finding of nonconformance on a Quality Notice report submitted to the Project Manager. The distribution of the audit report includes the RAC Program Manager, Project Manager, FOL, and the Program and Project QA/QC files. Any findings that require immediate corrective action will be communicated immediately to the FOL and to the Project Manager.

3.3.1.2 Performance Evaluation Samples

Performance Evaluation (PE) samples are sent to the laboratories with every group of field samples to evaluate the method accuracy for the matrix analyzed. The PE results are evaluated by EPA and used in validating the data of the associated sample results.

TtNUS subcontracted laboratories will be audited prior to contract assignment. PE samples will be submitted periodically to assess the subcontractor performance. If needed, corrective actions will be implemented prior to repeating the sample analysis.

3.3.1.3 Corrective Action Program

The corrective action program includes finding a non-conformance condition, studying the root cause, implementing the corrective action, and verifying the corrective actions effectiveness.

The identification of significant conditions adverse to quality, the cause of the conditions, and the corrective actions will be documented by the QAO and reported to the appropriate levels of management. The TtNUS Project Manager will have overall responsibility for implementing the corrective actions and must identify those persons responsible for initiating corrective actions to remedy immediate effects of the problem.

3.3.2 Reports to Management

The Project Manager will communicate on a continuing basis with the EPA RPM in regards to the status of the project. Monthly progress reports with the technical and financial status of the project will be submitted as described in the Work Plan.

The QAO will provide timely input to the TtNUS Program Manager concerning the QA/QC status for the project, including any QA/QC deficiencies noted.

Field Summary Reports will be completed by the FOL to document the field activities. The reports will be sent to the TtNUS Project Manager weekly and transmitted monthly to the EPA RPM. At the completion of field activities, the FOL will submit to the TtNUS Project Manager all field records, data, field notebooks, chain-of-custody forms, sample log sheets, and field summary reports, etc. The Project Manager will ensure that these

materials are entered into the RAC Program document control system in accordance with RAC I General Operating Procedures (GOP), Section 3.0.

Data validation reports are submitted to the EPA. The TtNUS Lead Chemist will identify in writing to EPA any significant, unsatisfactory problems or trends identified in the analytical data from CLP analysis. If problems are found with the analytical data from DAS analysis, the subcontracted laboratory will be notified and corrective action will be requested.

3.4 Data Validation and Usability

This section describes the data review, data verification, and data evaluation processes necessary to determine whether or not the data conforms to the specified criteria satisfying the project objectives.

3.4.1 Data Review, Validation, and Verification Requirements

Data will undergo data evaluation based on an assessment of the data summary and quality assurance forms consistent with the Region I data validation guidelines. TtNUS will validate the chemical analytical data. All chemical data results from CLP and DAS will be validated consistent with EPA Region I Tier II data validation guidelines, TOC and grain size data results will be validated according to Tier I. Data validation will be conducted according to the procedures listed in Section 3.4.2.

3.4.2 Validation and Verification Methods

Chain-of-custody records for sampling, shipping, analysis, and reporting will be checked for accuracy and completeness. Tier II data validation includes an assessment of the data completeness and laboratory and field QC such as hold time, blank contamination, and instrument calibration. The data validation guidelines are as follows:

- Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, EPA, 6/88 modified by Region I, 2/89.
- Volatile/Semi-volatile Data Validation Functional Guidelines - Part II. Region I EPA New England, December 1996.
- Laboratory Data Validation Functional Guidelines for Evaluating Organic Analysis. Region I EPA, November 1998.

3.4.3 Reconciliation and Data Quality Objectives

The results obtained from the project will be reconciled with the DQOs to satisfy the goals for precision, accuracy, representativeness, and data completeness. Limitations on the use of laboratory or field data will be communicated to the TtNUS Project Manager. Technical reasons for data rejection or qualification will be explained in the data validation report. Reanalysis or new sampling of the locations/samples affected might be required when critical data results do not meet the established DQOs.

APPENDIX A
HEALTH AND SAFETY PLAN

**HEALTH AND SAFETY PLAN
WOONASQUATUCKET RIVER SEDIMENT
INVESTIGATION**

**CENTREDALE MANOR SITE
NORTH PROVIDENCE, RHODE ISLAND**

RESPONSE ACTION CONTRACT (RAC), REGION I

**For
U.S. Environmental Protection Agency**

**By
Tetra Tech NUS, Inc.**

**EPA Contract No. 68-W6-0045
EPA Work Assignment No. 043-ANLA-016P
TtNUS Project No. N0400**

September 1999



TETRA TECH NUS, INC.

HEALTH AND SAFETY PLAN
WOONASQUATUCKET RIVER SEDIMENT INVESTIGATION

CENTREDALE MANOR SITE
NORTH PROVIDENCE, RHODE ISLAND

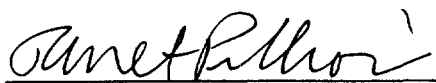
RESPONSE ACTION CONTRACT (RAC), REGION I

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TtNUS Project No. N0400

September 1999


Janet Pillion
Health and Safety Manager

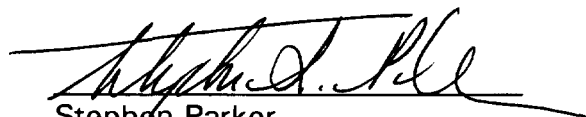

Stephen Parker
Project Manager

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1.0 INTRODUCTION

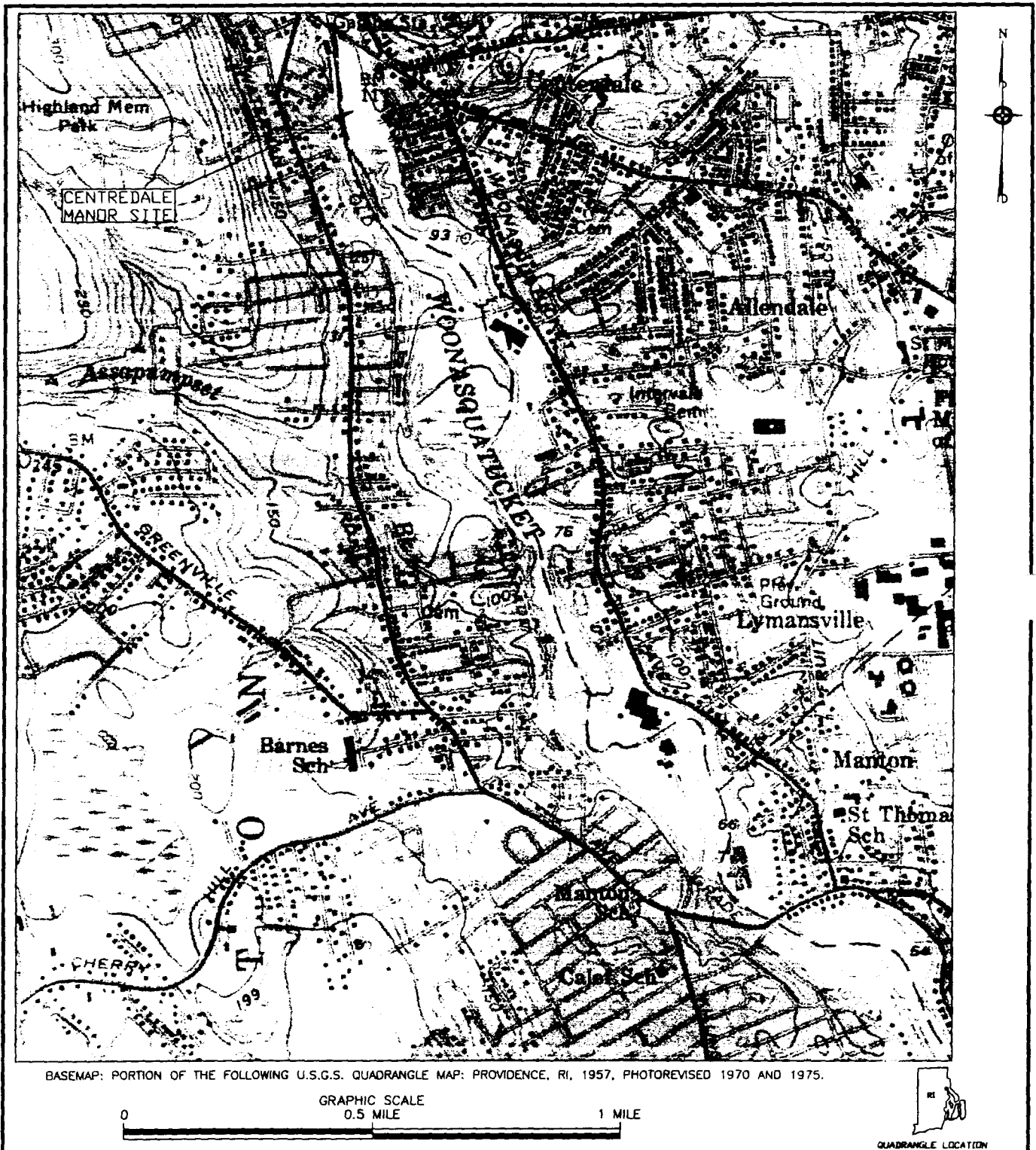
This Health and Safety Plan (HASP) was developed to provide safe work practices and procedures for Tetra Tech NUS, Inc. (TtNUS) and Team Subcontractor personnel engaged in selected site activities to be conducted in support of sediment sampling in the Woonasquatucket River and its tributaries near the Centredale Manor Site, located in North Providence, Rhode Island (Figure 1-1). This HASP is designed to be used in conjunction with the TtNUS Health and Safety Guidance Manual. The TtNUS Health and Safety Guidance Manual provides supporting information pertaining to procedures detailed in the HASP as well as TtNUS Standard Operating Procedures.

This HASP was developed in accordance with the requirements established by OSHA 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response" (HAZWOPER) and sections of 29 CFR 1926 "Safety and Health Regulations For Construction."

This HASP was also developed using information gathered from previous site visits and/or historical site background information regarding known or suspected chemical contaminants, and potential physical hazards associated with the proposed work and the history of the site. This HASP will be modified, as necessary, if new information becomes available. All changes to the HASP will be made with the approval of the RAC Health and Safety Manager (HSM). Requests for modifications to the HASP will be directed to the HSM, who will determine whether or not to make changes. The HSM will notify the Field Operations Leader, who will then notify all affected personnel of the changes.

1.1 Key Project Personnel and Organization

This section defines responsibility for site safety and health for TtNUS and team subcontractor personnel engaged in on-site activities. The specific project personnel (Project Manager and Field Operations Leader) assigned to these positions have primary responsibility for implementing on-site health and safety requirements and the HSM and the Site Safety Officer (SSO) will be the primary points of contact for any questions



SITE LOCUS FIGURE

FIGURE 1-1

CENTREDALE MANOR

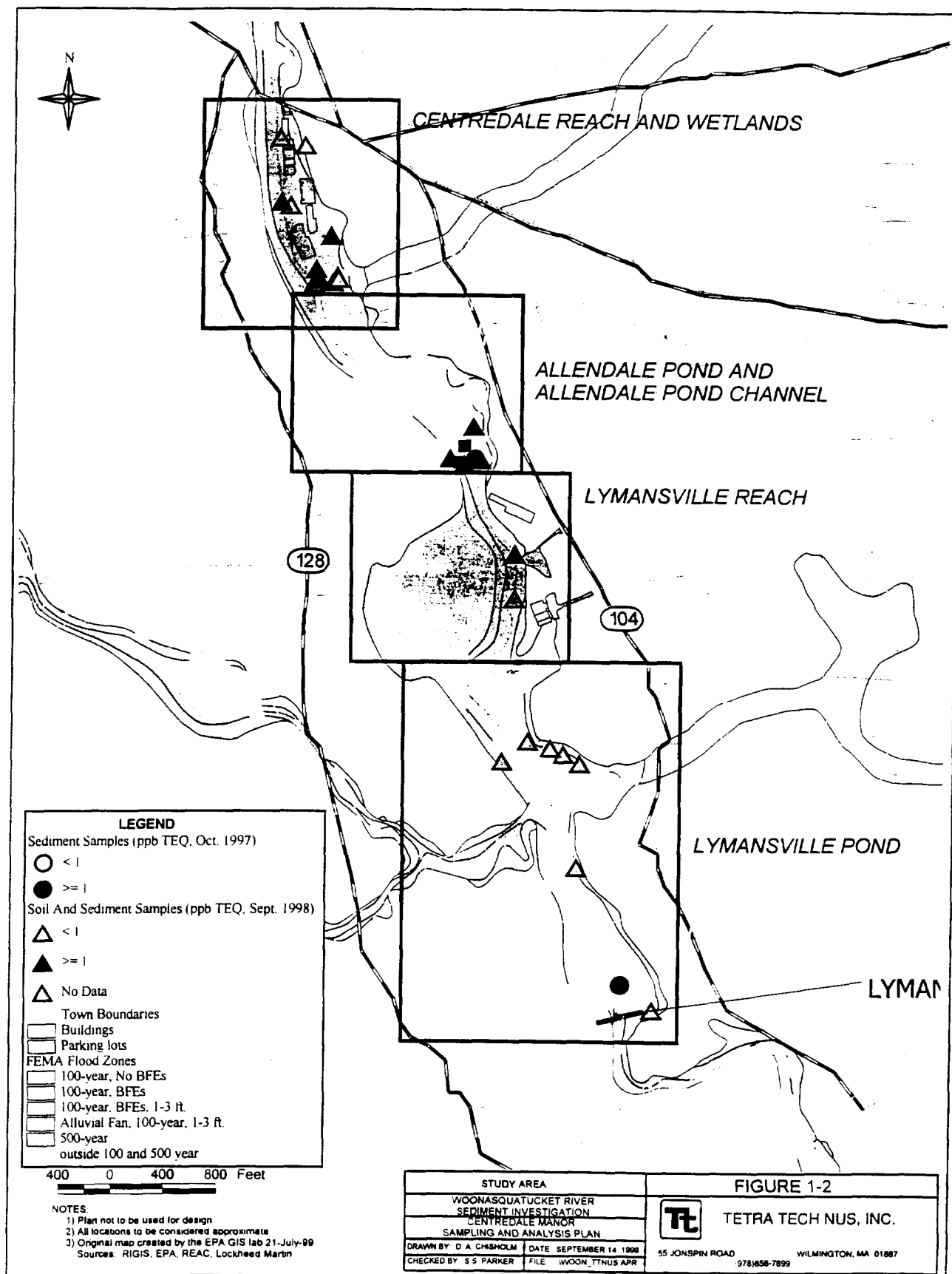
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CHECKED BY:	S. PARKER	DATE:	SEPTEMBER 8, 1999
SCALE:	AS NOTED	ACAD NAME:	DWG\CENTREDALE\HASP.DWG



TETRA TECH NUS, INC.

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 Wilmington, MA 01887



regarding the safety and health procedures and the selected control measures that are to be implemented for on-site activities:

- The TtNUS Project Manager is responsible for the overall direction and implementation of health and safety for this project.
- The TtNUS HSM is responsible for developing this HASP in accordance with applicable OSHA regulations. Specific responsibilities include:
 - Incorporating information regarding site contaminants and physical hazards associated with the site
 - establishing air monitoring and decontamination procedures
 - assigning personal protective equipment
 - determining emergency response procedures and emergency contacts
 - stipulating training requirements and reviewing appropriate training and medical surveillance certificates
 - providing standard work practices to minimize potential injuries and exposures associated with hazardous work
- The TtNUS/Team Subcontractor Field Operations Leader (FOL) is responsible for implementation of this HASP with the assistance of an appointed SSO. The FOL is responsible for all field activities, executes elements of the Work Plan (WP) and enforces safety procedures, as applicable to this HASP and the WP.
- The SSO supports site activities by advising the FOL on all aspects of health and safety on-site. These duties may include:
 - coordinating all health and safety activities with the FOL
 - selecting, applying, inspecting and maintaining personal protective equipment
 - establishing work zones and control points
 - implementing air monitoring procedures for on-site activities

- verifying training and medical status of on-site personnel
- implementing hazard communication, respiratory protection and other associated safety and health programs
- coordinating emergency services
- providing site specific training to all on-site personnel

Compliance to the requirements established in this HASP is monitored by the SSO and coordinated through the TtNUS HSM.

1.2 Site Information and Personnel Assignments

Site Name: Woonasquatucket River Centredale Manor Site

Address: 2074 Smith Street (Route 44), North Providence, RI

Site Contact: None **Phone Number:** NA

EPA Contact: Anna Krasko **Phone Number:** (617) 918-1232

Purpose of Site Work: Perform fieldwork in an effort to evaluate and characterize sediment contamination in support of other EPA activities.

Proposed Dates of Work: September 13, 1999 to September 24, 1999

Project Team:

TtNUS and Team Subcontractor Personnel:

Stephen S. Parker
TBD
Tim Armstrong
Janet Pillion

Discipline/Tasks Assigned:

Project Manager (PM)
Field Operations Manager (FOL)
Site Safety Officer (SSO)
Health and Safety Manager (HSM)

TtNUS Subcontractor Personnel

None

Prepared by: Tim Armstrong

2.0 EMERGENCY ACTION PLAN

2.1 Introduction

This section has been developed as part of a preplanning effort to direct and guide field personnel in the event of an emergency. As needed, site activities will be coordinated with Local Fire Protection and Emergency Services prior to commencement. In the event of on-site emergencies, site personnel will be evacuated to a safe place of refuge and the appropriate emergency response agencies will be notified. Since a majority of foreseeable emergency situations will require assistance from outside emergency responders, TtNUS/team subcontractor personnel will not provide emergency response support beyond the capabilities of on-site response. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of operations, which ensures adequate emergency response time. This Emergency Action Plan, therefore, conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), as designated in OSHA 29 CFR 1910.120(l)(1)(ii).

TtNUS/Team Subcontractor personnel will, through necessary services, provide the following response measures:

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

2.2 Pre-Emergency Planning

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

To minimize and eliminate these potential emergency situations, pre-emergency planning activities associated with this project include the following (which are the responsibility of the SSO and/or the FOL):

- Coordinating with local Emergency Response personnel in order to ensure that TtNUS emergency action activities are compatible with existing emergency response procedures.
- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:
 - List of Phone Numbers for Local Emergency Services
 - Chemical Inventory (used on-site), with Material Safety Data Sheets.
 - On-site personnel medical records (Medical Data Sheets).
 - A log book or sign in logsheet identifying personnel on site.

It will be the responsibility of the TtNUS/Team Subcontractor FOL to ensure specific information is available and present at the site, including:

- The chain of command for emergency action.
- Potential hazards and control measures associated with planned activities at the site, and providing methods for early recognition and prevention when possible.

2.3 Emergency Recognition and Prevention

2.3.1 Recognition

Foreseeable emergency situations that may be encountered during site activities will generally be recognizable by visual observation. Visual observation is primarily relevant for physical hazards that may be associated with the proposed scope of work. However, visual observation will also play a role in detecting some chemical exposures. To adequately recognize exposures to site contaminants, site personnel must have a clear knowledge of the signs and symptoms of exposure associated with the site contaminants. This information is provided in Table 6-1 of this HASP. Potential site hazards, the activities that they have been associated with, and the recommended control methods are discussed in detail in Section 5.0 and 6.0 of this HASP. Additionally, early recognition of emergency situations will be supported by site surveys to eliminate any situation considered predisposed to an emergency. The FOL and the SSO will be responsible for performing site surveys and document them in the Site Logbook. The above actions provide early recognition for potential emergency situations. However, should an incident occur, TtNUS/Team Subcontractor personnel will take measures to control these situations. If the FOL and the SSO determine that an incident has progressed to a serious emergency situation, TtNUS/Team Subcontractor personnel will withdraw and notify the appropriate response agencies listed in Table 2-1.

2.3.2 Prevention

TtNUS and team personnel will minimize the potential for emergencies by following the TtNUS Health and Safety Guidance Manual and complying with the HASP and applicable OSHA regulations.

2.4 Safe Distances and Places of Refuge

In the event that the site must be evacuated, all personnel will immediately stop activities and report to the designated safe place of refuge. Safe places of refuge will be identified prior to the commencement of site activities and will be conveyed to personnel as part of the safety meeting conducted each morning. Whenever possible, the safe place of refuge will also serve as the telephone communications point for that area. During an evacuation, personnel will remain at the refuge location until directed otherwise by the TtNUS/Team Subcontractor FOL or SSO. The FOL or the SSO will take a head count at this location to account for and to confirm the location of all site personnel. Emergency response personnel will be immediately notified of any unaccounted personnel.

2.5 Evacuation Routes and Procedures

An evacuation will occur whenever the health, safety or welfare of site workers is compromised. Specific examples of conditions that may initiate an evacuation include, but are not limited to the following: severe weather conditions; the occurrence of a fire or explosion; readings on monitoring instrumentation indicate levels of contamination that are greater than instituted action levels; or personnel show signs or symptoms of overexposure to potential site contaminants. In the event of an evacuation, personnel will proceed immediately to the designated place of refuge unless doing so would further jeopardize the welfare of workers. In such an event, personnel will proceed to a designated alternate location and remain until further notification from the TtNUS/Team Subcontractor FOL. Evacuation procedures will be discussed before the initiation of any work at the site. Evacuation routes from the site and safe places of refuge are dependent upon the location at which work is being performed and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) may dictate evacuation routes. As a result, assembly points will be selected and communicated to the workers relative to the site location where work is being performed.

TABLE 2-1
EMERGENCY REFERENCE TABLE
HEALTH AND SAFETY PLAN
WOONAQUATUCKET RIVER, CENTREDALE MANOR SITE
NORTH PROVIDENCE, RI

CONTACT	PHONE NUMBER
North Providence Emergency Numbers: Ambulance Police Fire	911 (401) 231-4533 (401) 231-8505
Rhode Island Dig Safe	(800) 225-4977
Poison Control Center	(800) 682-9211
Chemtrec National Response Center	(800) 424-9300
Project Manager: Stephen Parker	 (978) 658-7899
Field Operations Leader: TBD	 (978) 658-7899
EPA Work Assignment Manager Anna Krasko	 (617) 918-1232
Health and Safety Manager: Janet Pillion	 (978) 658-7899

2.6 Decontamination Procedures/Emergency Medical Treatment

During an evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. However, it is unlikely that an evacuation would occur which would require workers to evacuate the site without first performing decontamination procedures.

2.7 Emergency Alerting and Action/Response Procedures

At each site, TtNUS/Team Subcontractor personnel will be working in proximity to each other. As a result, hand signals, voice commands and air horns will be sufficient to alert site personnel of an emergency. Two-way radios may also be used to communicate between site workers.

If an emergency occurs, the following steps are to be taken:

- Initiate an evacuation by hand signals, voice commands, air horn or two-way radios. Report to the designated refuge point.
- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred and as many details as possible. Once all personnel are evacuated, appropriate response procedures will be enacted to control the situation.

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

- Call 911 or other emergency contacts (Table 2-1) and report the emergency. Give the operator the location of the emergency, the type of emergency, the number of people injured, and a brief description of what occurred. Stay on the phone and

follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

2.8 PPE and Emergency Equipment

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

2.9 Emergency Contacts

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

2.10 Emergency Route to Hospital

Directions to the Hospital:

Our Lady of Fatima/ Saint Joseph's Hospital
200 High Service Avenue
North Providence, RI 02940

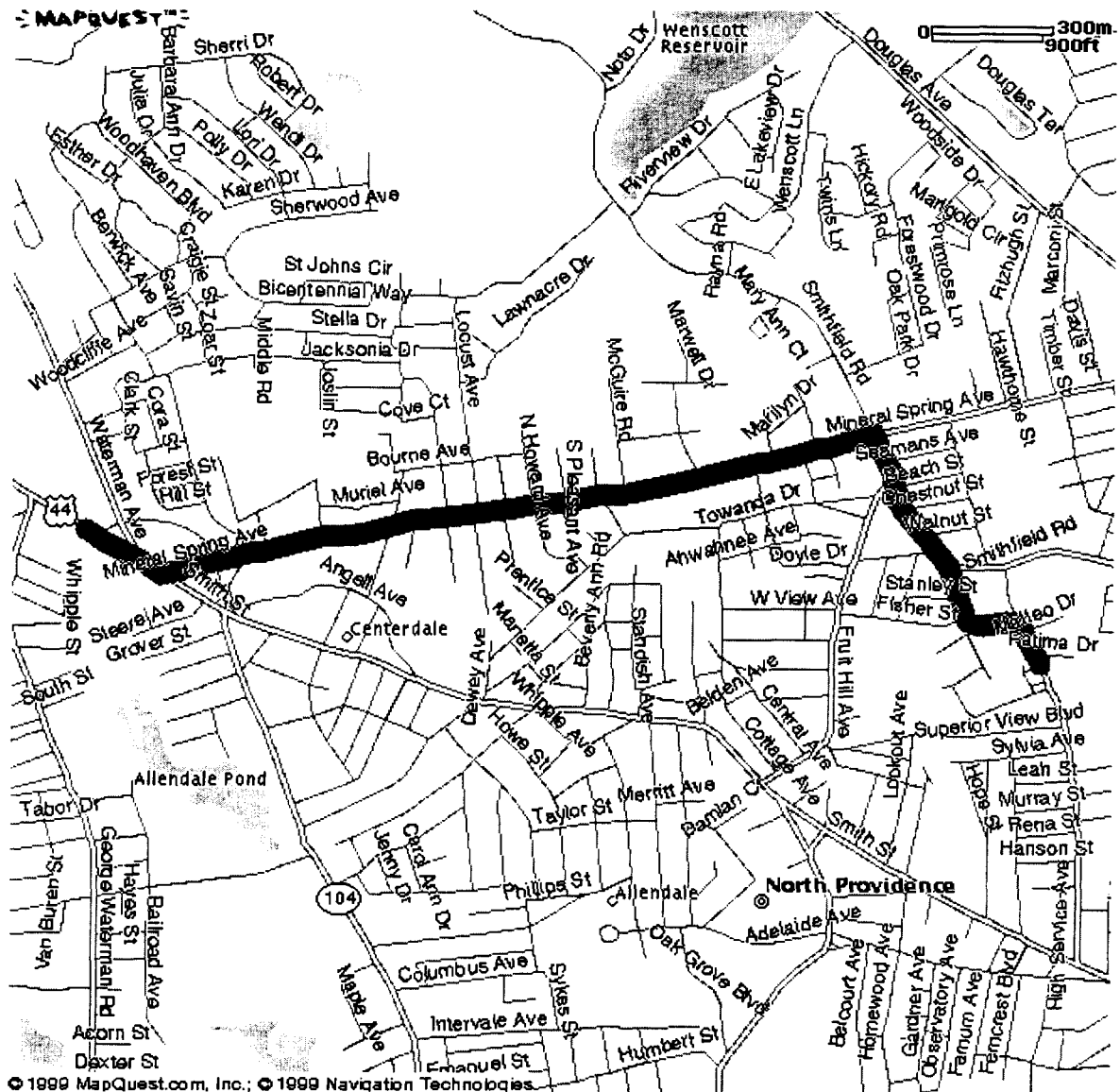
Telephone: (401) 456-3000

Exit Centredale Manor, turn right. Follow Route 44 east for approximately 0.1 miles towards Providence. Make a left onto Mineral Springs Avenue. Follow that for approximately 1.1 mile, turn right onto High Service Avenue. The hospital is approximately 0.5 miles down, on the right.

Driving time is approximately 5 minutes.

Refer to Figure 2-1 for a map to the Hospital.

**FIGURE 2-1
HOSPITAL ROUTE MAP
WOONASQUATUCKET RIVER SEDIMENT INVESTIGATION
CENTREDALE MANOR SITE
NORTH PROVIDENCE, RHODE ISLAND**



3.0 SITE BACKGROUND

3.1 Site Information

The Centredale Manor is a multi-unit apartment complex that houses elderly and handicapped adults. It is located at 2074 Smith Street (Route 44) in Centredale, a village of North Providence Rhode Island. This building, as well as the adjacent apartment building known as "Brook Village", is located on the property of the former Metro-Atlantic Chemical Corporation, which occupied a mill complex on the property from the 1940s to the 1970s. The Woonasquatucket River follows the west boundary of the property, and there is the remains of a raceway for the mill complex on the eastern boundary of the property.

Historical records of Metro-Atlantic Chemical indicate that hexachlorophene was manufactured on site, and there were shipments of trichlorophenols to the site. The mill complex was destroyed by fire in the late 1970s, and the apartment buildings were constructed in 1982. During construction of the apartment buildings, 400 drums and 6000 cubic yards of soil were removed from the site. Drum labels indicated that caustics, halogenated solvents, Polychlorinated Biphenyls (PCBs), and inks may have been contained in the drums.

Elevated levels of dioxin were discovered in fish in June 1996 by a study conducted by EPA Narragansett Laboratories and the Providence Urban Initiative program. Consequently, a study was conducted by the USEPA of the Woonasquatucket River (July 1998) which elevated concentrations of dioxin and PCBs in sediments in portions of the river and impoundments. Soil and sediment sampling was conducted in September 1998 and found dioxin present at concentrations above 1ppb in portions of the river and in Allendale Pond, the first impoundment to the south of the site. Further sampling was conducted in February 1999 on the property of the Centredale Manor and also found elevated concentrations of dioxin in soils and sediment.

In addition, immediately downstream is a large impoundment that serves as a settling basin for sediments, and therefore has the potential to act as a trap for contaminated sediments.

3.2 Working Project Definitions

This section provides definitions of the project site.

3.2.1 Site

The site includes the Centredale Manor Site, the Woonasquatucket River and adjacent wetlands as far south as the Lymanville Dam. Areas where sampling activities are to occur will include river bottoms, riverbanks, ponds, and residential properties located within the 100-year flood plain.

3.2.2 Facility

The facility is the former Metro Atlantic Chemical at 2074 Smith Street, North Providence, Rhode Island. It is currently occupied by the Centredale Manor, an apartment building constructed in the 1980s.

4.0 SCOPE OF WORK

4.1 Summary of Proposed Activities

The Sediment Sample Collection field activities scoped under this HASP include the following:

- Mobilization/Demobilization
- Residential Soil Sampling
- Bank Soil and Sediment Sampling
- Aquatic Sediment Sampling
- Surface Water Sampling
- Deep Sediment Sampling
- Perform global positioning survey (GPS) of each sample location
- IDW characterization and disposal

Refer to the site-specific Work Plan for more detailed information regarding the sampling activities.

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

Table 5-1 of this section serves as the primary portion of the site specific HASP and discusses the contaminants and physical hazards that are associated with each of the proposed tasks that are to be performed at the site. A new Table 5-1 must be developed and incorporated into this document should additional tasks occur at the site. Table 5-1 details the anticipated hazards, recommended control measures, air monitoring recommendations, required Personal Protective Equipment (PPE), and decontamination measures for each site task. This table and the associated control measures will be changed if the scope of work, contaminants of concern, or other conditions change.

By using the table, site personnel can determine the hazards associated with each task, the hazards present at each site, and the associated control measures necessary to minimize potential exposure or injuries related to those hazards. The table also assists field team members in determining which PPE and decontamination procedures to use, based on proper air monitoring techniques and site-specific conditions.

As discussed earlier, this table and HASP are accompanied by the TtNUS Health and Safety Guidance Manual. This manual is designed to further explain supporting elements for any site specific operations as required by 29 CFR 1910.120. This Guidance Manual will be available at the site and should be referenced, as necessary, for additional information regarding air monitoring instrumentation, decontamination activities, emergency response, hazard assessments, hazard communication and hearing conservation programs, medical surveillance, PPE, respiratory protection, site control measures, standard work practices, and training requirements. Many of TtNUS's SOPs are also provided in this Guidance Manual.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
HEALTH AND SAFETY PLAN
CENTREDALE MANOR
NORTH PROVIDENCE, RHODE ISLAND

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Mobilization/ Demobilization	Chemical hazards: Exposure to potential site contaminants are not anticipated during this activity. However, chemicals brought on site in support of field activities are to be identified, logged, accompanied by an appropriate MSDS, properly stored, and evaluated for purposes of hazard communication. Physical hazards: Potential physical hazards associated with this task may include: 1) Strain/muscle pulls from heavy/awkward lifting 2) Pinch/compression points 3) Uneven or unstable terrain (slip, trip, and fall hazards) 4) Natural hazards (insect/animal bites and stings, poisonous plants) 5) Other physical hazards associated with ongoing operations (foot and vehicular traffic)	Chemical Hazards: To eliminate potential chemical hazards associated with this task ensure the following: - A chemical inventory list is generated and MSDSs are available for all chemicals brought on-site (Complete Section 5.0 of the Health and Safety Guidance Manual). - Materials are stored in accordance with recommended practices and according to compatibility (See MSDS for storage and compatibility recommendations). Physical hazards: 1) Use machinery or multiple personnel for heavy lifts. - Use proper lifting techniques. 2) Use pinch bars or other equipment to keep hands from the point of operation. 3) Preview and prepare work locations where unstable/uneven terrain exists. 4) Avoid insect/animal nesting areas, use repellents. Report potential hazards to the SSO. Frequently inspect clothing and persons during and after activities in wooded areas for ticks and other vectors. 5) Set-up work area to reduce exposure to vehicle hazards. Use safety vests and safety cones as necessary.	Not required during mobilization/demobilization. Air monitoring will not be performed during these tasks given that these activities will not be performed in areas of known/suspect contamination.	Mobilization/demobilization activities are intended to initiate and proceed in Level D protection. Level D - (Minimum Requirements) - Standard field attire (Work shirt; long pants; or coveralls) - Safety work boots (Boots with steel toe/shank) - Safety glasses - Hardhat (when overhead hazards exists, or identified as an operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, or as directed on an operation by operation scenario. As a general rule of thumb, if you need to raise your voice to be heard while engaged in conversation with someone who is within 2 feet of your position, you may be exposed to excessive noise levels. If this occurs, use hearing protection. Note: Additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task. The following strategically placed emergency equipment will be maintained during onsite activities: -- Fire Extinguishers -- First Aid Kit -- Emergency Eye Wash -- Cellular phone	As potential site contaminants are not anticipated as part of this task, personal decontamination is not required. All equipment arriving/leaving the site will be inspected prior to permitting this equipment to enter or exit the site. The SSO will inspect the equipment and give the clearance to allow the equipment to pass. All equipment which fails the inspection will have to be decontaminated again to a level acceptable to the SSO prior to passage on or off site.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
HEALTH AND SAFETY PLAN
CENTREDALE MANOR
NORTH PROVIDENCE, RHODE ISLAND
PAGE 2 OF 4

Tasks/ Operation Location	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Sediment and Soil Sampling (surface and subsurface)	Chemical hazards 1) Various organic vapors and air/particulate borne contaminants at low to medium concentrations primarily consisting of dioxin, VOCs, SVOCs, metals, and PCBs. 2) Transfer of contamination into clean areas or onto persons Physical hazards 1) Noise in excess of 85 dBA (not anticipated) 2) Contact with underground utilities (electric lines, gas lines, water lines, etc.) (not anticipated) 3) Strain/muscle pulls from heavy/awkward lifting 4) Uneven or unstable terrain (slip, trip, and fall hazards) 5) Pinch/compression points 6) Other physical hazards associated with ongoing operations (foot and vehicular traffic) 7) Natural hazards (insect/animal bites or stings, poisonous plants, etc.) 8) Ambient temperature extremes	Chemical hazards 1) Use real-time monitoring instrumentation, action levels, and identified PPE to control exposures to potentially contaminated medias (e.g., air, water, soils, etc.). - Identify and physically barricade operational zones where potential contamination may exist to prevent incidental contact and transfer outside of the operational area. 2) Decontaminate all equipment and supplies between sampling locations as well as prior to leaving the site. Physical hazards 1) Excessive noise levels will be mitigated through the use of hearing protection. Any piece of equipment or operation that has the potential to generate excessive noise levels (i.e., you must raise your voice to speak to someone within two feet of where you are standing) will require hearing protection. 2) Prior to subsurface activities more than 2 feet below ground surface clearance shall be obtained through DIGSAFE. The locations of all underground utilities will be identified and marked prior to all subsurface investigations. 3) Use multiple personnel and proper lifting techniques for heavy/awkward lifting. - Use proper lifting techniques. 4) Preview work location for uneven/unstable terrain. Keep work area organized and free from clutter. 5) Use other equipment to remove hands from points of operation. 6) Traffic and equipment considerations are to include the following: - Establish safe work zones and utilize safety cones and/or tape as necessary. - All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility. 7) Wear appropriate clothing and PPE. Avoid potential nesting areas and suspicious vegetation (poison ivy, poison oak, etc.). When feasible and necessary, use commercially available insect repellents. Refer to the Health and Safety Guidance Manual for additional information regarding ticks and Lyme's disease. 8) Wear appropriate clothing for the anticipated weather conditions while maintaining the required level of protection. Terminate or reschedule work if weather conditions are severe.	Direct reading instrument such as photoionization detectors with an 10.6 eV source or flame ionization detectors will be used to detect volatile organic compounds, elemental decomposition products and carrier substances, as applicable. These instruments will only be used as screening devices in the following manner: 1) Source monitoring with a PID/FID will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location(s) which may impact operations crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. - Any sustained reading above 10 ppm in the breathing zone will require evacuation of the area until the breathing zone readings subside or the source of the readings can be identified and quantified.	Activities conducted at areas outside of known deposited contaminated waste are to be initiated in Level D protection. Level D protection constitutes the following minimum protection: - Standard field dress (Long pants and long or short sleeve shirts) - Steel toe/shank workboots These following items will be incorporated during sampling operations: - Disposable nitrile gloves - Safety glasses - Tyvek coveralls - Impermeable boot covers - Hardhat - PVC or PE coated Tyvek will be incorporated if there is a potential for saturation of work attire. (The italicized items are optional as conditions dictate) Tyvek coveralls will not be required for residential soil sampling.	Personnel Decontamination -This function will take place at an area adjacent to the sampling operations. This decontamination procedure for Level D protection will consist of - Equipment drop - Soap/water wash and rinse of outer gloves and outer boots, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Wash hands and face, leave contamination reduction zone Sampling equipment decontamination: All equipment used in the exclusion zone requires decontamination between locations and prior to removal from the site. All site vehicles will be restricted from access to exclusion zones.

TABLE 5-1
TASKS/HAZARDS/TOXICOLOGY DATA
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Task/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Surface Water and Sediment Sampling GPS Survey	Chemical hazards: 1) Various organic vapors at low to medium concentrations. 2) Dermal contact with contaminated water Physical hazards: 3) Deep water hazard in Lymansville Pond. 4) Strain/muscle pulls from heavy lifting 5) Uneven or unstable terrain (slip, trip, and fall hazards) 6) Natural hazards (insect/animal bites and stings, poisonous plants, etc.) 7) Ambient temperature extremes	Chemical hazards: 1) Use real-time monitoring instrumentation, action levels, and identified PPE to identify, quantify, and control exposures to potentially contaminated medias (e.g., air, water, soils). Exposure to dusty conditions will be controlled through the use of water suppression and personnel avoidance of visible dust plumes. 2) Restrict the cross use of equipment and supplies between sampling locations without first going through a suitable decontamination. Physical hazards: 3) Use of PFDs when working in water more than 3 feet deep. Do not work alone. Boats used must not be overloaded beyond USCG rated capacity. No wading into water greater than 2 feet in depth. 4) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 5) Preview work locations for unstable/uneven terrain. Barricade all excavations deeper than 2 feet from access closer than 2 feet from the edge. 6) Avoid insect / animal nesting areas (Do NOT use insect repellents during sampling activities). Report potential hazards to the SSO. 7) Wear appropriate clothing for the anticipated weather conditions while maintaining the required level of protection. If necessary, perform biological monitoring.	Elevated airborne concentrations impacting the field crews or downwind receptors are not anticipated. The following information is provided as a contingency action only. Direct reading instrument such as photoionization detectors with an 10.6 eV source or flame ionization detectors will be used to detect volatile organic compounds, elemental decomposition products and carrier substances, as applicable. These instruments will only be used as screening devices in the following manner: 1) Source monitoring with a PID/FID will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. - Any sustained reading above 5 ppm and less than 100 ppm in the breathing zone will require elevation to Level C until the breathing zone readings subside or the source of the readings can be identified and quantified. - If sustained readings exceed 100 ppm, personnel will immediately evacuate and await further direction from the FOL or SSO. 2) Visible plumes of dusts will be used as a qualitative action level to trigger upgrade to Level C.	All sampling activities are anticipated to proceed in a Level D protection. Level D respiratory protection and the following minimum personal protective equipment: - Standard field dress (Long pants and long or short sleeve shirts) <u>On-Shore</u> - Steel toe/shank safety boots - disposable latex/nitrile glove when sampling - potential for saturation of the work clothes exists, the use of a PE coated tyvek, impermeable boots (covers), and nitriles gloves is required. -safety glasses <u>Off-Shore</u> - Standard field dress - Disposable latex/nitrile gloves - Safety glasses - No steel toe-shank boots required - PFDs required when working near water greater than 3 feet in depth - Rubber boot covers as needed Area evacuation will be required if breathing zone readings are greater than 5 ppm and shall consist of: -Evacuation if no APR is available	Personnel Decontamination - Will consist of a water wash/rinse for non-disposable boots in areas of surficial contamination. This function will take place at an area adjacent to the sampling operations. Equipment decontamination: All non-disposable sampling equipment that comes in contact with sampling media will undergo a soap/water wash and rinse utilizing a suitable potable water source until visibly clean. Sampling equipment may also be high pressure soap/water wash and rinse or steam cleaned. All chemical decontamination will proceed in accordance with the other site documents such as QA/QC, Work Plan, and/or the Sampling Analysis Plan.

TABLE 5-1
TASKS/HAZARDS/TOCIGOLICAL DATA
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Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment*	Decontamination Procedures
Decontamination of sampling equipment	Chemical hazards: 1) Dermal contact – Various organic compounds consisting of dioxin VOCs, SVOCs, and PCBs, and metals 2) Airborne particulate contaminants - Various organic vapors at low to medium concentrations primarily consisting of dioxin, VOCs, SVOCs, metals, and PCBs. Physical hazards: 3) Strain/muscle pulls from heavy lifting	1) Use protective equipment to minimize contact with site contaminants and hazardous decontamination fluids - Have a means by which the eyes and/or skin may be flushed (i.e., portable camp shower, emergency eyewash, etc.) readily accessible. - Refer to MSDS for specific decontamination solvents and to determine appropriate PPE and safe handling procedures. 2) Use multiple persons where necessary for lifting and handling heavy pieces of equipment for decontamination purposes. 3) If necessary, provide stacking racks for air drying of decontaminated equipment to prevent unstable drying stacks of equipment from collapsing.	1) Use visual observation on all equipment and/or areas which have been cleaned and dried to ensure they have been properly cleaned of potentially contaminated medias (e.g., air, water, soils).	For sampling equipment including trowels, split bailers, etc.: Level D Minimum requirements - - Standard field attire (Long and short sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Nitrile gloves - Safety glasses or a splash shield In the event of overspray of chemical decontamination fluids, use PVC Rain suits or PE or PVC coated Tyvek. Respiratory protection is not anticipated for these activities.	This decontamination procedure for Level D protection will consist of - Soap/water wash and rinse of outer gloves - Soap/water wash and rinse of the outer splash suit, as applicable - Wash hands and face and leave contamination reduction zone

6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical and physical hazards associated with the site inspection and the activities that are to be conducted as part of the scope of work. Table 6-1 provides information on the most common and significant substances likely to be present at the site, based on review of available data. Specifically, toxicological information, exposure limits, symptoms of exposure, and physical properties are discussed in the table. Section 6.1 provides a general list of the contaminants that may be present at the site. Section 6.2 lists the physical hazards that may be present at the site or associated with site activities.

6.1 Chemical Hazards

The potential health hazards associated with the field activities include inhalation, ingestion, and dermal contact of various contaminants which are known to be or may be potentially present onsite. There is contaminated soil and sediment containing dioxin, volatile organic compounds, hexachlorophene, trichlorophenols, caustics, halogenated solvents, and inks.

Dioxin is known to be present in sediment at concentrations above 1ppb at some of the areas under investigation. This concentration warrants concern of dermal contact and inhalation/ingestion of soil particles. Field personnel will be alert for dry conditions that could allow inhalation of dust from sampling areas. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (e.g. hand augering/surface or subsurface soil sampling); non-intrusive activities, such as location sample stations with GPS, will be of lesser concern to worker health.

Hazards associated with this investigation include the potential for exposure to site contaminants via dermal contact and by inhalation of dust caused by disturbance of dry soil or sediment.

A chemical hazard evaluation for the work activities is as follows:

Soil Sampling

Soil-disturbing activities present the highest exposure potential of this investigation. Exposure concerns include inhalation of contaminant-laden particulates and/or volatile organic emissions caused by soil disturbance, and direct skin contact with contaminants. The physical hazards associated with these tasks are addressed in the following section and associated task tables.

Surface Water and Sediment Sampling

Exposure concerns include adsorption, by direct skin contact, and ingestion of contaminated water. The physical hazards associated with these tasks are addressed in the following section and associated tables.

Sampling Equipment Decontamination

This task presents a low exposure potential. The primary concern for this task is dermal contact with contaminant-laden particulates and/or volatile organic emissions as a result of decontamination activities. However, the potential for an inhalation or dermal hazard is unlikely due to the limited exposure to site media (e.g. small amounts of residual soil on sampling equipment).

GPS Sample Location Survey

There is limited potential for exposure to chemicals of concern with this activity. The primary concern is dermal contact with contaminated particles. However, the potential for exposure is limited due to the non-intrusive nature of the work.

**TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
4-Chloroaniline		IP: 9.96		PEL: 1 mg/m ³ IDLH: 100 mg/m ³ Carcinogenic		Boiling Pt: 468°F; 242°C Melting Point: Solubility: Flash Point: 261°C LEL/LFL: Not Available UEL/UFL: Density Vapor Density: Vapor Pressure: 0.2 mm Hg Specific Gravity: Incompatibilities: Appearance and Odor: Yellow crystalline solid with a sweet odor	Highly toxic, may be fatal if inhaled, swallowed or absorbed throughout the skin. Effects of contact or inhalation may be delayed
Acenaphthalene	83-32-9 208-96-8	No information found concerning ionization potentials or relative response ratios for PID or FID detection.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection; Sampling and analytical protocol in accordance with OSHA 07 or NIOSH Method #1501	None established for this compound. However, it is recommended that 0.2 mg/m ³ for coal tar pitch volatiles be employed where excessive concentrations may exist. This is more relevant for those PAHs considered carcinogenic.	Information regarding this substance was limited. This material is a natural constituent of coal tar. Adequate - Odor threshold 0.08-0.22 ppm. OSHA accepts the use of air-purifying respirators with organic vapor cartridge up to 10 mg/m ³ , providing cartridges are changed at the beginning of each shift. Recommended gloves: Butyl - > 8.00 hrs; are recommended for other coal tar pitch associated substances; Neoprene > 4.00 hrs; Nitrile > 1.00 hrs	Boiling Pt: 534°F; 279°C Melting Pt: 203°F; 95°C Solubility: Insoluble Flash Pt: Not available LEL/LFL: Not available UEL/UFL: Not available Density: 1.189 Vapor density: 5.32 Vapor Pressure: 10 mmHg Specific Gravity: 1.189 Incompatibilities: Strong oxidizers, caustics, and acids Appearance and Odor: Colorless needles with an aromatic odor at concentrations of 0.08-0.22 ppm	Overexposure may result in irritation to the eyes, nose, throat, and respiratory system.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Aroclor-1260 (Polychlorinated Biphenyl, PCB) It should be noted that this substance is representative of the more common isomers Aroclor - 1242, 1254, which may be encountered.	11096-82-5 53469-21-9 (42%) 11097-69-1 (54%)	Substance is not volatile (VP = 0.00006 mmHg), I.P. is unknown however is anticipated to be elevated, therefore, PID is not anticipated to detect substance. Substance is non combustible and as a result will not be detected by FID.	Air sample using a particulate filter, Florisil sorbent tube with glass fiber filter; hexane desorption; gas chromatography-electron capture detector. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #5503 (PCBs).	OSHA; ACGIH: 0.5 mg/m ³ (skin) NIOSH: 0.001 mg/m ³ IDLH: 5 mg/m ³	Inadequate - However due to the low volatility it is assumed unless agitated this substance does not present a volatile vapor or gas respiratory threat. For dusty conditions where this material may cling to particulates, use a HEPA filter. APRs are approved for escape only when concentrations exceed the exposure limits. Concentrations greater than the exposure limits require PAPR or supplied air respirators. Recommended glove: Butyl rubber > 24 hrs; Neoprene rubber > 24.00 hrs; Silver shield or Viton (for pure product).	Boiling Pt: distillation range 689- 734° F; 365-390°C Melting Pt: -2 to 50°F; -19 to 10°C Solubility: Insoluble Flash Pt: Not applicable LEL/LFL: Not applicable UEL/UFL: Not applicable Nonflammable liquid, however, exposure to fire results in black soot containing PCBs, dibenzofurans, & chlorinated dibenzo-p-dioxins Vapor Density: Not available Vapor Pressure: 0.00006 - 0.001 mmHg Specific Gravity: 1.566 @ 60°F; 15.5 °C Incompatibilities: Strong oxidizers Appearance and Odor: Colorless to pale yellow, viscous liquid or solid (Aroclor 54 below 50°F) with a mild, hydrocarbon odor	This substance is irritating to the eyes and skin. Chronic effects of overexposure may include potential to cause liver damage, chloracne, and reproductive effects. Recognized as possessing carcinogenic properties by NIOSH, and NTP.
Arsenic	7440-38-2	Particulate form - This substance is not detectable using a PID or FID.	Sample with a Mixed-cellulose ester (MCE) filter and analyze using Inductively coupled plasma / atomic emission spectroscopy in accordance with NIOSH Method 7300.	OSHA: 0.010 mg/m ³ (1910.1018) NIOSH: 0.002 mg/m ³ (Ceiling) ACGIH: 0.010 mg/m ³	The substance will generally be present in a particulate form or bound to particulates. As a result, air purifying respirators equipped with High Efficiency Particulate Air (HEPA) filters are suitable for use. Recommended glove: Given this chemicals particulate form, any glove material is suitable for protection. Nitrile is the most common glove material.	Boiling Pt: Sublimes Melting Pt: 1135°F; 613°C Solubility: Insoluble Flash Pt: Not available LEL/LFL: Not available UEL/UFL: Not available Vapor Density: Not available Vapor Pressure: 0 mmHg (approx.) Specific Gravity: 5.73 (metal) Incompatibilities: Strong oxidizers, bromine azide. Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine. Appearance and Odor: Metal - Silver-gray or tin-white, brittle, odorless solid.	Exposure to arsenic may cause ulceration of the nasal septum, dermatitis, gastrointestinal disturbances, respiratory irritation, hyperpigmentation of the skin, and peripheral neuropathy. Arsenic is recognized as a carcinogen by IARC, NTP, OSHA, and ACGIH. Target organs include the liver, kidneys, skin, lungs, and lymphatic system (lung and lymphatic cancer).

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Benzo(a)pyrene	50-32-8	Particulate form - This substance is not detectable using a PID or FID.	Air sample using a glass fiber or silver membrane filter; analysis by gas chromatography/infrared or other spectrophotometric method or colorimeter. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #11186).	OSHA: 0.2 mg/m ³ NIOSH: 0.1 mg/m ³	Adequate - use a full-face air-purifying respirator with dust/mist cartridge up to 10 mg/m ³ . Recommended glove: Nitrile	Boiling Pt: 594°F; 312°C Melting Pt: 354°F; 179°C Solubility: Insoluble Flash Pt: Not available LEL/LFL: Not available UEL/UFL: Not available Vapor Density: Not available Vapor Pressure: 10 mmHg @ 594°F; 312°C Specific Gravity: Not available Incompatibilities: Not available Appearance and Odor: Yellow odorless crystals.	Regulated primarily as a result of potential carcinogenic properties. Listed by NTP, IARC, and ACGIH as carcinogenic.
Bis(2-ethylhexyl) phthalate	117-81-7	No information found This is a combustible liquid therefore the FID should detect it however the relative response ratio is unknown.	Particulate filter; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #5020.	NIOSH; ACGIH: 5 mg/m ³ , STEL 10 mg/m ³ OSHA: 6 mg/m ³ IDLH: 5000 mg/m ³	Irritating, tingling sensation. Recommended APR Cartridge: Organic vapor acid gases with HEPA filter. Recommended gloves: Nitrile > 6.00 hrs has been the one most widely used for the other substances and is acceptable for this substance. Other options include butyl rubber > 8.00 hrs or neoprene > 6.00 hrs	Boiling Pt: 680°F; 386°C Melting Pt: freezes 6.8°F; -14°C Solubility: Insoluble Flash Pt: 419°F; 215°C LEL/LFL: 0.3% @ 473°F; 245°C UEL/UFL: Not available Vapor Density: Not available Vapor Pressure: < 0.01 mm Specific Gravity: 0.99 Incompatibilities: Nitrates, strong oxidizers, acids, and caustics. Appearance and odor: Colorless, oily liquid, odorless	This substance is a mild skin, eye, mucous membrane irritant, and mild gastric disturbance. In test animals liver damage and teratogenic effects have been noted.

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CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Cadmium	7440-43-9	Particulate Form - Unable to be easily detected by PID or FID.	Air sample using a mixed cellulose-ester filter / acid desorption and analysis by atomic absorption-flame. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7300 or #7048.	OSHA: 2 µg/m³ (0.002 mg/m³) ACGIH: 0.01 mg/m³ (total particulate) 0.002 mg/m³ (respirable particulate) IDLH: 9 mg/m³ (as cd)	The use of an air purifying, full face-piece respirator with a high efficiency particulate air filter for concentrations up to 0.25 mg/m³. Recommended Gloves: This is in particulate form. Therefore any glove suitable to prevent skin contact.	Boiling Pt: 1412°F; 767°C Melting Pt: 610°F; 321°C Solubility: Insoluble Flash Pt: Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) LEL/LFL: Not applicable UEL/UFL: Not applicable Vapor Density: Not available Vapor Pressure: 1 mmHg @ 741°F; 394°C Specific Gravity: 8.65 @ 90°F; 32°C Incompatibilities: Strong oxidizers, elemental sulfur, selenium, tellurium, zinc, nitric acid, and hydrazoic acid Appearance and Odor: Metal: Silver-white, blue-tinged lustrous, odorless solid. Fume: yellow-brown, finely divided particulate dispersed in air.	Overexposure to this substance may result in irritation to the respiratory tract, dyspnea, tightness in the chest, coughing, possibly pulmonary edema. Overexposure to fumes causes symptoms characteristic of the flu (headaches, chills, muscle aches, nausea, vomiting, diarrhea). Chronic exposure may result in damage to the lungs, kidneys and liver. This substance has been identified as a confirmed animal; potential human carcinogen by IARC and NTP.
Chlordane	57-74-9	Substance is not volatile (VP = .00001 mmHg) I.P. is unknown, therefore detection by PID is unknown. Substance is non-combustible, therefore a FID is not expected to have a response to chlordane.	Air sample using Chromosorb-102 sorbent tube with mixed cellulose-ester filter or a xad-2 sorbent tube with filter. Toluene desorption and analysis by gas chromatography-electron capture detector. Sampling and analytical protocol will proceed in accordance with NIOSH Method #5510 or OSHA Method #67.	OSHA; NIOSH; ACGIH: 0.5 mg/m³	Adequate - can use an air purifying respirator with an organic vapor & high efficiency air filter cartridges. Recommended gloves: PTFE Teflon for pure product. Nitrile acceptable for incidental contact.	Boiling Pt: 347°F; 175°C Melting Pt: Not available Solubility: Insoluble Flash Pt: Not available LEL/LFL: Not available UEL/UFL: Not available Vapor Density: Not available Vapor Pressure: 0.00001 mmHg Specific Gravity: 1.56 @ 60°F; 15.5° C Incompatibilities: Strong oxidizers and alkaline reagents Appearance and Odor: Amber-colored, viscous liquid with a pungent, chlorine like odor.	Earliest signs of overexposure manifest as hypersensitivity of the central nervous system characterized by hyperactive reflexes, muscle twitching, tremors, incoordination, ataxia, and clonic convulsions. Cycles of excitement and depression may be repeated over and over. Chronic health hazard information similar to those for DDT.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Chromium Compounds	7440-47-3 (Element)	Not detectable by PID. Not detectable by FID.	Air sample using mixed cellulose - ester filter; acid desorption and analysis by atomic absorption. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7024.	OSHA & NIOSH: (Chromium II, III) 0.5 mg/m ³ (Chromium VI) 0.1 mg/m ³ (Ceiling) ACGIH: 0.5 mg/m ³ (Chromium II, III compounds), 0.05 mg/m ³ (Chromium VI compounds) IDLH: 30 mg/m ³ (Chromium VI compounds)	The use of a air purifying, full face-piece respirator with a high efficiency particulate filter for concentrations up to 0.1 mg/m ³ . Recommended Gloves: This is in particulate form. Therefore any glove suitable to prevent skin contact.	Boiling Pt: 4788°F; 2642°C Melting Pt: 3452°F; 1900°C Solubility: Insoluble Flash Pt: Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) LEL/LFL: Not applicable UEL/UFL: Not applicable Vapor Density: Not available Vapor Pressure: 0 mmHg Specific Gravity: 7.14 Incompatibilities: Strong oxidizers, peroxides, and alkalis Appearance and Odor: Appearance and odor vary depending upon the specific compound.	Health hazards are characterized normally through chronic exposure manifesting as histologic fibrosis of the lungs and ulceration of the nasal septum and skin. IARC, NTP and ACGIH list various chromium compounds as possessing carcinogenic properties.
Chrysene	218-01-9	PID: Ionization potential 7.59 eV, relative response ratio unknown. FID: Relative response ratio for FID detection is unknown.	Air sample using 37 mm cassette, glass fiber, binder free, 1.0 micron pore size; HPLC-UV detection. Sampling and analytical protocol in accordance with OSHA 58 or NIOSH Method #1(184).	It is recommended that 0.2 mg/m ³ for coal tar pitch volatiles be employed where airborne concentrations may exist. This is relevant as this PAH is considered to be a suspected human carcinogenic.	Information regarding this substance was limited. This material is a natural constituent of coal tar. Adequate - Odor threshold 0.08-0.22 ppm. OSHA accepts the use of air-purifying respirators with organic vapor cartridge up to 10 ppm, providing cartridges are changed at the beginning of each shift. Recommended gloves: Butyl - > 8.00 hrs; are recommended for other coal tar pitch associated substances; Neoprene > 4.00 hrs; Nitrile > 1.00 hrs	Boiling Pt: 910°F; 488°C Melting Pt: 489°F; 254°C Solubility: Insoluble in water Flash Pt: 143°F; 62°C LEL/LFL: 1.1% @ 200°F; 93°C UEL/UFL: 12.7% @ 275°F; 135°C Vapor Density: 4.07 Vapor Pressure: 0.8 mmHg @ 72°F; 22°C Density: 1.274 Specific Gravity: 1.274 Incompatibilities: Strong oxidizers, strong caustics, and strong acids Appearance and Odor: Crystals	This substance is considered a suspected human carcinogen.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Copper	7440-50-8 (Cu) 1317-38-0 (CuO)	Substance is not volatile. Unable to be detected by PID or FID.	Air sample using a mixed cellulose ester filter; inductively coupled plasma/atomic emission spectroscopy. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7300.	NIOSH; OSHA: 0.10 mg/m ³ ACGIH: 0.2 mg/m ³	The use of an air-purifying full-face respirator with a high efficiency particulate air filter. Recommended gloves: This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	Boiling Pt: 4215°F; 2324°C Melting Pt: 1981°F; 1083°C Solubility: Insoluble Flash Pt: Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) LEL/LFL: Not applicable UEL/UFL: Not applicable Vapor Density: Not available Vapor Pressure: 1 mmHg @ 2962°F 1628°C Specific Gravity: 8.94 Incompatibilities: Oxidizers, alkalis, sodium azide, acetylene, bromates, chlorates, iodates, and acids. Appearance and Odor: Metal: Reddish, lustrous malleable, odorless solid. Fume: Finely divided black particulate dispersed in air.	Irritation to the nose, throat, and respiratory tract. Metallic taste. Discoloration of skin (potential dermatitis) and hair. Chronic exposure may result in dermatitis and damage to the liver and kidneys. Overexposure to fumes causes symptoms characteristic of the flu (headaches, chills, muscle aches, nausea, vomiting, diarrhea). Ingestion may cause burning in the mouth, throat, and stomach. Metallic taste with colicky abdominal pain. Individuals with Wilson's disease are at greater risk of chronic exposure as a result of the body's tendency to absorb and retain copper.
DDT and the major metabolites; DDD and DDE.	50-29-3 72-54-8 72-55-9	Substance is not volatile, I.P. is unknown, detection by PID is unknown. Substance non-combustible, therefore a FID is anticipated to have reduced response to DDT.	Air sample using a binder free, glass fiber filter; isooctane desorption; gas chromatography-electron capture detector. Sampling and analytical protocol will proceed in accordance with NIOSH Method #3(S274).	OSHA; ACGIH: 1 mg/m ³ NIOSH: 0.5 mg/m ³	Adequate - Can use air purifying respirator with high efficiency particulate air filter (HEPA). Recommended glove: Nitrile acceptable for incidental contact.	Boiling Pt: 230°F; 110°C Melting Pt: 226°F; 108°C Solubility: Insoluble Flash Pt: 162-171°F; 72-77°C LEL/LFL: Not available UEL/UFL: Not available Vapor Density: Not available Vapor Pressure: Low Specific Gravity: 0.99 Incompatibilities: Strong oxidizers and alkalis Appearance and Odor: Colorless crystals or off-white powder with a slight aromatic odor	Large doses are followed by vomiting due to gastric irritation, diarrhea may follow. Numbness and paresthesias of the lips tongue and face associated with malaise, headache, sorethroat, fatigue and weakness. Coarse tremors (usually first of the neck, head, and eyelids). This may be accompanied by confusion, apprehension, and depression. Convulsions may result and death may occur from respiratory failure. DDT is absorbed and retained in the fat of humans. Chronic exposure may result in damage to the liver, kidneys and Peripheral Nervous System. DDT is recognized as possessing carcinogenic properties by IARC and NTP.

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Dioxin (2,3,7,8-Tetrachloro- dibenzo-p-dioxin)	1746-01-6	PID: I.P. unknown. FID: Relative response ratio using FID is unknown.	An occupational health / industrial hygiene air sampling protocol was not identified.	OSHA & ACGIH: None established NIOSH: Carc. - lowest feasible concentration	Odor characteristics unknown. For situations where TCDD concentrations are low, an air- purifying respirator may be used. Use an SCBA or supplied-airline for higher or unknown concentrations. SCBA must be worn for all emergency or non- routine operations. Recommended glove: Butyl, Nitrile or Neoprene rubber	Boiling Pt: Decomposes Melting Pt: 581°F Solubility: Negligible Flash Pt: None reported LEL/LFL: None reported UEL/UFL: None reported Vapor Density: solid Vapor Pressure: <0.01 mmHg @ 68° F; 20°C Specific Gravity: 1.118 @ 68°F; 20°C Incompatibilities: None reported. Avoid heat and ignition sources. Appearance and Odor: Solid, colorless needles. No odor reported	Overexposure to materials contaminated with TCDD may cause a severe and disabling acne-like rash (chloracne) that may persist for years, metabolic disorders, and nervous system and liver damage. Acute effects: Inhalation - shortness of breath, headaches, fatigue, severe muscle pains, weakness, and digestive disturbance. Ingestion - nausea, vomiting, and possibly pancreatitis Skin - chloracne & chemical burns reported
General PAHs / Coal Tar Pitch Volatiles / Creosote / cresol (Fluoranthene, pyrene, benzo(a) anthracene, benzo(a) pyrene, benzo(f)fluoranthene, benzo(k)fluoranthene), etc.)	(CAS Numbers vary depending on specific compound)	PID: I.P. of 8.97 eV, relative response ratio unknown. FID: Response factor unknown but given the substances flammability, detection by FID can be anticipated.	Refer to NIOSH methods for each specific compound for appropriate air sampling protocols. Many PAHs can be sampled using <u>NIOSH Method 5506</u> or <u>5515</u> - Teflon filter with support ring - High pressure liquid chromatography with UV detector. For cresol (a major constituent of creosote) by silica gel or xad-7 sorbent tube; Acetone desorption and analysis by gas chromatography - flame ionization detector or high- pressure liquid chromatography. (NIOSH Method #2001, or OSHA Method #32)	General PAHs: Most PAHs have no established exposure limits. Other Coal Tar Pitch Volatiles / PAHs such as Chrysene and benzo(a)pyrene have an exposure limit of 0.2 mg/m ³ (OSHA and ACGIH). 0.1 mg/m ³ - (NIOSH) Creosote / Cresol: OSHA; ACGIH: 5 ppm NIOSH: 2.3 ppm IDLH: 80 mg/m ³	Adequate - use a full-face air- purifying respirator with organic vapor / dust/mist cartridge up to 250 ppm. Cresol has an Odor Threshold of 0.00005-0.0079 ppm. Recommended gloves: Viton > 96.00 hrs; butyl rubber > 90.00 hrs; neoprene > 4.50 hrs	Properties of various PAHs/Coal Tar Pitch Volatiles vary depending upon the specific compound. For Creosote/Cresol: Boiling Pt: 376-397°F; 191-203°C Melting Pt: 52-96°F; 10.9-35.5°C Solubility: Insoluble Flash Pt: 178°F; 81°C LEL/LFL: Not available UEL/UFL: Not available Vapor Density: 3.72 Vapor Pressure: 1 mmHg @ 100-127° F; 38-53°C Specific Gravity: 1.030-1.038 Incompatibilities: Nitric acid, ileum, chlorosulfonic acid, oxidizers Appearance and Odor: Yellowish or colorless, flammable, oily liquid (often brownish because of impurities or oxidation)	Regulated based on effects on respiratory tract and skin irritation Other effects may include eye irritation and central nervous system, disturbances. Acute exposures may result in difficulty breathing, respiratory failure and skin and eye irritation and burns. Chronic exposure may damage the liver, kidneys, lungs and skin and cause photosensitivity. IARC, NTP, NIOSH, ACGIH, and the EPA list some PAHs such as benzo(a)pyrene as a potential carcinogen (ARC 2A, NTP-2, ACGIH TLV-A2, NIOSH-X, EPA- B2).

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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Heptachlor	76-44-8	PID: PID will not detect this substance. FID: FID will not detect this substance.	Sample using a Chrom-102 sorbent tube with toluene desorption. Analyze using Gas chromatography - electron capture detector in accordance with OSHA Method #S287.	OSHA: 0.5 mg/m ³ NIOSH: 0.5 mg/m ³ ACGIH: 0.05 mg/m ³ (skin)	An air purifying respirator equipped with a combination filter for organic vapors, pesticides, and High Efficiency Particulate Air (HEPA) filter is acceptable. Recommended glove: Nitrile or neoprene gloves are adequate for protection against contact with the skin.	Boiling Pt: 293°F; 145°C Melting Pt: 203°F; 95°C Solubility: 0.0006% Flash Pt: Not available LEL/LFL: Not available UEL/UFL: Not available Vapor Density: Not available Vapor Pressure: 0.0003 mmHg Specific Gravity: 1.66 Incompatibilities: Iron and rust Appearance and Odor: White to light tan crystals with a camphor-like odor.	Exposure to this substance may cause tremors, convulsions, and liver damage. Target organs include the Central Nervous System (CNS) and liver. Cases of liver cancer were noted in laboratory animals exposed to heptachlor.
Lindane	58-89-9	PID: will not detect this substance. FID: will not detect this substance.	Sample using a glass fiber, binder free filter with a midjet impinger. Analyze with Gas Chromatography-electrolytic conductivity detector in accordance with NIOSH method 5502.	OSHA: 0.5 mg/m ³ NIOSH: 0.5 mg/m ³ ACGIH: 0.5 mg/m ³ (skin)	An air purifying respirator equipped with a combination filter for organic vapors, pesticides, and High Efficiency Particulate Air (HEPA) filter is acceptable. Recommended glove: Nitrile or neoprene gloves are adequate for protection against contact with the skin.	Boiling Pt: 614°F; 323°C Melting Pt: 235°F; 113°C Solubility: 0.001% Flash Pt: Not available LEL/LFL: Not available UEL/UFL: Not available Vapor Density: Not available Vapor Pressure: 0.00001 mmHg Specific Gravity: 1.85 Incompatibilities: Corrosive to metals Appearance and Odor: White to yellow, crystalline powder with a slight musty odor.	Exposure to lindane may cause irritation to the eyes, nose, and throat, headache, nausea, convulsions, respiratory difficulty, cyanosis (dark bluish or purplish coloration of the skin), aplastic anemia, and muscle spasms. Lindane is listed as a carcinogen by IARC (Class 2B), NTP (Class 2), and EPA (Class B2). Target organs include the eyes, skin, blood, liver, and kidneys.
Methylene chloride	75-09-2	PID: I.P. 11.32 eV, High response with PID and 11.7 eV lamp. FID: 100% response with FID.	Air sample using charcoal or Anasorb CMS sorbent tube; carbon disulfide desorption; gas chromatography-flame ionization detector; Sampling and analytical protocol shall proceed in accordance with OSHA Method #59, 80, or NIOSH Method #1005.	OSHA: 50 ppm, 100 ppm (Ceiling) ACGIH: 50 ppm NIOSH: Lowest feasible concentration IDLH: 2300 ppm	Inadequate - Odor threshold 160 ppm. Use a gas mask with a Type N canister for concentrations up to 25 ppm. In excess of 25 ppm, use a supplied air respirator (airline respirator with emergency escape cylinder or a self-contained Breathing Apparatus - (SCBA)). Recommended gloves: Nitrile rubber latex glove 3.00 hrs (vendor specific); supported Polyvinyl alcohol glove, unsupported 1-8 hrs; Silver shield 1.90 hrs	Boiling Pt: 104°F; 39.8°C Melting Pt: -141°F; -96°C Solubility: 2% Flash Pt: Not available LEL/LFL: 13% UEL/UFL: 12% Vapor Density: 2.93 Vapor Pressure: 380 mmHg @ 72°F; 22°C Specific Gravity: 1.33 Incompatibilities: Strong oxidizers, caustics, metals (i.e. aluminum, magnesium, potassium, sodium, lithium), and concentrated acids Appearance and Odor: Colorless liquid with a chloroform-like odor. (Note: A gas above 104°F; 40°C).	Effects of overexposure may include CNS effects - cause sleepiness, fatigue, weakness, lightheadedness, numbness of the limbs, altered cardiac rate and incoordination. These signs and symptoms may be accompanied by nausea, gastric and pulmonary irritation leading possibly to pulmonary edema. In addition to the narcosis long term effects may include liver injury. Listed as possessing carcinogenic properties by NTP, IARC, and ACGIH.

TABLE 6-1
 CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Pentachlorophenol Synonyms: PCP; Penta; 2,3,4,5,6- Pentachlorophenol				NIOSH/OSHA: PEL: 0.5 mg/m ³ [Skin] IDLH: 2.5 mg/m ³		Boiling Point: 588°F; 309°C Decomposes Melting Point: Solubility: Flash Point: Not Applicable LEL/LFL: Not Applicable UEL/UFL: Not Applicable None combustible solid Vapor Density: Vapor Pressure: 0.001 mm Hg Specific Gravity: Incompatibilities: Appearance and Odor: Colorless to white, crystalline solid with a benzene-like odor (fungicide)	Effect of overexposure include irritated eyes, nose and throat, sneezing, cough, eczema, anorexia, weight loss, headache, dizziness, dyspnea, chest pain, high fever, dermatitis.
Phenanthrene	85-01-8	Ionization potential for this compound is unknown. This material is combustible however the relative response ratio concerning FID detection is unknown.	Air sample using glass fiber filter, 37 mm cassette with pore size ranging from 0.8 to 1.0 microns in size; Gravimetric or HPLC-UV detection; Sampling and analytical protocol in accordance with OSHA Method #58.	It is recommended that 0.2 mg/m ³ for coal tar pitch volatiles be employed where excessive airborne concentrations may exist. This is more relevant for those PAHs considered carcinogenic. This substance is considered questionable regarding carcinogenic potential.	Information regarding this substance was limited. This material is a natural constituent of coal tar. Adequate - Odor threshold 0.055-0.060 ppm. OSHA accepts the use of air-purifying respirators with organic vapor cartridge up to 10 ppm, providing cartridges are changed at the beginning of each shift. Recommended gloves: Butyl - > 8.00 hrs; are recommended for other coal tar pitch associated substances; Neoprene > 4.00 hrs; Nitrile > 1.00 hrs	Boiling Pt: 644°F; 340°C Melting Pt: 212°F; 100°C Solubility: Insoluble in water Flash Pt: Not available LEL/LFL: Not available UEL/UFL: Not available Density: 1.179 @ 77°F; 25°C Vapor Density: 6.14 Vapor Pressure: 1 mmHg @ 245°F; 118.3°C Specific Gravity: 1.025 Incompatibilities: Strong oxidizers, alkalis, and acids. Appearance and Odor: Colorless leaflets with a burnt acid odor.	Overexposure to this substance has shown to be a skin, eye, and mucous membrane irritant. This substance is considered a photosensitizer and mild allergen. This substance is considered mildly to moderately toxic by ingestion.

TABLE 6-1
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Phenol	108-95-2	PID: I.P. 8.37 eV, relative response ratio is unknown. FID: Relative response ratio unknown, however, this substance is considered detectable.	Air sample using XAD-7 tube; methanol desorption; HPLC/UV detection. Sampling and analytical protocol shall be in accordance with OSHA sampling Method #32 or NIOSH Method #3502.	OSHA; NIOSH; ACGIH: 5 ppm, skin NIOSH: 15-minute ceiling 15.6 ppm IDLH: 250 ppm	The odor threshold established for phenol is 0.047 ppm. This is considered adequate. Recommended gloves: Butyl, neoprene, and nitrile in descending order.	Boiling Pt: 359°F; 181.9°C Melting Pt: 40.6°F; 4.7°C Solubility: 9% Flash Pt: 175°F; 79°C LEL/LFL: 1.8% UEL/UFL: Unknown Vapor Density: 3.24 Vapor Pressure: 1 mmHg @ 104°F; 40.1°C Specific Gravity: 1.06 Incompatibilities: Strong oxidizers, calcium hypochlorite, aluminum chloride, acids, formaldehyde, and nitrites Appearance and odor: Colorless to white solid, which turns pink to red if not pure with a sweet acrid odor.	Overexposure to this product may cause severe skin and eye irritation, irritation to corrosion of the respiratory and gastrointestinal tracts. This substance is readily absorbed through intact skin, and may cause dermatitis after limited exposures. Systemically, exposures can cause damage to the liver, kidneys, pancreas, and spleen. Ingestion of as little as 15 grams has resulted in a fatality.
Tetrachloroethylene See also Perchloroethylene PERK PCE	127-18-4	PID: I.P. 9.32 eV, relative response ratio 200% with 10.6 eV lamp. FID: 70% relative response ratio with a FID.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1003.	ACGIH: 25 ppm 100 ppm STEL OSHA: 100 ppm 200 ppm Ceiling; 300 ppm 5-minute max peak in any 3-hr period. IDLH: 150 ppm	Odor threshold for this substance has been determined to be at airborne concentrations of approximately 47 ppm, which is considered adequate. APR with organic vapor/acid gas cartridges should be used for escape purposes only. Exceedances over the recommended exposure limits requires the use of airline or airline/APR combination units. Recommended glove: Viton, PV alcohol 5-16 hrs; silver shield > 6.00 hrs; teflon 10-24 hrs; and Nitrile in that order. The breakthrough time for the nitrile glove ranges between 1.5 - 5.5 hrs. during complete immersion.	Boiling Pt: 250°F; 121°C Melting Pt: -2°F; 19°C Solubility: 0.02% Flash Pt: Not available LEL/LFL: Not available UEL/UFL: Not available Vapor Density: 5.83 Vapor Pressure: 14 mmHg @ 77°F; 25°C Specific Gravity: 1.62 @ 77°F; 25°C Incompatibilities: Strong oxidizers, alkalis, fuming sulfuric acid, and chemically active metals. When heated to decomposition temperatures will emit toxic fumes of chlorine. Appearance and Odor: Colorless liquid with a mild chloroform like odor.	Overexposure may result in irritation to eyes, nose, throat, and skin. Potential CNS effects including sleepiness, incoordination, headaches, hallucinations, distorted perceptions, and stupor (narcosis). Systemically, symptoms may result in nausea, vomiting, weakness, tremors, and cramps. Chronic exposures may result in dermatitis, enlarged tender liver, kidney, and lung damage. This material is considered a animal carcinogen (liver tumors), however, inadequate evidence exists concerning carcinogenic potential in humans.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
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Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Trichloroethylene	79-01-6	PID: I.P. 9.45 eV, High response with PID and 10.2 eV lamp. FID: 70% Response with FID.	Air sample using charcoal tube; carbon disulfide desorption; Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1022 or #1003.	OSHA: 50 ppm 200 ppm (Ceiling) ACGIH: 50 ppm 100 ppm STEL NIOSH: 25 ppm IDLH: 1000 ppm	Inadequate - Odor threshold 82 ppm. APRs with organic vapor/acid gas cartridges may be used for escape purposes. Exceedances over the exposure limits require the use of positive pressure-demand supplied air respirator. Recommended gloves: PV Alcohol unsupported > 16.00 hrs; Silver shield > 6.00 hrs; Teflon > 24.00 hrs; or Viton > 24.00 hrs; Nitrile (Useable time limit 0.5 hr, complete submersion for the nitrile selection)	Boiling Pt: 188°F; 86.7°C Melting Pt: -99°F; -73°C Solubility: 0.1% @ 77°F; 25°C Flash Pt: 90°F; 32°C LEL/LFL: 8% @ 77°F; 25°C UEL/UFL: 10.5 @ 77°F; 25°C Vapor Density: 4.53 Vapor Pressure: 100 mmHg @ 90°F; 32°C Specific Gravity: 1.46 Incompatibilities: Strong caustics and alkalis, chemically active metals (barium, lithium, sodium, magnesium, titanium, and beryllium) Appearance and Odor: Colorless liquid with a chloroform type odor. Combustible liquid, however, burns with difficulty.	Central nervous system effects including euphoria, analgesia, anesthesia, paresthesia, headaches, tremors, vertigo, and somnolence. Damage to the liver, kidneys, heart, lungs, and skin have also been reported. Contact may result in irritation to the eyes, skin, and mucous membranes. Ingestion may result in GI disturbances including nausea, and vomiting. NIOSH lists this substance a potential human carcinogen.
Trichlorophenol						Boiling Point: Melting Point: Solubility: Flash Point: LEL/LFL: UEL/UFL: Vapor Density: Vapor Pressure: Specific Gravity: Incompatibilities: Appearance and Odor:	

Mobilization/Demobilization

These tasks present a low exposure potential. No exposure potential is anticipated during these activities. However, concern for potential exposure during these tasks may exist when conducting work in areas of known or suspected surficial contamination. Personal protective clothing should be worn when the potential may exist for dermal exposure or potential contamination of work clothes.

6.2 Physical Hazards

The physical hazards that may be present during the performance of site activities are summarized below:

- Uneven or unstable terrain (slip, trip, and fall hazards).
- Contact with underground utilities (electric lines, gas lines, water lines, etc.).
- Strain/muscle pulls from heavy or awkward lifting.
- Pinch/compression points.
- Inclement weather.
- Ambient temperature extremes (heat or cold stress).
- Natural hazards (insect/animal bites or stings, poisonous plants)
- Other physical hazards associated with site activities/ongoing operations (proximity to vehicular traffic, etc.).
- Deep water hazard in Lymansville Pond

These physical hazards are discussed in Table 5-1 as applicable to each site task. Furthermore, many of these hazards are discussed in detail in Section 4.0 of the Health and Safety Guidance Manual. Specific discussion on some of these hazards is presented below.

6.2.1 Contact with Underground or Overhead Utilities

Clearance of underground utilities must be coordinated through DIGSAFE (1-888-344-7233). Disturbance of ground below 1.5 feet bgs is not anticipated for this sampling effort.

6.2.2 Heavy/Awkward Lifting

During any manual handling/lifting tasks, personnel are to lift with the force of the load supported by their legs and not by their backs. The correct number of personnel must be used to lift or handle awkward/heavy equipment. These procedures are to be employed to attempt to avoid back strain.

6.2.3 Inclement Weather/Ambient Temperature Extremes

In the event of inclement weather (heavy rain, thunder & lightening, etc.), work will be terminated and will not commence until conditions become safe to do so.

Ambient temperature extremes (heat or cold stress) may exist during performance of this work depending on the project schedule. Work performed when temperatures are below 50°F may result in varying levels of cold stress (frost nip, frost bite, etc.) depending on factors such as temperature, wind speed, and humidity; psychological factors such as metabolic rate and moisture content of the skin; and other factors such as the protective clothing being worn. Work performed when ambient temperatures exceed 70 °F may result in varying levels of heat stress (heat rash, heat cramps, heat exhaustion, and/or heat stroke) depending on factors similar to those presented for cold stress.

For more information concerning the effect and controls for cold and heat stress, see Section 4.0 of the TtNUS Health and Safety Guidance Manual.

6.2.4 Natural Hazards

Given that proposed work will be conducted outdoors and sometimes in brush, marsh, and other natural areas, various animals, insects, or poisonous plants indigenous to the area may be encountered. During warm months (spring through early fall), tick-borne Lyme Disease may be a potential health hazard in the region. Specific information on Lyme Disease is included in Section 4.0 of the Health and Safety Guidance Manual. In general, avoidance of areas of known insect infestation or poisonous plant growth will be the preferred exposure control. In addition, individuals with known allergic reactions to insect bites and poisonous plants should notify SSO prior to engaging in activities where these hazards may be encountered.

6.2.5 Requirements for Water Work

All work performed at or near water greater than 3 feet in depth will require use of a small work boat. Personnel in the work boat will be required to wear short rubber boots and Personal Floatation Devices (PFDs).

Wading is not permitted in water with a depth greater than 2 feet. Chest-type waders are not permitted for use at the site. Boats used for water work must not be overloaded beyond the USGC stated limits as shown on the transom plates. Boats or floating platforms not fitted with transom plates are not to be used for investigation activities.

7.0 AIR MONITORING

Monitoring devices such as Direct Reading Instruments (DRIs) will be used at the site to detect and evaluate the presence of site contaminants and other potentially harmful agents. The specific type of monitoring and the associated instruments, frequency of use, and applicable action levels are dependent upon the specific scope of work and the contaminants of concern. As a result, specific air monitoring measures and requirements will be established in Table 5-1 of this site specific HASP. Section 1.0 of the Health and Safety Guidance Manual contains detailed information regarding direct reading instrumentation and general calibration procedures of various instruments.

Generally, the anticipated air monitoring program will be limited to screening for VOCs at source areas and in the breathing zone using DRIs. No air sampling for airborne contaminant-laden particulates will be performed at any of the study areas during the investigative field work efforts based on the planned activities.

7.1 Photoionization Detector (PID)

A photoionization detector (PID) with a 10.6 eV (or equivalent) lamp may be used to monitor potential source areas and to screen source areas and breathing zones of employees during sampling and other intrusive activities. The PID has been selected because it is capable of detecting organic gases and vapors and some inorganic gases and vapors. Prior to the commencement of any field activities, the background level of the site must be determined and noted. A daily background reading must be taken away from areas of potential contamination to obtain accurate results. These readings, any influencing conditions (i.e., weather, temperature, humidity), and the location will also be documented in the field logbook as a matter of reference.

7.2 Flame Ionization Detector (FID)

A flame ionization detector (FID) may also be used to screen source areas and the worker's breathing zone during sampling and other intrusive activities. The FID is capable of detecting volatile organic gases and vapors using a different operating principle has been included as a backup instrument due to the different principle of operation relative to the PID.

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

This section is included to specify health and safety training and medical surveillance requirements for both TtNUS and team subcontractor personnel participating in site activities.

8.1 Introductory/Refresher/Supervisory Training

All personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at the site. Additionally, TtNUS/Team personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before they can be cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of TtNUS introductory, supervisory and refresher training as well as site-specific training will be maintained at the TtNUS Wilmington office. Copies of certificates or other official documentation will be used to fulfill this requirement. Team subcontractor personnel shall maintain appropriate copies of their training records at their respective office.

TtNUS/Team Subcontractor personnel will also conduct a brief Health & Safety meeting to discuss operations planned for that day. At the end of the workday, a short meeting will be held to discuss the operations completed and any problems encountered.

8.2 Site-Specific Training

TtNUS will provide site-specific training to all TtNUS employees and team subcontractor personnel who will perform onsite work for this project. Site-specific training will also be provided to all personnel (EPA, etc.) who may enter the site to perform functions that may be directly related to site operations. Site-specific training will include:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures

Site-specific documentation will be verified through the use of Figure 8-2. All site personnel and visitors must sign this document upon receiving site-specific training.

8.3 Medical Surveillance

All TtNUS and Team Subcontractor personnel participating in project field activities will have had a physical examination meeting the requirements of a medical surveillance program (per paragraph (f) of OSHA 29 CFR 1910.120) and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained in the TtNUS Wilmington office, and/or respective Team Subcontractor's office, and made available, as necessary.

SITE-SPECIFIC TRAINING DOCUMENTATION

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on-site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of contents of relevant Material Safety Data Sheets

[illegible]

Each field team member entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet presented in Section 7 of the Health and Safety Guidance Manual. This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

9.0 SPILL CONTAINMENT PROGRAM

9.1 Scope and Application

It is anticipated that quantities of bulk potentially hazardous materials (greater than 55-gallons) will be handled during some of the site activities conducted as part of the scope of work. Varying quantities of waste water (decontamination) and Investigative-Derived Wastes (IDW) may be generated as part of site activities. It is not anticipated, however, that spillage of these materials would constitute a significant danger to human health or the environment. Furthermore, it is possible that as the job progresses, that disposable PPE and other non-reusable items may be generated. IDW will be containerized in 55-gallon drums and other unwanted items generated during investigation activities. If needed, samples will be collected and analyzed to characterize the material and determine appropriate disposal measures. Once characterized, the waste can be removed from the staging area and disposed of in accordance with Federal, State and local regulations.

9.2 Potential Spill Areas

Potential spill areas will be monitored in an ongoing attempt to prevent and control further potential contamination of the environment. The areas vulnerable to this hazard include the central staging area and decontamination area.

9.2.1 Site Drums/Containers

All drums/containers used for containing soils and liquids will be sealed, labeled, and staged within a centralized area awaiting shipment or disposal.

9.3 Leak and Spill Detection

To establish an early detection of potential spills or leaks, a periodic walk around by the SSO will be conducted during working hours to visually determine containers are not

leaking. If a leak is detected, the first approach will be to transfer the container contents (using a hand pump) into a new container. Other provisions for the transfer of container contents will be made and the appropriate emergency contacts will be notified, if necessary. In most instances, leaks will be collected and contained using absorbents such as Oil-dry, vermiculite, or sand, which will be stored at the staging area in a conspicuously marked drum. This material will also be containerized for disposal pending analyses. All inspections will be documented in the Project Logbook.

9.4 Personnel Training and Spill Prevention

All personnel will be instructed on the procedures for spill prevention, containment and collection of hazardous materials in the site-specific training. The FOL and/or the SSO will serve as the Spill Response Coordinator for this operation should the need arise.

9.5 Spill Prevention and Containment Equipment

The following represents the minimum equipment which will be maintained at the staging area at all times for the purpose of supporting this Spill Prevention/Containment Program.

- Sand, clean fill, vermiculite, or other noncombustible absorbent (oil-dry);
- Drums (55-gallon U.S. DOT 17-E or 17-H)
- Portable storage tanks (if necessary)
- Shovels, rakes, and brooms
- Hand operated drum pump with hose
- Labels

9.6 Spill Control Plan

This section describes the procedures the TtNUS field crew members will employ upon the detection of a spill or leak.

- 1) Notify the SSO or FOL immediately upon the detection of a leak or spill.
- 2) Employ personnel protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the drum or raising the leak to the highest point. Spread the absorbent material in the area of the spill covering completely.
- 3) Transfer the material to a new container, collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment or disposal options.
- 4) Solid spills will be recontainerized with 2-inches of top cover and will await test results for treatment or disposal options.

It is not anticipated that a spill will occur in which the field crews cannot handle. Should this occur notification of appropriate emergency response agencies will be carried out by the FOL or SSO.

10.0 SITE CONTROL

This section outlines the means by which TtNUS/Team Subcontractor personnel will delineate work zones and use these work zones in conjunction with decontamination procedures in order to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site. This three zone approach will utilize an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants and protect individuals who are not cleared to enter work areas.

10.1 Exclusion Zone

The exclusion zone will be considered the area of the site where there is known or suspected contamination (river, ponds, wetlands, etc.).

10.1.1 DIGSAFE Clearance

Site investigation activities are not anticipated below the surface intervals of soil (less than 1.5 feet). Rhode Island DIGSAFE will be notified of sampling activities, however, it is anticipated that due to the nature of the work in the surface soils and the locations within ponds and rivers, no underground utilities will be present.

Therefore, Digsafe clearance is not required for this effort.

10.2 Contamination Reduction Zone

The contamination reduction zone (CRZ) will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. The personnel and equipment decontamination will take place in this area at a central location to facilitate and

support field activities. When applicable, this area will be delineated using barrier tape and/or cones to inform and direct personnel.

10.3 Support Zone

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

10.4 Site Visitors

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by TtNUS/Team Subcontractor personnel
- Regulatory personnel (EPA, RIDEM, OSHA, etc.)
- Residents of properties at or adjacent to sampling areas

Because the investigation area is public property, and not controlled, only each sample location currently active will be considered secure. All persons who require site access into active sampling locations will be required to obtain permission from the FOL or SSO. Upon gaining access to the site, all site visitors who contact the field team and are interested in observing operations in progress will be escorted by a TtNUS representative (arranged for by the FOL) and shall be required to meet the following minimum requirements:

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper

identification required), the entity which they represent, and the purpose of the visit.

- All site visitors not associated with the sampling team will be required to maintain a safe distance from the active sampling location as determined by the SSO.

Any and all visitors not meeting the requirements stipulated in this plan will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause the termination of all on-site activities until the unauthorized visitor is removed from the premises. Removal of unauthorized visitors will be accomplished with support from the FOL or SSO.

10.5 Site Security

Security of each active sampling location will be the responsibilities of TtNUS/Team Subcontractor personnel as necessary. TtNUS/Team Subcontractor personnel will retain control over active sample locations. The first line of security consists of visual barriers (e.g. safety cones/barrier tape) that restrict the general public. The second line of security will take place at the work site referring interested parties to the FOL. The FOL will serve as a focal point for site personnel, and will serve as the final line of security and the primary enforcement contact.

10.6 Buddy System

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

10.7 Material Safety Data Sheet (MSDs) Requirements

TtNUS and/or Team Subcontractor personnel will provide MSDSs for all chemicals brought on-site. The contents of these documents will be reviewed by the SSO with the user(s) of

the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of all chemicals used on site will be developed using Figure 1 (Section 5) of the Health and Safety Guidance Manual. The MSDSs will then be maintained in a central location and will be available for anyone to review upon request.

10.8 Communication

If personnel are not working in proximity to one another during field activities, a supported means of communication between field crews may be necessary. As a result, two-way radio communication devices may be used by field personnel while at the site.

External communication will be accomplished by using provided cellular telephones.

11.0 **CONFINED SPACE ENTRY**

It is not anticipated, under the proposed scope of work, that permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces.** A confined space is defined as an area which has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized and serious safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the SSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed.

12.0 MATERIALS AND DOCUMENTATION

The TtNUS/Team Subcontractor shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for all chemicals brought on-site, including decon solutions, fuels, sample preservatives, calibration gases, etc.
- Emergency Reference Form (TtNUS H & S Guidance Manual, Section 2.0, extra copy for posting)

12.1 Materials to be Available at the Site

The following documentation is to be available at the site for quick reference purposes. In situations where posting of these documents is not feasible, these documents should be separated and immediately accessible.

Material Safety Data Sheets (MSDSs) - The MSDSs should also be in a central area accessible to all site personnel. These documents should correspond with all of the substances employed on site. It is acceptable to have these documents within a central folder.

Site Clearance Sheet - This list is found within the training section of the HASP (See Figure 8-1). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. This list indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) - This list of numbers and the directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards - Medical Data Sheets will be filled out by all on-site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility.

APPENDIX B
FIELD FORMS



TETRA TECH NUS, INC.

SITE ENTRY LOG

Site Name: _____ Date: _____

Location: _____ Project Number _____

NAME	REPRESENTING	TIME IN (HOURS)	TIME OUT (HOURS)	INITIALS



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: _____
Project Manager: _____
Quality Assurance Officer: _____
Field Operations Leader: _____
Project File: _____

Others as Required: _____



TETRA TECH NUS, INC.

SAMPLE LOG SHEET - LIQUID PHASE

Site Name: _____
Sample ID: _____Tetra Tech NUS Job No./PMS _____
QC Information: _____ (if applicable)Sample Method/Device: _____
Depth Sampled: _____ feet Total Depth _____ feet (SW Only)
Sample Date & Time: ____/____/____ hours
Sampler(s): _____
Date Recorded By: _____
Signature _____

TYPE OF SAMPLE: (Check all that apply)

☐ Groundwater	☐ Trip Blank*
☐ Surface Water	☐ Rinsate Blank*
☐ Residential Supply	☐ Field Duplicate Collected
☐ Grab	☐ Other (Specify): _____
☐ Composite	

*include sample source & lot No.

WELL PURGE DATA:

Micro Tip/OVA Monitor Reading: _____ ppm

Well Depth	feet	Purge Start	hrs	Sampling/Purge Data:				
Inside Diameter	Inches	Purge Stop Time	hrs	Vol. #	Temp °C	pH	Spec. Cond.	DO
				0	_____	_____	_____	_____
				1	_____	_____	_____	_____
				3	_____	_____	_____	_____
				4	_____	_____	_____	_____
Water Level	feet	Total Gallons Purged						
Well Volume	gal.	Purge Method						
Color: _____ Turbidity: CLR/SL CLDY/CLDY/OPAO								

ANALYSIS	BOTTLE LOT NO.	TRAFFIC REPORT NO.		COMMENTS
		ORGANIC	INORGANIC	



TETRA TECH NUS, INC.

SAMPLE LOG SHEET - SOLID PHASE

Site Name: _____
Sample ID: _____Tetra Tech, NUS Job No./PMS _____
QC Information: _____ (if applicable)Sample Method: _____
Depth Sampled: _____ feet
Sample Date & Time: ____/____/____ hours Dup ____ hours
Sampler(s): _____

TYPE OF SAMPLE: (Check all that apply)

_____ Soil	_____ Trip Blank *
_____ Sediment	_____ Rinsate Blank *
_____ Lagoon/Pond	_____ Field Duplicate collected
_____ Grab	_____ Other (Specify): _____

Data Recorded By: _____
Signature

PID/OVA Monitor Reading: _____ ppm

Description: (Sand, Clay, Muck, Peat, Dry, Moist, Wet, Etc.) _____

_____SAMPLE DATA/REMARKS: _____

ANALYSIS	BOTTLE LOT NO.	NOTES/SKETCH:



TETRA TECH NUS, INC.

PHOTOIONIZATION DETECTOR FIELD CALIBRATION LOG

Serial No.: _____

Model No.: _____

Decal No.: _____

Site Name/Location: _____

Tetra Tech NUS Job No./PMS: _____

CALIBRATION DATE	STANDARD GAS- ISOBUTYLENE	CALIBRATION READING Isobutylene Equiv. (ppm)	CALIBRATION CHECK Isobutylene Equiv. (ppm)	SIGNATURE	COMMENTS
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				
	Lot # _____ Conc. = _____ ppm				



TETRA TECH NUS, INC.

FIELD INSTRUMENT CALIBRATION LOG

INSTRUMENT NAME: _____

MODEL NO.: _____

SERIAL NO.: _____

DECAL NO.: _____

TETRA TECH NUS JOB NO./PMS _____

CALIBRATION DATE	INITIAL READING	PROCEDURE	FINAL READING	SIGNATURE	COMMENTS



Serial No.: _____ Model No.: _____ Decal No.: _____

Site Name: _____ Job No.: _____ Buffer Lot No.: _____

Instrument is calibrated in accordance with Manufacturer's Instructions

Tt NUS Form 0023



TETRA TECH NUS, INC.

YSI 6820 MULTIPARAMETER METER

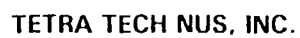
Serial No.: _____ Model No.: _____ Decal No.: _____

Site Name: _____ Job No.: _____

Instrument is calibrated in accordance with Manufacturer's Instructions

DATE:	Pre Calibration Readings	Post Calibration Readings	PM Check	Calibration STDs (lot #'s)	Signature	Remarks
Cond. mS/cm						
pH = 4.0						
pH = 7.0						
pH = 10.0						
D.O. mg/l						
REDOX mV						
Turbidity 0 NTUs						
Turbidity 100 NTUs						
Temp °C						
Salinity 0/00						

DATE:						
Cond. mS/cm						
pH = 4.0						
pH = 7.0						
pH = 10.0						
D.O. mg/l						
REDOX mV						
Turbidity 0 NTUs						
Turbidity 100 NTUs						
Temp °C						
Salinity 0/00						



SAMPLE COLLECTION SUMMARY RECORD

PROJECT NAME: _____

TETRA TECHNUS JOB NO./PMS: _____

SAMPLING EVENT: _____

CASE NO.: _____

DAS NO.: _____

[illegible]

Inorganic Traffic Report & Chain of Custody Record (For Inorganic CLP Analysis)

Case No.

[illegible]

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	Is custody seal intact? Y/N/none

100

DISTRIBUTION:

Green - Region Copy
White - Lab Copy for Return to Region

Pink - CLASS Copy
Yellow - Lab Copy for Return to CLASS

EPA Form 9110-1

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS
*SEE REVERSE FOR PURPOSE CODE DEFINITIONS



TETRA TECH NUS, INC.

RECORD OF FIELD WORK ORIENTATION

Page ____ of ____

SITE: _____

JOB NO.: _____

WORK ASSIGNMENT NO.: _____

TASK OR ACTIVITY: _____

DATE OF ORIENTATION: _____

<u>PERSONNEL ATTENDING</u> <u>MGR.</u>	<u>TRAINERS</u>	<u>FOL</u>	<u>PROJECT</u>
1.	1.	1.	1.
2.	2.		
3.	3.		
4.			
5.			
6.			
7.			

VERIFICATIONS (CHECK AND INITIAL BY ATTENDEES)

WORK PLAN REVIEWED	SAP/QAPP REVIEWED	SOGs REVIEWED	SITE/EQUIP. SECURITY REVIEWED	EQUIPMENT OPERATION	H&S PLAN REVIEWED	PURCHASING	INITIALS
1. _____	_____	_____	_____	_____	_____	_____	_____
2. _____	_____	_____	_____	_____	_____	_____	_____
3. _____	_____	_____	_____	_____	_____	_____	_____
4. _____	_____	_____	_____	_____	_____	_____	_____
5. _____	_____	_____	_____	_____	_____	_____	_____
6. _____	_____	_____	_____	_____	_____	_____	_____
7. _____	_____	_____	_____	_____	_____	_____	_____

RETURN ORIGINAL TO THE QUALITY ASSURANCE OFFICER

Copies to: PROJECT FILE: _____

PROJECT MANAGER: _____

PROGRAM MANAGER: _____

CUSTODY SEAL

Date

Signature



CUSTODY SEAL

Date

Signature



Organic Traffic Report & Chain of Custody Record (For Organic CLP Analysis)

Case No.

[illegible]

CHAIN OF CUSTODY RECORD

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	Is custody seal intact? Y/N/none

[illegible]

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS
*SEE REVERSE FOR PURPOSE CODE DEFINITIONS



ANALYTICAL SERVICE
Packing List/Chain-of-Custody

Case No.

Page _____ of _____

Subcontract No.

Project No.

Laboratory Name:

Container Type

Container Type	Container Number	Container Description	Container Location	Container Status
1	100	100	100	100
2	200	200	200	200
3	300	300	300	300
4	400	400	400	400
5	500	500	500	500
6	600	600	600	600
7	700	700	700	700
8	800	800	800	800
9	900	900	900	900
10	1000	1000	1000	1000
11	1100	1100	1100	1100
12	1200	1200	1200	1200
13	1300	1300	1300	1300
14	1400	1400	1400	1400
15	1500	1500	1500	1500
16	1600	1600	1600	1600
17	1700	1700	1700	1700
18	1800	1800	1800	1800
19	1900	1900	1900	1900
20	2000	2000	2000	2000
21	2100	2100	2100	2100
22	2200	2200	2200	2200
23	2300	2300	2300	2300
24	2400	2400	2400	2400
25	2500	2500	2500	2500
26	2600	2600	2600	2600
27	2700	2700	2700	2700
28	2800	2800	2800	2800
29	2900	2900	2900	2900
30	3000	3000	3000	3000
31	3100	3100	3100	3100
32	3200	3200	3200	3200
33	3300	3300	3300	3300
34	3400	3400	3400	3400
35	3500	3500	3500	3500
36	3600	3600	3600	3600
37	3700	3700	3700	3700
38	3800	3800	3800	3800
39	3900	3900	3900	3900
40	4000	4000	4000	4000
41	4100	4100	4100	4100
42	4200	4200	4200	4200
43	4300	4300	4300	4300
44	4400	4400	4400	4400
45	4500	4500	4500	4500
46	4600	4600	4600	4600
47	4700	4700	4700	4700
48	4800	4800	4800	4800
49	4900	4900	4900	4900
50	5000	5000	5000	5000
51	5100	5100	5100	5100
52	5200	5200	5200	5200
53	5300	5300	5300	5300
54	5400	5400	5400	5400
55	5500	5500	5500	5500
56	5600	5600	5600	5600
57	5700	5700	5700	5700
58	5800	5800	5800	5800
59	5900	5900	5900	5900
60	6000	6000	6000	6000
61	6100	6100	6100	6100
62	6200	6200	6200	6200
63	6300	6300	6300	6300
64	6400	6400	6400	6400
65	6500	6500	6500	6500
66	6600	6600	6600	6600
67	6700	6700	6700	6700
68	6800	6800	6800	6800
69	6900	6900	6900	6900
70	7000	7000	7000	7000
71	7100	7100	7100	7100
72	7200	7200	7200	7200
73	7300	7300	7300	7300
74	7400	7400	7400	7400
75</				

Container Type

Container Type

Container Type
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Sampler Signatures

Date Shipped

Carrier

Analysis

Analysis

Analysis

Analysis

Analysis

Airbill No.

No. of Coolers

Preservative

Preservative

Preservative

Preservative

Preservative

Sample Number

Matrix

Date/Time

Sample Location

Tag Number(s)

QC

Relinquished By:
(Signature)

Date/Time

Received By: (Signature)

Shipment for Case Complete?

Remarks

YES NO

Relinquished By:
(Signature)

Date/Time

Received for Laboratory By:

Date/Time	Location	Activity	Remarks
10/10/2023 10:00	Room 101	Meeting with Mr. Smith	Discussed project progress
10/10/2023 14:30	Office	Writing report	Completed section 2
10/11/2023 09:00	Room 102	Meeting with Ms. Jones	Reviewed documents
10/11/2023 16:00	Office	Reviewing emails	Nothing urgent
10/12/2023 11:00	Room 103	Meeting with Mr. Brown	Discussed new initiative
10/12/2023 15:30	Office	Preparing presentation	Almost ready
10/13/2023 10:30	Room 104	Meeting with Mr. Green	Discussed budget
10/13/2023 14:00	Office	Reviewing contracts	Everything in order
10/14/2023 09:30	Room 105	Meeting with Mr. White	Discussed client feedback
10/14/2023 13:00	Office	Writing email responses	Completed 5 responses
10/15/2023 10:00	Room 106	Meeting with Mr. Black	Discussed marketing strategy
10/15/2023 14:30	Office	Reviewing sales figures	Performance good
10/16/2023 09:00	Room 107	Meeting with Mr. Grey	Discussed HR matters
10/16/2023 13:30	Office	Preparing for tomorrow's meeting	Notes ready
10/17/2023 10:30	Room 108	Meeting with Mr. Gold	Discussed IT support
10/17/2023 15:00	Office	Reviewing project timeline	On track
10/18/2023 09:30	Room 109	Meeting with Mr. Silver	Discussed legal matters
10/18/2023 14:00	Office	Reviewing financial statements	Everything clear
10/19/2023 10:00	Room 110	Meeting with Mr. Copper	Discussed operational issues
10/19/2023 14:30	Office	Preparing for next week's meeting	Agenda set
10/20/2023 09:00	Room 111	Meeting with Mr. Zinc	Discussed customer service
10/20/2023 13:00	Office	Reviewing employee records	Compliance check
10/21/2023 10:30	Room 112	Meeting with Mr. Nickel	Discussed product development
10/21/2023 15:00	Office	Reviewing project budget	Within limits
10/22/2023 09:30	Room 113	Meeting with Mr. Cobalt	Discussed quality control
10/22/2023 14:00	Office	Reviewing customer feedback	Positive response
10/23/2023 10:00	Room 114	Meeting with Mr. Manganese	Discussed supply chain
10/23/2023 14:30	Office	Preparing for next month's meeting	Notes ready
10/24/2023 09:00	Room 115	Meeting with Mr. Iron	Discussed market trends
10/24/2023 13:00	Office	Reviewing sales reports	Good growth
10/25/2023 10:30	Room 116	Meeting with Mr. Steel	Discussed future plans
10/25/2023 15:00	Office	Reviewing project status	On schedule
10/26/2023 09:30	Room 117	Meeting with Mr. Aluminum	Discussed innovation
10/26/2023 14:00	Office	Reviewing employee performance	Excellent results
10/27/2023 10:00	Room 118	Meeting with Mr. Titanium	Discussed sustainability
10/27/2023 14:30	Office	Preparing for next week's meeting	Agenda set
10/28/2023 09:00	Room 119	Meeting with Mr. Vanadium	Discussed risk management
10/28/2023 13:00	Office	Reviewing project timeline	On track
10/29/2023 10:30	Room 120	Meeting with Mr. Chromium	Discussed customer service
10/29/2023 15:00	Office	Reviewing sales figures	Performance good
10/30/2023 09:30	Room 121	Meeting with Mr. Nickel	Discussed marketing strategy
10/30/2023 14:00	Office	Reviewing project budget	Within limits
10/31/2023 10:00	Room 122	Meeting with Mr. Cobalt	Discussed quality control
10/31/2023 14:30	Office	Preparing for next month's meeting	Notes ready

APPENDIX C
DATA QUALITY OBJECTIVES SUMMARY FORMS

TtNUS

FREE WATER WEIGHT DETERMINATION DATA FORM

Sample ID	Sediment "Wet" Wgt ¹ (g)	Weight of Free Water Recovery ¹ (g)	Date/Signature	Soil Description - Comments

¹ - All weight measurements to the nearest 0.1 gram

Filter Blank Test is to be completed in triplicate (once) during sampling program

Saturated Filter Wgt: 1) _____ g 2) _____ g 3) _____ g
Tare wgt of dry filter: _____ g _____ g _____ g
Filter Blank wgt: _____ g _____ g _____ g

Filter Type/Manufacturer: _____

EPA-NE - DQO SUMMARY FORM

Page 1^a of 3

A separate Form should be completed for each sampling event. Refer to Attachment A for instructions on completing this form, Attachment B for a complete list of the parameter codes and Attachment C for an example of a completed form.

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2. QAPP Title and Revision Date <u>Sampling & Analysis Plan, Womasquicket River Sediment Investigation, T.N.W.S. Inc. Sept. 1999</u> Approved by: <u>Anna Krasko</u> Date of Approval: _____ Title of Approving Official: <u>Remedial Project Manager</u> Organization*: _____ *If other than EPA, record date approval authority was delegated: _____ EPA Oversight Project (circle one) Y <u>N</u> Type of EPA Oversight (circle one) PRP or FF Other: _____ Confirmatory Analysis for Field Screening Y <u>N</u> If EPA Oversight or Confirmatory: % splits _____ Are comparability criteria documented? Y <u>N</u>									
3. a.	Matrix Code¹	<u>SO</u>	<u>SO</u>	<u>SO</u>	<u>SO</u>				
b.	Parameter Code¹	<u>OLM03.2</u>	<u>OLM03.2</u>	<u>OLM04.0</u>	<u>8290</u>				
c.	Preservation Code¹	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>				
d.	Analytical Services Mechanism	<u>CLP</u>	<u>CLP</u>	<u>CLP</u>	<u>CLP</u>				
e.	No. of Sample Locations	<u>90</u>	<u>90</u>	<u>90</u>	<u>90</u>				
f.	Field QC:								
g.	Field Duplicate Pairs	<u>9</u>	<u>9</u>	<u>9</u>	<u>9</u>				
h.	Equipment Blanks	<u>9</u>	<u>9</u>	<u>9</u>	<u>9</u>				
i.	VOA Trip Blanks	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>				
j.	Cooler Temperature Blanks	<u>1 Per Cooler</u>	<u>1 Per Cooler</u>	<u>1 Per Cooler</u>	<u>1 Per Cooler</u>				
k.	Bottle Blanks	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>				
l.	Other: _____	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>				
m.	PES sent to Laboratory	<u>6</u>	<u>6</u>	<u>6</u>	<u>12</u>				
n.	Laboratory QC:								
o.	Reagent Blank	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>				
p.	Duplicate	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>				
q.	Matrix Spike	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>				
r.	Matrix Spike Duplicate	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>				
s.	Other: _____								

4. Site Information
 Site Dimensions Not Defined
 List all potentially contaminated matrices Sediment, Soil, Surface water
 Range of Depth to Groundwater _____
 Soil Types: Surface Subsurface Other: _____
 Sediment Types: Stream Pond Estuary Wetland Other: _____ Expected Soil Sediment Moisture Content: High Low

When multiple matrices will be sampled during a sampling event, complete Sections 5-10 for each matrix. Matrix Code: _____

5. Data Use (circle all that apply) Site Investigation/Assessment PRP Determination Removal Actions
Nature and Extent of Contamination Human and/or Ecological Risk Assessment Remediation Alternatives
Engineering Design Remedial Action
Post-Remedial Action (quarterly monitoring) Other: _____

6. Summarize DQOs: Data will be used to determine presence of contamination and for human health & ecological risk assessment. Data will later be used for engineering evaluation of remedial actions

Complete Table if applicable

COCs	Action Levels	Analytical Method-Quantitation Limits

7. Sampling Method (circle technique) Bailer Low flow pump (Region I method: Yes No) Peristaltic Pump
Positive Displacement Pump Faucet or Spigot Other: Sediment Core Tube
Split Spoon Dredge Trower

Sampling Procedures (SOP name, No., Rev. #, and date) Refer to QAP:P Appendices
List Background Sample Locations Refer to QAP:P Figure 2-2
Circle: Grab or Composite
Hot spots sampled: Yes No

8. Field Data (circle) ORP pH Specific Conductance Dissolved O₂ Temperature Turbidity
Other: _____

9. Analytical Methods and Parameters

Method title/SOP name	Method/SOP Identification number	Revision Date	Target Parameters (VOA, SV, Pest/PCB, Metals, etc.)

10. Validation Criteria (circle one) 1. Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part II, III or IV
2. Other Approved Validation Criteria: _____
Validation Tier (circle one) I II III Partial Tier III: _____
Company/Organization Performing Data Validation T+MUS (CLP) and EPA (DAC) Prime or Subcontractor (circle one)

11. Company Name T+MUS Inc. Contract Number 68-426-0045
Contract Name (e.g. START, RACS, etc.) BAC 7 Work Assignment No. 043-ANLA-016P
Person Completing Form/Title Stephen S. Fisher Date of DQO Summary Form Completion 9-14-99
Project Manager

Matrix Codes: - Refer to Attachment B, Part I
Parameter Codes: - Refer to Attachment B, Part II

Preservation Codes¹

1. HCl to pH ≤ 2	7. K ₂ Cr ₂ O ₇
2. HNO ₃	8. Freeze
3. NaHSO ₄	9. Room Temperature (avoid excessive heat)
4. H ₂ SO ₄	10. Other (Specify)
5. Cool @ 4°C (± 2°)	N. Not preserved
6. NaOH	

* - To supplement Matrix Codes and/or Parameter Codes contact the QA Unit

EPA-NE - DQO SUMMARY FORM

Page 2a of 3

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Circle: Grab or Composite
"Hot spots" sampled: Yes No

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Other: _____

9. Analytical Methods and Parameters

Method title/SOP name	Method/SOP Identification number	Revision Date	Target Parameters (VOA, SV, Pest/PCB, Metals, etc.)
<u>Lloyd Kahn</u>		<u>July 1986</u>	<u>TOC</u>
<u>Allen & Fu</u>		<u>Dec. 1991</u>	<u>SEM and AVS</u>

10. Validation Criteria (circle one) 1. Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part II, III or IV
2. Other Approved Validation Criteria:
Validation Tier (circle one) I II III Partial Tier III:
Company/Organization Performing Data Validation T+MUS (CLP) and EPA (DAS) Prime or Subcontractor (circle one)

11. Company Name T+MUS Inc. Contract Number 68-426-0045
Contract Name (e.g. START, RACS, etc.) RACS Work Assignment No. 043-ANLA-016P
Person Completing Form/Title Stephen S. Feltner Date of DQO Summary Form Completion 9-14-99
Project Manager

Matrix Codes: - Refer to Attachment B, Part I
Parameter Codes: - Refer to Attachment B, Part II

Preservation Codes¹

1. HCl to pH ≤ 2	7. K ₂ Cr ₂ O ₇
2. HNO ₃	8. Freeze
3. NaHSO ₄	9. Room Temperature (avoid excessive heat)
4. H ₂ SO ₄	10. Other (Specify)
5. Cool @ 4°C (± 2°)	N. Not preserved
6. NaOH	

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EPA-NE - DQO SUMMARY FORM

Page 3a of 3

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3. a.	Matrix Code¹	SW	SW	SW	SW				
b.	Parameter Code ²	OLM03.2 ^P	OLM03.2 ^S	ILM04.0 ^{MT}	8290				
c.	Preservation Code ³	5	5	2	5				
d.	Analytical Services Mechanism	CLP	CLP	CLP	CLP				
e.	No. of Sample Locations	40	40	40	40				
f.	Field QC:								
g.	Field Duplicate Pairs	4	4	4	4				
h.	Equipment Blanks	4	4	4	4				
i.	VOA Trip Blanks	0	0	0	0				
j.	Cooler Temperature Blanks	1 Per Cooler	→	→	→				
k.	Bottle Blanks	0	0	0	0				
l.	Other:	-	-	-	-				
m.	PES sent to Laboratory	3	3	3	6				
n.	Laboratory QC:								
o.	Reagent Blank	/	✓	/	✓				
p.	Duplicate	/	/	/	/				
q.	Matrix Spike	/	/	/	/				
r.	Matrix Spike Duplicate	/	/	/	/				
s.	Other:								

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 Site Dimensions Not Defined
 List all potentially contaminated matrices Sediment, Soil, Surface water
 Range of Depth to Groundwater _____
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 Circle: Grab or Composite
 "Hot spots" sampled: Yes No

8. Field Data (circle) ORP pH Specific Conductance Dissolved O₂ Temperature Turbidity
 Other: _____

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 Person Completing Form/Title Stephen S. Fether Date of DQO Summary Form Completion 9-14-99
Project Manager

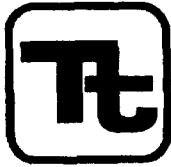
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Preservation Codes¹

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3. NaHSO ₄	9. Room Temperature (avoid excessive heat)
4. H ₂ SO ₄	10. Other (Specify)
5. Cool @ 4°C (± 2°)	N. Not preserved
6. NaOH	

* - To supplement Matrix Codes and/or Parameter Codes contact the QA Unit

APPENDIX D: STANDARD OPERATING GUIDELINES (SOGs)



TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

Number	SA-1.2	Page	1 of 10
Effective Date	06/99	Revision	4
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich 		

Subject
SURFACE WATER AND SEDIMENT SAMPLING

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1.0 PURPOSE

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

2.0 SCOPE

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

3.0 GLOSSARY

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

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

4.0 RESPONSIBILITIES

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

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

5.0 PROCEDURES

5.1 Introduction

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

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

Subject SURFACE WATER AND SEDIMENT SAMPLING	Number SA-1.2	Page 3 of 10
	Revision 4	Effective Date 06/99

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.

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5.2.2 Location of Sampling Stations

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

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

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

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

5.2.3 Frequency of Sampling

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

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

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5.3 Surface Water Sample Collection

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

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

Samples from different depths or cross-sectional locations in the watercourse taken during the same sampling episode, shall be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore shall not be composited. Generally, the number and type of samples to be taken depend on the river's width, depth, discharge and on the suspended sediment the stream or river transports. The greater the number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

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

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

5.3.2 Lakes, Ponds and Reservoirs

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

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

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

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

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

5.3.3 Estuaries

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

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

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

5.3.4 Surface Water Sampling Equipment

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

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

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

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The criteria for selecting a sampler include:

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

As specified in the project plan document plan documents, each sample (grab or each aliquot collected for compositing) shall be measured for:

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

Sample measurements shall be conducted as soon as the sample is acquired. Measurement techniques described in SOP SA-1.1 shall be followed. All pertinent data and results shall be recorded in a field notebook or on sample logsheets (see SOP SA-6.3). These analyses will provide information on water mixing/stratification and potential contamination.

Dip Sampling

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

Weighted Bottle Sampling

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

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

- Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).
- Pull out the stopper with a sharp jerk of the stopper line.
- Allow the bottle to fill completely, as evidenced by the absence of air bubbles.
- Raise the sampler and cap the bottle.

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- Decontaminate the outside of the bottle. This bottle can be used as the sample container as long as the bottle is an approved container type.

Kemmerer

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

5.3.5 Surface Water Sampling Techniques

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

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

5.4 Onsite Water Quality Testing

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

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

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

5.5.2 Sampling Equipment and Techniques

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

When boats are used for sampling, life preservers must be provided and two individuals must undertake the sampling. An additional person shall remain onshore in visual contact at all times.

The following samplers may be used to collect bottom materials:

- Scoop sampler.
- Dredge samplers.

Each type of sampler is discussed subsequently.

Scoop Sampler

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

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

Dredges

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

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

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

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave" and permitting direct access to the secured sample without opening the closed jaws. The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

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TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

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Subject
SOIL SAMPLING

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1.0 PURPOSE

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

2.0 SCOPE

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

3.0 GLOSSARY

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

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

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

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

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

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

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

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

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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

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surveys available through the U.S. Geological Surveys and other government or farm agencies. It is the intent of this procedure to present the most commonly employed soil sampling methods used at hazardous waste sites.

5.2 Soil Sample Collection

5.2.1 Procedure for Collecting Soil Samples for Volatile Organic Compounds

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

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

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

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

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

5.2.1.1 Soil Samples to be Preserved at the Laboratory

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

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

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

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5.2.1.2 Soil Samples to be Preserved in the Field

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

Methanol Preservation (Medium Level):

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

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

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

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

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

Sodium Bisulfate Preservation (Low Level):

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

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

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

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

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

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5.2.2 Procedure for Collecting Non-Volatile Soil Samples

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

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

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

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

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ground, (i.e., top of sample is up) in a cool place out of the sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

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

5.3 Surface Soil Sampling

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

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

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

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

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

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5.4 Near-Surface Soil Sampling

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

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

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

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

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

5.5 Subsurface Soil Sampling With a Hand Auger

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

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

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

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

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

1. Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.
2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).
3. Begin augering (periodically removing accumulated soils from the bucket bit) and add additional rod extensions as necessary. Also, note (in a field notebook or on standardized data sheets) any changes in the color, texture or odor of the soil.

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4. After reaching the desired depth, slowly and carefully withdraw the apparatus from the borehole.
5. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is commonly smaller in diameter than the bucket bit employed to initiate the borehole.
6. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.
7. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.
8. Discard the top of the core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the sample material.
9. Fill volatile sample container(s), using a properly decontaminated stainless steel trowel, with sample material directly from the bucket bit. Refer to Section 5.2.1 of this procedure.
10. Utilizing the above trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl and thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.
11. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

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

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

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

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

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

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

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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 center (this area represents the least disturbed area with minimal atmospheric contact). Refer to Section 5.2.1 of this procedure.
3. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl. Thoroughly homogenize the sample material prior to filling the remaining sample containers. Refer to Section 5.2.2 of this procedure.
4. Follow steps 4 and 5 listed under Section 5.3 of this procedure.

5.7 Subsurface Sol Sampling Using Direct Push Technology

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

5.8 Excavation and Sampling of Test Pits and Trenches

5.8.1 Applicability

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

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

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

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

5.8.2 Test Pit and Trench Excavation

These procedures describe the methods for excavating and logging test pits and trenches excavated to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented as described in SOP SA-6.3.

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

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

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

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

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

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

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

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

5.8.3 Sampling in Test Pits and Trenches

5.8.3.1 General

Test pits and trenches are usually logged as they are excavated. Records of each test pit/trench will be made as described in SOP SA-6.3. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

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

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

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

5.8.3.2 Sampling Equipment

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

- Backhoe or other excavating machinery.
- Shovels, picks and hand augers, stainless steel trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottleware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.

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- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps and right angle adapter for conduit (see Attachment B).

5.8.3.3 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 5.7.3.4.

- Excavate trench or pit in several depth increments. After each increment, the operator will wait while the sampler inspects the test pit from grade level to decide if conditions are appropriate for sampling. (Monitoring of volatiles by the SSO will also be used to evaluate the need for sampling.) Practical depth increments range from 2 to 4 feet.
- The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:
- Any fluid phase or groundwater seepage is encountered in the test pit.
- Any drums, other potential waste containers, obstructions or utility lines are encountered.
- Distinct changes of material are encountered.

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

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

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

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handled shovel or hoe) to remove the smeared zone that has contacted the backhoe bucket. The sample shall then be collected directly into the sample jar, by scraping with the jar edge, eliminating the need to utilize samplers and minimizing the likelihood of cross-contamination. The sample jar is then capped, removed from the assembly, and packaged for shipment.

- Complete documentation as described in SOP SA-6.3.

5.8.3.4 In-Pit Sampling

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

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

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

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

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

5.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 5.7.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., open tube samplers), which can be pushed or driven into the floor of the test pit.

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- Suitable driving (i.e., a sledge hammer) or pushing (i.e., the backhoe bucket) equipment which is used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

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

Relatively undisturbed samples are usually extracted in cohesive soils using open tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe, rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the sampler when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 5.7.3.4 of this procedure must be followed. The open tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate, because the sample will not have the correct orientation.

A sledge hammer or the backhoe may be used to drive or push the sampler or tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry of the test pit, the requirements in Section 5.7.3.4 of this procedure must be followed. Prepare, label, pack and transport the sample in the required manner, as described in SOP SA-6.3.

5.8.4 Backfilling of Trenches and Test Pits

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

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

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

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

5.9 Records

The appropriate sample log sheet (see SOP SA-6.3; Field Documentation) must be completed by the site geologist/sampler. All soil sampling locations must be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see SOP SA-6.3; Field Documentation) shall contain a sketch of pit conditions. In addition, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

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

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

6.0 REFERENCES

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

NUS Corporation, 1986. Hazardous Material Handling Training Manual.

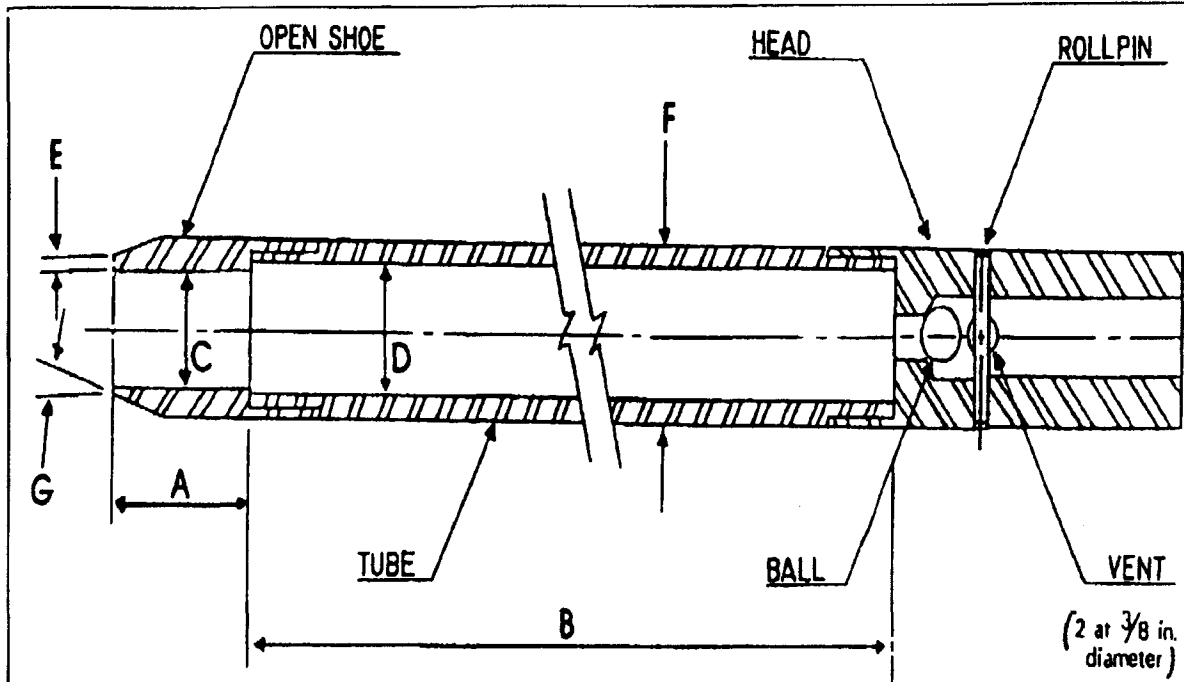
NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

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

OSHA, Confined Space Entry 29 CFR 1910.146.

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ATTACHMENT A
SPLIT-SPOON SAMPLER

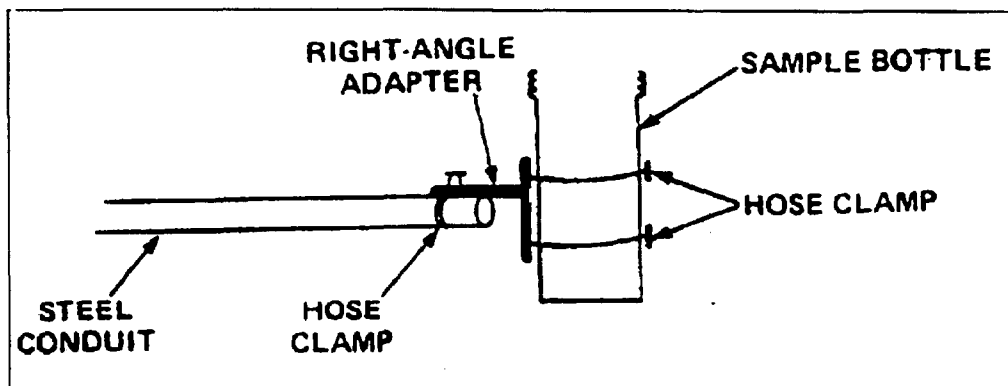


- A = 1.0 to 2.0 in. (25 to 50 mm)
 B = 18.0 to 30.0 in. (0.457 to 0.762 m)
 C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
 D = 1.50 ± 0.05 - 0.00 in. (38.1 ± 1.3 - 0.0 mm)
 E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
 F = 2.00 ± 0.05 - 0.00 in. (50.8 ± 1.3 - 0.0 mm)
 G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

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





TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

Subject PHOTOVAC MICROFID HANDHELD
FLAME IONIZATION DETECTOR

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Effective Date	06/99	Revision	1
Applicability	Tetra Tech NUS, Inc.		
Prepared	Health Sciences Department		
Approved	D. Senovich <i>DS</i>		

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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

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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

DOCUMENTATION OF FIELD CALIBRATION

PROJECT NO.: _____

[illegible]

SITE NAME:

PROJECT NO.: _____

PAGE OF

[illegible]

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SITE NAME: _____

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DRILLER:

Converted to Well:	Yes	No	Well I.D. #:

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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.

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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.

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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.

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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.

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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.

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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.

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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.		

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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.

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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.

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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.

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FIGURE 6-1

EXAMPLE HAZARDOUS AIRBILL FOR HYDROGEN

FedEx <i>Dangerous Goods</i> 7180927 <i>Airbill</i>		Sender's Copy RETAIN FOR 1 YEAR RETAIN THIS COPY FOR YOUR RECORDS		<i>The World On Time.</i>	
Press (please print and press hard)					
Date _____ Sender's FedEx Account Number _____					
Sender's Name _____ Phone _____					
Company _____					
Address _____ Dept./Floor/Box/Room _____					
City _____ State _____ ZIP _____					
Your Internal Billing Reference Information (Optional. Please fill in reference with appear on invoice)					
To (please print and press hard)					
Recipient's Name TECH PATTON Phone (412) 262 4583					
Company TETRA TECH NUS					
Address SPRING RUN RD EXT STE 140 B 1					
City CORACAPOLIS State PA ZIP 15108					
ForHOLD at FedEx Location check here: ☐ Hold Warehouse ☐ Hold Saturday (Not available at all locations) ☐ Hold Sunday (Not available at all locations)					
ForWEEKEND Delivery check here: ☐ Saturday Delivery (Available for FedEx Priority Overnight and FedEx 2Day only) ☐ Sunday Delivery (Available for FedEx Priority Overnight only)					
Express Package Service Packages over 100 lbs. ☐ FedEx Priority Overnight (Next business day) ☐ FedEx Standard Overnight (Next business day) ☐ FedEx 2Day (Second business day) ☐ FedEx Express Saver (Third business day)					
Express Freight Service Packages over 100 lbs. ☐ FedEx Overnight Freight (Next business day) ☐ FedEx 2Day Freight (Second business day) ☐ FedEx Express Saver Freight (Third business day)					
Signature Release Unavailable					
Public Tracking Number 807286973876					
Form I.D. No. 355					
Page 1 of 1 Pages					
TRANSPORT DETAILS					
Airport of Departure _____					
Airport of Destination _____					
NATURE AND QUANTITY OF DANGEROUS GOODS					
Proper Shipping Name: Hydrogen Compressed					
Class or Division: 2.1					
UN or L.D. No.: UN 1049					
Packing Group: III					
Substanc Risk: 2.1					
Quantity and Type of Packaging: 1 Plastic Box X 1.0 Kg					
Packing Unit: 200					
Authorization: _____					
Additional Handling Information: _____					
Prepared for AIR TRANSPORT according to: ☐ 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 labelled/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) 1-800-935-5053					
IF ACCEPTABLE FOR PASSENGER AIRCRAFT THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.					

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FIGURE 6-2

EXAMPLE HAZARDOUS AIRBILL FOR METHANE IN AIR

FedEx <i>Dangerous Goods</i> 67300 7181180 Airbill		Sender's Copy RETAIN FOR 1 YEAR RETAIN THIS COPY FOR YOUR RECORDS		<i>The World On Time</i>																	
1 From (please print and press hard) Date _____ Sender's FedEx Account Number _____ Sender's Name _____ Phone () _____ Company _____ Address _____ Dept./Floor/Box/Room _____ City _____ State _____ ZIP _____																					
2 Your Internet Billing Reference Information (Optionally Print 30 characters and 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 (We Cannot Deliver to P.O. Boxes or P.O. ZIP Codes) Dept./Floor/Box/Room _____ City Coraopolis State PA ZIP 15108																					
4a Express Package Service Packages under 150 lbs. ☐ FedEx Priority Overnight (Next business day morning) ☐ FedEx Standard Overnight (Next business day 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 (Third business day)																					
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 (Other FedEx Account No. or Credit Card No. below)																					
FedEx Tracking Number 807286974806 Form I.D. No. 0204																					
TRANSPORT DETAILS This shipment is subject to the International Transportation Regulations. (If shipping non-hazardous goods, see back for details.) Airport of Departure: _____ Airport of Destination: _____ Shipment type: (select non-applicable) NON-RADIOACTIVE																					
NATURE AND QUANTITY OF DANGEROUS GOODS <table border="1"> <thead> <tr> <th>Proper Shipping Name</th> <th>Class or Division</th> <th>UN or L.O. No.</th> <th>Packing Group</th> <th>Subsidiary Risk</th> <th>Quantity and Type of Packaging</th> <th>Packing Inst.</th> <th>Authorization</th> </tr> </thead> <tbody> <tr> <td>Compressed Gas N.O.S. (mixture Nitrogen and Oxygen)</td> <td>2.2</td> <td>UN 1956</td> <td></td> <td></td> <td>1 Plastic box x 0.56 Kg</td> <td>200</td> <td></td> </tr> </tbody> </table>						Proper Shipping Name	Class or Division	UN or L.O. No.	Packing Group	Subsidiary Risk	Quantity and Type of Packaging	Packing Inst.	Authorization	Compressed Gas N.O.S. (mixture Nitrogen and Oxygen)	2.2	UN 1956			1 Plastic box x 0.56 Kg	200	
Proper Shipping Name	Class or Division	UN or L.O. No.	Packing Group	Subsidiary Risk	Quantity and Type of Packaging	Packing Inst.	Authorization														
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																					
IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.																					



BROWN & ROOT ENVIRONMENTAL

STANDARD OPERATING PROCEDURES

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Effective Date 03/01/96	Revision 0
Applicability B&R Environmental, NE	
Prepared Earth Sciences Department	
Approved D. Senovich	

Subject

NON-RADIOLOGICAL SAMPLE HANDLING

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1.0 PURPOSE

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

2.0 SCOPE

This procedure:

- Describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.
- Provides instruction for sample packaging and shipping in accordance with current U.S. Department of Transportation (DOT) regulations.

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.

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.

ORM - Other regulated material (see DOT 49 CFR 173.144).

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

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

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Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H₂SO₄
- Nitric Acid - HNO₃
- Sodium Hydroxide - NaOH

Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - Na₂S₂O₃

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. Thus, a one-molar solution of HCl, containing 1 gram-atom of H, is "one normal," whereas a one-molar solution of H₂SO₄, containing 2 gram-atoms of H, is "two normal."

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 common carrier.

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 bottle orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

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

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples and high-hazard organics samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO₃, 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 preserved.

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

5.2.2 Preparation and Addition of Reagents

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

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

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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 (assuming that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required). Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

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

Additional considerations are discussed below:

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

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

Continue with proper base preservation of the sample as described, generally, 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.

- To test if sodium thiosulfate must be added to remove residual chlorine from a sample, test the sample for residual chlorine using a field test kit especially 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, generally, 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.

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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 silicon tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).
- To perform filtration, thread the silicon 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.
- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

5.4 Sample Packaging and Shipping

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

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

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

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place sample container, properly identified and with lid securely fastened in a plastic bag (e.g. Ziploc baggie), and seal the bag.
- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic (e.g. "garbage" bag).
- Pack with enough noncombustible, absorbent, cushioning materials such as vermiculite (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.

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- If cooling is required (see Attachments A and B), double-bag ice in Ziploc baggies and place around container shoulders, and on top of absorbent packing material (minimum of 8 pounds of ice for a medium-size cooler).
- Seal (i.e., tape or tie top in knot) large liner bag.
- The original (top, signed copy) and extra carbonless copies of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the first cooler. The COC form should then state how many coolers are included with that shipment.
- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

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

5.4.2 Determination of Shipping Classification for Hazardous Material Samples

Samples not determined to be environmental samples, or samples known or expected to contain hazardous materials, must be considered hazardous material samples and transported according to the requirements listed below.

5.4.2.1 Known Substances

If the substance in the sample is known or can be identified, package, mark, label, and ship according to the specific instructions for that material (if it is listed) in the DOT Hazardous Materials Table, 49 CFR 172.101. (DOT Guide for shippers can be found in Attachment D of this document.)

To determine the proper shipping name, use the following steps to help locate the shipping name on the Hazardous Materials Table, DOT 49 CFR 172.101.

1. Look first for the chemical or technical name of the material, for example, ethyl alcohol. Note that many chemicals have more than one technical name, for example, perchloroethylene (not listed in 172.101) is listed as tetrachloroethylene (listed 172.101). It may be useful to consult a chemist for all possible technical names a material can have. If your material is not listed by its technical name, then . . .
2. Look for the chemical family name. For example, pentyl alcohol is not listed but the chemical family name is: alcohol, n.o.s. (not otherwise specified). If the chemical family name is not listed, then . . .
3. Look for a generic name based on end use. For example, Paint, n.o.s or Fireworks, n.o.s. If a generic name based on end use is not listed, then . . .
4. Look for a generic family name based on end use, for example, drugs, n.o.s. or cosmetics, n.o.s. Finally, if your material is not listed by a generic family name but you suspect or know the material is hazardous because it meets the definition of one or more hazardous classes, then . . .

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5. You will have to use the general hazard class for a proper shipping name. For example, Flammable Liquid, n.o.s. or Oxidizer, n.o.s.

5.4.2.2 Unknown Substances

For samples of hazardous substances of unknown content, select the appropriate transportation category according to the DOT hazardous materials classification of a material having more than one hazard. This procedure is outlined in DOT Regulation 49 CFR 173.2a. (This can be found in Attachment C of this SOP.)

The correct shipping classification for an unknown sample is selected through a process of elimination, as outlined in DOT Regulation 49 CFR 172.101(c)(11). By using the provisions in this paragraph, the proper shipping name and description will be determined. A step-by-step guide is provided by the Department of Transportation (DOT) and can be found in Attachment D of this SOP.

5.4.3 **Packaging and Shipping of Samples Classified as Flammable Liquid (or Solid)**

5.4.3.1 Packaging

Applying the word "flammable" to a sample does not imply that it is in fact flammable. The word prescribes the class of packaging according to DOT regulations.

1. Containerize sample as required (see Attachments A and B). To prevent leakage, fill container no more than 90 percent full. Seal lid with teflon tape or wire.
2. Complete sample label and attach securely to sample container.
3. Seal container and place in 2-mil-thick (or thicker) polyethylene bag (e.g., Ziploc baggie), one sample per bag. Position sample identification label so that it can be read through bag. Seal bag.
4. For soil jars, place sealed bag inside metal can (available from laboratory or laboratory supplier) and cushion it with enough noncombustible, absorbent material (for example, vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to hold can lid securely, tightly and permanently. Mark can as indicated in Paragraph 1 of Section 5.3.4.2, below. Single 1-gallon bottles do not need to be placed in metal cans.
5. Place one or more metal cans (or a single 1-gallon bottle) into a strong outside container, such as a metal picnic cooler or a DOT-approved fiberboard box. Surround cans (or bottle) with noncombustible, absorbent cushioning materials for stability during transport. The absorbent material should be able to absorb the entire contents of the container. Mark container as indicated in Paragraph 2 below.

5.4.3.2 Marking/Labeling

1. Use abbreviations only where specified. Place the following information, either hand-printed or in label form, on the metal can (or 1-gallon bottle):
 - Laboratory name and address.

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- Proper shipping name from the hazardous materials table (DOT Regulation CFR 49 172.101). Example: "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325." This will include packing group (see Section 5.3.4.2, No. 2.)

Not otherwise specified (n.o.s) is not used if the flammable liquid (or solid) is identified. If identified, the name of the specific material is listed before the category (for example, Acetone, Flammable Liquid), followed by its appropriate UN number found in the DOT Hazardous Materials table (49 CFR 172.101).

2. Determine packing group. The packing group is part of the proper shipping name and must be included on the shipping papers in the description section.

- I. Most Hazardous
- II. Medium Hazard
- III. Least Hazardous

The packing group will be listed in the hazardous materials table, column 5.

3. Place all information on outside shipping container as on can (or bottle), specifically:

- Proper shipping name
- UN or NA number
- Proper label(s)
- Addressee and sender

Place the following labels on the outside shipping container: "Cargo Aircraft Only" and DOT label such as: "Flammable Liquid" (or "Flammable Solid"). "Dangerous When Wet" label shall be used if the Flammable Solid has not been exposed to a wet environment. "Laboratory Samples" and "THIS SIDE UP" or "THIS END UP" shall also be marked on the top of the outside container, and upward-pointing arrows shall be placed on all four sides of the container.

5.4.3.3 Shipping Papers

1. Use abbreviations only where specified. Complete the carrier-provided bill of lading and sign certification statement. Provide the following information in the order listed (one form may be used for more than one exterior container):

- Proper shipping name. (Example: "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325 Packing Group I, II, III").
- "Limited Quantity" (or "Ltd. Qty."). (See No. 3, below.)
- "Cargo Aircraft Only."
- Net weight (wt) or net volume (vol), just before or just after "Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s.," by item, if more than one metal can is inside an exterior container.
- "Laboratory Samples" (if applicable).

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2. Include Chain-of-Custody Record, properly executed in outside container; use custody seals.
3. "Limited Quantity" means the maximum amount of a hazardous material for which there is a specific labeling or packaging exception (DOT CFR 49 171.8). This may mean that packages are exempted from labeling requirements. To determine if your sample meets the Limited Quantity Exception, refer to DOT Regulation CFR 49 Subpart C 173.50 through 173.156. First, determine the proper classification and shipping name for the material; then refer to the exception requirements for that particular class of material beginning with 173.50.

Example: "Flammable Liquid n.o.s. UN1993 Packing Group 1." The outer package can weigh no more than 66 pounds gross weight. The inner package or container can weigh no more than 0.1 gallon net capacity for each container.

To determine whether the material can be shipped as a "Limited Quantity," you must check the specific requirement for that class of material.

5.4.3.4 Transportation

1. The majority of unknown hazardous substance samples will be classified as flammable liquids. The samples will be transported by rented or common carrier truck, railroad, or express overnight package services. Do not transport samples on any passenger-carrying air transport system, even if the system has cargo-only aircraft. DOT regulations permit regular airline cargo-only aircraft, but difficulties with most suggest avoiding them. Instead, ship by airline carriers that carry only cargo. If unsure of what mode of transportation to use, consult the FOL or Project Manager.
2. For transport by government-owned vehicle, including aircraft, DOT regulations do not apply. However, procedures described above, with the exception of execution of the bill of lading with certification, shall still be followed.
3. Use the hazardous materials shipping check list (Attachment E) as a guidance to ensure that all sample-handling requirements are satisfied.
4. In some cases, various materials may react if they break during shipment. To determine if you are shipping such materials, refer to the DOT compatibility chart in Attachment F.

5.5 Shipment of Lithium Batteries

Monitoring well data are analyzed using either the Hermit SE 1000 or the Hermit SE 2000 environmental data logger. These instruments are powered by lithium batteries. The Department of Transportation has determined that lithium batteries are a hazardous material and are to be shipped using the following information:

¹ Note: If you are unsure as how to ship the sample (hazardous or environmental sample), contact the FOL or Project Manager so that a decision can be made as to the proper shipping practices. The DOT penalties for improper shipment of a hazardous material are stringent and may include a prison term for intentional violations.

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- Product Designation
 - Hermit SE 1000
 - Hermit SE 2000
- DOT Proper Shipping Name
 - Lithium batteries, contained in equipment, UN3091
- Classification or Division
 - Class 9

Shipment of equipment containing lithium batteries must be accompanied by shipping papers completed as indicated in Attachment G. The instrument will be shipped by Federal Express as a Hazardous Material. Place the instrument in the same container in which it was received. This container or case is a DOT-approved shipping container. For Federal Express procedures to ship hazardous materials, call 1-800-238-5355, extension 922-1666. In most cases, the return shipping papers and DOT labels will be shipped to you from the company warehouse or the vendor. An example of the types of labels used for shipment and the wording are shown in Attachment G. These labels will be attached to the outside container with the following wording:

- Lithium Batteries Contained in Equipment
 - UN-3091
 - Shipped Under CA-9206009

6.0 REFERENCES

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

U.S. Department of Transportation, 1993. 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.

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ATTACHMENT A

GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration	Container ⁽¹⁾	Sample Size	Preservation ⁽²⁾	Holding Time ⁽²⁾

WATER

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

SOIL

Organics (GC&GC/MS)	VOC		Wide-mouth glass with teflon liner	2 x 4 oz.	Cool to 4°C	14 days
	Extractables SVOCs and pesticides/PCBs)	(Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	7 days until extraction; 40 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction

AIR

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

(1) All glass containers should have Teflon cap liners or septa.

(2) See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

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ATTACHMENT B

ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container ⁽¹⁾	Preservation ⁽²⁾⁽³⁾	Maximum Holding Time ⁽⁴⁾
INORGANIC TESTS:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C: H ₂ SO ₄ to pH 2	28 days
Biocemical 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 ₂ SO ₄ to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C: NaOH to pH 12; 0.6 g ascorbic acid ⁽⁵⁾	14 days ⁽⁶⁾
Fluoride	P	None required	28 days
Hardness	P, G	HNO ₃ to pH 2; H ₂ SO ₄ to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C: H ₂ SO ₄ to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C: H ₂ SO ₄ to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C: H ₂ SO ₄ to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C: HCl or H ₂ SO ₄ to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C: H ₂ SO ₄ to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C: H ₂ SO ₄ to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

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**ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,
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PAGE TWO**

Parameter Number/Name	Container ⁽¹⁾	Preservation ⁽²⁾⁽³⁾	Maximum Holding Time ⁽⁴⁾

INORGANIC TESTS (Cont'd):

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

METALS:⁽⁷⁾

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

ORGANIC TESTS:⁽⁸⁾

Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ HCl to pH 2 ⁽⁶⁾	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ adjust pH to 4-5 ⁽¹⁰⁾	14 days
Phenols ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction; 40 days after extraction
Benzidines ^{(11), (12)}	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction ⁽¹³⁾
Phthalate esters ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitrosamines ^{(11), (14)}	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction; 40 days after extraction
PCBs ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ ; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs) ^{(11), (14)}	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ ; store in dark	7 days until extraction; 40 days after extraction
Haloethers ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF) ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction; 40 days after extraction

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**ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,
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PAGE THREE**

Parameter Number/Name	Container ⁽¹⁾	Preservation ⁽²⁾⁽³⁾	Maximum Holding Time ⁽⁴⁾

RADIOLOGICAL TESTS:

1-5 Alpha, beta and radium	P. G	HNO ₃ to pH 2	6 months

- (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% Na₂S₂O₃ 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% Na₂S₂O₃.

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ATTACHMENT C

DOT HAZARDOUS MATERIAL CLASSIFICATION (49 CFR 173.2a)

1. Radioactive material (except a limited quantity)
2. Division 2.3, Poisonous Gases
3. Division 2.1, Flammable Gas
4. Division 2.2, Nonflammable gas
5. Division 6.1, Poisonous Liquids, Packing Group 1 (poison by inhalation only)
6. Division 4.2, Pyrophoric Material
7. Division 4.1, Self-Reactive Material
8. Class 3, Flammable Liquids*
9. Class 8, Corrosive Material
10. Division 4.1, Flammable Solid*
11. Division 4.2, Spontaneously Combustible Materials*
12. Division 4.3, Dangerous When Wet Materials*
13. Division 5.1, Oxidizers*
14. Division 6.1, Poisonous Liquids or Solids (other than Packing Group 1)*
15. Combustible liquid
16. Class 9, Miscellaneous Hazardous Materials

* If a material has or meets the criteria for more than one hazard class, use the precedence of hazardous table on the following page for Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1, and 6.1. The following table ranks those materials that meet the definition of Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1, and 6.1.

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ATTACHMENT C (Continued)

PRECEDENCE OF HAZARD TABLE

(Hazard Class and Packing Group)

Class	Packing Group	4.2	4.3	5.1 I ^(a)	5.1 II ^(a)	5.1 III ^(a)	6.1 I (Dermal)	6.1 I (Oral)	6.1 II	6.1 III	8 I (Liquid)	8 I (Solid)	8 II (Liquid)	8 II (Solid)	8 III (Liquid)	8 III (Solid)
3	I						3	3	3	3	3	(d)	3	(d)	3	(d)
3	II						3	3	3	3	8	(d)	3	(d)	3	(d)
3	III						6.1	6.1	6.1	3 ^(d)	8	(d)	8	(d)	3	(d)
4.1	II ^(b)	4.2	4.3	5.1	4.1	4.1	6.1	6.1	4.1	4.1	(d)	8	(d)	4.1	(d)	4.1
4.1	III ^(b)	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	(d)	8	(d)	8	(d)	4.1
4.2	II		4.3	5.1	4.2	4.2	6.1	6.1	4.2	4.2	(d)	8	(d)	4.2	(d)	4.2
4.2	III		4.3	5.1	4.2	4.2	6.1	6.1	6.1	4.2	(d)	8	(d)	8	(d)	4.2
4.3	I			5.1	4.3	4.3	6.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
4.3	II			5.1	4.3	4.3	6.1	4.3	4.3	4.3	8	8	8	4.3	4.3	4.3
4.3	III			5.1	4.3	4.3	6.1	6.1	6.1	4.3	8	8	8	8	4.3	4.3
5.1	I ^(a)						5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5.1	II ^(a)						6.1	5.1	5.1	5.1	8	8	8	5.1	5.1	5.1
5.1	III ^(a)						6.1	6.1	6.1	5.1	8	8	8	8	5.1	5.1
6.1	I, Dermal										8	6.1	6.1	6.1	6.1	6.1
6.1	I, Oral										8	6.1	6.1	6.1	6.1	6.1
6.1	II, Inhalation										8	6.1	6.1	6.1	6.1	6.1
6.1	II, Dermal										8	6.1	8	6.1	6.1	6.1
6.1	II, Oral										8	8	8	6.1	6.1	6.1
6.1	III										8	8	8	8	8	8

^(a) There are at present no established criteria for determining Packing Groups for liquids in Division 5.1. At present, the degree of hazard is to be assessed by analogy with listed substances, allocating the substances to Packing Group I, Great; Group II, Medium; or Group III, Minor Danger.

^(b) Substances of Division 4.1 other than self-reactive substances.

^(c) Denotes an impossible combination.

^(d) For pesticides only, where a material has the hazards of Class 3, Packing Group III, and Division 6.1, Packing Group III, the primary hazard is Division 6.1, Packing Group III.

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ATTACHMENT D

GUIDE FOR HAZARDOUS MATERIALS SHIPPERS

USE OF GUIDE - This guide is presented as an aid to shippers of hazardous materials. It does not contain or refer to all of the DOT requirements for shipping hazardous materials. For specific details, refer to all of the DOT requirements for shipping hazardous materials, as provided in the Code of Federal Regulations (CFR), Title 49, Transportation, Parts 100-199.

The following is offered as a step-by-step procedure to aid in compliance with the applicable DOT regulations.

STEP 1 - DETERMINE THE PROPER SHIPPING NAME. The shipper must determine the proper shipping name of the materials as listed in the Hazardous Materials Table, 49 CFR 172.101, Column (2).

STEP 2 - DETERMINE THE HAZARD CLASS OR CLASSES.

- Refer to the Table, 49 CFR 172.101, Column (3), and locate the hazard class of the material.
- If more than one class is shown for the proper shipping name, determine the proper class by definition.
- If the materials have more than one hazard, classify the material based on the order of hazards in 49 CFR 173.2.

STEP 3 - SELECT THE PROPER IDENTIFICATION NUMBERS.

- Refer to the Table, 49 CFR 172.101, Column (3a), and select the Identification Number (ID) that corresponds to the proper shipping name and hazard class.
- Enter the ID number(s) on the shipping papers and display them, as required, on packagings, placards and/or orange panels.

STEP 4 - DETERMINE THE MODE(S) OF TRANSPORT TO ULTIMATE DESTINATION.

- As a shipper, you must assure yourself that the shipment complies with various modal requirements.
- The modal requirements may affect the following: (1) Packaging; (2) Quantity per Package; (3) Marking; (4) Labeling; (5) Shipping Papers; and (6) Certification.

STEP 5 - SELECT THE PROPER LABEL(S) AND APPLY AS REQUIRED.

- Refer to the Table, 49 CFR 172.101, Column (4) for required labels.
- For details on labeling refer to (1) Additional Labels, 49 CFR 172.402; (2) Placement of Labels, 49 CFR 172.406; (3) Packagings (Mixed or Consolidated), 49 CFR 172.404(a) and (h); (4) Packages Containing Samples, 49 CFR 172.402(h); (5) Radioactive Materials, 49 CFR 172.403; and (6) Authorized Label Modifications, 49 CFR 172.405.

STEP 6 - DETERMINE AND SELECT THE PROPER PACKAGES.

- Refer to the Table, 49 CFR 172.101, Column (5a) for exceptions and Column (5b) for specification packagings. Consider the following when selecting an authorized package: Quantity per Package; Cushioning Material, if required; Proper Closure and Reinforcement; Proper Pressure; Outage; etc., as required.
- If packaged by a prior shipper, make sure the packaging is correct and in proper condition for transportation.

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GUIDE FOR HAZARDOUS MATERIALS SHIPPERS

STEP 7 - MARK THE PACKAGING (INCLUDING OVERPACKS).

- a. Apply the required markings (49 CFR 172.300); Proper shipping name and ID number, when required (49 CFR 172.301); Name and address of Consignee or Consignor (49 CFR 172.306).
- b. For details and other required markings, see 49 CFR 172.300 through 172.338.

STEP 8 - PREPARE THE SHIPPING PAPERS.

- a. The basic requirements for preparing shipping papers include Proper Shipping Name; Hazard Class; ID Number; Total Quantity; Shipper's Certification; and Emergency Response Telephone Number.
- b. Make all entries on the shipping papers using the information required and in proper sequence (49 CFR 172.202).

STEP 9 - CERTIFICATION.

- a. Each shipper must certify by printing (manually or mechanically) on the shipping papers that the materials being offered for shipment are properly classified, described, packaged, marked and labeled, and in proper condition for transportation according to the applicable DOT Regulations (49 CFR 172.202).

STEP 10 - LOADING, BLOCKING, AND BRACING. When hazardous materials are loaded into the transport vehicle or freight container, each package must be loaded, blocked, and braced in accordance with the requirements for mode of transport.

- a. If the shipper loads the freight container or transport vehicle, the shipper is responsible for the proper loading, blocking, and bracing of the materials.
- b. If the carrier does the loading, the carrier is responsible.

STEP 11 - DETERMINE THE PROPER PLACARD(S). Each person who offers hazardous materials for transportation must determine that the placarding requirements have been met.

- a. For Highway, unless the vehicle is already correctly placarded, the shipper must provide the required placard(s) and required ID number(s) (49 CFR 172.506).
- b. For Rail, if loaded by the shipper, the shipper must placard the rail car if placards are required (49 CFR 172.508).
- c. For Air and Water shipments, the shipper has the responsibility to apply the proper placards.

STEP 12 - HAZARDOUS WASTE/HAZARDOUS SUBSTANCE.

- a. If the material is classed as a hazardous waste or hazardous substance, most of the above steps will be applicable.
- b. Pertinent Environmental Protection Agency regulations are found in the Code of Federal Regulations, Title 40, Part 262.

As a final check and before offering the shipment for transportation, visually inspect your shipment. The shipper should ensure that emergency response information is on the vehicle for transportation of hazardous materials.

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ATTACHMENT E

HAZARDOUS MATERIALS SHIPPING CHECK LIST

PACKAGING

1. Check DOT 173.24 for appropriate type of package for hazardous substance.
2. Check for container integrity, especially the closure.
3. Check for sufficient absorbent material in package.
4. Check for sample tags and log sheets for each sample and for chain-of-custody record.

SHIPPING PAPERS

1. Check that entries contain only approved DOT abbreviations.
2. Check that entries are in English.
3. Check that hazardous material entries are specially marked to differentiate them from any nonhazardous materials being sent using same shipping paper.
4. Be careful that all hazardous classes are shown for multiclass materials.
5. Check total amounts by weight, quantity, or other measures used.
6. Check that any limited-quantity exemptions are so designated on the shipping paper.
7. Check that certification is signed by shipper.
8. Make certain driver signs for shipment.

RCRA MANIFEST

1. Check that approved state/federal manifests are prepared.
2. Check that transporter has the following: valid EPA identification number, valid driver's license, valid vehicle registration, insurance protection, and proper DOT labels for materials being shipped.
3. Check that destination address is correct.
4. Check that driver knows where shipment is going.
5. Check that the driver is aware of emergency procedures for spills and accidents.
6. Make certain driver signs for shipment.
7. Make certain one copy of executed manifest and shipping document is retained by shipper.

ATTACHMENT F

DOT SEGREGATION AND SEPARATION CHART

Class or Division	Notes	1.1-1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3 gas Zone A*	2.3 gas Zone B*	3	4.1	4.2	4.3	5.1	5.2	6.1 liquids PG-I Zone A*	7	8 liquids only
Explosives 1.1 and 1.2	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Explosives 1.3		*	*	*	*	*	X		X	X	X		X	X	X	X	X		X
Explosives 1.4		*	*	*	*	*	O		O	O	O		O				O		O
Very insensitive explosives 1.5	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Extremely insensitive explosives 1.6		*	*	*	*	*													
Flammable gases 2.1		X	X	O	X				X	O							O	O	
Non-toxic, non-flammable gases 2.2		X			X														
Poisonous gas - Zone A** 2.3		X	X	O	X		X				X	X	X	X	X	X			X
Poisonous gas - Zone B** 2.3		X	X	O	X		O				O	O	O	O	O	O			O
Flammable liquids 3		X	X	O	X				X	O					O		X		
Flammable solids 4.1		X			X				X	O							X		O
Spontaneously combustible materials 4.2		X	X	O	X				X	O							X		X
Dangerous-when-wet materials 4.3		X	X		X				X	O							X		O
Oxidizers 5.1	A	X	X		X				X	O	O						X		O
Organic peroxides 5.2		X	X		X				X	O							X		O
Poisonous liquids PG I - Zone A** 6.1		X	X	O	X		O				X	X	X	X	X	X			X
Radioactive materials 7		X			X		O												
Corrosive liquids 8		X	X	O	X				X	O		O	X	O	O	O	X		

No entry means that the materials are compatible (have no restrictions).

X These materials may not be loaded, transported, or stored together in the same vehicle or facility.

O The materials may not be loaded, transported, or stored together in the same vehicle or facility unless they are separated for 4 feet on all sides.

* Check the explosives compatibility chart in 49 CFR 179.848(f).

A Ammonium nitrate fertilizers may be stored with Division 1.1 materials.

** Denotes inhalation hazardous for poisons; consult field team leader or project manager if you encounter a material in this class before shipment.

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SAMPLE HANDLING

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3224637861

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

WARNING

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

TRANSPORT DETAILS

This shipment is within the limitations prescribed for:
(delete non applicable)

~~HAZARDOUS~~

CARGO
AIRCRAFT
ONLY

Airport of Departure

Airport of Destination:

19CYS

Shipment type: (delete non-applicable)

NON-RADIOACTIVE ~~RADIOACTIVE~~**NATURE AND QUANTITY OF DANGEROUS GOODS**

Dangerous Goods Identification

Proper Shipping Name	Class or Division	UN or ID No.	Subsidiary Risk	Quantity and type of packing	Packing Inst.	Authorization
LITHIUM BATTERIES CONTAINED IN EQUIPMENT	9	UN309		1 PLASTIC BOX X 55 GRAMS	912 II	PER CA-9206009

Additional Handling Information

1 HERMIT SERIES DATALOGGER X 55 GRAMS (11 GRAMS/CELL)

I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in the proper condition for transport by air according to the applicable International and National Government Regulations.

Emergency Telephone Number (Required for US Origin or Destination Shipments)

800-535-5053

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.

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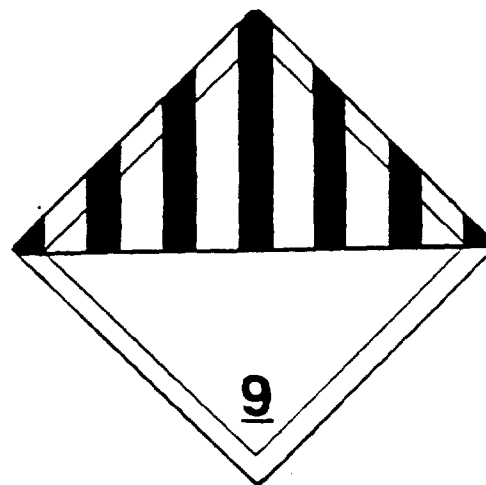
Effective Date

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ATTACHMENT G
LITHIUM BATTERY SHIPPING PAPERS

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**ATTACHMENT G (CONTINUED)
LITHIUM BATTERY SHIPPING PAPERS**



**LITHIUM BATTERIES CONTAINED
IN EQUIPMENT.
UN-3091.
SHIPPED UNDER CA-9206009**



BROWN & ROOT ENVIRONMENTAL

STANDARD OPERATING PROCEDURES

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Applicability B&R Environmental, NE	
Prepared Earth Sciences Department	
Approved D. Senovich <i>[Signature]</i>	

Subject FIELD DOCUMENTATION

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field record forms, logs and reports generally initiated and maintained for documenting Brown & Root Environmental field activities.

2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Brown & Root Environmental field activities, as applicable. Other or additional documents may be required by special client contracts.

3.0 GLOSSARY

None

4.0 RESPONSIBILITIES

Project Manager - 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 forms used in site activities (i.e., records, field reports, and upon the completion of field work the site logbook) in the project's central file.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate 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 (daily) in the site logbook:

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

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that onsite activities take place which involve Brown & Root Environmental or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

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

- Project name
- Brown & Root Environmental 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 site notebook in which the measurements are recorded (see Attachment A).

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

5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook 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. If possible, such techniques shall be avoided, since they can adversely affect the admissibility of photographs as evidence. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Adequate logbook notation and receipts must be compiled to account for routine film processing. Once processed, the slides of photographic prints shall be consecutively numbered and labeled according to the logbook descriptions. The site photographs and associated negatives must be docketed into the project's central file.

5.2 Site Notebooks

Key field team personnel may maintain a separate dedicated 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 site notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a site notebook.

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5.3 Sample Forms

A summary of the forms illustrated in this procedure is shown as the listing of Attachments in of Contents for this SOP. Forms may be altered or revised for project-specific needs contin client approval. Care must be taken to ensure that all essential information can be doc Guidelines for completing these forms can be found in the related sampling SOP.

5.3.1 Sample Collection, Labeling, Shipment and Request for Analysis

5.3.1.1 Sample Log Sheet

Sample Log Sheets are used to record specified types of data while sampling. Attachments I are examples of Sample Log Sheets. The data recorded on these sheets are useful in desc waste source and sample as well as pointing out any problems encountered during sampli sheet must be completed for each sample obtained, including field quality control (QC) sam

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B-5. Adhesive labels must be completed an to every sample container. Sample labels can usually be obtained from the appropriate Progra 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 acqu accompanies a sample (or group of samples) as they are transferred from person to person. must be used for any samples collected for chemical or geotechnical analysis whether the ana performed on site or off site. One part of the completed COC form is retained by the field or the other two or three portions are sent to the laboratory. The original (top, signed copy) a carbonless copies of the COC form shall be placed inside a large Ziploc-type bag and taped ir lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the C should be sent with the first cooler. The COC form should then state how many coolers are with that shipment. An example of a Chain-of-Custody Record form is provided as Attachmen supply of these forms are purchased and stocked by the field department of the various Brown Environmental offices. Alternately, COC forms supplied by the laboratory may be used. C samples are received at the laboratory, the sample cooler and contents are checked and any p are noted on the enclosed COC form (any discrepancies between the sample labels and COC fi any other problems that are noted are resolved through communication between the laboratory (contact and the Brown & Root Environmental Project Manager). The COC form is signed and the remaining two parts are retained by the laboratory while the last part becomes part of the s corresponding analytical data package. Internal laboratory chain-of-custody procedures are docu in the Laboratory Quality Assurance Plan (LQAP).

5.3.1.4 Chain-of-Custody Seal

Attachment B-7 is an example of a custody seal. The Custody seal is also an adhesive-backe It is part of a chain-of-custody process and is used to prevent tampering with samples after the been collected in the field and sealed in coolers for transit to the laboratory. The COC seals are and dated by the samplers and affixed across the opening edges of each cooler cor environmental samples. COC seals may be available from the laboratory; these seals may a purchased from a supplier.

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5.3.2 Geohydrological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

A groundwater level measurement sheet, shown in Attachment C-1 must be filled out for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The pumping test data sheet (Attachment C-2) facilitates this task by standardizing the data collection format, and allowing the time interval for collection to be laid out in advance.

5.3.2.3 Packer Test Report Form

A packer test report form shown in Attachment C-3 must be completed for each well upon which a packer test is conducted following well installation.

5.3.2.4 Summary Log of Boring

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring (Attachment C-4) is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples or cuttings from the borehole (using HNU or OVA detectors), these results must be entered on the boring log (under the "Remarks" column) at the appropriate depth. The "Remarks" column can also be used to subsequently enter the laboratory sample number and the concentration of a few key analytical results. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well piezometer or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock), different forms are used (see Attachments C-5 through C-9). Similar forms are used for flush-mount well completions. The Monitoring Well Construction Details Form is not a controlled document.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log (Attachment C-10) must be filled out by the responsible field geologist or sampling technician.

5.3.3 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

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equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

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

5.4 Field Reports

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

5.4.1 Weekly Status Reports

To facilitate timely review by project management, Xeroxed copies of logbook/notebook entries must be made for internal use. To provide timely oversight of onsite contractors, Daily Activities Reports must be completed and submitted as described below.

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

5.4.2 Daily Activities Report

5.4.2.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. The 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 work performed and form the basis of payment to subcontractors (Attachment E is an example of a Daily Activities Report).

5.4.2.2 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.

5.4.2.3 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.

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6.0 ATTACHMENTS

Attachment A	TYPICAL SITE LOGBOOK ENTRY
Attachment B-1	EXAMPLE GROUNDWATER SAMPLE LOG SHEET
Attachment B-2	EXAMPLE SURFACE WATER SAMPLE LOG SHEET
Attachment B-3	EXAMPLE SOIL/SEDIMENT SAMPLE LOG SHEET
Attachment B-4	CONTAINER SAMPLE LOG SHEET FORM
Attachment B-5	SAMPLE LABEL
Attachment B-6	CHAIN-OF-CUSTODY RECORD FORM
Attachment B-7	CHAIN-OF-CUSTODY SEAL
Attachment C-1	EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET
Attachment C-2	EXAMPLE PUMPING TEST DATA SHEET
Attachment C-3	PACKER TEST REPORT FORM
Attachment C-4	EXAMPLE BORING LOG
Attachment C-5	EXAMPLE OVERBURDEN MONITORING WELL SHEET
Attachment C-5A	EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)
Attachment C-6	EXAMPLE CONFINING LAYER MONITORING WELL SHEET
Attachment C-7	EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL
Attachment C-8	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK
Attachment C-8A	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK (FLUSHMOUNT)
Attachment C-9	EXAMPLE TEST PIT LOG
Attachment D	EXAMPLE EQUIPMENT CALIBRATION LOG
Attachment E	EXAMPLE DAILY ACTIVITIES RECORD
Attachment F	FIELD TRIP SUMMARY REPORT

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**ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY**

START TIME: _____ DATE: _____

SITE LEADER: _____

PERSONNEL: _____

BROWN & ROOT ENV.	DRILLER	EPA
_____	_____	_____
_____	_____	_____
_____	_____	_____

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 manager 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

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**ATTACHMENT B-1
EXAMPLE GROUNDWATER SAMPLE LOG SHEET**

GROUNDWATER SAMPLE LOG SHEET		Page ____ of ____
Project Site Name: _____		Sample ID No.: _____
Project No.: _____		Sample Location: _____
☐ Domestic Well Data ☐ Monitoring Well Data ☐ Other Well Type: _____ ☐ QA Sample Type: _____		Sampled By: _____ C.O.C. No.: _____
Sampling Data		
Date: _____	pH: _____	Temp (°C): _____
Time: _____	Turbidity: _____	Color: _____
Method: _____	TBD: _____	TBD: _____
Purge Data		
Date: _____	Volume: _____	pH: _____
Method: _____	Inlet	Temp (°C): _____
Monitor Reading (ppm):	1	Turbidity: _____
Well Casing Dia. & Material	2	Color: _____
Type:	3	TBD: _____
Total Well Depth (TD):	4	TBD: _____
Static Water Level (WL):	5	
TD-WL (ft.) =		
One Casing Volume (gal/L)		
Start Purge (hrs.):		
End Purge (hrs.):		
Total Purge Time (min):		
Total Amount Purged (gal/L):		
Analysis: _____	Preservative: _____	Container Requirements: _____
Collected (g): _____		
Observations/Notes:		
Circle if Applicable: _____ MS/MSD Duplicate ID No: _____ Signature(s): _____		

TBD: To Be Determined

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**ATTACHMENT B-2
EXAMPLE SURFACE WATER SAMPLING LOG SHEET**

		SURFACE WATER SAMPLING LOG SHEET				Page ____ of ____	
Project Site Name: _____			Sample ID No.: _____				
Project No.: _____			Sample Location: _____				
☐ Spring ☐ Pond ☐ Stream ☐ Lake ☐ Other _____ ☐ QA Sample Type: _____			Sampled By: _____				
			C.O.C. No.: _____				
Sample Data							
Date and Time		Method		Depth			
pH	S.C.	Temp. (°C)	Turbidity	Color	TBD	TBD	TBD
Analysis		Preservation		Container Requirements		Collected	
Observations/Notes: 							
Circle if Applicable: _____						Signature(s): _____	
MS/MSD Duplicate ID No.: _____							
TBD: To Be Determined							

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**ATTACHMENT B-3
EXAMPLE SOIL/SEDIMENT SINGLE SAMPLE LOG SHEET**

		SOIL/SEDIMENT SINGLE SAMPLE LOG SHEET		Page ____ of ____
Project Site Name: _____		Sample ID No.: _____		
Project No.: _____		Sample Location: _____		
☐ Surface Soil ☐ Subsurface Soil ☐ Sediment ☐ Other _____ ☐ QA Sample Type: _____		Sampled By: _____ C.O.C. No.: _____		
Sample Method:				
Depth Sampled:	Sample	Time	Color/Description	
Sample Date and Time:				
Type of Sample ☐ Grab ☐ Composite ☐ Grab-Composite ☐ High Concentration ☐ Low Concentration				
	Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)		
Observations/Notes: 				
Circle if Applicable: _____		Signature(s): _____		
MS/MSD	Duplicate ID No: _____			

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**ATTACHMENT B-4
CONTAINER SAMPLE LOG SHEET FORM**



Brown & Root Environmental

P:

☐ Container Data

G:

By: _____

Project Site Name: _____ Project Site No. _____

Brown & Root Env. Source No. _____ Source Location: _____

Container Source		Container Description			
☐ Drum ☐ Bung Top ☐ Lever Lock ☐ Bolted Ring ☐ Other _____ ☐ Bag/Sack ☐ Tank ☐ Other _____		Color: _____ Condition: _____ Markings: _____ Vol. of Contents: _____ Other: _____			
Disposition of Sample		Sample Description			
☐ Container Sampled ☐ Container opened but not sampled. Reason: _____ ☐ Container not opened. Reason: _____		Phase Color Viscosity % of Total Volume Other	Layer 1 ☐ Sol. ☐ Liq. _____ ☐ L ☐ M ☐ H	Layer 2 ☐ Sol. ☐ Liq. _____ ☐ L ☐ M ☐ H	L ☐ S _____ ☐ L
Monitor Reading:		Type of Sample			
Sample Method:		☐ Low Concentration ☐ High Concentration			
Sample Date & Time:		☐ Grab ☐ Composite ☐ Grab-composite			
Sampled by:		Sample Identification	Organic	Inorga.	
Signature(s):					
Analysis:		Date Shipped			
		Time Shipped			
		Lab			
		Volume			

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ATTACHMENT B-5

SAMPLE LABEL

	Brown & Root Environmental	PROJECT: _____
STATION LOCATION: _____		
DATE: ____ / ____ / ____		TIME: ____ hrs.
MEDIA: WATER ☐	SOIL ☐	SEDIMENT ☐
CONCENTRATION: LOW ☐	MEDIUM ☐	HIGH ☐
TYPE: GRAB ☐ COMPOSITE ☐		
ANALYSIS		PRESERVATION
VOA ☐	BNAs ☐	Cool to 4°C ☐
PCBs ☐	PESTICIDES ☐	HNO ₃ to pH < 2 ☐
METALS: TOTAL ☐ DISSOLVED ☐		NaOH to pH > 12 ☐
CYANIDE ☐		☐
Sampled by: _____		
Remarks: _____		

ATTACHMENT B-6

[illegible]

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ATTACHMENT B-7
CHAIN-OF-CUSTODY SEAL

Signature 		CUSTODY SEAL
Date 		Date
CUSTODY SEAL 		Signature



ATTACHMENT C-3

PACKER TEST REPORT FORM

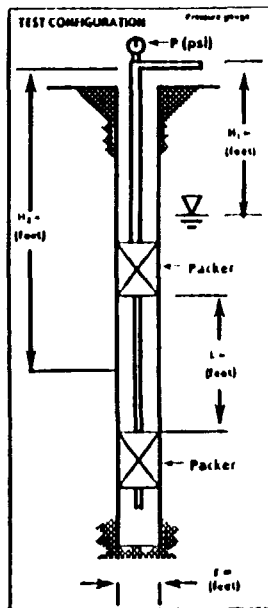
PROJECT: _____ PROJECT NO.: _____ TEST NO.: _____ PAGE _____ OF _____
BORING NO.: _____ CASING DEPTH: _____ CONTRACTOR: _____ STATIC WATER LEVEL _____
TEST INTERVAL: _____ BY: _____ CHECKED: _____ PACKER PRESSURE _____

[illegible]

CP = $\{1/(2 + 1)\} \ln(1/r)$ (70.315 S)
7.48 Gallons = 1 ft³
1 pm = 2.31 ft head
Remarks

H_1 is used when the test length is below the water table
 H_2 is used when the test length is above the water table

Remarks



Length of test (minutes)	Cp			
	at starting of test			
	$\bar{x}$ (1°)	$\bar{x}$ (2°)	$\bar{x}$ (3°)	$\bar{x}$ (4°)
1	10 000	10 000	21 000	20 000
2	10 000	10 000	10 000	10 000
3	0 000	0 000	0 000	0 000
5	0 000	0 000	0 000	0 000
10	0 000	0 000	0 000	0 000
15	0 000	0 000	0 000	0 000
20	0 000	0 000	0 000	0 000

LEGEND
SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

UNIFIED SOIL CLASSIFICATION (USCS)										
COARSE-GRAINED SOILS More Than Half of Material is LARGER Than No. 200 Sieve Size					FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size					
FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES	
					Identification Procedures on Fraction Smaller Than No. 40 Sieve Size					
						DAY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)			COHESIVENESS (Consistency near Plastic Limit)
GRAVELS SOX(-) > 1/4" Ø	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.	SILTS AND CLAYS Liquid Limit < 50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, such as flour, silty or clayey fine sands with slight plasticity.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.		Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	GRAVELS W/FINES (High % Fines)	Non plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.	Slight to Medium	Slow	Slight	OL	Organic silts and organic silt clays of low plasticity.	
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.	Slight to Medium	Slow to none	Slight to medium	MH	Inorganic silts, micaceous or distasteful fine sandy or silty soils, elastic silts.	
SANDS SOX(+) < 1/4" Ø	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.	SILTS AND CLAYS Liquid Limit > 50	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.		Medium to High	None to Very Slow	Slight to medium	OH	Organic clays of medium to high plasticity.
	SANDS W/FINES (High % Fines)	Non plastic fines (for identification procedures, see ML)	SM	Silty sands, poorly graded sand-silt mixtures.	HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			PT	Peat and other organic soils
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.						

Boundary classification: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel sand mixture with clay binder. All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESCRIPTION	STANDARD PENETRATION RESISTANCE (BLMS/FOOT)
Very Loose	0-4
Loose	5-10
Medium Loose	11-20
Dense	21-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNC. COMPRESSIVE STRENGTH (TENS/50, P.S.I.)	STANDARD PENETRATION RESISTANCE (BLMS/FOOT)	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist.
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENESS		
Descriptive Term	Screwdriver or Knife Effects	Hammer Effects	Descriptive Term	Abbreviation	Spacing
Soft	Easily gouged	Crushes when pressed with hammer	Very Broken	(V. Br.)	0'-2"
Medium Soft	Can be gouged	Breaks (one blow); crumbly edges	Broken	(Br.)	2'-3'
Medium Hard	Can be scratched	Breaks (one blow); sharp edges	Blocky	(Bl.)	3'-3'
Hard	Cannot be scratched	Breaks considerably (several blows); sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES
 1. 2" Split Barrel Sample
 2. 1" O.D. Undisturbed Sample
 3. Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES
 1. MC (Conventional) Core (1.2 1/8" O.D.)
 2. MQ (Wireline) Core (1.2 1/8" O.D.)
 3. Other Core Types, Specify in Remarks

WATER LEVELS
 12/10
 12/10
 12/10
 Initial level - water & depth
 Stabilized level - water & depth

Subject

FIELD DOCUMENTATION

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0

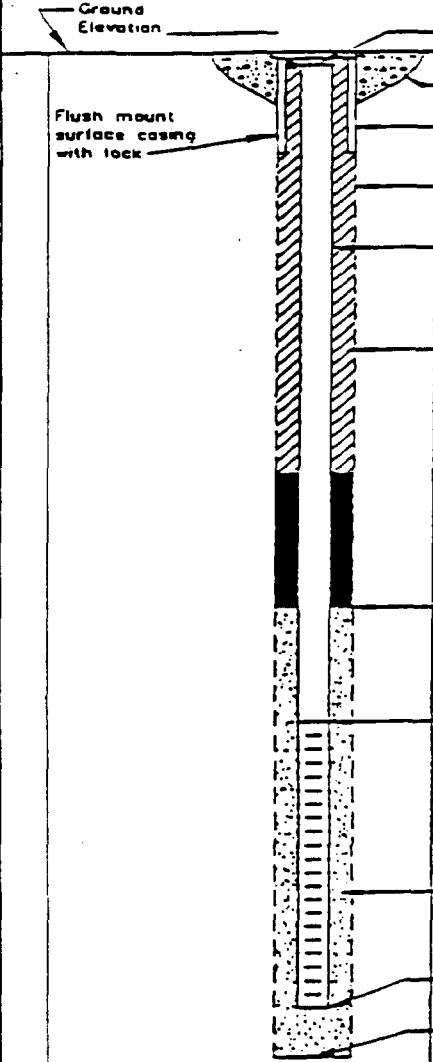
Effective Date

03/01/96

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**ATTACHMENT C-5A
EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)**

		BORING NO.: _____	
MONITORING WELL SHEET			
PROJECT _____ PROJECT NO. _____ ELEVATION _____ FIELD GEOLOGIST _____		LOCATION _____ BORING _____ DATE _____ DRILLER _____ DRILLING METHOD _____ DEVELOPMENT METHOD _____	



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____

I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____

RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____

DEPTH/ELEVATION TOP OF SAND: _____

DEPTH/ELEVATION TOP OF SCREEN: _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

DEPTH/ELEVATION BOTTOM OF SCREEN: _____

DEPTH/ELEVATION BOTTOM OF SAND: _____

DEPTH/ELEVATION BOTTOM OF HOLE: _____

BACKFILL MATERIAL BELOW SAND: _____

NOTE: USE RED INK FOR ALL FIELD DATA

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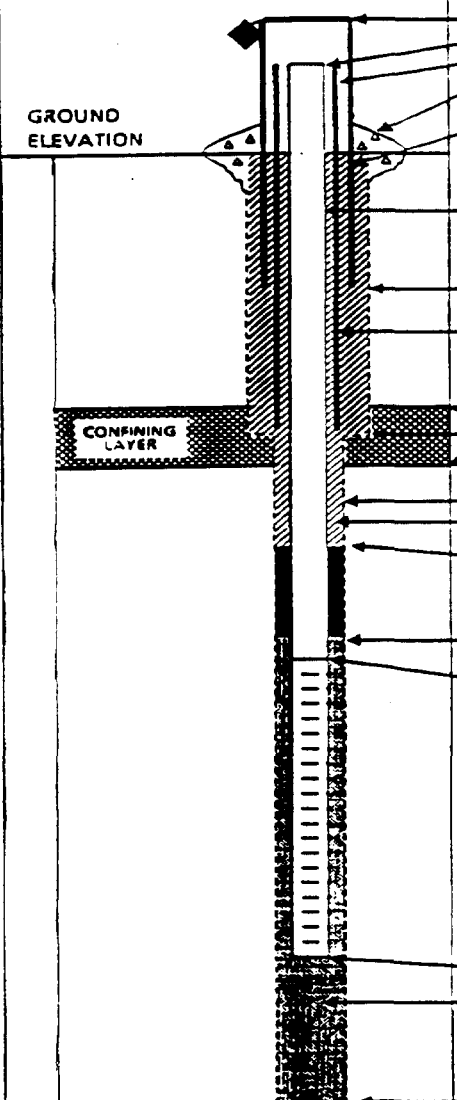
**ATTACHMENT C-6
EXAMPLE CONFINING LAYER MONITORING WELL SHEET**

BORING NO.: _____



**CONFINING LAYER
MONITORING WELL SHEET**

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING _____
ELEVATION _____	DATE _____	METHOD _____
FIELD GEOLOGIST _____		DEVELOPMENT _____
		METHOD _____



ELEVATION OF TOP OF SURFACE CASING: _____

ELEVATION OF TOP OF RISER PIPE: _____

ELEVATION TOP OF PERM. CASING: _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____

TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____

TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

PERM. CASING I.D. _____

TYPE OF CASING & BACKFILL: _____

ELEVATION / DEPTH TOP CONFINING LAYER: _____

ELEVATION / DEPTH BOTTOM OF CASING: _____

ELEVATION / DEPTH BOT. CONFINING LAYER: _____

BOREHOLE DIA. BELOW CASING: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____

TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION/DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____

TYPE OF SAND PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____

ELEVATION / DEPTH BOTTOM OF SAND PACK: _____

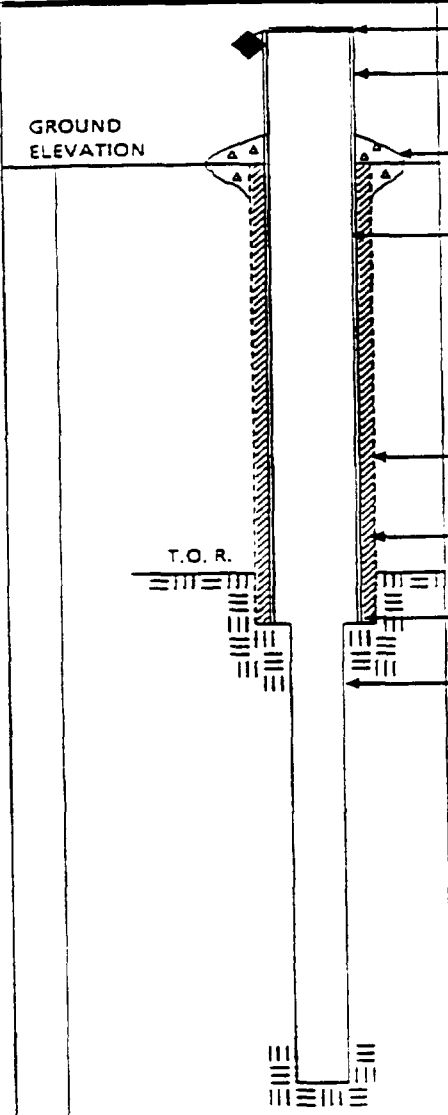
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

ELEVATION / DEPTH OF HOLE: _____

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**ATTACHMENT C-7
EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL**

 BORING NO.: _____ BEDROCK MONITORING WELL SHEET OPEN HOLE WELL		
PROJECT _____ PROJECT NO. _____ ELEVATION _____ FIELD GEOLOGIST _____	LOCATION _____ BORING _____ DATE _____	DRILLER _____ DRILLING _____ METHOD _____ DEVELOPMENT _____ METHOD _____



ELEVATION OF TOP OF CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

TYPE OF SURFACE SEAL: _____

I.D. OF CASING: _____

TYPE OF CASING: _____

TEMP. / PERM.: _____

DIAMETER OF HOLE: _____

TYPE OF CASING SEAL: _____

DEPTH TO TOP OF ROCK: _____

DEPTH TO BOTTOM CASING: _____

DIAMETER OF HOLE IN BEDROCK: _____

DESCRIBE IF CORE / REAMED WITH BIT:

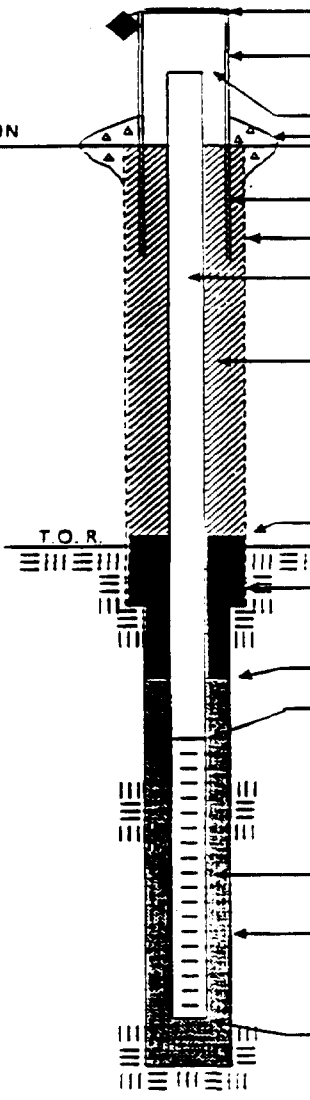
DESCRIBE JOINTS IN BEDROCK AND DEPTH:

ELEVATION / DEPTH OF HOLE: _____

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**ATTACHMENT C-8
EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK**

 BEDROCK MONITORING WELL SHEET WELL INSTALLED IN BEDROCK		BORING NO.: _____
PROJECT _____ PROJECT NO. _____ ELEVATION _____ FIELD GEOLOGIST _____	LOCATION _____ BORING _____ DATE _____	DRILLER _____ DRILLING METHOD _____ DEVELOPMENT METHOD _____



ELEVATION OF TOP OF SURFACE CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____

DIAMETER OF HOLE: _____

RISER PIPE I.D.: _____

TYPE OF RISER PIPE: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____

ELEVATION / DEPTH TOP OF BEDROCK: _____

TYPE OF SEAL: _____

ELEVATION / DEPTH TOP OF SAND: _____

ELEVATION / DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. SCREEN: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

CORE / REAM: _____

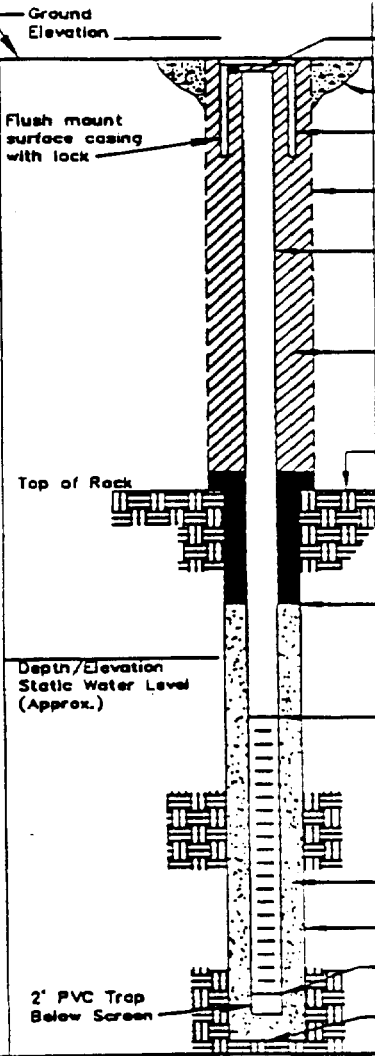
ELEVATION / DEPTH BOTTOM SCREEN: _____

ELEVATION / DEPTH BOTTOM OF HOLE: _____

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**ATTACHMENT C-8A
EXAMPLE BEDROCK MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK (FLUSHMOUNT)**

 BORING NO.: _____		
BEDROCK MONITORING WELL SHEET WELL INSTALLED IN BEDROCK		
PROJECT: _____ PROJECT NO.: _____ ELEVATION: _____ FIELD GEOLOGIST: _____	LOCATION: _____ BORING: _____ DATE: _____	DRILLER: _____ DRILLING METHOD: _____ DEVELOPMENT METHOD: _____



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____

I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____

RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____

DEPTH/ELEVATION TOP OF BEDROCK: _____

DEPTH/ELEVATION TOP OF SAND: _____

DEPTH/ELEVATION TOP OF SCREEN: _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

DEPTH/ELEVATION BOTTOM OF SCREEN: _____

DEPTH/ELEVATION BOTTOM OF SAND: _____

DEPTH/ELEVATION BOTTOM OF HOLE: _____

BACKFILL MATERIAL BELOW SAND: _____

SCALE: 1/4" = 1' (SEE VERTICAL SCALE)

ATTACHMENT D

EXAMPLE EQUIPMENT CALIBRATION LOG



Brown & Root Environmental

EQUIPMENT CALIBRATION LOG

INSTRUMENT NAME / MODEL : _____

JOB NAME :

MANUFACTURER: _____

JOB NUMBER : _____

[illegible]

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**ATTACHMENT F
FIELD TRIP SUMMARY REPORT
PAGE 1 OF 2**

SUNDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

MONDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

TUESDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

WEDNESDAY

Date: _____ Personnel: _____

Weather: _____ Onsite: _____

Site Activities: _____

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ATTACHMENT F
PAGE 2 OF 2
FIELD TRIP SUMMARY REPORT

THURSDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____

FRIDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____

SATURDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____



TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

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

Subject

PHOTOVAC 2020 PHOTOIONIZATION AIR MONITOR

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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
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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/m³.

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.

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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.

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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/m³. A reading greater than 99.9 will be shown with a resolution of 1 ppm or mg/m³. The meter will display concentrations up to 2000 ppm or 2(XX) mg/m³.

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

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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.

FIGURE 5-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: _____

PROJECT NO.: _____

[illegible]

DIRECT-READING INSTRUMENT RESPONSE DATA

PAGE OF

[illegible]

SITE NAME: _____

PROJECT NO.:

PAGE _____ OF _____

[illegible]

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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.

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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.

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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.

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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.

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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.

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- 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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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

FIGURE 5-5

FedEx *Dangerous Goods* **Airbill** **Sender's Copy**
67300 7161150 **RETAIN FOR 1 YEAR**
RETAIN THIS COPY FOR YOUR RECORDS

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) Please print clearly and legibly so it can be read.

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** Check here if recipient is a resident of a foreign country for FedEx Express Service.
City **Coraopolis** State **PA** ZIP **15108**
City _____ State _____ ZIP _____

4a Express Package Service Packages under 150 lbs.
☐ FedEx Priority Overnight (Next business day)
☐ 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 (Second business day)
☐ FedEx Express Saver Freight (Third business day)

(See for delivery schedule. Some restrictions apply. See back for detailed descriptions of freight services.)

The World On Time

Service Conditions, Restricted Areas, and Limit of Liability - By using this Airbill you agree to the terms and conditions of the current FedEx Service Guide or U.S. Government Service Guide. These are available on request. **GET BACK TO SENDER'S COPY OF THIS AIRBILL FOR INFORMATION AND ADDITIONAL TERMS.** We warrant the performance of our service. Invoices are \$20 per invoice. When the need of this service, please call our toll-free number, 1-800-468-3338, or visit our website, www.fedex.com. We warrant the performance of our service. Invoices are \$20 per invoice. When the need of this service, please call our toll-free number, 1-800-468-3338, or visit our website, www.fedex.com. We warrant the performance of our service. Invoices are \$20 per invoice. When the need of this service, please call our toll-free number, 1-800-468-3338, or visit our website, www.fedex.com.

Questions? Call 1-800-Go-FedEx (800) 468-3338

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 (Please print in block letters) ☐ 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 #15051 Rev. Date 6/98 ©1994-99 FedEx - PRINTED IN U.S.A.

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

Page 1 of 1 Pages

TRANSPORT DETAILS
This shipment is within the limitations provided for:
PASSENGER AIRCRAFT ☒ PASSENGER AIRCRAFT ☒
Airports of Departure: _____
Airports of Destination: _____
Shipment type: (delete non-applicable) **NON-RADIOACTIVE** **NON-RADIOACTIVE**

NATURE AND QUANTITY OF DANGEROUS GOODS					Quantity and Type of Packaging	Packing Inst.	Authorization
Proper Shipping Name	Class or Division	UN or 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**

Signature (Date, name, and address) _____

Signature (Date, name, and address) _____

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

APPENDIX E

ORGANIC, INORGANIC AND DIOXIN TARGET ANALYTE AND QUANTITATION LIMITS LIST

Exhibit C -- Section 2
Semivolatiles (SVOA)

2.0 SEMIVOLATILES TARGET COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS

Semivolatiles	CAS Number	Quantitation Limits			
		Water	Low	Med.	On
		ug/L	ug/Kg	ug/Kg	Column (ng)
34. Phenol	108-95-2	10	330	10000	(20)
35. bis-(2-Chloroethyl) ether	111-44-4	10	330	10000	(20)
36. 2-Chlorophenol	95-57-8	10	330	10000	(20)
37. 1,3-Dichlorobenzene	541-73-1	10	330	10000	(20)
38. 1,4-Dichlorobenzene	106-46-7	10	330	10000	(20)
39. 1,2-Dichlorobenzene	95-50-1	10	330	10000	(20)
40. 2-Methylphenol	95-48-7	10	330	10000	(20)
41. 2,2'-oxybis (1-Chloropropane) ¹	108-60-1	10	330	10000	(20)
42. 4-Methylphenol	106-44-5	10	330	10000	(20)
43. N-Nitroso-di-n-propylamine	621-64-7	10	330	10000	(20)
44. Hexachloroethane	67-72-1	10	330	10000	(20)
45. Nitrobenzene	98-95-3	10	330	10000	(20)
46. Isophorone	78-59-1	10	330	10000	(20)
47. 2-Nitrophenol	88-75-5	10	330	10000	(20)
48. 2,4-Dimethylphenol	105-67-9	10	330	10000	(20)
49. bis(2-Chloroethoxy) methane	111-91-1	10	330	10000	(20)
50. 2,4-Dichlorophenol	120-83-2	10	330	10000	(20)
51. 1,2,4-Trichlorobenzene	120-82-1	10	330	10000	(20)
52. Naphthalene	91-20-3	10	330	10000	(20)
53. 4-Chloroaniline	106-47-8	10	330	10000	(20)
54. Hexachlorobutadiene	87-68-3	10	330	10000	(20)
55. 4-Chloro-3-methylphenol	59-50-7	10	330	10000	(20)
56. 2-Methylnaphthalene	91-57-6	10	330	10000	(20)
57. Hexachlorocyclopentadiene	77-47-4	10	330	10000	(20)
58. 2,4,6-Trichlorophenol	88-06-2	10	330	10000	(20)
59. 2,4,5-Trichlorophenol	95-95-4	25	830	25000	(50)
60. 2-Chloronaphthalene	91-58-7	10	330	10000	(20)
61. 2-Nitroaniline	88-74-4	25	830	25000	(50)
62. Dimethylphthalate	131-11-3	10	330	10000	(20)
63. Acenaphthylene	208-96-8	10	330	10000	(20)
64. 2,6-Dinitrotoluene	606-20-2	10	330	10000	(20)
65. 3-Nitroaniline	99-09-2	25	830	25000	(50)
66. Acenaphthene	83-32-9	10	330	10000	(20)
67. 2,4-Dinitrophenol	51-28-5	25	830	25000	(50)

¹Previously known by the name bis(2-Chloroisopropyl) ether.

Exhibit C -- Section 2
Semivolatiles (SVOA)

Semivolatiles	CAS Number	Quantitation Limits			
		Water	Low Soil	Med. Soil	On Column
		ug/L	ug/Kg	ug/Kg	(ng)
68. 4-Nitrophenol	100-02-7	25	830	25000	(50)
69. Dibenzofuran	132-64-9	10	330	10000	(20)
70. 2,4-Dinitrotoluene	121-14-2	10	330	10000	(20)
71. Diethylphthalate	84-66-2	10	330	10000	(20)
72. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330	10000	(20)
73. Fluorene	86-73-7	10	330	10000	(20)
74. 4-Nitroaniline	100-01-6	25	830	25000	(50)
75. 4,6-Dinitro-2-methylphenol	534-52-1	25	830	25000	(50)
76. N-Nitroso-diphenylamine	86-30-6	10	330	10000	(20)
77. 4-Bromophenyl-phenylether	101-55-3	10	330	10000	(20)
78. Hexachlorobenzene	118-74-1	10	330	10000	(20)
79. Pentachlorophenol	87-86-5	25	830	25000	(50)
80. Phenanthrene	85-01-8	10	330	10000	(20)
81. Anthracene	120-12-7	10	330	10000	(20)
82. Carbazole	86-74-8	10	330	10000	(20)
83. Di-n-butylphthalate	84-74-2	10	330	10000	(20)
84. Fluoranthene	206-44-0	10	330	10000	(20)
85. Pyrene	129-00-0	10	330	10000	(20)
86. Butylbenzylphthalate	85-68-7	10	330	10000	(20)
87. 3,3'-Dichlorobenzidine	91-94-1	10	330	10000	(20)
88. Benzo(a)anthracene	56-55-3	10	330	10000	(20)
89. Chrysene	218-01-9	10	330	10000	(20)
90. bis(2-Ethylhexyl)phthalate	117-81-7	10	330	10000	(20)
91. Di-n-octylphthalate	117-84-0	10	330	10000	(20)
92. Benzo(b)fluoranthene	205-99-2	10	330	10000	(20)
93. Benzo(k)fluoranthene	207-08-9	10	330	10000	(20)

Exhibit C -- Section 2
Semivolatiles (SVOA)

Semivolatiles	CAS Number	Quantitation Limits			
		Water	Low Soil	Med. Soil	On Column
		ug/L	ug/Kg	ug/Kg	(ng)
94. Benzo(a)pyrene	50-32-8	10	330	10000	(20)
95. Indeno(1,2,3-cd) - pyrene	193-39-5	10	330	10000	(20)
96. Dibenzo(a,h) - anthracene	53-70-3	10	330	10000	(20)
97. Benzo(g,h,i)perylene	191-24-2	10	330	10000	(20)

Exhibit C -- Section 3
Pesticides/Aroclors (PEST/ARO)

3.0 PESTICIDES/AROCLORS TARGET COMPOUND LIST AND CONTRACT REQUIRED
QUANTITATION LIMITS^{2,3}

Pesticides/Aroclors	CAS Number	Quantitation Limits		
		Water ug/L	Soil ug/Kg	On Column (pg)
98. alpha-BHC	319-84-6	0.050	1.7	5
99. beta-BHC	319-85-7	0.050	1.7	5
100. delta-BHC	319-86-8	0.050	1.7	5
101. gamma-BHC (Lindane)	58-89-9	0.050	1.7	5
102. Heptachlor	76-44-8	0.050	1.7	5
103. Aldrin	309-00-2	0.050	1.7	5
104. Heptachlor epoxide ⁴	111024-57-3	0.050	1.7	5
105. Endosulfan I	959-98-8	0.050	1.7	5
106. Dieldrin	60-57-1	0.10	3.3	10
107. 4,4'-DDE	72-55-9	0.10	3.3	10
108. Endrin	72-20-8	0.10	3.3	10
109. Endosulfan II	33213-65-9	0.10	3.3	10
110. 4,4'-DDD	72-54-8	0.10	3.3	10
111. Endosulfan sulfate	1031-07-8	0.10	3.3	10
112. 4,4'-DDT	50-29-3	0.10	3.3	10
113. Methoxychlor	72-43-5	0.50	17	50
114. Endrin ketone	53494-70-5	0.10	3.3	10
115. Endrin aldehyde	7421-93-4	0.10	3.3	10
116. alpha-Chlordane	5103-71-9	0.050	1.7	5
117. gamma-Chlordane	5103-74-2	0.050	1.7	5
118. Toxaphene	8001-35-2	5.0	170	500
119. Aroclor-1016	12674-11-2	1.0	33	100
120. Aroclor-1221	11104-28-2	2.0	67	200
121. Aroclor-1232	11141-16-5	1.0	33	100
122. Aroclor-1242	53469-21-9	1.0	33	100
123. Aroclor-1248	12672-29-6	1.0	33	100
124. Aroclor-1254	11097-69-1	1.0	33	100
125. Aroclor-1260	11096-82-5	1.0	33	100

²There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of pesticides/Aroclors.

³The lower reporting limit for pesticide instrument blanks shall be one-half the CRQL values for water samples.

⁴Only the exo-epoxy isomer (isomer B) of heptachlor epoxide is reported on the data reporting forms (Exhibit B).

INORGANIC TARGET ANALYTE LIST (TAL) - TABLE 1

Analyte	Contract Required Detection Limit ^{1,2} (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

- (1) Subject to the restrictions specified in Exhibits D and E, any analytical method specified in ILM04.0, Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead: Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 220
Contract Required Detection Limit (CRDL) = 3

The value of 220 may be reported even though the instrument detection limit is greater than CRDL. The instrument or method detection limit must be documented as described in Exhibits B and E.

- (2) The CRDLs are the minimum levels of detection acceptable under the contract Statement of Work.

METHOD 8290

POLYCHLORINATED DIBENZODIOXINS (PCDDs) AND POLYCHLORINATED DIBENZOFURANS (PCDFs) BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/HRMS)

1.0 SCOPE AND APPLICATION

1.1 This method provides procedures for the detection and quantitative measurement of polychlorinated dibenzo-p-dioxins (tetra- through octachlorinated homologues; PCDDs), and polychlorinated dibenzofurans (tetra- through octachlorinated homologues; PCDFs) in a variety of environmental matrices and at part-per-trillion (ppt) to part-per-quadrillion (ppq) concentrations. The following compounds can be determined by this method:

Compound Name	CAS No ^a
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	57653-85-7
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	19408-74-3
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-39-4
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	3268-87-9
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0

^a Chemical Abstract Service Registry Number

1.2 The analytical method calls for the use of high-resolution gas chromatography and high-resolution mass spectrometry (HRGC/HRMS) on purified sample extracts. Table 1 lists the various sample types covered by this analytical protocol, the 2,3,7,8-TCDD-based method calibration limits (MCLs), and other pertinent information. Samples containing concentrations of specific congeneric analytes (PCDDs and PCDFs) considered within the scope of this method that are greater than ten times the upper MCLs must be analyzed by a protocol designed for such concentration levels, e.g., Method 8280. An optional method for reporting the analytical results using a 2,3,7,8-TCDD toxicity equivalency factor (TEF) is described.

Table 1.

Types of Matrices, Sample Sizes and 2,3,7,8-TCDD-Based
Method Calibration Limits (Parts per Trillion)

	Water	Soil Sediment Paper Pulp ^b	Fly Ash	Fish Tissue ^c	Human Adipose Tissue	Sludges, Fuel Oil	Still- Bottom
Lower MCL ^a	0.01	1.0	1.0	1.0	1.0	5.0	10
Upper MCL ^a	2	200	200	200	200	1000	2000
Weight (g)	1000	10	10	20	10	2	1
IS Spiking Levels (ppt)	1	100	100	100	100	500	1000
Final Extr. Vol. (μL) ^d	10-50	10-50	50	10-50	10-50	50	50

a For other congeners multiply the values by 1 for TCDF/PeCDD/PeCDF, by 2.5 for HxCDD/HxCDF/HpCDD/HpCDF, and by 5 for OCDD/OCDF.

b Sample dewatered according to Sec. 6.5.

c One half of the extract from the 20 g sample is used for determination of lipid content (Sec. 7.2.2).

d See Sec. 7.8.1, Note.

NOTE: Chemical reactor residues are treated as still bottoms if their appearances so suggest.

<u>Analyte</u>	<u>Detection/Limit</u>
TOC	100 mg/kg
Grain Size Distribution	0.1 mg (down to No. 200 mesh sieve)

<u>Analyte</u>	<u>Reporting Limit</u>
AVS/SEM	1.0 μ mol AVS/g dry weight

NOTE:

The required quantitation limit for sediment samples are the same values listed in the previous tables for soil samples. The analytical methods in the DAS Technical Specifications S99-RACI-117 and S99-RACI-118 are modified to compensate for the high percent of water of the sediment samples.

LUCY GUZMAN
SENIOR CHEMIST/QUALITY ASSURANCE OFFICER
TETRA TECH NUS, INC.
WILMINGTON, MASSACHUSETTS

PROPOSED ROLE: Lead Chemist and Quality Assurance Officer

EDUCATION: M.S. Food Science and Resource Chemistry,
University of Rhode Island, 1979
M.S. (equivalent, six-year program) Chemistry and Pharmacy,
University of Chile, 1970
Inductively Coupled Plasma-Mass Spectrometry Auditors Training,
EPA, 1992
Quality Improvement Process, Halliburton NUS, 1990
29 CFR 1910.120 OSHA 8-Hour Annual Refresher Training, 1990 - 1998
29 CFR 1910.120 OSHA 8-Hour Supervisor Training, 1990
29 CFR 1910.120 OSHA 40-Hour Health and Safety Training, 1989
Quality Assurance Training, Halliburton NUS, 1989
Air Toxics Training, EPA, 1989
Quality Improvement Training, American Management Association, 1986
High Resolution Capillary Column GC, Fisheries Research Board of
Canada, 1975

EXPERIENCE: Tetra Tech NUS (includes predecessors), 1989 - present
Roy F. Weston, 1989
ENSECO/Erco Laboratory, 1981 - 1988
University of Rhode Island, 1977 - 1979
Fisheries Development Institute of Chile, 1971 - 1977

Ms. Guzman is an analytical chemist with more than 20 years of experience in environmental analysis, quality assurance/quality control, data validation/interpretation, and data management. For the past 9 years, she has served in a dual role as lead chemist and quality assurance officer for the Tetra Tech NUS office in Wilmington, MA. She has extensive experience developing Quality Assurance Project Plans (QAPPs) and scoping sampling and chemical analysis needs to develop Sampling and Analysis Plans.

Lead Chemist: Responsible for developing Data Quality Objectives (DQOs) for field sampling activities in support of remedial investigations, remedial actions, remedial investigation oversight, and technical assistance projects; developing sampling and analysis plans; and developing method specifications for requests of analytical services of air, fish, waste, water, and solid samples for organic and inorganic analyses. Ms. Guzman is responsible for oversight of field screening of volatile compounds, PCBs, and metals using gas chromatography, x-ray fluorescence, and immunoassay techniques. She coordinates sample scheduling and analysis, and participates in data evaluation and interpretation in support of remedial investigations and remedial action studies.

Quality Assurance Officer: Ms. Guzman reviews and prepares Quality Assurance Project Plans for site activities and performs field audits to determine Sampling and Analysis Plan compliance to Quality Assurance/Sampling Plans. She performs laboratory audits and select laboratories. She also performs quality assurance training for Tetra Tech NUS personnel.

Project Manager: Ms. Guzman is responsible for technical issues, costs, and scheduling laboratory subcontracting activities.

Senior Data Validator: Responsible for the data validation of hundreds of organic and inorganic data packages. Manages the data validation task, and is responsible for scheduling, reviewing the data validation reports, and controlling data validation budgets.

Organic Laboratory Director: Previously responsible for overall technical direction and management of volatile organic, gas chromatography/mass spectroscopy, and hydrocarbon laboratories with more than 50 technical personnel.

PROJECT EXPERIENCE:

Lead Chemist/QA Officer; numerous Superfund sites for U. S. EPA Region I - Participates as lead chemist, senior data validator, and quality assurance officer for numerous projects. Provides technical assistance on Sampling and Analysis Plans and advises on data usability and interpretation. Reviews project activities to ensure that the standards of performance comply with the QAPP.

Senior Organic Data Validator; Superfund and Resource Conservation and Recovery Act (RCRA) sites for U.S. EPA Region I - Performed organic data validation for dioxins, Special Analytical Services (SAS) and Routine Analytical Services (RAS) protocols for Superfund and RCRA projects.

Laboratory Program Manager; EPA Contract Laboratory Program - Responsible for the analysis of hazardous substances at potential hazardous waste sites, according to CLP protocols and requirements.

Expert Witness; New York Department of Environmental Conservation - Provided expert testimony on the hazardous waste testing of waste samples at White Plains, New York.

STEPHEN S. PARKER
PROJECT MANAGER
WILMINGTON, MASSACHUSETTS

EDUCATION: M.S. Environmental Studies, 1987, Southern Illinois University at Edwardsville
B.A. Biology, 1984, Franklin Pierce College

29 CFR 1910.120 OSHA, 8-Hour Refresher Training, Annually
29 CFR 1910.120 OSHA, 8-Hour Supervisory Training
29 CFR 1910.120 OSHA, 40-Hour Health and Safety Training

CERTIFICATIONS/ Massachusetts Certified Asbestos Inspector
REGISTRATION: Massachusetts Certified Asbestos Management Planner

Mr. Parker has more than fourteen years of experience in various environmental contract, research, and consulting capacities, and currently supervises the Life Sciences Group. He is a manager for various projects including on-shore and off-shore remedial investigations and ecological risk assessments, UST removal and corrective actions, and other investigation and remedial action-related projects. He directs internal staff and subcontractors, and develops work plans, implementation plans, and subcontract specifications. He is responsible for all aspects of project work, including technical content of deliverable documents, budget maintenance and reporting, directing work efforts, and schedule compliance. Performs extensive client interaction on both managerial and technical levels.

In addition, Mr. Parker provides technical assistance and subcontractor oversight for asbestos projects, lead paint survey and industrial hygiene projects; risk assessments; risk analyses; wetlands delineation and mitigation studies; and fishery, industrial hygiene, and emergency response projects.

PROJECT EXPERIENCE:

Project Manager; Naval Education and Training Center; Derecktor Shipyard; Newport, RI; Marine Remedial Investigation, Risk Assessments and Feasibility Studies.

Managed progress and financial concerns of multiple subcontractors including engineering firms, analytical laboratories, off-shore survey crews, commercial divers and others who performed the field and analytical work for the study. Coordinated preparation of Ecological and Human Health Risk Assessment reports, responses to comments and report revisions. Prepared feasibility study evaluating remedial options for contaminated sediment. Provided public meeting presentations for all phases of these studies.

Project Manager; Naval Education and Training Center; Old Fire Training Area; Newport, RI; Off-Shore Remedial Investigation and Ecological Risk Assessment.

Managed progress and financial concerns of subcontractors, including the University of Rhode Island Graduate School of Oceanography and others who performed the field and analytical work for the off-shore study.

Project Manager; Naval Education and Training Center; McAllister Point Landfill; Newport, RI; Off-Shore Remedial Investigation and Ecological Risk Assessment.

Managed progress and financial concerns of subcontractors, including the University of Rhode Island Graduate School of Oceanography and others who performed the field and analytical work for the off-shore study. Followed up original study with two phases of off-shore drilling operations, hot spot investigations, technical memoranda, report preparation and support to the FS for this site.

Project Manager; Naval Education and Training Center; Derecktor Shipyard; Newport, RI; On- Shore Study Area Screening Evaluation.

Managed in-house site assessment project in accordance with work plans and regulatory oversight at a former shipyard site in Rhode Island. Coordinated and directed multiple sampling crews, on-site analytical efforts, and multiple subcontractors including analytical services, drilling, well installation, test pit excavations, general environmental cleanup. Directed report preparation, technical presentations, responses to regulatory comments, and document revisions.

Project Manager; Naval Education and Training Center, Newport, RI; Work Plans for On-Shore and Off- Shore Investigations.

Prepared work plans for extended program of field investigations for multiple sites. Coordinated internal preparation of work plans for on-shore field investigations of a former shipyard. Coordinated subcontractors, researched information, and prepared work plans for on-shore and off-shore remedial investigations and ecological risk assessments at multiple hazardous waste sites.

Field Operations Leader; Stratford Sites; Stratford, CT; Emergency Response Actions.

Coordinated mobilization/demobilization of field equipment, personnel, and subcontractors performing sampling and generating on-site reports. Controlled sample collection efforts and data production from three subcontracted laboratories, one subcontracted labor group, and two field sampling crews. Created and directed data transfer systems between laboratories, sampling crews, and report production staff.

Project Manager; Naval Construction Battalion Center; Davisville, RI; UST Corrective Actions and Pre-Design Investigations.

Secured subcontractors, and managed in-house staff and subcontract work for multiple concurrent tasks, including report preparation, field investigations, and design of remedial actions.

Project Manager; Naval Construction Battalion Center; Davisville, RI; UST Site Investigations and Corrective Action Plans.

Performed site investigations at multiple former UST sites, activities included securing subcontractors, managed in-house staff for field investigations and subcontract work for multiple concurrent tasks including drilling, test pit excavation, corrective action excavations, and laboratory analysis. Prepared reports of investigations with recommendations for corrective actions.

Field Operations Leader; Solvents Recovery Services of New England, Inc.; Southington, CT; RI/FS; Environmental Sampling.

Coordinated mobilization of field equipment, personnel, and subcontractors; controlled sample collection efforts; and monitored data production for three phases of field sampling between 1990 and 1993 with durations between 4 and 20 weeks. Controlled data documentation and reports to project manager and technical lead personnel.

Industrial Hygienist; Various Sites and Locations; Asbestos Survey and Removal Actions.

Served as senior industrial hygienist and project manager for asbestos removal projects at Boston City Schools, Office buildings in New York, Atlanta, and many other locations. Responsibilities involved budget management, subcontractor supervision, and technical direction of work oversight performed by internal staff.

Project Manager/Task Manager; Various Sites and Locations; Asbestos Inspections/Air Sampling.

Performed asbestos inspections and air sampling surveys in office buildings, shopping malls, and schools throughout the United States. Responsibilities included bid preparation and negotiation; supervision of technical effort, including staff and subcontractors; report preparation; and client billing. Extensive client interaction and public relations efforts required for all asbestos projects.

Industrial Hygienist/Task Manager; Various Sites and Locations; Air Quality Management.

Completed air quality emissions permits for leather finishing manufacturers for compliance with CAA permit requirements. Supported clients in SARA Title III reports, permit compliance, and control strategies. Designed and performed air sampling programs for formaldehyde, asbestos, and particulates in homes. Provided consultation services to homeowners for mitigation actions for various contaminant sources. Supported in-house safety personnel for lighting manufacturing plant in Lynn, Massachusetts, by developing and performing an air sampling program for mercury and sulfur dioxide.

KEVIN O'NEILL
ENVIRONMENTAL SCIENTIST/ ECOLOGIST

PROFESSIONAL QUALIFICATIONS

EDUCATION:

B.S. in Biology, 1979, State University of New York College at Cortland, Cortland, New York
Wetlands Biology, Lowell University, 1989
Wetlands Identification and Delineation. University of Massachusetts, 1991

REGISTRATION AND CERTIFICATIONS:

Certified Professional Wetland Scientist
OSHA 29 CFR 1910.120 40-Hour Hazardous Waste Site Training
OSHA 29 CFR 1910.120 8-Hour Refresher Training, renewed annually
OSHA 29 CFR 1910.120 8-Hour Supervisory Training

PROFESSIONAL ASSOCIATIONS:

Society of Wetland Scientists

EXPERIENCE

Tetra Tech NUS, formerly Brown & Root Environmental, 1984 to present
Bioassay Systems Corporation, 1981 to 1984
Clinical Data, 1980 to 1981

Over 14 years experience working as an environmental scientist for U.S. EPA, U.S. Navy (CLEAN) project, and New England state and industrial projects. Versatile in wide range of multi-media environmental contamination study techniques including air, biota, groundwater, surface water, soil, and sediment investigations. Served as field operations leader on several RI/FS studies of hazardous waste sites throughout New England. Responsible for thorough understanding of project objectives and schedule. Responsible for implementation and successful completion of the sampling programs and served as the prime interface with residents and local, state, and federal agencies. Skills include preparation of Work Plans and Sampling and Analysis Plans, coordination, logistics, oversight, and performance of field sampling tasks, compilation and evaluation of analytical data, and preparation of technical reports. Supervised and trained personnel in the use of state-of-the-art environmental sampling techniques and equipment, health and safety monitoring, and personal protective equipment. Supervised and trained personnel in the operation of field mobile laboratories during short- and long-term studies. Supervised and performed soil gas surveys and ambient air sampling in support of environmental studies.

Also serves as the lead specialist in wetland and ecological studies. Assists project managers in developing work plans, field sampling plans, and preparing reports on the various aspects of ecological study programs as they relate to site remedial investigations and cleanup projects. Interfaces with staff engineers and engineering subcontractors to develop compensatory wetland designs and provides technical oversight during construction.

PROJECT EXPERIENCE

Field Operations Leader; U.S. EPA Region I/RACS and ARCS; Raymark Industries, Inc., Stratford, Connecticut; CERCLA; Remedial Investigation/Feasibility Studies:

Field operations leader responsible for planning and Implementation of field activities in support of three town-wide RI/FS studies. Field activities included: sampling program of more than 100 surface water and sediment locations and installation, sampling of 150 groundwater monitoring stations over the duration of the five year study. Supervised TtNUS field crew of more than 10 personnel, in addition to drilling, Vibracore, Geoprobe, test pitting, and survey subcontractors. Performance of ecological inventories including identification, delineation, and functional assessment of coastal and inland wetland areas.

Environmental Scientist; U.S. EPA Region I/ARCS; Industri-Plex Site, Woburn, Massachusetts; CERCLA; Remedial Design/Remedial Action:

Remedial activities for metals contamination in suburban Boston, Massachusetts. Performed technical oversight, evaluation, and review of PRP design and construction studies. Provided technical oversight of construction management of site cleanup and installation of geotextile/soil cap and mitigation for 12 wetland and stream areas. Provided review of PRP sediment, surface water, and biological sampling and analysis plans and data reports.

Environmental Scientist/Wetlands Scientist; U.S. Navy; Naval Housing Facility, Quincy, Massachusetts; Site Assessment/UST Closure under the Massachusetts Contingency Plan:

Performed technical oversight of UST removal operations and an ecological study for stressed vegetation of coastal salt marsh of a coastal site in Quincy, Massachusetts under the U.S. Navy CLEAN contract.

Field Operations Leader/Wetlands Scientist; U.S. EPA Region I/ARCS; Former Nyanza Chemical; Ashland, Massachusetts; CERCLA; Remedial Investigation/Feasibility Study:

Field operations leader in a three-year study of 31 miles of the Sudbury River. Tasks included preparing Work Plans, Field Sampling and Analysis Plans, and evaluating data and final reports. Performed a wetlands characterization and evaluation study of bordering wetlands along the Sudbury River. Supervised sampling events including surface waters, sediments, soils, fish, and benthic organisms over the duration of the study. Designed and supervised sediment profile sampling from a floating platform while using supplied air respiratory protection in a continuing contaminant source area.

Environmental Scientist; Massachusetts Water Resources Authority; Quincy Shipyard Site, Quincy, Massachusetts; U.S. EPA Region I; MA State Regulations; Site Assessment:

Site Assessment of a 180-acre shipyard site in Quincy, Massachusetts that was completed in a six-month period. Responsible for development and implementation of programs involving sampling marine waters and sediments, field analytical screening, interpretation of field and laboratory data, and monitoring well installations.

Environmental Scientist; U.S. EPA Region I/ARCS; Re-Solve, Inc.; North Dartmouth, Massachusetts; CERCLA, Remedial Design/Remedial Action:

Performed technical oversight and review of PRP wetlands mitigation design, construction, monitoring, and evaluation of two compensatory wetland areas.

Environmental Scientist; U.S. EPA Region I; Municipal Water Supply Wells, Woburn, Massachusetts; CERCLA; Remedial Investigation/Feasibility Study:

Remedial Investigation for metals and solvent contamination in suburban Boston, Massachusetts. Conducted on-site analytical screening, and sampling and technical oversight enforcement activities during PRP drilling and test pit excavation of contaminated riverine wetlands.

Field Operations Leader; U.S. EPA Region I/ARCS; Kearsarge Metallurgical Corporation Site, North Conway, New Hampshire; CERCLA; Pre-Design Investigation:

Field operations leader responsible for preparing Work Plans, Field Sampling and Analysis Plans, coordinating and performing field sampling tasks, evaluating data, and preparing final reports. Performed a wetlands identification, delineation, and functional assessment study that included a flora and fauna survey.

Environmental Scientist; U.S. Navy; Landfill Site, Newport, Rhode Island; Remedial Investigation/Feasibility Study:

Performed wetland identification, delineation, functional assessment, and flora and fauna survey of a 30-plus acre coastal site on Narragansett Bay in Rhode Island under the U.S. Navy CLEAN contract in support of an RI/FS.

Environmental Scientist; U.S. EPA Region I/ARCS; Solvents Recovery Service of New England, Inc.; CERCLA; Remedial Investigation/Feasibility Study:

Remedial Investigation and Feasibility Study at a solvent recycling facility in southwestern Connecticut. Performed an ecological assessment including wetland and upland plant communities characterization, wetlands identification and delineation, and flora and fauna surveys. Performed sampling and analytical screening at an on-site mobile laboratory. Conducted soil gas sampling and on-site analyses to delineate areas of high concentrations, which were used to determine subsequent locations for soil borings and soil sampling.

Environmental Scientist; U.S. EPA Region I/ARCS; Saco Tannery Waste Pits, Saco, Maine; CERCLA; Pre-Design Investigation:

Performed a wetlands identification and delineation study of a 233-acre site in southern Maine. The study included the evaluation of more than 58 natural and artificially created on-site wetlands. Evaluated on-site and off-site areas for the design of compensatory wetlands to replace wetlands lost during remedial actions. Performed technical oversight of construction, monitoring, and evaluation of the success of the compensatory wetland.

Environmental Scientist; Industrial Battery Manufacturer; Reading, Pennsylvania; U.S. EPA Region III; RCRA; RCRA Facility Assessment:

Interpreted and evaluated 12 years of historical sampling data for an industrial facility in eastern Pennsylvania with subsequent development of a sampling and analysis plan to refine site contamination characterization for federal and state permit applications. Performed field sampling and analytical screening for volatile organic contaminants.

Environmental Scientist; U.S. EPA Region I; Landfill Site, New Bedford, Massachusetts; CERCLA: Site investigation of PCB and solvent contamination at a quarry in southeastern Massachusetts. Developed and implemented an on-site air monitoring program designed to protect the health and safety of on-site personnel and local residents. Performed on-site VOC screening during test pit excavations.

Environmental Scientist; Chemical Manufacturer; Chattanooga, Tennessee; U.S. EPA Region IV; RCRA; Characterization of Settling and Waste Lagoons:

Site characterization performing on-site organic compound sampling and screening at an industrial facility in Tennessee. The study included characterizing nine settling and waste lagoons that were evaluated for cleanup and closure.

**BRIAN R. FENNELLY
ENVIRONMENTAL ENGINEER
TETRA TECH NUS, INC.
WILMINGTON, MASSACHUSETTS**

PROPOSED ROLE: Project Engineer

EDUCATION: M.S., Environmental Engineering, University of New Hampshire, 1998
B.S., Environmental Science, Syracuse University, 1992

29 CFR 1910.120 OSHA, 8-Hour Supervisory Training, 1999
49 CFR 172.704(a)(1) and (2) Manifesting, Label, and Packaging
Hazardous Materials, 1999
29 CFR 1910.120 OSHA, 8-Hour Refresher Training, Annually
29 CFR 1910.120 OSHA, 40-Hour Health and Safety Training

CERTIFICATIONS/

REGISTRATIONS: Engineer in Training, 1997

AFFILIATIONS: National Society of Professional Engineers

EXPERIENCE: Tetra Tech NUS, 1999 - present

Mr. Fennelly has over 6 years of experience in the environmental engineering field. Mr. Fennelly has been involved in all phases of environmental restoration projects including evaluation of remedial alternatives, design, implementation, and construction management. His broad experience includes conducting site assessments related to hazardous waste contamination and the remediation activities associated with these projects.

Mr. Fennelly has supported project management activities by preparing proposals, work plans, budgets, cost estimates, contracts, design drawings and specifications, and other documentation associated with the implementation of projects.

Prior to joining Tetra Tech NUS, Mr. Fennelly worked with a Massachusetts Engineering Consulting Firm which specialized in projects involving releases of hazardous wastes. Mr. Fennelly was responsible for coordinating and conducting environmental sampling and data collection events.

PROJECT EXPERIENCE:

Project Engineer: Design and Construction of Dual Phase Extraction (DPE) System to address light non-aqueous phase liquid (LNAPL) contamination at a former fuel oil recycling and distribution facility in Plaistow, NH (Beede Waste Oil Superfund Site). Responsible for the design and specifications of various aspects of a DPE System used to remove three LNAPL plumes with a total area of approximately two acres. The system includes 143 4-inch vacuum extraction wells, 5000 feet of transmission piping, an air/water separator, an oil/water separator, a vacuum pump, and four granular activated carbon units.