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FINAL WORK PLAN, SAMPLING AND ANALYSIS PLAN AND HEALTH AND SAFETY PLAN
FOR PRELIMINARY GROUNDWATER ASSESSMENT AT SITES SS003, OWS704, SS004,
SS006 AND SS009 KANSAS CITY MO

3/1/1996
VERSAR

United States Air Force

Environmental Restoration Program

F I N A L ADMINISTRATIVE
RECORD COPY

**Work Plan
Sampling and Analysis Plan
Health and Safety Plan**

**Preliminary Groundwater Assessment at
Sites SS003, OWS704, SS004, SS006, and SS009**

**Operating Location Q, Missouri
(Richards-Gebaur Air Force Base)**



**Contract No. F4162-94-D-8051
Delivery Order No. 0016
AFBCA Project No. UEBL 95-7011**

March 1996

F I N A L

**Work Plan
Sampling and Analysis Plan
Health and Safety Plan**

**Preliminary Groundwater Assessment at
Sites SS003, OWS704, SS004, SS006, and SS009**

March 1996

Prepared for

**Air Force Center for Environmental Excellence (AFCEE/ERB)
Base Closure Restoration Division
Brooks Air Force Base, Texas 78235-5328**

**USAF Contract No. F41624-94-D-8051, Delivery Order No. 0016
AFBCA Project No. UEBL 95-7011**

Prepared by

**Versar, Inc.
6850 Versar Center
Springfield, Virginia 22151**

TAB

Work Plan

United States Air Force

Environmental Restoration Program

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Sites SS003, OWS704, SS004, SS006, and SS009**

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NOTICE

This plan has been prepared for the United States Air Force by Versar, Inc. for the purpose of aiding in the environmental investigation under the Air Force Environmental Restoration Program. Because this plan supports environmental investigations at the site, its release prior to an Air Force final decision on site conditions may be in the public's interest. The limited objectives of this plan and the ongoing nature of the investigations, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this plan because subsequent facts may become known that may make this plan premature or inaccurate. Acceptance of this plan in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1294, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503.

1 AGENCY USE ONLY (Leave Blank)		2 REPORT DATE March 1996	3 REPORT TYPE AND DATES COVERED Final	
4 TITLE AND SUBTITLE Work Plan Preliminary Groundwater Assessments at Sites SS003, OWS704, SS004, SS006, and SS009			5 FUNDING NUMBERS USAF Contract No. F41624-94-D-8051, Delivery Order No. 0016 AFBCA Project No. UEBL 95-7011	
6 AUTHOR(S) Michael E. Dorman Christina Archambeault				
7 PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Versar, Inc. 6850 Versar Center Springfield, Virginia 22151			8 PERFORMING ORGANIZATION REPORT NUMBER	
9 SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Center for Environmental Excellence (ERB) Base Closure Restoration Division Brooks Air Force Base, TX 78235-5000			10 SPONSORING/MONITORING AGENCY REPORT NUMBER	
11 SUPPLEMENTARY NOTES				
12a DISTRIBUTION/AVAILABILITY STATEMENT			12b DISTRIBUTION CODE	
13 ABSTRACT (Maximum 200 words) This Work Plan (WP) summarizes the activities and efforts for Preliminary Groundwater Assessments of Sites SS003, OWS704, SS004, SS006, and SS009 at Operating Location Q, formerly Richards-Gebaur Air Force Base. This WP includes reporting requirements, project management structure, and the project schedule.				
14 SUBJECT TERMS Sampling, Work Plan			15 NUMBER OF PAGES 48	
			16 PRICE CODE	
17 SECURITY CLASSIFICATION OF REPORT Unclassified	18 SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19 SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20 LIMITATION OF ABSTRACT Unclassified	

ACRONYMS & ABBREVIATIONS

ADC	Air Defense Command
AFCS	Air Force Communications Service
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AFRES	Air Force Reserve
ASTM	American Society of Testing Material
ATV	all-terrain vehicle
B & M	Burns & McDonnell
BCP	Base Cleanup Plan
beg	below existing grade
BNA	Base-neutral acids
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenze, and xylenes
CDRL	Contract Data Requirements Lists
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CO	Contracting Officer
COR	Contracting Officer Representative
DoD	Department of Defense
DSMOA	Department of Defense and State Memorandum of Agreement
E & E	Ecology & Environment
EPA	Environmental Protection Agency
FFA	Federal Facility Agreement
FSP	Field Sampling Plan
GSA	General Services Administration
HASP	Health and Safety Plan
ID	inner diameter
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
MAC	Military Airlift Command
MDNR	Missouri Department of Natural Resources
MDOH	Missouri Department of Health
msl	mean sea level
NPL	National Priorities List
O & G	O'Brien & Gere
OL	Operating Location
PA	Preliminary Assessment
PCB	polychlorinated biphenyl
PID	photoionization detector
POL	petroleum oil, and lubricants
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control

ACRONYMS & ABBREVIATIONS

RA	Remedial Action
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Studies
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S.	United States
USAF	United States Air Force
USCS	Unified Soil Classification System
UST	Underground Storage Tank
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WBS	Work Breakdown Structure
WP	Work Plan

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SECTION 1.0

INTRODUCTION

This Work Plan (WP) describes the preliminary groundwater assessments to be performed by Versar, Incorporated (Versar) at Operating Location Q (OL-Q), formerly known as Richards-Gebaur Air Force Base (Missouri). This work is part of the United States (U.S.) Air Force Installation Restoration Program (IRP) efforts to evaluate and remediate contamination at Air Force facilities. Versar, under contract to the Air Force Center for Environmental Excellence (AFCEE), will perform groundwater sampling at Sites SS003, OWS704, SS004, SS006, and SS009 on the base.

This WP has been prepared in accordance with the requirements specified in the AFCEE "Handbook for IRP Remedial Investigation/Feasibility Studies" (1993).

1.1 DESCRIPTION OF THE AIR FORCE INSTALLATION RESTORATION PROGRAM

The objectives of the Air Force IRP are to assess past hazardous waste disposal practices and releases at Air Force installations and to develop remedial actions for those sites that pose a threat to human health and welfare or to the environment. The IRP process is designed to address a variety of U.S. laws pertaining to the protection of the environment.

The U.S. Department of Defense (DoD) developed the IRP to ensure compliance with the Resource Conservation and Recovery Act of 1976 (RCRA). The IRP process was initiated in June 1980 by the DoD through the Defense Environmental Quality Program Policy Memorandum 80-6. The IRP procedures were implemented by the DoD in December 1980.

Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980. The IRP complies with CERCLA in identifying and remediating contaminated sites at Air Force facilities. The U.S. Environmental Protection Agency (EPA) is the primary policy and enforcement agency regarding contaminated sites. Executive Order 12316, adopted in 1981, gave various federal agencies, including DoD, the responsibility to act as lead agencies to conduct investigations and implement remediation efforts when the agency is the sole contributor or a co-contributor to contamination on or off their properties.

The Superfund Amendments and Reauthorization Act of 1986 (SARA) extends the requirements of CERCLA, and modifies CERCLA with respect to goals for remediation and the process leading to the selection of a remedial action. The ultimate objective of the Remedial Investigation/Feasibility Studies (RI/FS) process is to evaluate and determine the remedial actions for CERCLA sites that, when implemented, will provide adequate public health and environmental protection.

The identification and evaluation of sites on DoD properties where environmental concerns may exist are the primary objectives of the IRP process. These environmental concerns may be associated with: (1) past hazardous waste disposal practices, spills, leaks, or other activities; (2) the control of the migration of hazardous contaminants; and (3) the control of health and environmental hazards that may result from past DoD disposal operations. The following IRP tasks are typically completed to meet these objectives:

- Develop a project data base through records review, field investigation, laboratory analysis, and data evaluation.
- Develop and implement a quality assurance/quality control (QA/QC) program to ensure the generation of meaningful and defensible data.
- Develop and follow site and laboratory safety plans to protect the health and safety of personnel and to prevent the release of contaminants.
- Identify data gaps and recommend and implement appropriate additional or supplemental studies.
- Use a rigorous procedure to identify, evaluate, and select appropriate corrective measures.
- Conduct the IRP in compliance with applicable federal, state, and local regulations and guidance.
- Provide information to the public and appropriate regulatory agencies regarding the nature of identified contamination, the effects of contamination on the community, the progress of the IRP, and the selected corrective measure and its impacts.

Historically, IRP studies were organized into four phases: Phase I-Installation Assessment/ Records Search; Phase II-Confirmation/Quantification; Phase III-Technology Base Development; and Phase IV-Remedial Actions. The Air Forces' IRP program now follows the CERCLA process and includes the following phases: Preliminary Assessment (PA), Site Inspection (SI), Remedial Investigation (RI), Feasibility Study (FS), Remedial Design (RD), and Remedial Action (RA).

Activities and results from the IRP program were incorporated into the summary and recommendations presented in the U.S. Air Force, Base Realignment and Closure (BRAC) Cleanup Plan (BCP). The BCP is a comprehensive strategy for implementing response actions necessary to protect human health and the environment.

1.2 HISTORY OF THE INSTALLATION

1.2.1 Background

OL-Q is located approximately 18 miles south of downtown Kansas City, Missouri (Figure 1-1). The northern portion of the Base is located in Jackson County and the southern portion of the base is located in Cass County. Primary access to the Base is by U.S. Highway 71.

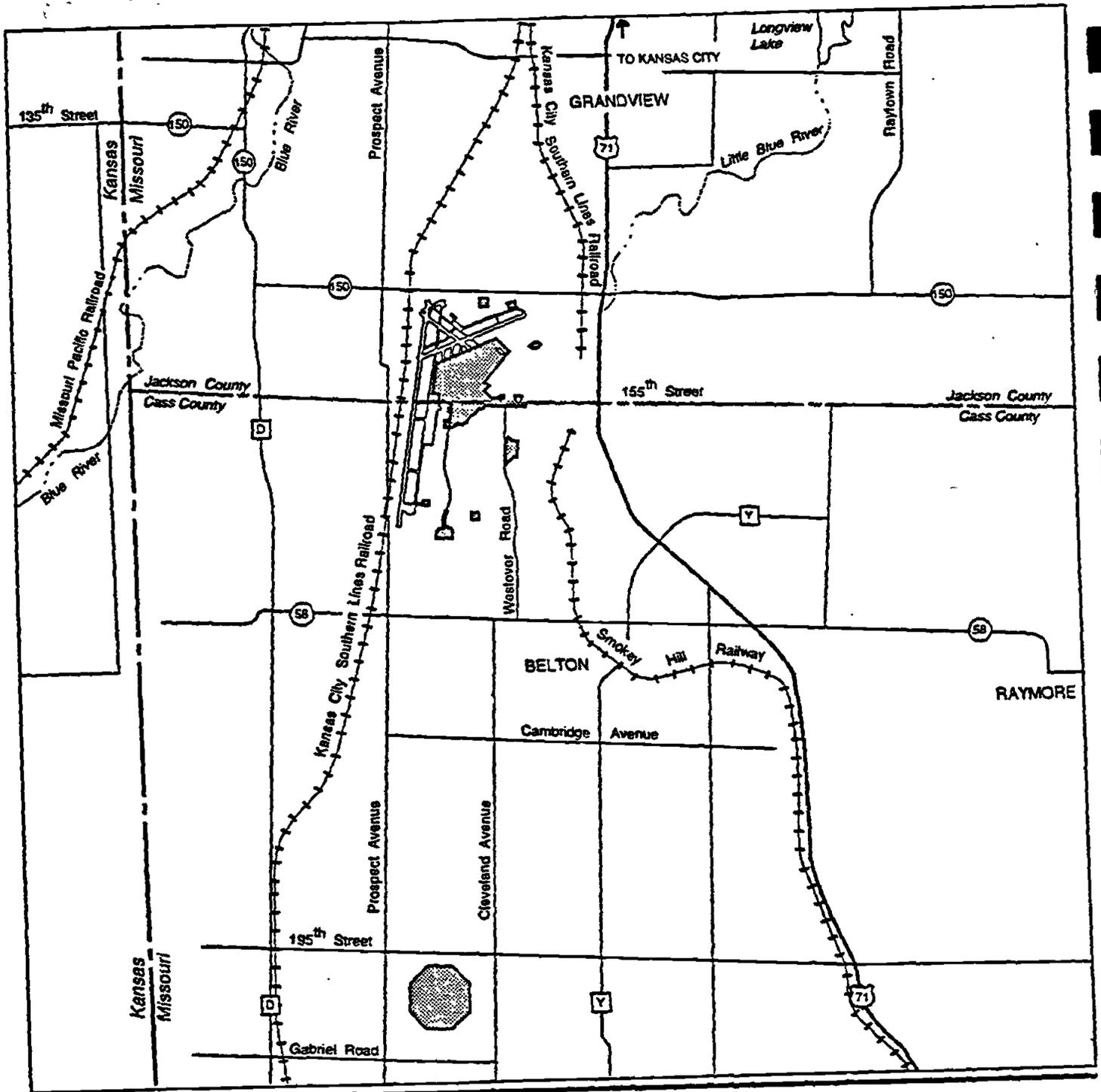
In 1941, portions of the land now occupied by OL-Q were acquired by Kansas City for use as an auxiliary airport (Grandview Airport). In 1952, the Aerospace Defense Command leased the airport from the city for air defense operations and, in 1953, the property (approximately 2,400 acres) was turned over to the Federal Government for establishment of an Air Force base. Initially, only C-46 airlift aircraft were stationed at the Base. Conversion to C-119 and C-124 aircraft occurred in 1957 and 1961, respectively. The Base was given the name Richards-Gebaur Air Force Base (AFB) in 1957.

Until 1970, the Air Defense Command (ADC) had the primary mission on the Base. In 1970, the Air Force Communications Service (AFCS) relocated its headquarters from Scott AFB, Illinois to Richard-Gebaur AFB, and assumed command of the Base. In 1971, the C-124 aircraft were phased out and replaced with C-130 aircraft. This conversion reportedly reduced the industrial waste produced by the base and also reduced the generation of waste oil. In 1977, AFCS moved back to Scott AFB and Richards-Gebaur came under the Military Airlift Command (MAC).

The Air Force Reserve (AFRES) assumed operational control of the Base in October 1980. In 1981, approximately 80 percent of the base property (including runways and taxiways) was transferred to the General Services Administration (GSA). The GSA then transferred a majority of the airport-related property to the Kansas City Aviation Department as a public benefit transfer with the condition of continued runway access by the Air Force. Other excessed parcels were also transferred by GSA for public and other military uses to Kansas City, the Federal Aviation Administration, the City of Belton, the Department of the Navy, and the Department of the Army. Currently, the Base property comprises approximately 428 acres, with an additional 421 acres of easements. Richards-Gebaur was closed on September 30, 1994, and is now known as Operating Location Q (OL-Q).

1.2.2 Base Regulatory History

OL-Q is not on the National Priorities List (NPL) and the ongoing Installation Restoration Program (IRP) has no Federal Facility Agreement (FFA) with the U.S. Environmental Protection Agency (USEPA) Region VII; however, DoD, on behalf of the Base, has entered into a cooperative agreement (Department of Defense and State Memorandum of Agreement [DSMOA]) with the Missouri Department of National Resources (MDNR) for oversight and guidance for DoD implementation of CERCLA/SARA cleanups. Since 1982, the IRP process has identified eight sites that require environmental investigation and possible remediation located in currently owned parcels, and seven additional sites on property now owned or indentured to other parties. The Army Corps of Engineers is responsible for environmental restoration on property no longer owned by the Department of Defense. Of the eight IRP sites on OL-Q, seven are located in the main Cantonment Area.



EXPLANATION

-  Base Property
-  U. S. Highway
-  State Highway
-  County Road



SOURCE: DAMES & MOORE, 1995



FIGURE 1-1
OL-Q Location Map

1.3 DESCRIPTION OF CURRENT STUDY

Versar, Inc., is performing preliminary groundwater assessments at OL-Q under contract to AFCEE. The sites to be investigated are located within the Base property boundary and are identified as sites SS003, OWS704, SS004, SS006, and SS009. Figure 1-2 shows the locations of the sites on the Base. The following sections describe the project objectives, other documents produced for conducting the studies, and what subcontractors will participate in the work.

1.3.1 Project Objectives

The purpose of this project is to perform preliminary groundwater assessments at five sites to determine the presence or absence of groundwater contamination as a result of contaminated soils that were or are currently present at each site. Direct-push technology will be utilized for groundwater sampling and to install temporary piezometers to determine groundwater flow direction. Groundwater samples will be collected from three locations within each site and analyzed for the appropriate parameters. If the use of direct push does not yield groundwater, permanent groundwater monitoring wells will be installed. Additional information is provided in Section 3.0.

1.3.2 Scoping Documents

Scoping documents prepared for the Preliminary Groundwater Assessments, other than this Work Plan, include:

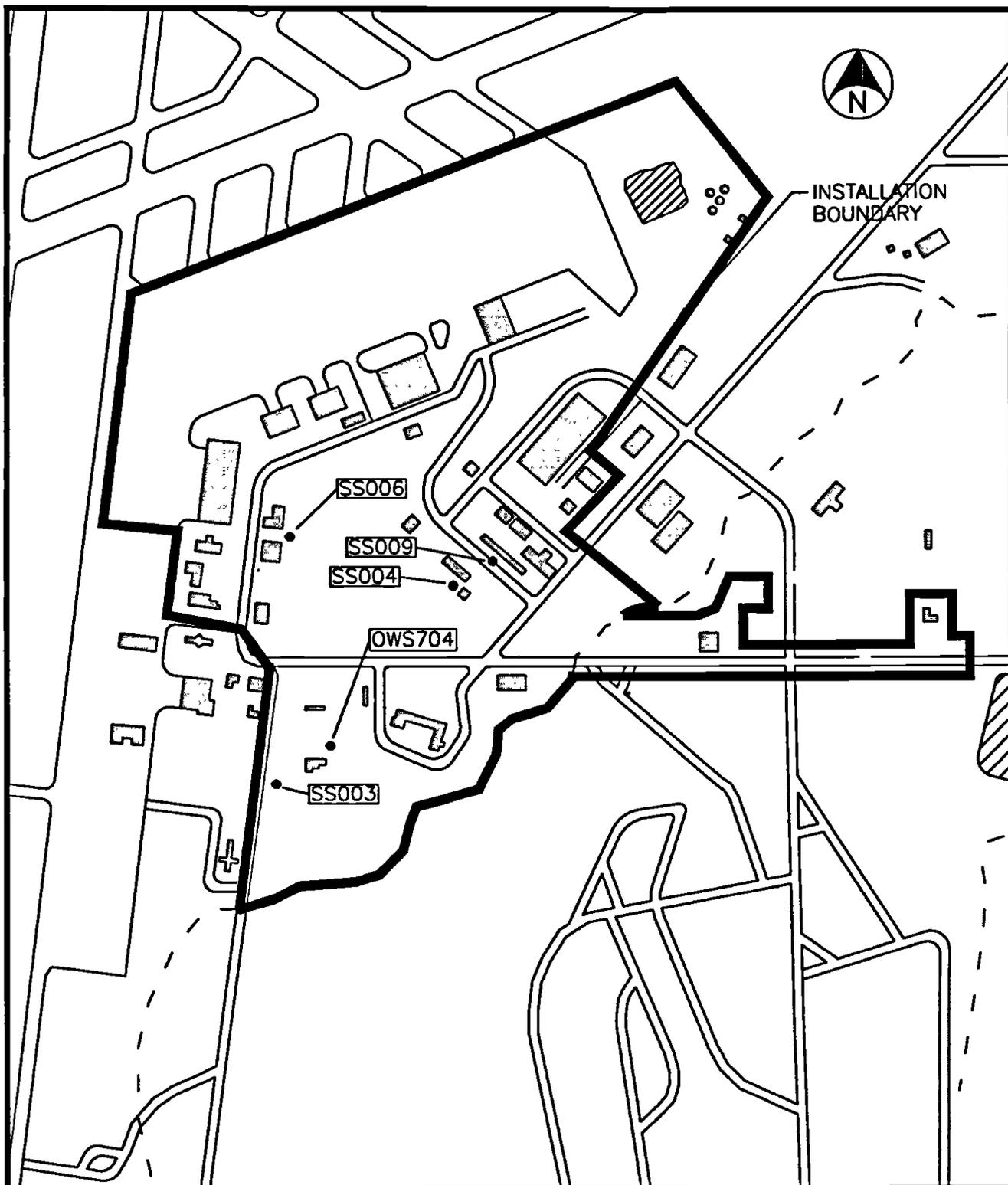
1. Site-specific Health and Safety Plan (HASP), prepared by Versar (1995a), which covers all expected safety and health issues related to performing sampling work at the sites; and,
2. Sampling and Analysis Plan (SAP), prepared by Versar (1995b), which includes a field sampling plan (FSP), and a project-specific Quality Assurance Project Plan (QAPP).

These documents were prepared in accordance with guidance provided in the U.S. Air Force's *Handbook to Support the Installation Restoration Program (IRP) Remedial Investigation/Feasibility Studies* (1993), referred to herein as "the AFCEE Handbook."

1.3.3 Subcontractors

Subcontractors will be utilized during the performance of the preliminary groundwater assessments at OL-Q for the following activities:

- laboratory analysis
- data validation
- direct push
- monitoring well installation



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NOTE: ALL OL-Q PROPERTY IS NOT SHOWN ON THIS MAP

AFCEE/OL-Q			
DESIGNED DORMAN	DATE	LAYOUT OF OPERATING LOCATION Q AND SITE LOCATIONS	
DRAWN MACLIN	DATE		
Versar INC. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		PROJECT NO. 2816-201	SCALE: AS SHOWN
		DRAWING NO. 9510-439	FIGURE 1-2

- surveying
- waste disposal

At this time, none of the subcontractors have been selected by Versar or approved by AFCEE.

SECTION 2.0

SUMMARY OF EXISTING INFORMATION

The summaries of the environmental setting of OL-Q presented in this section have been compiled from the BRAC Cleanup Plan (BCP) (1994).

2.1 GEOGRAPHY

OL-Q is located approximately 18 miles south of downtown Kansas City, Missouri. The northern portion of the base is located in Jackson County and the southern portion of the base is located in Cass County. Primary access to the base is by U.S. Highway 71. The base property is currently composed of approximately 428 acres in 11 parcels. The Cantonment Area, covering 209 acres, is the largest parcel and contains the main aviation support and administrative areas. Nine smaller parcels, ranging from 1 to 13 acres, surround the Cantonment Area. The Belton Training Complex, approximately 4 miles south of the Cantonment Area, encompasses 184 acres and is largely undeveloped.

2.2 TOPOGRAPHY

OL-Q is located within the Osage Plains region of the Central Lowland physiographic province. The region is characterized by low relief, wide, maturely dissected uplands, and relatively steep valley slopes. The topography of the base is gently rolling, with an elevation range between 1,060 feet and 960 feet above mean sea level (msl). Most of the base stormwater drains into the Little Blue River, with the exception of the Belton Training Complex, which drains into the West Fork of East Creek. Both of these watersheds ultimately flow into the Missouri River.

2.3 GEOLOGY

The geology of the base is characterized by thin loess deposits over residual soils derived from the in-place weathering of the underlying limestones and shales. The soils belong to the Macksburg-Urban series, which is defined as being poorly drained silt and silt clay loams, covered in places by urban features. Rock outcrops are found along Scope Creek and include the Argentine Limestone Member of the Wyandotte Formation, the Lane Formation, the Raytown Limestone Member of the Iola Formation limestone, and the Chanute Formation. The Argentine Member is a light gray limestone characterized by thin, wavy bedding, except in the lower few feet, where the unit is thick-bedded. The Lane Formation is a medium gray to bluish-gray shale that is commonly silty in the upper part. The Raytown Member is a medium bluish-gray, wavy bedded limestone, locally containing interbedded lenses of shale approximately 3 inches thick. The Chanute Formation is a gray, purplish-red, and green shale with thin nodular limestone near the middle, and local occurrences of cross bedded sandstone and conglomerate. All of the exposed units are Pennsylvanian in age. The weathered zone overlying these rocks (in the undisturbed) state) is typically 2 to 15 feet thick. The soil is generally fine silty clay with a hydraulic conductivity of approximately 1×10^{-7} centimeters per second. The depth to groundwater is generally shallow, but varies seasonally.

with topography, and the variance is highly dependent on the number and composition of the perched aquitards in the local area.

2.4 SURFACE WATER

The main Base area is within the Missouri River drainage basin; the Belton Training Complex is within the South Grand portion of the Osage River drainage basin. The local surface hydrology is dominated by the drainage systems of the Blue and Little Blue Rivers. Scope Creek, a natural drainage/surface water feature next to the Base, flows from the south to the northeast, terminating in the Little Blue River. Scope Creek is an intermittent stream that contains water much of the time. A number of impoundments have also been built in the area, creating a few ponds. No recreational ponds are on OL-Q, although two are near Base property. No major natural springs exist in the vicinity of the Base.

The primary drinking water source for the entire region is the Missouri River. The water is piped from the river by the Kansas City Water and Pollution Control Department.

2.5 DESCRIPTION OF STUDY AREAS

2.5.1 Site SS003

The Oil-Saturated Area (Site SS003) is located west of Building 704. The area was used previously for the storage of waste oil products by the Motor Pool. This maintenance and storage area was in operation since the mid-1950s. An area was noticeably saturated with waste oil and possibly hydraulic fluids and solvents. During completion of an IRP Phase II Stage 2 investigation of the site by Ecology & Environment (E&E, 1988), lead was found in soils between 0 and 1 foot below existing grade (beg). E&E collected three surficial and three subsurface soil samples from the oil-saturated area, three sediment soil samples and one surface water sample from a drainage ditch that runs along the west edge of the site. The surface soils were found to have levels of total petroleum hydrocarbons (TPH) well above the state of Missouri guideline of 200 mg/kg. Lead concentrations found were above background levels for the area. The subsurface samples, as well as the surface sediment soils and surface water sample, indicated background levels for TPH and lead. Based on the depth of contamination, it was determined that surficial spills contributed to the contamination encountered. Based on the locations of the borings and samples, the TPH and lead contamination appeared to be contained in the soil-stained area, and was not flowing into the ditches or soils surrounding the site.

O'Brien and Gere (O&G, 1991) collected and analyzed three surface soil samples from within the fenceline, next to the storage shed. Detectable levels of metals were reported, although these levels are within normal background levels for the area. One sample of soils contained detectable levels of xylenes and lead. No volatile organic compounds (VOCs) or semivolatile organic compounds (SVOCs) were detected in the samples.

The soils data presented by E&E and O&G indicate that the TPH and lead contamination encountered at the oil-saturated area was confined to the immediate vicinity of

the stained soils on either side of the fence line. Based on low or nondetected levels of these contaminants in soils adjacent to, beneath, and in the surface runoff path, it does not appear contaminants have migrated from the oil-saturated area. Also, the surface water and soils samples collected from east of the area were free of contamination.

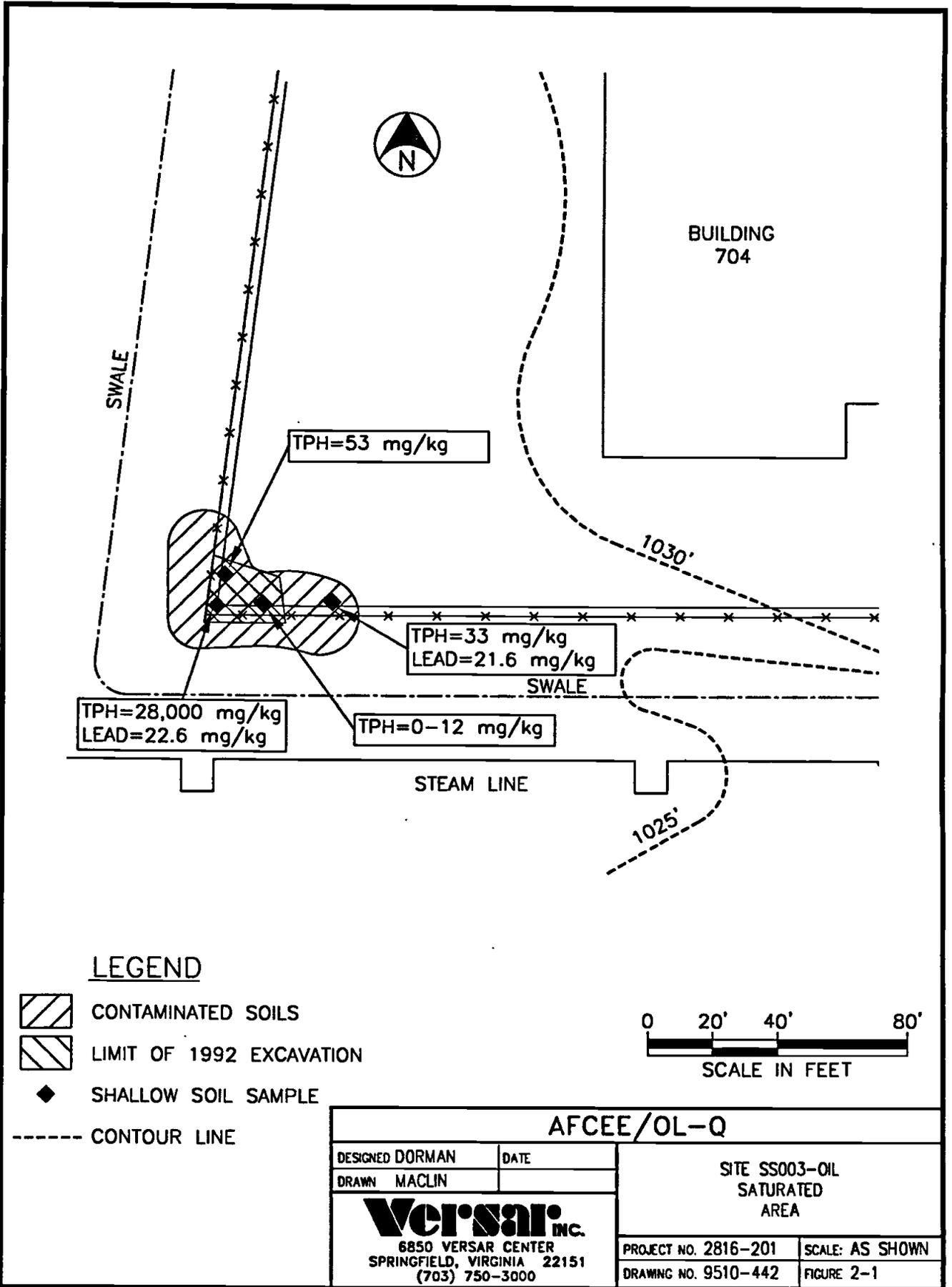
In November 1991, Burns and McDonnell (B&M) removed 27 cubic yards of contaminated soils from the oil-saturated area. Samples of soils collected from the bottom of the 24-inch deep excavation indicated that the soils were not clean (i.e., above the state cleanup goals of 200 mg/kg for TPH and 238 mg/kg for lead). In February 1992, an additional 15 cubic yards of material were removed and the excavation bottom sampled. Based on the results of laboratory analyses, the soils were considered clean and the site was recommended for closure. Although soils in the oil-saturated area had been remediated, the effect of the contaminants on local groundwater is unknown. Figure 2-1 summarizes the soil sampling and excavation work completed at the site to date.

2.5.2 Site OWS704

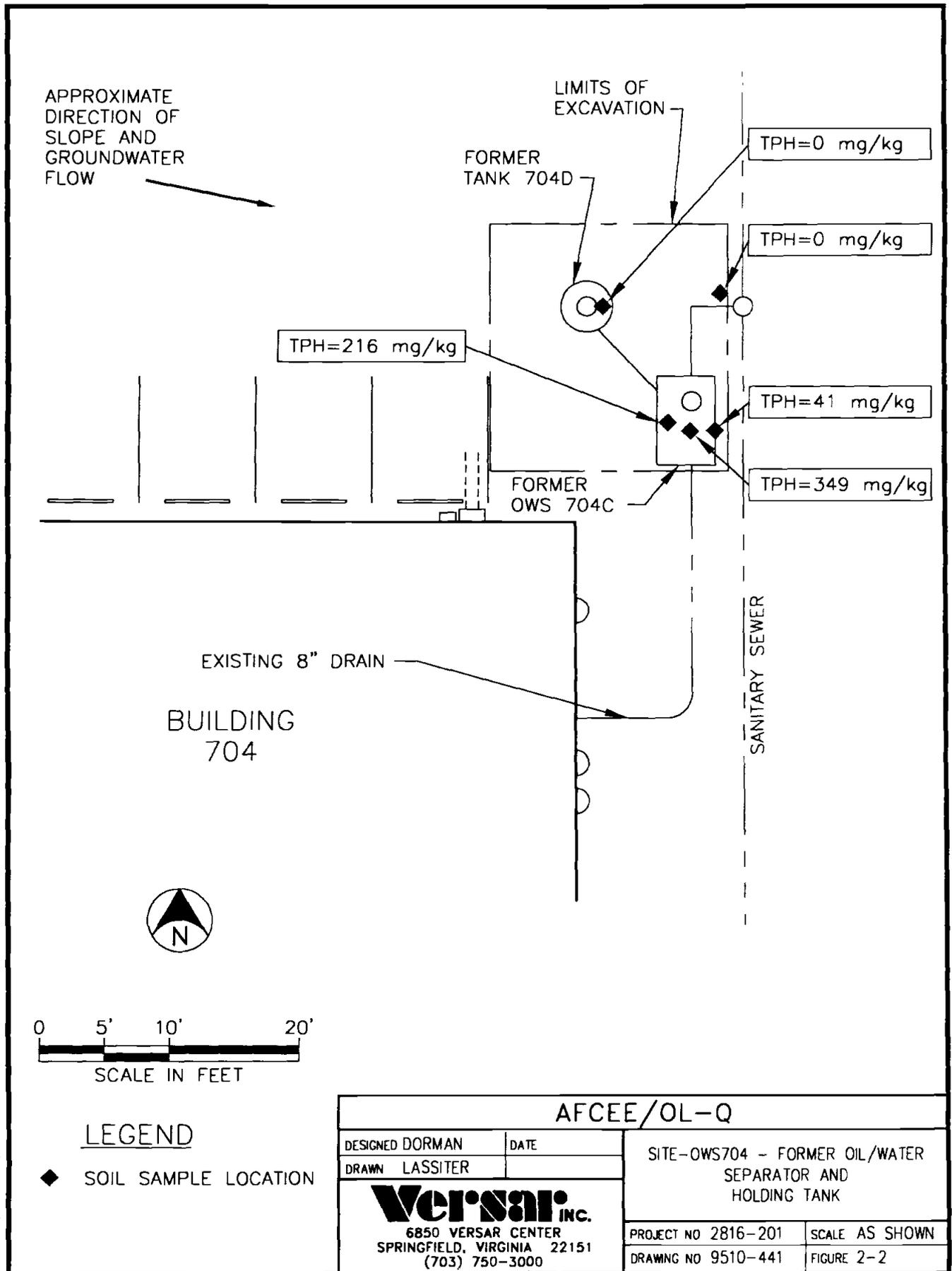
The 500-gallon oil/water separator and associated 250-gallon holding tank, located northeast of Building 704, had been in operation from 1956 to 1993, when they were cleaned and removed. The original components of the oil/water separator had been replaced during its operational life. The separator was replaced in 1975, and the holding tank in 1989. The tanks stored vehicle wash water and wash residual. B&M directed the excavation and removal of the concrete underground storage tanks (USTs). Soils from around the tanks were excavated on October 29, 1993, and soil samples were collected from the bottom of the excavation. A total of 205 cubic yards of contaminated soils were removed from the excavation. Results of these analyses indicated TPH levels for nondetect to 349 mg/kg in samples collected from below the tanks, downgradient from the tanks, and from a composite of the stockpiled soils. Detected levels of barium, silver, and lead were also reported. The USTs were cleaned in November 1993 and a downgradient sample of soil was collected. Detectable levels of TPH (41 mg/kg), arsenic, barium, cadmium, silver, 2-butanone, and methylene chloride were reported in the soils. On November 19, 1993, the over excavation bottom sample and stockpile sample were collected. The TPH levels from the stockpile were 157 ppm and detectable levels of 2-butanone were present. Detected levels of barium, cadmium, 2-butanone, 2-hexanone, 1,1,2,2-Tetrachloroethane, and TPH (349 mg/kg) were detected in the sample collected from soils at the bottom of the excavation. The tanks were crushed and removed, and the debris and excavated soils were hauled to Laidlaw Southeast Landfill in Kansas City, Missouri. A review of the results of analysis for soils left in the ground beneath the USTs indicates that all contaminated soils were not removed to levels below 200 mg/kg for TPH. Local groundwater has not been assessed for this area. Figure 2-2 summarizes the soil and tank removal activities for this site.

2.5.3 Site SS004

The Hazardous Waste Storage Area (Site SS004) was located previously at the southwest corner of Building 923, north of the intersection of Andrews Road and 155th Street. This area was used, for an undetermined number of years, for the storage of



\AFCEE\2816-201\9510-442.DWG PLOT DATE: 01-18-96 FIG 2-1



\AFCEE\2816-201\9510-441.DWG PLOT DATE 01-31-96 FIG 2-2

AFCEE/OL-Q		
DESIGNED DORMAN	DATE	SITE-OWS704 - FORMER OIL/WATER SEPARATOR AND HOLDING TANK
DRAWN LASSITER		
Versar INC. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		PROJECT NO 2816-201
		SCALE AS SHOWN
		DRAWING NO 9510-441
		FIGURE 2-2

hazardous and nonhazardous drummed wastes prior to disposal. The area is partially surfaced with asphalt and tarmac, but surface water runoff flows into a grassy drainage ditch to the west. It was noted in the IRP Phase II Stage 2 report that remedial efforts, such as the overpacking of seeping drums, removal of stained soils, and scraping of the asphalt surface, were performed.

E&E completed one soil boring and collected three subsurface soils in the direct path of runoff at the site, three surface soil samples within the eastern fence line, one soil sample from outside the fence line in the north corner of the site where the drums were stored previously, and one surface water sample from the site. The fourth surface soil sample and the surface water sample were collected from a location 200 to 300 feet from the site in the natural drainage pattern from the site. TPH were detected in soils from the area directly outside the northern fence line where the drums had been stored previously. These TPH levels were well above the state of Missouri guidelines. Concentrations of TPH (55 to 140 mg/kg) were detected in soils from within the eastern fence line.

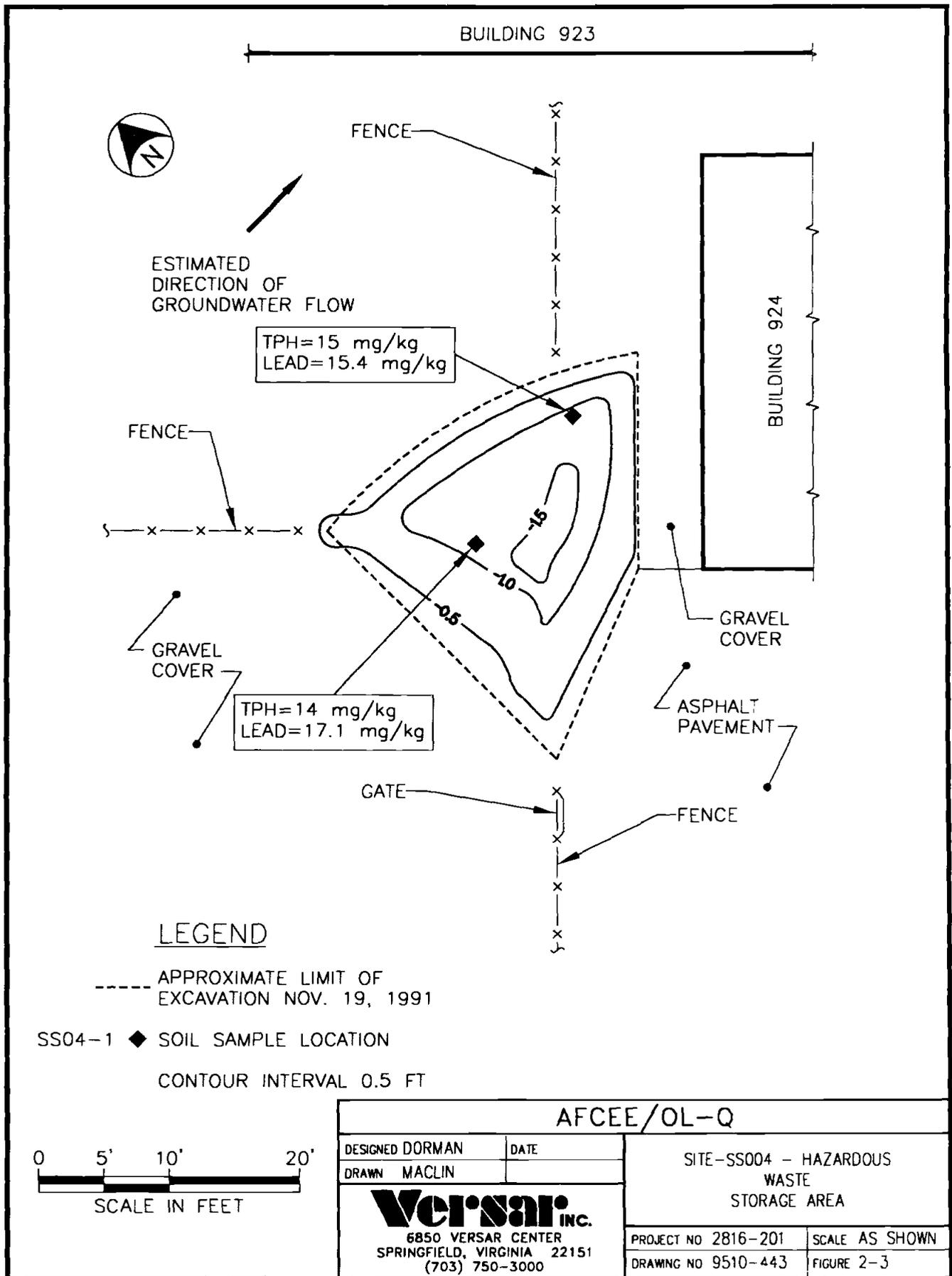
O&G collected four surface soil samples from 0 to 2 feet beg in the grassy area inside the northwest fence line. Results of analyses for these soils analysis did not indicate TPH or metal levels above background and no volatile organic compounds (VOCs) or base-neutral acids (BNAs) were detected.

B&M removed 15 cubic yards of contaminated soils in November 1991. The depth of the excavation was 12 inches in the northwest portion and 30 inches in the southeast portion. Soil samples were collected from the bottom of the excavation. Results of analysis indicated that the soils were clean. Although soils in the former drum storage area had been remediated, the effect of the contaminants on local groundwater is unknown. Figure 2-3 summarizes the soil sampling and excavation work completed to date for the site.

2.5.4 Site SS006

Since 1957, Building 927 had been used as an aircraft engine and propeller maintenance shop using various degreasers, solvents, oils, and lubricants, most of which were stored on racks behind the rear of the shop in metal barrels and containers on the grass bank adjacent to the parking lot (Site SS006). The grassy bank had been observed in the past to have stressed vegetation. After the racks were removed, the stressed vegetation was no longer evident. At times, waste solvents from parts cleaning operations and used engine oil from maintenance procedures were also stored temporarily at this site. The topography at the site slopes to the east into Scope Creek. The surface drainage of the site is separated from the parking lot drainage with a 6-inch high curb running between the site and the parking lot.

In 1988, O&G collected two surface samples from 0 to 2 feet beg within the area of former stressed vegetation. No volatile organic compounds were detected in the soil samples; however, several BNAs were detected at both sampling locations. Metals detected at the site were within the normal background levels in soils. Lead concentrations were slightly higher than typical background levels.



\AFCEE\2816-201\9510-443.DWG PLOT DATE: 01-31-96 FIG 2-3

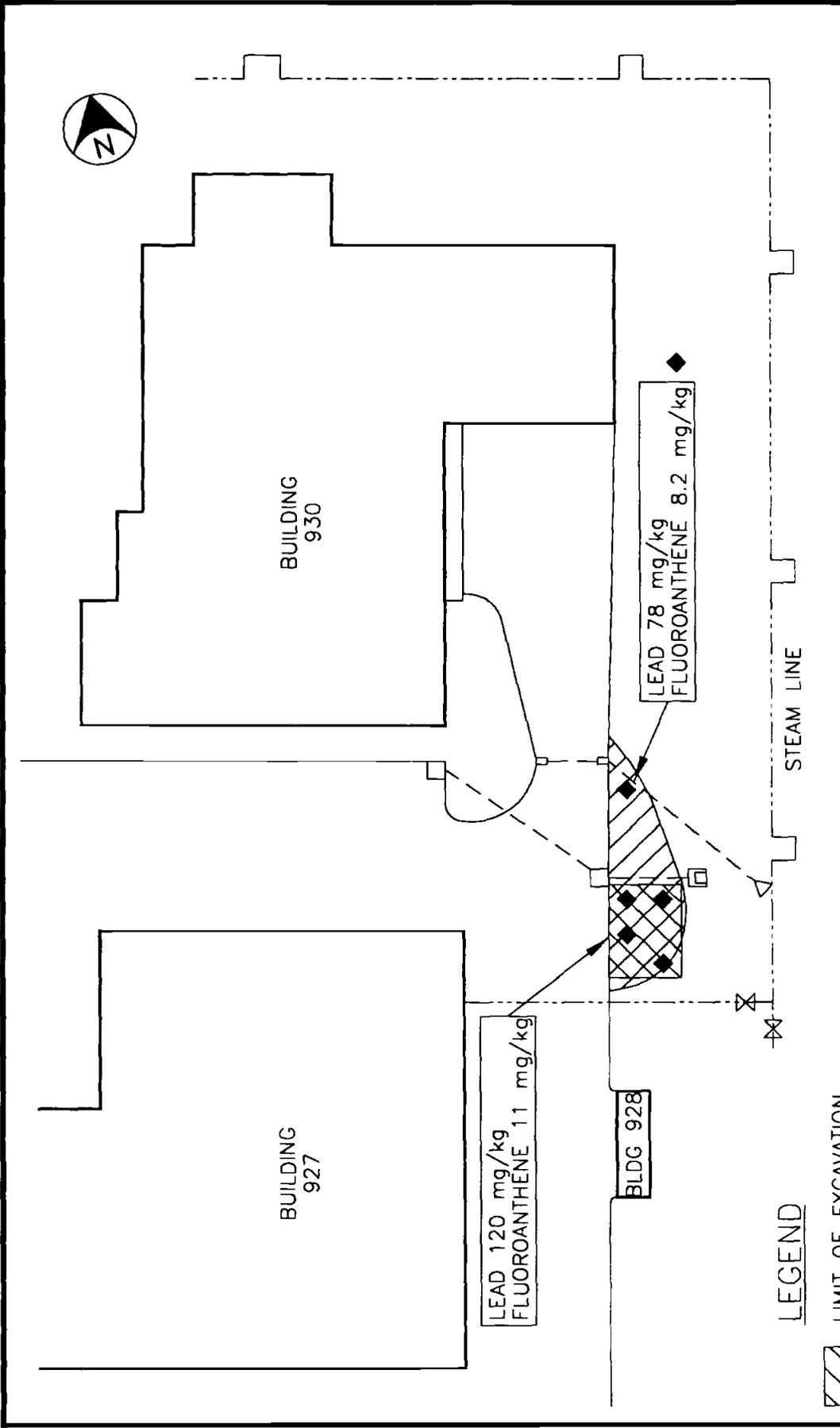
B&M completed a Site Inspection in 1991 that included drilling six soil borings and collecting SVOC samples from 1 to 6 feet beg. Only Boring No. 1, with soils collected at 2 feet beg, had detectable levels of SVOCs.

B&M excavated approximately 40 cubic yards of contaminated soils from the former storage rack area in June 1993 in layers until photoinization detector (PID) screenings indicated that the soils were clean. The depth of the excavation was approximately 3 feet beg. Soil samples were collected from the bottom of the excavation and analyzed for SVOCs. The results of analysis indicated no levels of SVOCs were detected. The area was backfilled with clean soils. Although soils in the former storage rack area had been remediated, the effect of the contaminants on local groundwater is unknown. Figure 2-4 shows the location of SS006 and summarizes the soil sampling and excavation work completed to date for the site.

2.5.5 Site SS009

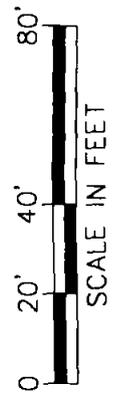
Site SS009, located near Building 605, is located on Corkill Road, southeast of the intersection of Westover and Corkill Roads. Petroleum products were encountered in the Fire Valve Area during an excavation to repair an underground water main valve. Approximately 10 cubic yards of soils were removed from the area. The excavated soils were analyzed and found to have TPH and benzene, toluene, ethylbenzene, and xylene (BTEX) levels in excess of Missouri's cleanup goals for sites requiring corrective action. Tetra Tech completed four soil borings southeast, north, and northwest of the previously removed 10-foot by 10-foot area of soils, and one soil boring was completed along the water line located northwest of the fire valve area. Eighteen field screen borings were completed to depths of 8 to 15 feet beg. These field screen borings were completed in March 1994 along gas and water lines that ran toward the abandoned petroleum, oil, and lubricants (POL) lines located to the northwest of the Fire Valve Area. A total of 15 field screen borings were drilled along these lines, and no contamination was encountered beyond Building 605. Three additional field screen borings were completed southwest of the Fire Valve Area to determine the existence of contamination observed previously in a water line trench. Petroleum hydrocarbons (TPH) were detected in one of these three borings. A small area of contaminated soils was encountered near the site of the former excavation along the water line and to the northwest adjacent to the Fire Valve Area. Contamination was not encountered along the utility lines leading away from the site. No further soils action was recommended for the site. Groundwater in the area has not been assessed. Figure 2-5 summarizes the soil sampling and removal activities for this site.

\\AFCEE\2816-201\9510-444.DWG PLOT DATE. 01-31-96 FIG 2-4



LEGEND

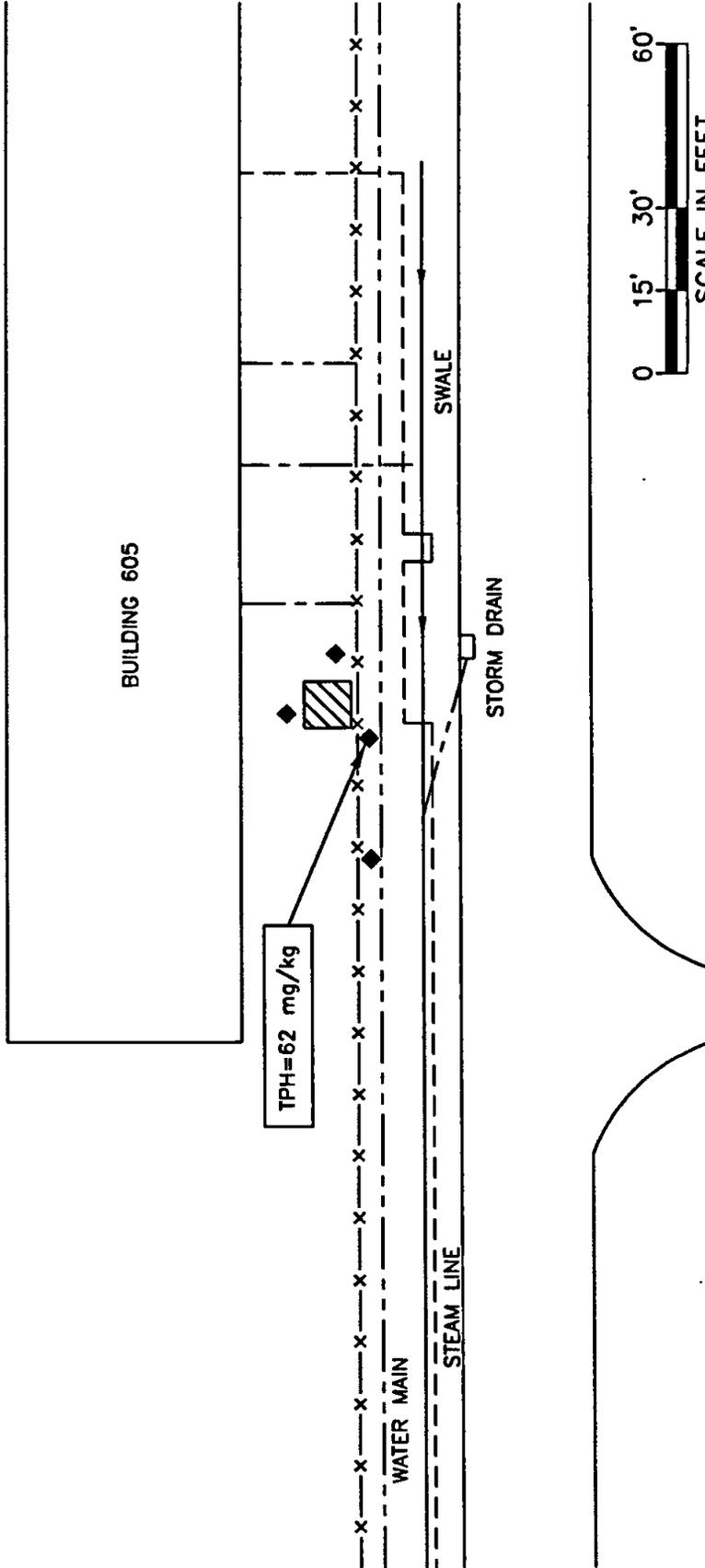
-  LIMIT OF EXCAVATION
-  FORMER AREA OF STRESSED VEGETATION
-  SOIL SAMPLE LOCATIONS



AFCEE/OL-Q

DESIGNED DORMAN	DATE	SITE - SS006 - HAZARDOUS MATERIAL STORAGE	
DRAWN MACLIN	DATE	PROJECT NO. 2816-201	SCALE. AS SHOWN
 Vetcon INC. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		DRAWING NO. 9510-444	FIGURE 2-4

\\AFCEE\2816-201\9510-440.DWG PLOT DATE: 01-25-96 FIG 2-5



LEGEND

-  LIMITS OF EXCAVATION
-  SOIL SAMPLE LOCATIONS

AFCEE/OL-Q

DESIGNED DORMAN	DATE 10/03/95	 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000	SITE SS009- FIRE VALVE AREA
DRAWN MACLIN	DATE 10/03/95		PROJECT NO. 2816-201
			DRAWING NO. 9510-440
			FIGURE 2-5

SECTION 3.0

PRELIMINARY GROUNDWATER ASSESSMENTS

As part of the preliminary groundwater assessments of sites SS003, OWS704, SS004, SS006, and SS009, direct-push technology will be used to collect groundwater samples at three locations at each site. Temporary piezometers will also be installed at each location to determine the groundwater flow direction at each site. If groundwater yields from the direct-push borings are not sufficient for sampling, groundwater monitoring wells will be installed: three each at sites SS003, SS006, and SS009; and one downgradient well each at sites OWS704 and SS004. Figures 3-1 through 3-5 show the layout of the five sites and the groundwater sampling locations.

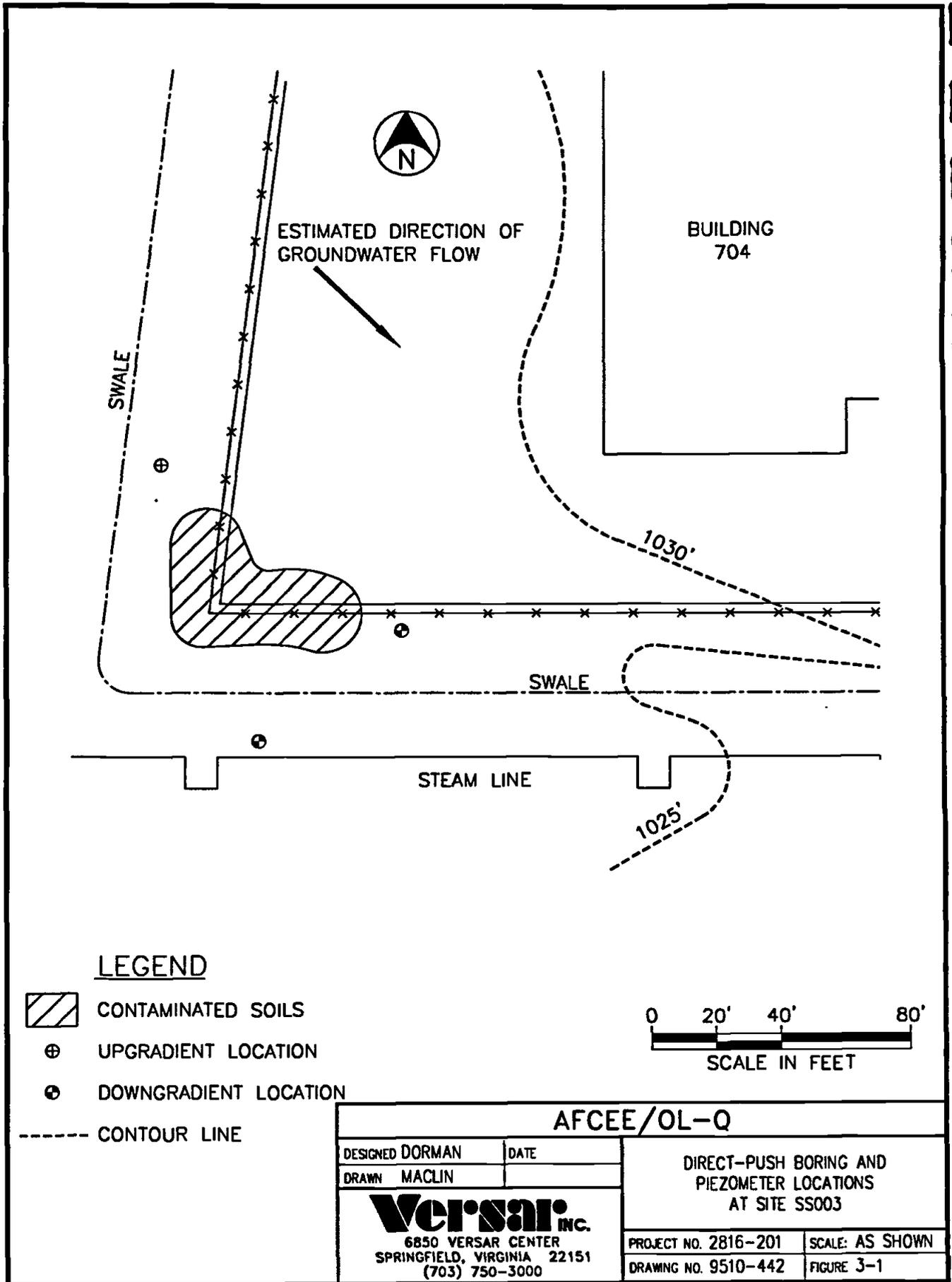
3.1 RATIONALE FOR SAMPLING LOCATIONS

The locations of the groundwater sampling and water level measurement points for each of the five sites was selected based on the location of the former source of shallow soils contamination, topography of the surrounding area, accessibility, and the direction of surface water runoff and expected groundwater flow. Three points will be selected for each site surrounding the areas of former soils contamination. The points will be triangulated around the areas with more points positioned in the expected downgradient direction across each site. This placement increases the chance of delineating the contaminant plume if found in the groundwater samples collected.

3.2 FIELD ACTIVITIES SUMMARY

Three groundwater samples shall be collected, using direct-push technology, at each site. Soil samples will be collected continuously during direct-push activities using split-spoon barrel samplers fitted with removable Teflon® inner liners. Soil samples for lithology and classification will be collected from the direct-push machinery by hydraulically driving a 1.25-inch inner diameter (ID) piston-type sampler to the top of the desired sample interval. The piston within the sampler will then be released and the pipe will be advanced through the target interval. The Teflon® liner containing soils can be removed and the soils classified. Each temporary well will be completed to a depth of approximately 20 feet beg. Soil samples will be collected continuously throughout drilling activities in order to determine lithology and depth to collect groundwater samples. The groundwater samples will be collected by driving the probe to the first water-bearing unit determined during drilling. The water samples will be collected by a hydropunch type cylindrical sampler that is advanced by the probe rig or other approved equipment such as the use of tubing, a mini-bailer, or a double valve pump (or bladder pump) in order to efficiently collect the larger volumes of samples and to reduce loss of VOCs during sampling. The water sample can then be removed and transferred to the appropriate sample containers.

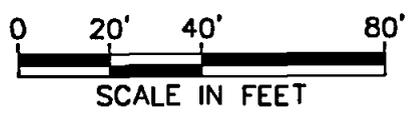
Groundwater samples will be analyzed for one or more of the following parameters based on contaminants encountered previously at each of the five sites: total recoverable



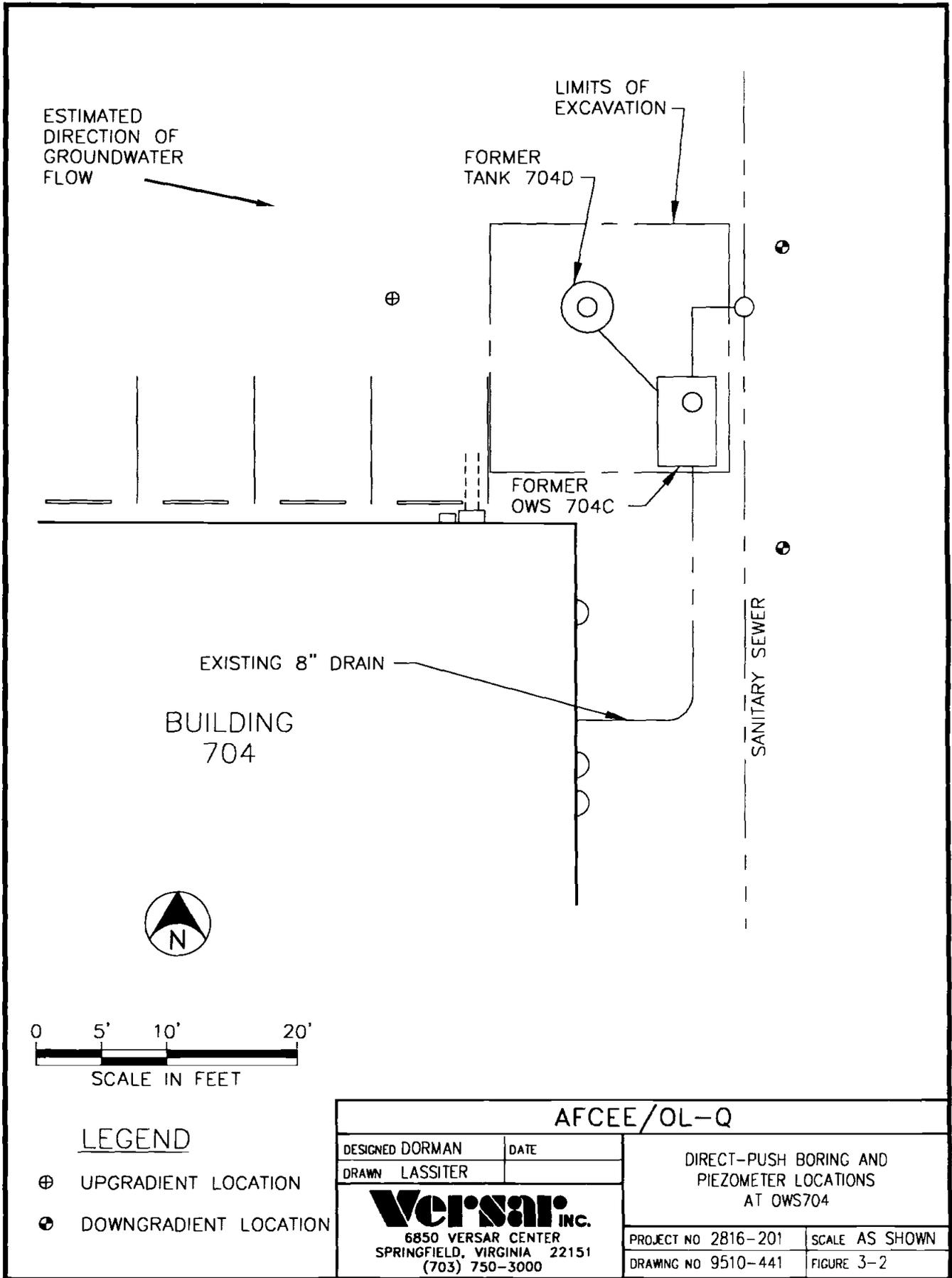
AFCEE\2816-201\9510-442.DWG PLOT DATE: 01-18-96 FIG 3-1

LEGEND

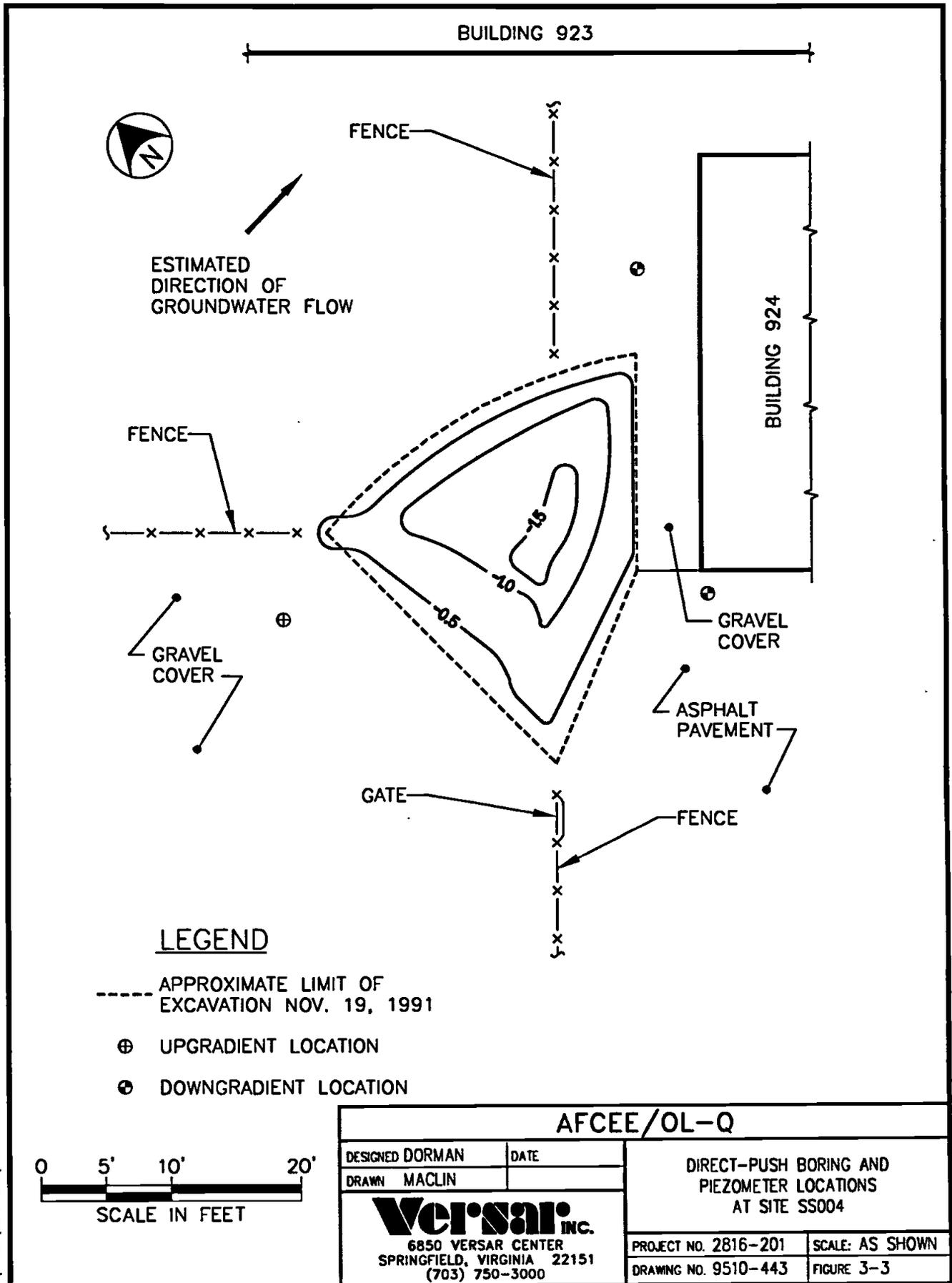
-  CONTAMINATED SOILS
-  UPGRADIENT LOCATION
-  DOWNGRADIENT LOCATION
-  CONTOUR LINE



AFCEE/OL-Q		DIRECT-PUSH BORING AND PIEZOMETER LOCATIONS AT SITE SS003	
DESIGNED DORMAN	DATE	PROJECT NO. 2816-201	SCALE: AS SHOWN
DRAWN MACLIN		DRAWING NO. 9510-442	FIGURE 3-1
 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000			

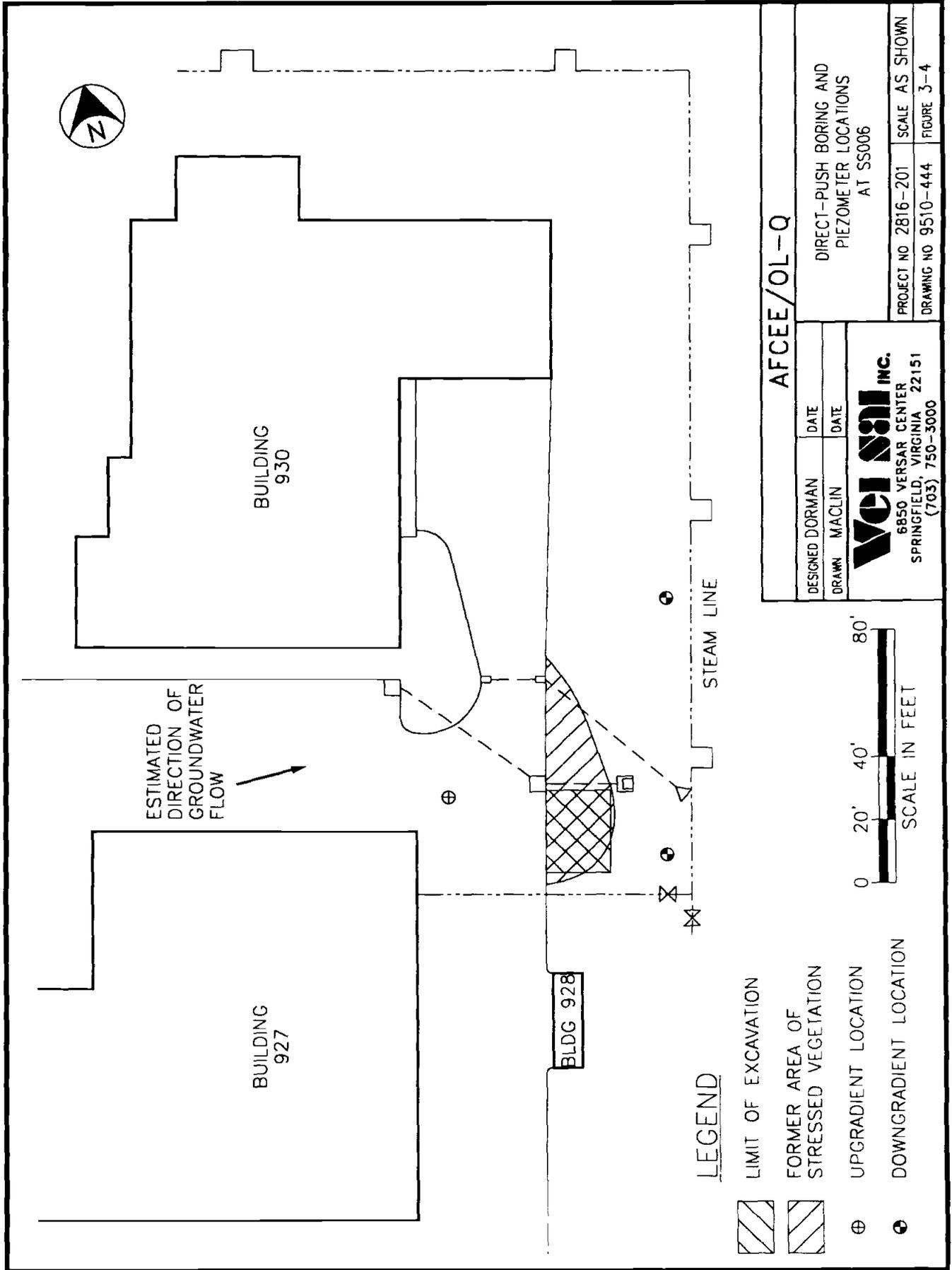


\AFCEE\2816-201\9510-441.DWG PLOT DATE 01-18-96 FIG 3-2



\AFCEE\2816-201\9510-443.DWG PLOT DATE: 01-18-96 FIG 3-3

AFCEE\2816-201\9510-444.DWG PLOT DATE 01-25-96 FIG 3-4



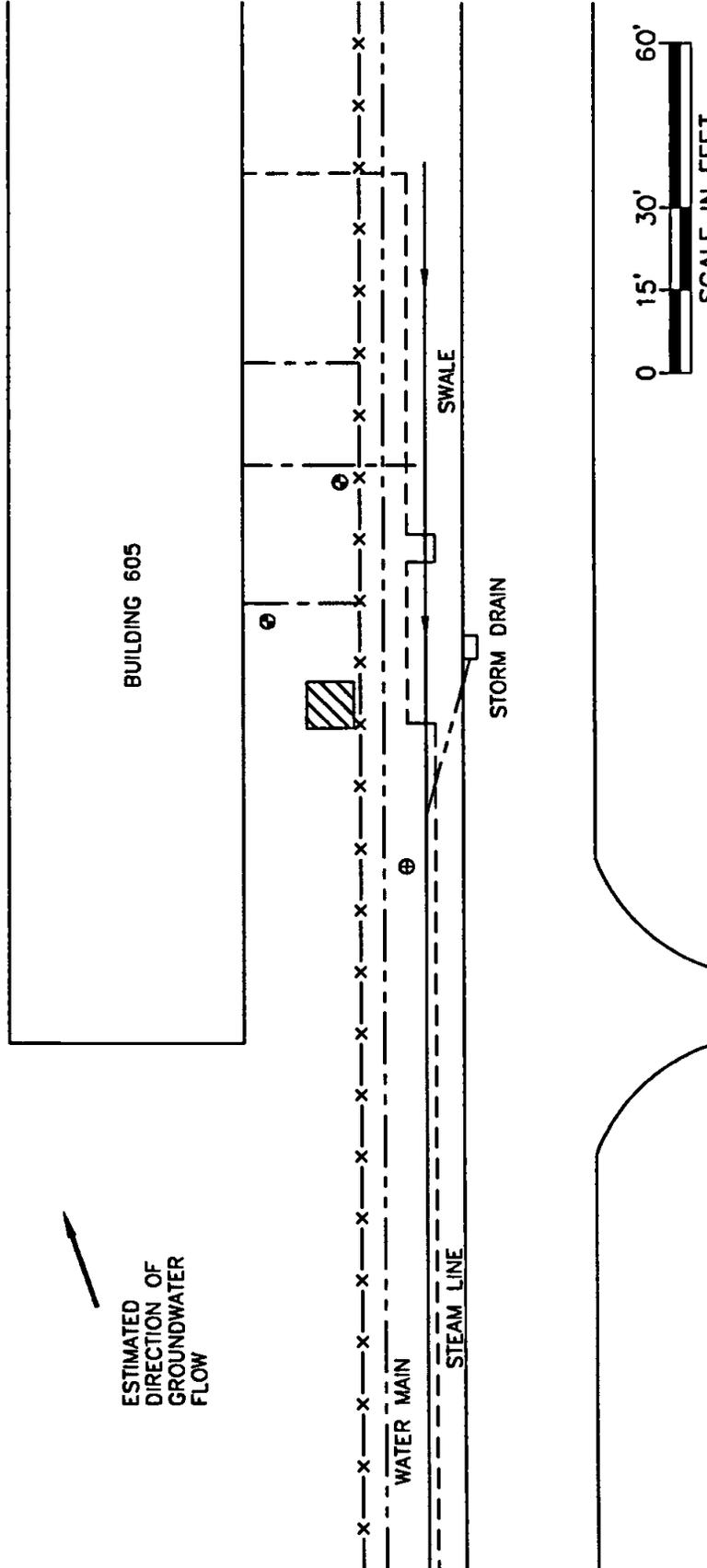
AFCEE/OL-Q

DESIGNED	DORMAN	DATE	
DRAWN	MACLIN	DATE	
veisai inc.			
6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000			
DIRECT-PUSH BORING AND PIEZOMETER LOCATIONS AT SS006			PROJECT NO 2816-201 SCALE AS SHOWN
			DRAWING NO 9510-444 FIGURE 3-4

\\AFCEE\2816-201\9510-440.DWG PLOT DATE: 01-25-96 FIG 3-5



ESTIMATED
DIRECTION OF
GROUNDWATER
FLOW



LEGEND

-  LIMITS OF EXCAVATION
-  UPGRADIENT LOCATION
-  DOWNGRADIENT LOCATION

AFCEE/OL-Q

DESIGNED DORMAN	DATE 10/03/95
DRAWN MACLIN	10/03/95

DIRECT-PUSH BORING AND
PIEZOMETER LOCATIONS
AT SITE SS009

WCI **SAI** **INC.**
6850 VERSAR CENTER
SPRINGFIELD, VIRGINIA 22151
(703) 750-3000

PROJECT NO. 2816-201	SCALE: AS SHOWN
DRAWING NO. 9510-440	FIGURE 3-5

petroleum hydrocarbons (TRPH), VOCs, SVOCs, polychlorinated biphenyls (PCBs), and RCRA metals. Table 3-1 presents the summary of analytical methods for each site. Details of the sampling locations, procedures, sample handling, and laboratory analysis are provided in the *Sampling and Analysis Plan (SAP)*, prepared by (Versar 1995b) as part of this work effort. All field work will be performed in accordance with the requirements specified in the AFCEE Handbook (USAF, 1993).

Immediately following the collection of groundwater samples, a temporary groundwater measuring point will be installed either on or adjacent to and at the same depth as the groundwater sample in order to measure the potentiometric head of the shallow groundwater unit. The direct-push borings will be fitted with a temporary disposable 1-inch ID polyvinyl chloride (PVC) well screen (slot size of 0.010 inch). The measurement points will be sealed from surface water intrusion with a bentonite or similar seal. The groundwater in each measuring point will be allowed to reach static equilibrium 48 hours after the collection of the last groundwater sample. Static groundwater levels will be measured from the top of the temporary well casings to the nearest 0.01 foot with an electric water level indicating instrument. All static water level measurements will be collected within 15 minutes of each other.

Each groundwater measuring point will be surveyed for by a registered land surveyor using the state-plane coordinate system and national geodetic vertical datum. The surveyor will determine the horizontal coordinates, the top of casing elevation, and the ground surface elevation for each measuring point. From these measurements, a groundwater contour map will be generated for each site, indicating the location of the groundwater sampling points, elevation of the static groundwater, measurement date, and groundwater flow direction. Field correctness and accuracy of the measurements will be verified prior to completion of survey work.

Following completion of groundwater sampling and measurement, the temporary groundwater measuring points will be removed and the temporary groundwater wells will be abandoned in accordance with MDNR regulations. The temporary measurement points will be disposed of according to Section 3.4.2 of the SOW (dated 26 July 1995), Worksite Maintenance.

If the temporary groundwater monitoring wells do not yield groundwater, monitoring wells drilled using either hollow-stem augers or air rotary and a mobile drill rig will be installed. Three groundwater monitoring wells will be installed at sites SS003, SS006, and SS009, and one well each will be installed at sites OWS704 and SS004. The latter two wells will be installed downgradient from the former areas of soil contamination. Due to the close proximity of sites SS003 and SS009 to sites OWS704 and SS004, the three wells installed at these sites can be used to determine groundwater gradients.

The following summarizes the procedures for drilling monitoring wells in place of DirectPush/Geoprobe® temporary wells.

TABLE 3-1
Summary of Analytical Methods

Site	Estimated No. of Samples¹	Analytical Group	Analytical Method
SS003	3	TRPH	SW 8015 Modified
	3	VOCs	SW 8240
	3	RCRA Metals	SW 6010/7000s
OWS704	3	TRPH	SW 8015 Modified
	3	VOCs	SW 8240
	3	RCRA Metals	SW 6010/7000s
SS004	3	TRPH	SW 8015 Modified
	3	VOCs	SW 8240
	3	RCRA Metals	SW 6010/7000s
SS006	3	TRPH	SW 8015 Modified
	3	VOCs	SW 8240
	3	SVOCs	SW 8270
	3	RCRA Metals	SW 6010/7000s
SS009	3	TRPH	SW 8015 Modified
	3	VOCs	SW 8240
	3	PCBs	SW 8080
	3	SVOCs	SW 8270
	3	RCRA Metals	SW 6010/7000s

¹ Estimated number of samples does not include QA/QC samples.

Soil borings for monitoring wells will be advanced with a truck or all-terrain vehicle (ATV) mounted drill rig equipped with standard 4.25-inch ID hollow stem augers. If bedrock is encountered during direct-push activities, the air rotary method of drilling may need to be applied in order to install the permanent wells.

Hollow-Stem Auger Drilling

Hollow-stem auger drilling uses interconnected hollow auger flights equipped with a cutting head. The screw action of the augers as they are rotated and pressed into the ground pulls the soils cuttings to the surface. The bottom of the auger flight is fitted with a pilot bit and center plug attached to drill rods that prevent material from entering the augers during drilling. Soil samples are collected by removing the drill rods and center plug and advancing a sampling ahead of the augers.

Air Rotary Drilling

Air rotary drilling uses a rotating rock bit attached to drill rods. Air is used as the drilling fluid to lift rock cuttings from the borehole as the bit is advanced. Equipment needed for air rotary drilling includes a large air compressor, a swivel hose assembly connected to the top of the drill pipe or kelly, and a rock bit (i.e., tricone, roller type). Air is forced down through the center of the drill pipe and exits through small openings at the bottom of the drill bit. The cuttings are lifted along the annular space of the borehole, forced out the top of the borehole, and deposited on the surface. Air rotary drilling allows cuttings to be removed rapidly and increases penetration rates, and extreme cold does not impede drilling operations. This method of drilling can only be performed in consolidated or semi-consolidated materials.

Undisturbed soil samples will be collected with 2-foot long split-barrel samplers in accordance with ASTM Standard D-1586 until bedrock is encountered. Split-barrel sampling will be performed continuously starting from 1 foot below until the water table is intercepted. Soil samples will be described in detail on a standardized field soil boring log by an experienced Versar geologist/hydrogeologist. Soil textural descriptions will conform with ASTM Standard D-2488, commonly referred to as the Unified Soil Classification System (USCS).

Field screening for the presence of potential contamination in unsaturated soil samples will be performed by the on-site Versar geologist/hydrogeologist. Each split-spoon sample will be checked for the presence of unusual odors, coloration, or staining of the soil. Visual observations will be noted on the field soil boring logs.

Decontamination procedures as specified in the AFCEE Handbook will be followed to prevent cross-contamination between sampling locations and horizons. Drilling equipment that comes in contact with potentially contaminated soil and groundwater (e.g., augers, rods, and split spoons) will, at a minimum, be steam cleaned between soil boring locations. Split-spoon samplers will be thoroughly washed between sampling horizons at each boring location in accordance with current MDNR and AFCEE protocols.

Soil cuttings from each well installation will be placed into designated and labeled 55-gallon drums and stored in a designated area prior to disposal. Samples will be collected from each drum (20 drums are estimated) and analyzed for parameters necessary for disposal characteristics. These parameters include: RCRA Metals (7000), Ignitability (1010), Reactivity (9010), Corrosivity (9040), and Paint Filter Test (9095).

Monitoring wells will be developed no sooner than 24 hours after grouting is completed. During development, each well will be mechanically surged followed by the purging of a minimum of 4 well casings and borehole volumes. Surging and purging will continue until the pH, temperature, conductivity, and turbidity are stabilized. To perform the stabilization test, the pH, temperature, specific conductance, and turbidity of the development water will be monitored. The wells will be considered developed when readings remain stable within plus or minus 10 percent between three consecutive measurements. Examples of the forms to be filled out during well development and sampling are shown in Figures 3-6 and 3-7, respectively.

After well installation and development are completed, samples will be collected from each well according to selected parameters specified for each of the five sites. Table 3-1 summarizes the analytical methods for each site.

3.3 DECONTAMINATION PROCEDURES

Decontamination procedures as specified in the AFCEE Handbook will be followed to prevent cross-contamination between sampling locations and horizons. Investigation-derived waste is expected to be limited to be water generated from equipment decontamination activities and soil cuttings if permanent groundwater monitoring wells are installed in place of temporary groundwater monitoring wells. Decontamination water and soil cuttings, if generated, will be contained in 55-gallon drums and stored on site for further disposal.

**FIGURE 3-6
WELL DEVELOPMENT FORM**

Date: Beg. _____ End _____

Site Name _____

Well No./Location _____ Job No. _____

1. Well Information¹
 Inner Casing Diameter _____
 Outer Casing Diameter _____
 Outer Casing Height _____
 ΔOuter Casing/Inner Casing _____
²Inner Casing Height _____
 Depth to Product (to TIC) _____
 Total Depth (from TIC) _____
 DTW (from TIC) _____
 Water Column Length _____
 Casing Volume _____
 x 3 _____
 DTW Time _____
 Date _____
 Personnel _____

4. Sample Methods
 Date _____
 Time: Begin _____ End _____
 Personnel _____
 Equipment _____
 Lot # _____

2. General Observations
 Organic Vapors (HNu, OVA, TIP) _____
 Reading: Breathing Zone _____
 Reading: Water/Air Interface _____
 Radiation _____
 Sediment _____
 Color _____
 Odor _____

5. Notes

- Facility Well Security _____
- Dedicated Equipment _____
- Casing Material _____
- Nonaqueous Phases _____
- Product Width _____
- Sampling Ambient Conditions (weather, etc.) _____
- Other _____

3. Purge Methods
 Date _____
 Time: Begin _____ End _____
 Equipment _____
 Personnel _____
 Volume Removed _____
 Disposition of Purge Water _____
 Equipment _____

¹All length measurements to 0.01 foot
²Above ground or below surfaces, use negative number for below surface

**FIGURE 3-7
WELL SAMPLING FORM**

Site _____

Well No. _____ Date _____

Volume Removed 1) 2) 3) 4) _____

Time 1) 2) 3) 4) _____

Well No. _____

Performed by _____

<u>Specific Conductance</u>	<u>Trial No. 1</u>	<u>Trial No. 2</u>	<u>Trial No. 3</u>	<u>Trial No. 4</u>
Temperature °C	_____	_____	_____	_____
Uncorrected (µmhos/cm)	_____	_____	_____	_____
Corrected Factor	_____	_____	_____	_____
Specific Conductance	_____	_____	_____	_____
Corrected (µmhos/cm)	_____	_____	_____	_____

pH

	<u>Initial sample pH reading:</u>	<u>pH calibration</u>
1)	standard: _____	4 = _____ 7 = _____ 10 = _____
2)	standard: _____	4 = _____ 7 = _____ 10 = _____
3)	standard: _____	4 = _____ 7 = _____ 10 = _____
4)	standard: _____	4 = _____ 7 = _____ 10 = _____

	<u>Trial No. 1</u>	<u>Trial No. 2</u>	<u>Trial No. 3</u>	<u>Trial No. 4</u>
Temperature	_____	_____	_____	_____
Sample pH	_____	_____	_____	_____

1) pH recheck	4 = _____	7 = _____	10 = _____
2)	4 = _____	7 = _____	10 = _____
3)	4 = _____	7 = _____	10 = _____
4)	4 = _____	7 = _____	10 = _____

SECTION 4.0

REPORTING REQUIREMENTS

Several report deliverables will be required during the Preliminary Groundwater Assessments of Sites SS003, OWS704, SS004, SS006, and SS009. Versar will prepare and submit the deliverables listed in the scope of work and as described in the Contract Data Requirements Lists (CDRLs). Although many deliverables are site-specific and covered under specific work tasks, other deliverables are more general and encompass all project activities. These general deliverables include: monthly reports, including performance and cost reports; manhour expenditure charts; status reports; personnel charts; and other deliverables generated on an as needed basis, such as presentation materials, meeting minutes, and letter reports. Project-specific deliverables include: Work Plan (WP), Health and Safety Plan (HASP), Sampling and Analysis Plan (SAP) containing a site-specific Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP), and technical reports. These deliverables are described in detail in the following paragraphs.

4.1 STATUS REPORTS

Each month, a report describing the project's technical status and the progress made during the previous month will be submitted to the AFCEE Team Chief. The objective of the Status Report is to apprise the Team Chief of the progress of the project and to present justification for the resources expended during the reporting period. The Status Report shall include:

- Identification of installation and activity in progress
- Status of major work elements and progress to date
- Problems encountered, if any, and corrective actions taken
- Activities planned for the next period

4.2 TECHNICAL REPORTS

Two Groundwater Investigation Reports will be prepared at the end of the project. Sites SS003, SS004, SS006, and SS009 will be combined into one report. A separate report will be generated for Site OWS704 as per the Statement of Work. The report will present a description of each site, its operational history, and results of previous environmental investigations. The reports will describe the field activities performed during Preliminary Groundwater Assessments at the sites and discuss the analytical results. Based on the results, the reports will evaluate possible courses of action, including No Further Action, and present recommendations. Table 4-1 provides a general outline of the reports.

TABLE 4-1

General Outline for Preliminary Groundwater Assessment Reports

Disclaimer

Report Documentation Page

Table of Contents

Executive Summary

- 1.0 Introduction
 - 1.1 Purpose of Investigation
 - 1.2 Report Organization
 - 1.3 Site History
 - 1.4 Site Description
 - 1.5 Operational History
- 2.0 Site Background
 - 2.1 Physiography and Topography
 - 2.2 Geology and Hydrogeology
 - 2.3 Surface Water
- 3.0 Preliminary Groundwater Assessments
 - 3.1 Objectives
 - 3.2 Installation of Temporary Wells
 - 3.3 Installation of Permanent Wells (if necessary)
 - 3.4 Groundwater Sampling
 - 3.5 Surveying
- 4.0 Results of Field Investigation (by site)
- 5.0 Summary
 - 5.1 Assessment of Environmental Concerns
 - 5.2 Data Gaps
 - 5.3 Recommendations

Appendices

- Chain of Custody Records
- Analytical Data Summaries
- Data Validation Summaries

4.3 LETTER REPORTS AND MEETING MINUTES

At various times during the Preliminary Groundwater Assessments process, letter reports may be prepared and submitted to AFCEE. The purpose of these reports is to keep the Air Force apprised of key activities and information to enable them to be involved in the decisions based on such information. The letter reports are expected to contain:

- Status reports on field activities
- Versar's evaluation of available data
- Site-specific technical information
- Other relevant information

During the course of the project, formal meetings may be held for the purpose of reporting project status to representatives of the regulatory agencies and community and citizen groups. Meeting minutes will be prepared to summarize the issues discussed, conclusions reached, decisions made, and action items identified at each meeting. These minutes will be transmitted to all attendees.

In addition to the above, presentation materials will be provided to the Air Force on an as needed basis for their use in meetings and briefings. Versar will prepare slides and overhead transparencies, and will submit paper copies of all material.

4.4 DATA MANAGEMENT

Field and laboratory data shall be recorded in a computerized data base format. The input of the sampling and laboratory data into AFCEE's IRPIMS is required under this project. All data collected during the course of this project, including raw laboratory data, quality control data, data validation results, and surveying information will be included in the appendices to the technical report.

SECTION 5.0

PROJECT ORGANIZATION AND SCHEDULE

5.1 PROJECT ORGANIZATION

Versar has a centralized management structure in Springfield, Virginia, to perform all program management for this investigation. This includes financial and deliverable reporting on a contract basis, and implementation of contract-wide quality assurance and health and safety procedures. The Program Manager assigns all delivery orders to a Project Manager who has all the resources available to successfully complete the objectives of the specific task.

The management structure for conducting the preliminary groundwater assessments at OL-Q is shown in Figure 5-1. The Project Manager will supervise all personnel and their activities. When additional technical support is required, the Project Manager will coordinate with the Program Manager who has access to a staff of over 475 people located in 16 Versar offices nationwide.

The Project Team was chosen because it can best satisfy the requirements of the delivery order objectives. Versar's proposed Project Team provides benefits to AFCEE as follows:

- Extensive Program and Project Management experience, including successful management of many other large task order government projects.
- Effective budget control, high quality deliverables, and personnel management skills.
- Experienced and qualified key technical personnel have been assigned to perform all Work Breakdown Structure (WBS) tasks.
- Independent quality assurance and health and safety functions, which act independently from the key technical staff by providing valuable checks and balances to the Program Manager.
- Direct open line of communication between the AFCEE Project Officer and the Versar Project Manager.

The Project Manager has authority to commit all technical resources in the Springfield, Virginia, headquarters office for this project. The Program Manager, as an officer of Versar, can commit resources from each of our 16 national offices to the project. This will help to ensure that potential scheduling conflicts are avoided and project milestones are satisfied.

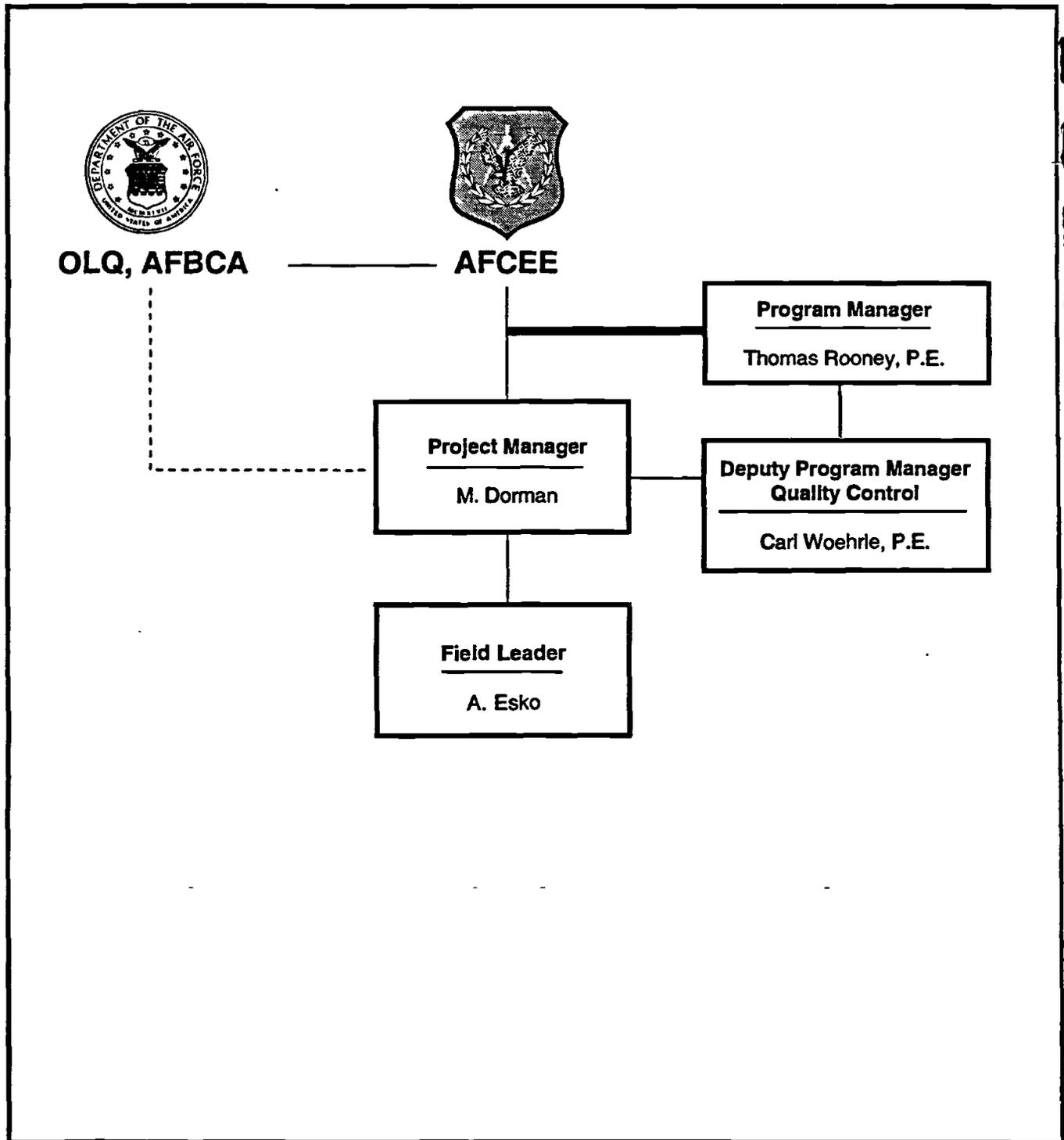


Figure 5-1 Project Organization

The roles and responsibilities of these key personnel are described below.

Mr. Thomas Rooney, Program Manager - Mr. Rooney is responsible for all quality assurance and overall direction on the entire AFCEE contract. His responsibilities include the following:

- Attendance at all project reviews and major meetings.
- Formal communication with the Contracting Officer (CO), and Contracting Officer Representative (COR).
- Adherence to all contract terms, and Versar and AFCEE standard operating procedures and guidelines.
- Supplying resources required to complete each task order.
- Final approval and review of work plans, deliverables, management plans, and contract changes.
- Approving satisfactory completion of each WBS task.

Mr. Rooney has the authority to select personnel assigned to the project from Versar's staff of 475 people located in 16 offices nationwide. He will also approve all submissions, and modifications to budgets and schedules. The Program Manager will interact frequently with the Project Manager and the AFCEE Project Officer to ensure consistency of work products and adherence to project milestones.

Mr. Carl Woehrle, Deputy Program Manager/Project Quality Control Monitor - Mr. Woehrle will assist Mr. Rooney during the day to day activities. His responsibilities include the following:

- Establish schedules and tracking mechanisms for all deliverables.
- Coordinate monthly cost and performance reports.
- Coordinate delivery of all technical plans and documents.
- Track expenditures and implement corrective action, if necessary.
- Ensure that all final project deliverables are based on defensible, documented data in full conformance with the AFCEE QA/QC program.
- Ensure that adequate QC documentation is provided for all project deliverables and that all deliverables undergo both editorial and technical review.

- Ensure that all QC problems are resolved in an expeditious manner and brought to the attention of the technical managers.

Mr. Michael Dorman, Project Manager - Mr. Dorman will be responsible for ensuring technical coordination for the sampling at OL-Q. Mr. Dorman's responsibilities include the following:

- Effective daily management of all WBS tasks.
- Technical and project management interactions with the AFCEE Project Manager.
- Assist during preparation of cost and performance reports.
- Technical review of all task deliverables.
- Management of the Project Team to meet all project objectives.
- Effective management and procurement of all labor, material, and subcontractors for the project.

Mr. Alan Esko, Field Leader - Mr. Esko will be responsible for overseeing all field operations during the direct push/drilling activities. He will oversee all subcontractors and Versar sampling personnel. Mr. Esko holds the required certifications to oversee drilling activities in the State of Missouri.

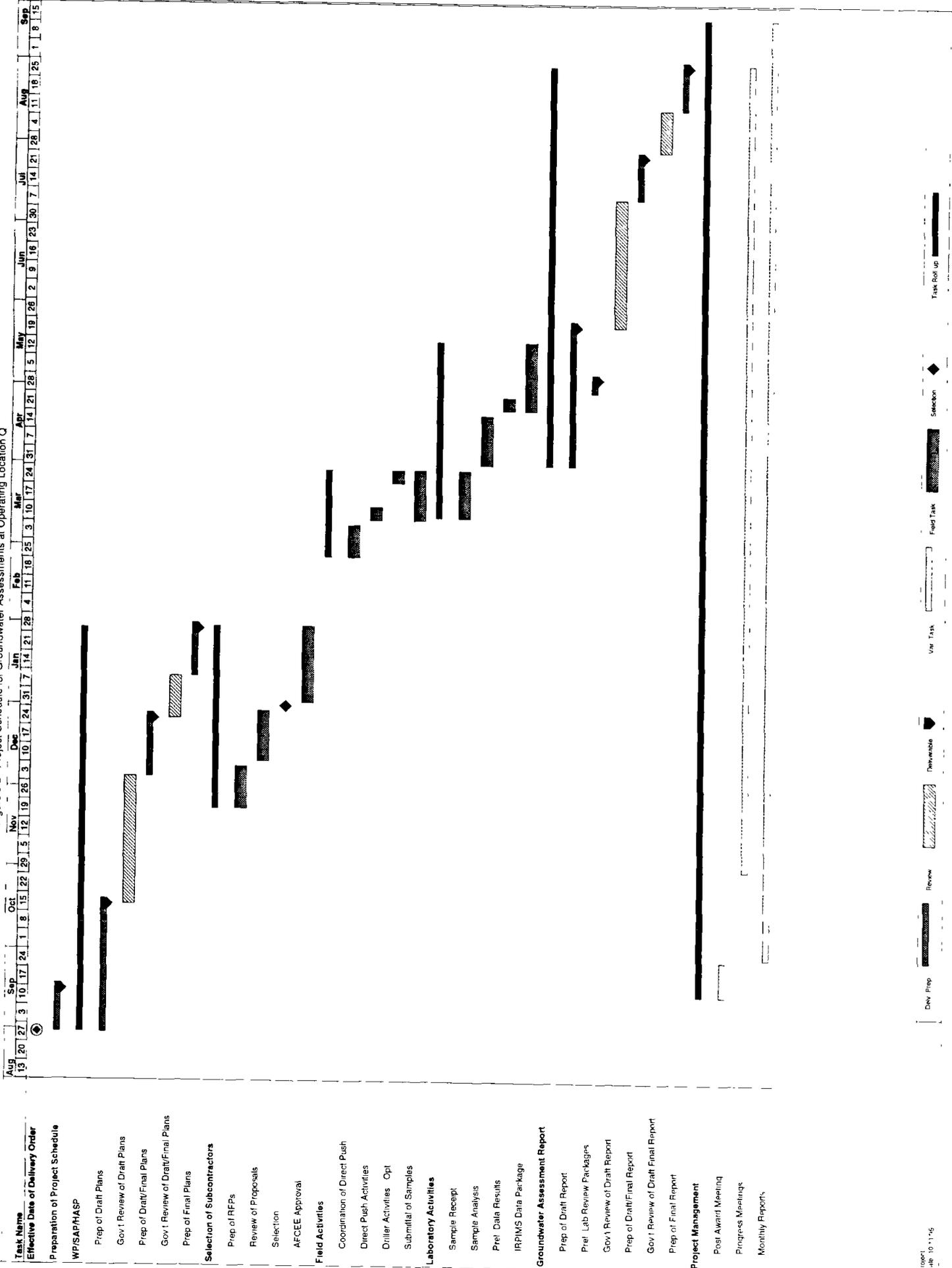
5.2 PROJECT STRUCTURE AND SCHEDULE

Versar will use a series of management controls to help ensure that project milestones are met. These management controls are detailed below and include an outline and schedule for each project task and work element, a detailed list of all required technical plans and reports, a schedule for delivery of technical plans and reports, and a listing of all project meeting and briefings and their anticipated schedule.

A copy of the delivery order schedule by WBS is shown as Figure 5-2. The schedule identifies each task and subtask work element and provides the sequence and duration for each. The entire project is estimated to last 12 months from Versar's award of the contract in August 1995. Figure 5-2 will provide a valuable management tool in tracking monthly progress and identifying any schedule problems that are encountered.

The Deputy Program and Project Manager will compare the task schedule to actual progress made on each task on a continuous basis. Any slippage in schedules will be reported immediately to the AFCEE Project Manager. Corrective action, if necessary, will be recommended and implemented as needed. Figure 5-2 will be used when preparing the monthly performance and cost report for AFCEE.

Figure 5-2 Project Schedule for Groundwater Assessments at Operating Location Q



5.3 DELIVERABLES SCHEDULE

An outline of the deliverables schedule for the Groundwater Investigation Reports at OL-Q is shown in Table 5-1. A separate report will be generated for Site OWS704. The remaining sites (SS003, SS004, SS006, and SS009) will be included in a single report. A draft and final Sampling and Analysis Plan and Health and Safety Plan will be prepared for the AFCEE according to the proposed schedule. All reports will be reviewed and approved by the Project Manager or Program Manager.

5.4 MEETINGS

AFCEE may request meetings with OL-Q, the USEPA, or the State of Missouri on occasion to discuss various technical or policy issues. Requests for meetings/briefings with Region VII will be made by AFCEE to the designated EPA Contact Person. It is anticipated that Versar may participate in these meetings/briefings. In addition, Versar will participate in meetings with AFCEE personnel as required.

TABLE 5-1
Deliverables Schedule

Deliverables	CDRL	Submittal Date
Health and Safety Plan - Draft - Final	A002	45 calendar days from award of Contract 30 calendar days from receipt of AFCEE comments
Sampling and Analysis Plan - Draft - Final	A004	45 calendar days from award of Contract 30 calendar days from receipt of AFCEE comments
Work Plan - Draft - Final	A004	45 calendar days from award of Contract 30 calendar days from receipt of AFCEE comments
Groundwater Assessments Reports - Draft - Final	A030	240 calendar days from award of Contract 30 calendar days from receipt of AFCEE comments
Performance and Cost Report Status Report Manhour Expenditure Chart	B006 A001 B007	30 calendar days after each calendar month

CDRL = Contract Data Requirements List

SECTION 6.0**REFERENCES**

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- Jacobs Engineering Group, Inc., 1995. Draft Groundwater Evaluation Report, Richards-Gebaur Air Force Base, Kansas City, Missouri.
- O'Brien & Gere, 1991. Handbook for Remedial Investigation for North Burn Pit, Site FT002; Oil-Saturated Area, Site SS003; Hazardous Waste Drum Storage, Site SS004; POL Storage Yard, Site ST005. U.S. Army Corps of Engineers Kansas City District, Richards-Gebaur Air Force Base, Belton, Missouri.
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- U.S. Air Force, 1995. Installation Restoration Program (IRP), Preliminary Assessment of IRP Site SS009, Draft Technical Report, Richards-Gebaur Air Force Base, Kansas City, Missouri.
- Versar, 1995a. Health and Safety Plan (Draft), Richards-Gebaur Air Force Base, Missouri.
- Versar, 1995b. Sampling and Analysis Plan (Draft), Richards-Gebaur Air Force Base, Missouri.

TAB

SAP

United States Air Force

Environmental Restoration Program

F I N A L

Sampling and Analysis Plan

**Preliminary Groundwater Assessment at
Sites SS003, OWS704, SS004, SS006, and SS009**

**Operating Location Q, Missouri
(Richards-Gebaur Air Force Base)**



**Contract No. F41625-94-D-8051
Delivery Order No. 0016
AFBCA Project No. UEBL 95-7011**

March 1996

F I N A L

**Operating Location Q
(Richards-Gebaur Air Force Base)**

SAMPLING AND ANALYSIS PLAN

**Preliminary Groundwater Assessments of
Sites SS004, OWS704, SS004, SS006, and SS009**

March 1996

Prepared for

**Air Force Center for Environmental Excellence (AFCEE/ERB)
Base Closure Restoration Division
Brooks Air Force Base, Texas 78235-5328**

**USAF Contract No. F41624-94-D-8051, Delivery Order No. 0016
AFBCA Project No. UEBL 95-7011**

Prepared by

**Versar, Inc.
6850 Versar Center
Springfield, Virginia 22151**

NOTICE

This plan has been prepared for the United States Air Force by Versar, Inc. for the purpose of aiding in the environmental investigation under the Air Force Environmental Restoration Program. Because this plan supports environmental investigations at the site, its release prior to an Air Force final decision on site conditions may be in the public's interest. The limited objectives of this plan and the ongoing nature of the investigations, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this plan because subsequent facts may become known that may make this plan premature or inaccurate. Acceptance of this plan in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1294, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503.

1 AGENCY USE ONLY (Leave Blank)

2 REPORT DATE
March 1996

3 REPORT TYPE AND DATES COVERED
Final

4 TITLE AND SUBTITLE
Sampling and Analysis Plan
Preliminary Groundwater Assessment of Sites SS003, OWS704, SS004,
SS006, and SS009

5 FUNDING NUMBERS
USAF Contract No. F41624-94-D-8051
Delivery Order 0016
AFBCA Project No. UEBL 95-7011

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Air Force Center for Environmental Excellence (AFCEE/ERB)
Base Closure Restoration Division
Brooks Air Force Base, TX 78235-5000

10 SPONSORING/MONITORING
AGENCY REPORT NUMBER

11 SUPPLEMENTARY NOTES

12a DISTRIBUTION/AVAILABILITY STATEMENT

12b DISTRIBUTION CODE

13 ABSTRACT (Maximum 200 words)

The Sampling and Analysis Plan describes quality assurance protocols and fields requirements for the activities performed under the Preliminary Groundwater Assessments of Sites SS003, OWS704, SS004, SS006, and SS009 at Operating Location Q (Richards-Gebaur Air Force Base), Missouri. The work includes activities associated with direct-push technology, installation of groundwater monitoring wells, and groundwater measurements and sampling.

14 SUBJECT TERMS
IRP, QAPP, Quality Assurance, Sampling and Analysis

15 NUMBER OF PAGES
87

16 PRICE CODE

17 SECURITY CLASSIFICATION
OF REPORT
Unclassified

18 SECURITY CLASSIFICATION
OF THIS PAGE
Unclassified

19 SECURITY CLASSIFICATION
OF ABSTRACT
Unclassified

20 LIMITATION OF ABSTRACT
Unclassified

ACRONYMS & ABBREVIATIONS

AA	Atomic absorption
ADC	Air Defense Command
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Environmental Excellence
AFCS	Air Force Communications Service
AFRES	Air Force Reserve
AV	all-terrain vehicle
BCP	Base Cleanup Plan
beg	below existing grade
BNA	base-neutral acids
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	chain of custody
COR	Contracting Officer's Representative
CRADA	Cooperative Research and Development Agreement
DI	deionized water
DoD	Department of Defense
DQO	data quality objective
EPA	Environmental Protection Agency
EQL	estimated quantitation limit
FID	flame ionization detection
FSL	Field Sampling Leader
FSP	Field Sampling Plan
GC	gas chromatograph
GSA	General Services Administration
HASP	Health and Safety Plan
ICP	inductively-coupled plasma
ID	inner diameter
IDL	instrument detection limit
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
LCS	laboratory control sample
MAC	Military Airlift Command
MDL	method detection limit
MDNR	Missouri Department of Natural Resources
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
mL/L	milliliters per liter

ACRONYMS & ABBREVIATIONS

MS	mass spectrometer
MS/MSD	Matrix spike/matrix spike duplicate
NIST	National Institute for Standards and Technology
OL	Operating Location
PA	Preliminary Assessment
PCB	polychlorinated biphenyl
POC	Point of Contact
PPE	personal protective equipment
PQL	practical quantitation limit
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
RSD	relative standard deviation
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SOP	Standard Operating Procedure
SOW	Statement of Work
SRM	standard reference material
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
TCLP	toxicity characteristic leachate procedure
TRPH	total recoverable petroleum hydrocarbon
USCS	Unified Soil Classification System
VOA	volatile organic analysis
VOC	volatile organic compound
WP	work plan
°C	Degrees Celsius
°F	Degrees Fahrenheit

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Appendix A - Calibration and QC Procedures for Analytical Methods

FOREWORD

This Sampling and Analysis Plan (SAP) summarizes the work to be performed under the Preliminary Groundwater Assessments at Operating Location Q (OL-Q), Missouri, formerly Richards-Gebaur Air Force Base (AFB), Belton, Missouri. The Preliminary Groundwater Assessments will be completed for sites SS003, OWS704, SS004, SS006, and SS009. Versar, Inc. (Versar) is conducting this work as part of the U.S. Air Force Installation Restoration Program (IRP), which is designed to evaluate and remediate hazardous waste contamination at U.S. Air Force facilities.

This SAP, consisting of a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP), describes laboratory and field procedures that will be followed during the sampling. The purpose of the site-specific QAPP is to describe the overall quality control (QC) measures that will be implemented to ensure that field and laboratory activities will generate reliable data. This includes recognizing deficiencies that may affect the quality of data, and providing corrective actions, where necessary. The FSP provides guidance and procedural information for all field activities related to the sampling.

SECTION 1.0

QUALITY ASSURANCE PROJECT PLAN

This QAPP is a site-specific document for the Preliminary Groundwater Assessments of sites SS003, OWS704, SS004, SS006, and SS009 at Operating Location Q (OL-Q). An assessment of groundwater in each of the five identified sites will be completed.

1.1 INTRODUCTION

1.1.1 U.S. Air Force Installation Restoration Program

The objectives of the Air Force IRP are to assess past hazardous waste disposal and spill sites at Air Force installations and to develop remedial actions for those sites that pose a threat to human health and welfare or to the environment. The IRP process is designed to address a variety of U.S. laws pertaining to the protection of the environment, including, but not limited to, the ones discussed in the following paragraphs.

The U.S. Department of Defense (DoD) developed the IRP to ensure compliance with the Resource Conservation and Recovery Act of 1976 (RCRA). The IRP process was initiated in June 1980 by DoD through the Defense Environmental Quality Program Policy Memorandum 80-6. The IRP procedures were implemented by DoD in December 1980.

Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980. The IRP is designed to identify and remediate contaminated sites at Air Force facilities in compliance with CERCLA. Congress provided the U.S. Environmental Protection Agency (EPA) the authority to enforce CERCLA, and the EPA is identified as the primary policy and enforcement agency regarding contaminated sites. Executive Order 12316, which was adopted in 1981, gave various federal agencies, including DoD, the responsibility to act as lead agencies to conduct investigations and implement remediation efforts when they are the sole contributor or a co-contributor to contamination on or off their properties.

The Superfund Amendments and Reauthorization Act of 1986 (SARA) extended the requirements of CERCLA, and modified CERCLA with respect to remediation goals and the process leading to the selection of a remedial action.

The primary objective of the IRP process is the identification and evaluation of sites located on DoD property that may have environmental concerns. These environmental concerns may be associated with past hazardous waste disposal practices, spills, leaks, or other activities. The goals of the IRP program are to control the migration of hazardous contaminants and control health and environmental hazards that may result from historic DoD operations. The following IRP tasks are usually completed to meet these objectives:

- Develop a project data base through records review, field investigation, laboratory analysis, and data evaluation.
- Develop and implement a quality assurance/quality control (QA/QC) program to assure meaningful and defensible data.
- Develop and follow site and laboratory safety plans to protect the health and safety of personnel and to prevent the release of contaminants.
- Identify data gaps and recommend and implement appropriate additional or supplemental studies.
- Use a rigorous procedure to identify, evaluate, and select appropriate solutions.
- Conduct the IRP in compliance with applicable federal, state, and local regulations and guidances.
- Provide information to the public and appropriate regulatory agencies regarding the nature of identified contamination, the effects of contamination on the community, the progress of the IRP, and the selected corrective measure and its impacts.

Activities and results from the IRP program were incorporated into recommendations presented in the U.S. Air Force, Base Realignment and Closure (BRAC) Cleanup Plan (BCP). The BRAC is a comprehensive strategy for implementing response actions necessary to protect human health and the environment. The environmental status of Richards-Gebaur AFB as documented in the BCP as of March 1994 has been incorporated herein to determine the activities of the Preliminary Groundwater Assessments discussed in the subsequent sections of this SAP.

1.1.2 Purpose and Scope

Quality assurance refers to the overall system of activities providing assurance that reliable data have been generated during sampling and analysis. Quality control is defined as the specific actions that are taken to ensure that the system performance is consistent with established limits. QC actions ensure the precision, accuracy, and completeness of analytical data. This site-specific QAPP has been developed to address QA/QC requirements specific to the Preliminary Groundwater Assessment of sites SS003, OWS704, SS004, SS006, and SS009. The primary objectives of this QAPP are to describe the overall quality control measures that will be implemented to ensure that field and laboratory activities will result in the generation of reliable data, to recognize deficiencies that may affect the quality of data, and to provide corrective actions where necessary. This QAPP will be used to ensure that proper QA and QC procedures are implemented during all phases of data acquisition, analysis, and evaluation for the Preliminary Groundwater Assessments. All QA/QC procedures have been developed in accordance with the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, Quality Assurance Project Staff, US

Environmental Protection Agency, 1983, and, where applicable, the U.S. Air Force *Handbook for the Installation Restoration Program Remedial Investigations and Feasibility Studies*. (AFCEE Handbook), 1993.

1.2 PROJECT DESCRIPTION

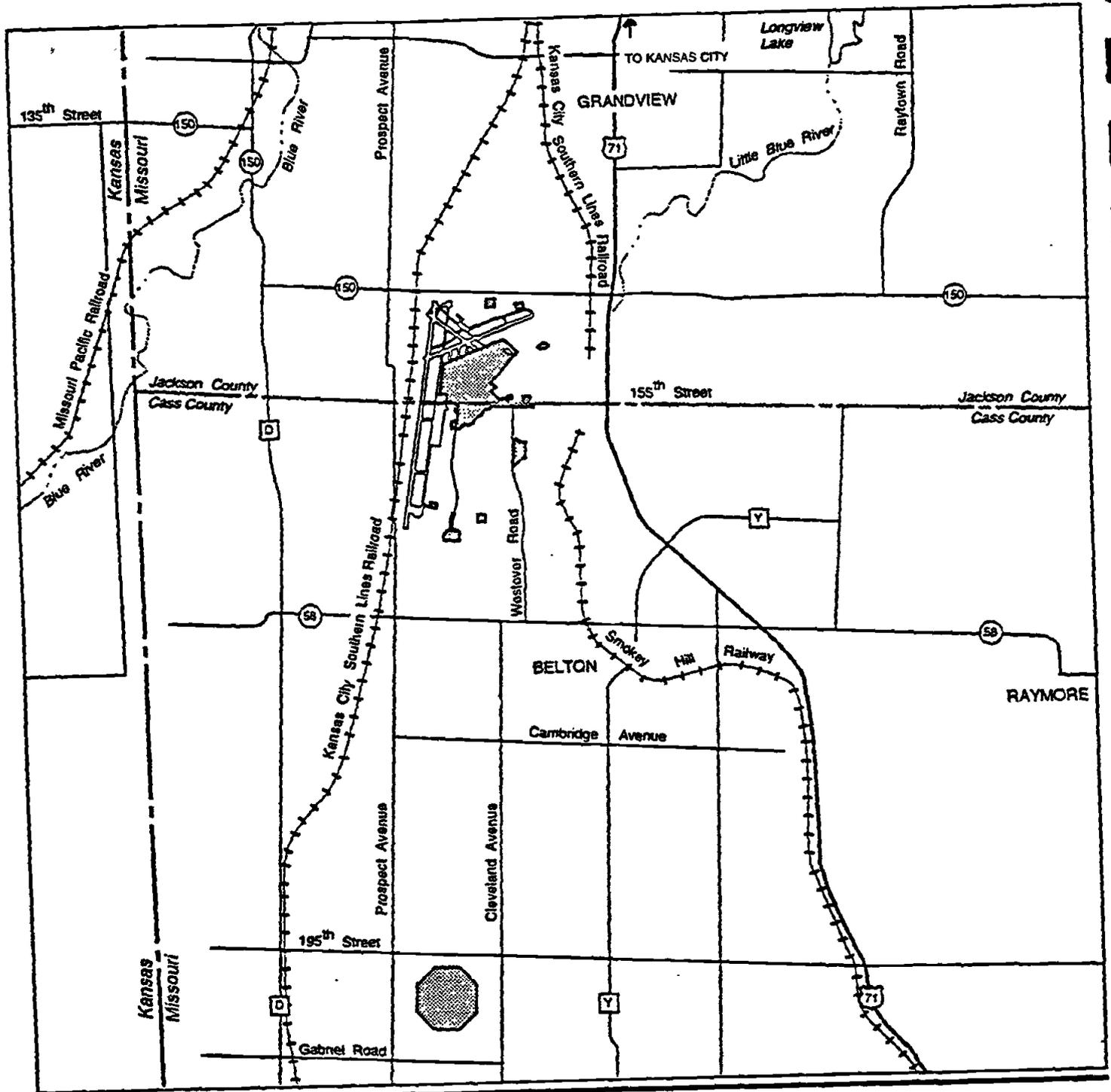
1.2.1 Project Background

Operating Location Q is located approximately 18 miles south of downtown Kansas City, Missouri (Figure 1-1). The northern portion of the base is located in Jackson County and the southern portion of the base is located in Cass County. Primary access to the OL-Q is by U.S. Highway 71. The property is currently composed of approximately 428 acres in 11 parcels. The Cantonment Area, covering 209 acres, is the largest parcel and contains the main aviation support and administrative areas. Nine smaller parcels, ranging from 1 to 13 acres, surround the Cantonment Area. The Belton Training Complex, about 4 miles south of the Cantonment Area, encompasses 184 acres and is largely undeveloped.

In 1941, portions of the land now occupied by OL-Q were acquired by Kansas City for use as an auxiliary airport (Grandview Airport). In 1952, the Aerospace Defense Command leased the airport from the city for air defense operations and, in 1953, the property (approximately 2,400 acres) was turned over to the Federal government for establishment of an Air Force Base. Initially, only C-46 airlift aircraft were stationed at the Base. Conversion to C-119 and C-124 aircraft occurred in 1957 and 1961, respectively. The Base was given the name Richards-Gebaur Air Force Base (AFB) in 1957.

Until 1970, the Air Defense Command (ADC) had the primary mission on base. In 1970, the Air Force Communications Service (AFCS) relocated its headquarters from Scott AFB, Illinois to Richards-Gebaur AFB and assumed command of the Base. In 1971, the C-124 aircraft were phased out and replaced with C-130 aircraft. This conversion reportedly reduced the industrial waste produced by the Base and also reduced the generation of waste oil. In 1977, AFCS moved back to Scott AFB and Richards-Gebaur AFB came under the Military Airlift Command (MAC).

The Air Force Reserve (AFRES) assumed operational control of the Base in October 1980. In 1981, approximately 80 percent of the Base property (including runways and taxiways) was transferred to the General Services Administration (GSA). The GSA then transferred a majority of the airport related property to the Kansas City Aviation Department as a public benefit transfer, with the condition of continued runway access by the Air Force. Other excessed parcels were also transferred by GSA for public and other military uses to Kansas City, Federal Aviation Administration, City of Belton, Department of the Navy, and the Department of the Army. Currently, Base property comprises approximately 428 acres, with an additional 421 acres of easements. Richards-Gebaur AFB was closed on September 30, 1994, and is now managed by the Air Force Base Conversion Agency (AFBCA) and designated as Operation Location Q.



EXPLANATION

-  Base Property
-  U. S. Highway
-  State Highway
-  County Road



SOURCE. DAMES & MOORE, 1995

Figure 1-1
OL-Q Location Map



1.2.2 Previous Investigative Activities and Documentation

SS003, Oil-Saturated Area. A field investigation was performed to determine the extent of lead and petroleum contamination in the site soils. Approximately 42 cubic yards of soil were removed to minimize risk to human health and the environment.

OWS704, Former Oil/Water Separator Excavation. OWS704C and 704D, an oil/water separator and a wash residual holding tank, respectively, were removed from the same excavation and the soils were sampled for petroleum hydrocarbons and heavy metals. The contaminants in the soil were petroleum hydrocarbons and detectable amounts of barium, silver, lead, selenium, and cadmium.

SS004, Hazardous Waste Storage Area. A field investigation was performed to determine the extent of contamination in the site soils. The only contaminants in the soil were petroleum hydrocarbons. Approximately 15 cubic yards of soil were removed to minimize risk to human health and the environment.

SS006, Hazardous Material Storage. A field investigation was performed to determine the extent of contamination in the site soils. The soil was analyzed for volatile organics, base-neutral acids (BNAs), and the following total metals: barium, cadmium, chromium, lead, silver, arsenic, mercury, and selenium. BNAs were found at two locations in low concentrations. Approximately 40 cubic yards of soil were removed to minimize risk to human health and the environment.

SS009, Fire Valve Area. A field investigation was performed to determine the extent of contamination in the site soils. The soil was analyzed for volatile organics, BNAs, and petroleum-related contaminants. The contaminants in the soil were petroleum hydrocarbons, volatile organics, and BNAs. The original source of contamination was removed and studies were performed to determine if another source was present. Contamination was only encountered within the vicinity of the original source.

1.2.3 Project Scope and Objectives

The purpose of this project is to perform preliminary groundwater assessments at the above listed sites to determine the presence or absence of groundwater contamination as a result of contaminated soils encountered at each site. Direct-push technology will be utilized for collection of groundwater samples and to install temporary piezometers that will be used to determine groundwater flow direction. Groundwater samples will be collected from three locations at each site and analyzed for the appropriate parameters.

Additional documents prepared for this Preliminary Groundwater Assessments project include a project-specific Health and Safety Plan (HASP), and the Preliminary Groundwater Assessments Work Plan (WP). These documents were prepared in accordance with the AFCEE Handbook (1993).

1.3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

1.3.1 General Data Quality Objectives

Data quality objectives (DQOs) are qualitative or quantitative statements developed to specify the quality of data needed from a particular data collection activity to support the end use of the data. A summary of DQOs developed for the Preliminary Groundwater Assessments is presented in Table 1-1 for the field activity planned. The objective of the sampling is to collect groundwater data, review the collected data to determine the presence or absence of contamination in the media, and determine if closure for the site should be granted.

1.3.2 Scoping

Scoping, the initial phase of the sampling process, is the critical planning phase that is refined continuously throughout the field activities. Scoping typically begins with the collection and review of existing site data to identify a sampling approach and potential site problems, and to define operational issues, including site health and safety requirements. This activity includes meetings with the appropriate Base personnel and development of project work plans. The scoping phase will involve one site visit for two persons to visually examine the sites.

1.3.3 Analytical Data Quality Objectives

In accordance with the US EPA's *Data Quality Objectives for Remedial Response Activities*, March 1987, there are five levels of analytical data. These analytical levels, numbered I through V, are summarized as follows. In general, Level I analyses are used for qualitative field screening activities; Level II analyses are used for quantitative field screening activities; Level III analyses use off-site laboratories, but do not rely on rigorous data validation; Level IV analyses are performed in off-site laboratories using Contract Laboratory Program (CLP) data validation procedures; and Level V relies on off-site analysis using nonstandard methods. Levels IV and V will not be used in this study.

The selection of the appropriate analytical level is based on the end use of the data. Indicators of data quality to be used during this investigation include: accuracy, precision, completeness, representativeness, and comparability. These indicators are typically used to define quality levels for analytical activities and are discussed in the following sections. The procedures used to assess data quality indicators are presented in Section 1.12 of this document.

1.3.3.1 Accuracy

Accuracy is defined as a measurement of the closeness of agreement between an observed value and an accepted reference value (or bias in a system). Accuracy will be assessed through the evaluation of the percent recoveries associated with reference samples (i.e., laboratory control samples or surrogates). Acceptance criteria for percent recoveries

**TABLE 1-1
Data Quality Objectives**

TYPE OF STUDY	ACTIVITY	OBJECTIVE	DATA USE	ANALYTICAL LEVEL
Preliminary Groundwater Assessments	Site Visits/ Background Review	Site visits and review of background documentation will be conducted to assess potential environmental actions and well placement at each site.	Prioritize Site Investigations	NA
	Groundwater Sampling	Groundwater data will be collected to determine the potential impact of contaminated soils to shallow groundwater at each site.	Groundwater Assessment	II & III
	Soil Sampling	Soil samples will be collected to classify the soils at each site. The soils will not be analyzed in a laboratory.	Soil Classification Only	NA

NA - Not Applicable

associated with reference samples will be developed by the contracted laboratory. Whenever an analyte in a reference sample is outside of the recovery acceptance limit, data for that analyte will be reported, but qualified. All samples in that analytical batch will then be reanalyzed for that analyte after the system problems have been resolved and system control has been reestablished. When an analyte in a reference sample exceeds the upper control limit and that analyte is not detected in the associated samples, the data for that analyte do not need to be qualified and no corrective action is required.

Field sampling and shipping procedures, as well as laboratory procedures, may result in the introduction of contamination to the samples that may affect the accuracy of the analytical results. Equipment blanks, ambient condition blanks, and trip blanks will be collected in the field to help detect field contamination. Method blanks will be used during laboratory procedures to assess the introduction of laboratory contamination.

1.3.3.2 Precision

Precision measures the reproducibility of repetitive measurements. It is strictly defined as *the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions*. Analytical precision is a measurement of the variability associated with duplicate (two) or replicate (more than two) analyses of the same sample in the laboratory and is determined by analysis of laboratory duplicates. Total precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Precision data shall be interpreted by taking into consideration all possible sources of variability. Duplicate samples or duplicate spiked samples may be analyzed to assess field and analytical precision, and the results are assessed using the RPD between duplicate measurements.

1.3.3.3 Representativeness

Representativeness is a qualitative measure used to determine the degree to which obtained data correlate to the population sampled. Sample locations, sampling procedures, and analytical methods have been selected based on a detailed evaluation of historical site data in order to collect samples that are representative of site-wide conditions. In order to ensure sample representativeness, all field and laboratory personnel must develop a complete and thorough understanding of sample collection methodologies, equipment decontamination and use, and the use of appropriate analytical methods. The evaluation of this parameter will be expressed through field auditing and QA review of SOPs and Work Plans.

1.3.3.4 Completeness

Completeness is defined as the percentage of measurements evaluated and judged to be valid measurements. For this project, the QA objective for completeness is 90 percent. At the end of each sampling event, all field data will be carefully reviewed to assess the completeness of the data set. If any data omissions are found, appropriate corrective action

will be taken, including resampling if necessary. Laboratory results will be evaluated for completeness on a continuing basis. If it is determined that laboratory data do not meet completeness goals, appropriate corrective action will be taken. If necessary, additional samples will be collected and analyzed.

1.3.3.5 Comparability

Comparability is a qualitative measure used to assess the confidence with which data sets obtained for similar samples and sample conditions can be correlated. This parameter is largely dependent upon the accuracy and precision of the analytical methods and procedures. Because this project will draw upon historical site data, the FSP, including sampling procedures and analytical methods, has been developed to mirror the activities of previous site investigations to the maximum extent practical. This approach will maximize the comparability of data from the confirmatory sampling with historical site data.

1.4 SAMPLING PROCEDURES

1.4.1 Sampling Protocols

In general, field activities shall be conducted in accordance with the methods specified in the AFCEE Handbook (1993) and standard industry practices. Sampling locations and analytical parameters have been determined based on previous field sampling and background documentation. Groundwater samples will be collected in a manner that reduces the chance of cross contamination or loss of volatiles.

1.4.2 Sample Handling

1.4.2.1 Sample Containers

The potential for sample contamination from the sample containers will be reduced by using the appropriate cleaning techniques. All containers will be cleaned by the AFCEE-approved laboratory in accordance with procedures dictated by the specific method of analysis to be performed. The clean sample containers will be accompanied by a chain of custody form, and the receptacle used to ship the containers will be custody-sealed. Containers that will be used for the sampling will include:

- 40 milliliter (mL) Teflon® septum sealed glass vials for organic compounds and petroleum hydrocarbons
- 1-liter polyethylene bottles for metals and PCBs analyses
- 1-liter amber glass bottles for semivolatile organic compounds

1.4.2.2 Labeling

Each sample will be assigned a unique sequential number, at the time of sampling, which will be permanently affixed to the sample container. The labels will be covered with

clear tape to prevent any losses during shipment. The sample label will include the following information, when applicable:

- Sample number
- Sampling date
- Preservative
- Filtered
- Analyte(s)
- Sampler's name
- Installation name

1.4.2.3 Sample Documentation

Bound logbooks with sequentially numbered pages will be used for all recordkeeping purposes in the field and laboratory. The use of the bound logbook will result in a chronological sequence of data insertion. All entries will be recorded using indelible ink. Correction to entries will be made by drawing a single line through the incorrect entry, recording the correct information, and initialing and dating the corrected entry. If computerized information is utilized, a hard copy, which has been permanently affixed to the logbook, will be acceptable as an original record of sampling and laboratory logging.

The following information shall be recorded for all activities:

- Location
- Date and time
- Identity of persons performing the activity
- Weather conditions

The following information shall be recorded for all field measurements:

- The numerical value and units of each measurement
- The calibration results for each field instrument

The following information shall be recorded for all sampling activities:

- Sample type and method
- Sample identification number and depth(s) of sample
- The quantity/volume of each sample
- Sample description (e.g., color, odor, texture)
- Type of sampling device used
- Discussion of conditions that may affect the representativeness of a sample (e.g., damaged casing)

Logbooks containing information specific to the project will be forwarded to AFCEE at the end of the project.

1.4.2.4 Chain of Custody Documentation

Chain of custody (COC) procedures will be followed during all sampling and analyses procedures. Sample custody is essential to maintaining the integrity of field and commercial laboratory analyses. A sample is deemed to be in the custody of a person if:

- It is in his/her actual possession.
- It is clearly in his/her view subsequent to being in his/her possession.
- It is securely locked up subsequent to being in his/her possession.

Evidence of sample custody will be traceable from the time the cleaned sample bottles leave the laboratory, until filled sample bottles are sent back to the laboratory. To achieve these criteria, field personnel will complete COC forms (triplicate copies) and affix COC seals to each sample bottle and to sample shipment containers. Figure 1-2 is an example of Versar's COC form. Field personnel will not leave samples unattended and will relinquish samples only to the laboratory sample custodian or an authorized shipping agent.

The white and yellow copies of the COC forms will be given to the laboratory sample custodian when samples are submitted to the laboratory. The pink copy will be retained by the Project Manager. The original white copy will be transmitted by the laboratory to the Versar Project Manager once the laboratory has received the samples. The Project Manager will retain the original with the project files, and will submit the information as a deliverable to AFCEE at the completion of the project.

1.4.2.5 Preservation

Preservatives inhibit degradation of constituents in samples during transit and storage prior to laboratory analysis. Appropriate preservatives will be added to sample bottles before the time of collection. Ice or contaminant-free "blue ice" containers will be used to maintain the internal cooler temperatures required for preservation during transit to the laboratory. The types of preservatives required for the analytes of interest are contained in Table 1-2.

1.4.3 Field Quality Control Samples

Quality control samples ensure that the sampling and analytical systems used in support of project activities are in control, and verify the quality of the data generated from these activities. Quality control samples for this project will consist of trip blanks, ambient condition blanks, equipment blanks, duplicates, replicates, and laboratory quality control samples. These quality control samples are summarized in Table 1-3.

The ambient blank is a sample of organic-free water that is collected and processed using the same sampling and handling procedures as other samples. Ambient blanks are used to assess the potential introduction of contaminants from ambient sources to the samples during sample collection and are prepared only for VOC samples. One ambient blank is collected for each day of volatile organic sampling.

TABLE 1-2
Requirements for Containers, Preservatives, Holding
Times, and Sample Volume

Parameter	Analytical Method	Container	Preservation	Holding Time	Volume
TRPH purgeable	SW-846 8015 modified	B	4 drops HCl to pH <2 Cool, 4°C	14 days	2 x 40 mL
TRPH extractable	SW-846 8015 modified	A	Cool, 4°C	7 days to extraction, 40 days to analysis	1 liter
VOCs	SW-846 8240	B	4 drops HCl to pH <2 Cool, 4°C	14 days	2 x 40 mL
SVOCs	SW-846 8270	A	Cool, 4°C	7 days to extraction, 40 days to analysis	1 liter
PCBs	SW-846 8080	A	Cool, 4°C	7 days to extraction 40 days to analysis	1 liter
Filtered Metals - to be filtered in the field prior to shipping					
Mercury	SW-846-7470	C	HNO ₃ to pH <2	28 days	1 liter
All other metals	SW-846-6010 or 7000	C	Cool, 4°C	6 months	1 liter
Unfiltered Metals					
Mercury	SW-846-7470	C	HNO ₃ to pH <2	28 days	1 liter
All other metals	SW-846-6010 or 7000	C	Cool, 4°C	6 months	1 liter

Sampling Containers

- A - 1 liter amber bottle with Teflon® cap liner
- B - 40 mL VOA vial with Teflon® cap liner
- C - 1 liter glass or plastic bottle

TABLE 1-3
Summary of Quality Control Samples

Parameter	Equipment Blank	Trip Blank	Field Duplicate	MS/MSD	Ambient Blank
TRPH	1 per sampling day	None	1 per 10	1 per 20	None
SVOCs	1 per sampling day	None	1 per 10	1 per 20	None
Metals	1 per sampling day	None	1 per 10	1 per 20	None
VOCs	1 per sampling day	1 per cooler	1 per 10	1 per 20	1 per sampling day
PCBs	1 per sampling day	None	1 per 10	1 per 20	None

Trip blanks will be collected to indicate any potential contamination associated with shipping and handling of samples. Trip blanks will be included at a frequency of one per shipping container of soil and water samples during the course of volatile organic sampling. A trip blank is a volatile organic compound (VOC) sample vial filled in the laboratory with reagent grade water (or higher grade), transported to the site, handled like a sample, and returned to the laboratory for analysis.

Equipment blanks will be used to provide information on the extent of potential cross-contamination at the site. Equipment blanks will be collected at a frequency of one per sampling team, per sampling day. An equipment blank consists of reagent grade water (or higher grade) that is poured through or over the sampling device, transferred to a sample bottle, and transported to the laboratory for analysis. The equipment blank should be poured immediately after the equipment has been decontaminated.

One field duplicate sample will be collected for every 10 water samples collected. Field duplicates are two samples collected independently from one sampling location.

One matrix spike/matrix spike duplicate (MS/MSD) sample will be collected for every 20 samples. It is necessary to collect triplicate sample volume in the field to enable the laboratory to analyze the MS/MSD samples. Laboratory quality control samples, including MSs/MSDs, are discussed Section 1.9.3.

1.5 SAMPLE CUSTODY PROCEDURES

1.5.1 Field Operations

Sample custody will begin, in all cases, at the time of sample collection. Samples will be placed into an iced cooler, or appropriate container, in the possession of the Field Sampling Leader (FSL) or an appropriate designee. A line item on the field COC form will be completed immediately and initialed by the designated field sample custodian. A sample copy of Versar's standard COC form is included as Figure 1-2.

Upon completing the line items, or after sample pickup, the samplers will sign, date, list the time, and confirm the completeness of all descriptive information contained on the COC form. Each individual who subsequently assumes responsibility for the samples will sign and date the COC form, and will record the reason for assuming custody. The field COC form terminates upon laboratory receipt of samples. The Project Manager should retain the pink copy of the COC form for program files. The original white and yellow copies will be submitted to the laboratory. The original white copy will be transmitted to the Versar Project Manager once the laboratory has received the samples.

When samples are shipped to a laboratory, a COC form must accompany each shipment. When shipping chilled samples in coolers, the sample containers will be packed securely, sample documentation (i.e., COC forms) will be placed in a sealed plastic bag, coolers will have COC seals affixed and be well sealed, and the cooler with the COC papers

will be marked (e.g., the master airbill will be affixed to the cooler containing the COC forms).

1.5.2 Laboratory Operations

Samples transported to the AFCEE-certified laboratory will be accepted by the laboratory sample custodian or an appropriate designee during laboratory operating hours. Laboratory sample management will be initiated using the following sequence of events:

1. The carrier and the time of arrival will be documented in the daily receipt log. The number of items on the airbill will be checked with the actual number received to ensure that all samples arrived.
2. Notation will be made as to whether the sample cooler was sealed.
3. The cooler will be opened, the internal ambient temperature of the cooler taken, and the samples itemized. All deviations will be noted and reported to the laboratory QA Manager and the Project Manager.
4. Samples will be assigned a unique sample laboratory identification number. The laboratory identification number and corresponding field identification number will be logged onto a laboratory custody log.
5. Once the sample has been transmitted to the laboratory, the following sequence of events will occur:
 - a. The samples will be recorded on the Sample Log-In Form to summarize all the information pertaining to the sample/order and instructing the laboratory on the proper analysis and reporting of samples.
 - b. After the samples are logged in, they will be assigned to the appropriate storage refrigerator.
 - c. All transfers of samples into and out of storage will be documented.
 - d. Samples will remain in secured storage until removed for analysis.
 - e. To ensure refrigerators are operating at the appropriate temperature, a refrigeration log will be maintained. The log will indicate the ambient internal temperatures as well as the initials of the person recording the reading and the date. Should the temperature fluctuate outside of the specified temperature range, corrective action will be taken immediately.

Once the sample has been analyzed, a laboratory lot control number will be assigned to the sample. All samples within a given laboratory analysis group (i.e., samples sharing the same QC samples) will have the same laboratory lot control number. In accordance with the

IRPIMS, the laboratory lot control number will consist of the analysis date, method number, and sequential analysis number. For example, 951115-8270-04 represents the fourth SW-846 8270 sample analyzed on November 15, 1995.

1.6 CALIBRATION PROCEDURES FOR FIELD EQUIPMENT

Calibration procedures establish the relationship between a calibration standard(s) and the measurement of that standard by an instrument or analytical procedure.

All field equipment will be calibrated according to the FSP (Section 2.0) prior to use in the field. A record of the instrument calibration will be maintained by the FSL. Procedures for the calibration and maintenance of equipment typically used for field activities are provided in Section 2.3 of the FSP.

1.7 ANALYTICAL PROCEDURES

This section outlines the requirements for the analysis of environmental samples to be followed during this project. Groundwater samples will be analyzed for one or more of the following parameters based on contaminants previously encountered at each of the five sites: Total recoverable petroleum hydrocarbons (TRPH), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and RCRA metals. Table 1-4 presents the summary of analytical methods for each site. If investigation derived waste is generated during the course of the project, the waste will be analyzed by using the Toxicity Characteristics Leading Procedure (TCLP). Details of the laboratory analysis, sampling locations, procedures, and sample handling are provided in Sections 1.4 and 2.0 of this SAP. All field work will be performed in accordance with the requirements specified in the AFCEE Handbook (USAF, 1993).

1.7.1 Identification of Analytical Methods

Analytical procedures will generally be conducted in accordance with the methodology set forth in US EPA, *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods*, (SW-846), July 1992, unless otherwise approved by AFCEE. Table 1-4 provides a summary of the analytical parameters, analytical methods, and estimated number of samples (including QA/QC samples) for each field activity.

Stationary laboratory methods (i.e., commercial laboratory analysis) will be used for the analysis of groundwater samples collected from sites SS003, OWS704, SS004, SS006, and SS009. It is estimated that groundwater samples will be collected at 15 different locations. Soils will not be collected for laboratory analysis. The samples will be analyzed for TRPH, VOCs, SVOCs, and RCRA metals. At site SS009, PCB samples will also be collected. The methods are described below, with the specific target analytes and laboratory derived PQLs listed in Table 1-5. The TCLP analytes and regulatory limits are shown in Table 1-6. A summary of all tuning and calibration requirements is given in Table 1-7, with additional laboratory QC information provided in Appendix A. All methods are to be from the most recent promulgated release of SW-846 without regard to extension (8270B vs. 8270).

**TABLE 1-4
Summary of Analytical Methods**

Field Activity	Matrix	Estimated No. of Samples ¹	Analytical Group	Analytical Method
Groundwater Sampling	Water	25	Total recoverable petroleum hydrocarbons	SW 8015 Modified
		33	Volatile organic compounds	SW 8240
		13	Semivolatile organic compounds	SW 8270
		11	PCBs	SW 8080
		50*	RCRA metals	SW 6010/7000

* .Includes both filtered and unfiltered samples

¹ Includes QA/QC sample estimates

TABLE 1-5
Analytical Methods and Target Analytes

Parameter/Method	Analyte	Water	
		PQL	Unit
Total Petroleum Hydrocarbons SW-846-8015	TPH	1	mg/L
Volatile Organic Compounds SW-846-8240	Acetone	0.5	µg/L
	Benzene	0.5	µg/L
	Bromodichloromethane	0.5	µg/L
	Bromoform	0.5	µg/L
	Bromomethane	0.5	µg/L
	2-Butanone	0.5	µg/L
	Carbon disulfide	0.5	µg/L
	Carbon tetrachloride	0.5	µg/L
	Chlorobenzene	0.5	µg/L
	Chlorodibromomethane	0.5	µg/L
	Chloroethane	0.5	µg/L
	Chloroform	0.5	µg/L
	Chloromethane	0.5	µg/L
	1,2-Dibromo-3-chloropropane	5	µg/L
	1,2-Dibromoethane	100	µg/L
	1,2-Dichlorobenzene	0.5	µg/L
	1,3-Dichlorobenzene	0.5	µg/L
	1,4-Dichlorobenzene	0.5	µg/L
	1,1-Dichloroethane	0.5	µg/L
	1,2-Dichloroethane	0.5	µg/L
	1,1-Dichloroethene	0.5	µg/L
	1,2-Dichloroethene	0.5	µg/L
	trans-1,2-Dichloroethene	0.5	µg/L
	1,2-Dichloropropane	0.5	µg/L
	cis-1,3-Dichloropropene	0.5	µg/L
	trans-1,3-Dichloropropene	0.5	µg/L
	Ethylbenzene	0.5	µg/L
	2-Hexanone	0.5	µg/L
	Methyl(tert)butylethene	500	µg/L
	Methylene chloride	0.5	µg/L
	4-Methyl-2-pentanone	0.5	µg/L
	Pentachloroethane	10	µg/L
	Propionitrile	100	µg/L
Styrene	0.5	µg/L	
1,1,2,2-Tetrachloroethane	0.5	µg/L	
Tetrachloroethene	0.5	µg/L	
Toluene	0.5	µg/L	
1,1,1-Trichloroethane	0.5	µg/L	
1,1,2-Trichloroethane	0.5	µg/L	
Trichloroethene	0.5	µg/L	
Vinyl chloride	0.5	µg/L	
Xylene (Total)	0.5	µg/L	

TABLE 1-5 (Continued)
Analytical Methods and Target Analytes

Parameter/Method	Analyte	Water	
		PQL	Unit
Semivolatile Organic Compounds SW-846-8270	Phenol	10	µg/L
	Benzo(k)fluoranthene	10	µg/L
	Benzo(a,h,i)perylene	10	µg/L
	Benzo(a)pyrene	10	µg/L
	Dibenz(g,h)anthracene	10	µg/L
	2-Chlorophenol	10	µg/L
	2-Methylphenol	10	µg/L
	bis(2-Chloroisopropyl) ether	10	µg/L
	4-Methylphenol	10	µg/L
	N-Nitroso-Di-N-propylamine	10	µg/L
	Nitrobenzene	10	µg/L
	Isophorone	10	µg/L
	2-Nitrophenol	10	µg/L
	2,4-Dimethylphenol	10	µg/L
	bis(2-Chloroethoxy) methane	10	µg/L
	2,4-Dichlorophenol	10	µg/L
	Naphthalene	10	µg/L
	4-Chloroaniline	20	µg/L
	4-Chloro-3-methylphenol	20	µg/L
	2-Methylnaphthalene	10	µg/L
	2,4,6-Trichlorophenol	10	µg/L
	2,4,5-Trichlorophenol	10	µg/L
	2-Chloronaphthalene	10	µg/L
	2-Nitroaniline	50	µg/L
	Dimethyl phthalate	10	µg/L
	Acenaphthylene	10	µg/L
	3-Nitroaniline	50	µg/L
	Acenaphthene	10	µg/L
	2,4-Dinitrophenol	50	µg/L
	4-Nitrophenol	10	µg/L
	Dibenzofuran	10	µg/L
	2,4-Dinitrotoluene	10	µg/L
	2,6-Dinitrotoluene	10	µg/L
	Diethylphthalate	10	µg/L
	4-Chlorophenyl phenyl ether	10	µg/L
	Fluorene	10	µg/L
	4-Nitroaniline	20	µg/L
	4,6-Dinitro-2-methylphenol	50	µg/L
	N-Nitrosodiphenylamine	10	µg/L
	4-Bromophenyl phenyl ether	10	µg/L
	Hexachlorobenzene	10	µg/L
	Pentachlorophenol	50	µg/L
	Phenanthrene	10	µg/L
	Anthracene	10	µg/L
	Di-n-butylphthalate	10	µg/L
	Fluoranthene	10	µg/L
	Pyrene	10	µg/L
	Butyl benzyl phthalate	10	µg/L
	3,3'-Dichlorobenzidine	20	µg/L
	Benzo(a)anthracene	10	µg/L
bis(2-ethylhexyl)phthalate	10	µg/L	
Chrysene	10	µg/L	
Di-n-octyl phthalate	10	µg/L	
Benzo(b)fluoranthene	10	µg/L	

TABLE 1-5 (Continued)
Analytical Methods and Target Analytes

Parameter/Method	Analyte	Water	
		PQL	Unit
RCRA Metals ² SW-846-6010/7000s	Arsenic	0.01	mg/L
	Barium	0 ²	mg/L
	Cadmium	0.005	mg/L
	Chromium	0.01	mg/L
	Lead	0.1	mg/L
	Mercury (7470)	0.0002	mg/L
	Silver	0.01	mg/L
	Selenium	0.3	mg/L
PCBs SW-846-8080	PCB-1016	1	µg/L
	PCB-1221	2 ¹	µg/L
	PCB-1232	1	µg/L
	PCB-1242	1	µg/L
	PCB-1248	1	µg/L
	PCB-1254	1	µg/L
	PCB-1260	1	µg/L

¹Exceeds PQLs listed in Table 2-4 of the AFCEE Handbook (1993).

²Analyte-specific method for mercury is 7470; 6010 for all others

TABLE 1-6
TCLP Analytes and Regulatory Limits

Constituents	Concentration (mg/l)
Arsenic	5.0
Barium	100.0
Benzene	0.5
Cadmium	1.0
Carbon Tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100.0
Chloroform	6.0
Chromium	5.0
Cresol	200.0
m-Cresol	200.0
o-Cresol	200.0
p-Cresol	200.0
2,4-D	10.0
1,4-Dichlorobenzene	7.5
1,2-Dichlorethane	0.5
1,1-Dichloroethylene	0.7
2,4-Dinitrotoluene	0.13
Endrin	0.02
Heptachlor	0.008
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Hexachloroethane	3.0
Lead	5.0
Lindane	0.4
Mercury	0.2
Methoxychlor	10.0
Methyl ethyl ketone	200.0
Nitrobenzene	2.0
Pentachlorophenol	100.0
Pyridine	5.0
Selenium	1.0
Silver	5.0
2,4,5-TP (Silvex)	1.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
Vinyl chloride	0.2

TABLE 1-7
Summary of Quality Control Samples by Analytical Method

Parameter	Estimated No. of Field Samples	Method Blank	Laboratory Control Sample	MS/MSD	Surrogates
TPH purgeable	15	1 per 20 or day	1 per 10 injections	1 per 20	Every sample
TPH extractable	15	1 per extraction batch	1 per extraction batch	1 per extraction batch	Every sample
SVOCs*	6	1 per extraction batch	1 per extraction batch	1 per extraction batch	Every sample
VOC*	15	1 per 20 or day	1 per 12 hours	1 per 20	Every sample
PCBs*	3	1 per extraction batch	1 per extraction batch	1 per extraction batch	Every sample
Metals*	15	1 per digestion batch	1 per digestion batch	1 per digestion batch	Not needed

NOTES:

A preparation batch is a group of up to 20 field samples prepared together by extraction or digestion. The LCS for the preparation batch must contain all analytes of interest and be prepared as a sample. The Method Blank for VOC and TRPH purgeable is to be performed at a rate of 1 per 20 samples or 1 per day, whichever is less.

*TCLP Parameters follow the same SW-846 QC process for each parameter group. For example, TCLP metals will follow the same QC procedures as SW-846-6010/7000s.

Total TRPH will be analyzed for both purgeable and extractable compounds. The purgeable TRPH will be analyzed using a purge-and-trap device connected to a gas chromatograph (GC). The extractable TRPH will be extracted prior to analysis using applicable methodology from SW-846 and analyzed using a GC. The results of the purgeable and extractable TRPH should be reported separately. The selected analytical methodology for both analyses is SW-846-8015 modified. This method is modified by the laboratory from the promulgated Method 8015 to fit the requirements of TRPH analysis. General instrument calibration requirements are given in SW-846 general Method 8000 and specifically in Method 8015.

VOCs will be analyzed using a purge-and-trap device connected to a gas chromatograph fitted with a mass spectrometer detector (GC/MS). The calibration and analytical requirements are from SW-846-8240. The instrument is to be tuned and calibrated according to the specific requirements in the method. It is preferred that a capillary column be used in place of the packed column specified in the method because this yields greater resolution and precision.

SVOCs will be analyzed by GC/MS. The samples are to be extracted prior to analysis using the applicable method from SW-846. Specific requirements for tuning and calibrating the instrument are given in SW-846-8270.

Metals are to be analyzed by either inductively-coupled plasma (ICP)-atomic emission spectroscopy or atomic absorption (AA) spectroscopy depending upon the analyte metal and the required practical quantitation limit (PQL) for that analyte. Mercury is to be analyzed by atomic absorption only following the requirements of SW-846-7470. All metals may be analyzed for either method necessary to achieve the PQL specified in Table 2-2 of the Handbook (AFCEE, 1993). Because the ability of the laboratory to achieve the PQL by a specific method may change during the period of this project, the decision of methodology is left to the laboratory. Emission interference may require a sample to be analyzed by AA as opposed to ICP, or the instrument detection limit (IDL) for a particular analyte may require AA in lieu of ICP to meet the PQL requirement. All methods are to be from SW-846, either 6010 or 7000 series, and adhere strictly to method requirements.

TCL PCBs will be analyzed by the GC technique in accordance with the methods set forth in SW-846 8080. Water samples will be prepared in accordance with the methods set forth in SW-846 3550(w).

1.7.2 Detection and Quantitation Limits

1.7.2.1 Method Detection Limits

The method detection limit (MDL) is the lowest concentration at which a particular analyte can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero. The MDL is determined from the analysis of a sample in a given matrix type containing the analyte. The MDL should be determined by multiplying

the appropriate one-sided 99 percent t-statistic by the standard deviation obtained from a minimum of three analyses of a matrix spike containing the analyte of interest at a concentration of three to five times the estimated MDL. MDLs for each target analyte will be determined by the analytical laboratory using the applicable SW-846 protocol or the method specified in 40 Code of Federal Regulations (CFR) Part 136, Appendix B.

1.7.2.2 Instrument Detection Limits

The IDL is limited to the instrument portion of detection, not sample preparation, dilution factors, or method-specific parameters. The IDL is defined as three times the standard deviation of seven replicate analyses at the lowest concentration that is statistically different from a blank.

1.7.2.3 Practical Quantitation Limits

As specified in SW-846, PQLs, also referred to as the estimated quantitation limits (EQLs), are defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The PQL or EQL is generally five to ten times the MDL, but may be nominally selected within these guidelines to simplify data reporting. In accordance with the AFCEE Handbook, PQLs for this project shall not exceed the PQLs presented in Tables 2-2 and 2-3 of the IRP Handbook.

1.7.3 Method Calibration

Prior to analysis, chemical calibration for each target analyte will be performed to ensure that the analytical instrumentation is functioning within the established sensitivity range. Method calibration shall be conducted in accordance with the procedures outlined in the approved analytical method. The multipoint calibration curve must include a standard at concentrations below the practical PQL value listed in Table 1-5. All analytes specified in the SAP must be present in the initial and continuing calibrations, and these calibrations must meet the acceptance criteria specified by the respective method. Calibration standards and solutions will be of known concentration and purity to achieve the criteria necessary for validation of the analytical results. Inorganic standards must be traceable to the National Institute of Standards and Technology (NIST) Central QA Laboratory. Organic standards must be traceable to materials certified by Cooperative Research and Development Agreement (CRADA), NIST, or Contract Laboratory Program (CLP)-Standard Reference Material.

Standards used in this program will be prepared and maintained under the normal laboratory standards tracking system. This system ensures preparation, checking, documentation, storage, and disposal of standards according to specified procedures and schedules appropriate for each analyte of interest.

1.8 DATA COLLECTION, VALIDATION, REDUCTION, AND REPORTING

1.8.1 Data Collection

Laboratory data are initially collected, converted to standard reporting units, and recorded in standard formats by project analysts who conduct preliminary data analysis using a variety of methods and procedures. Because many analytical instruments are microprocessor controlled, some of the requisite analyses can be performed directly in the instrument's operating or outputting mode. Those instruments interfaced to stand-alone computers or microprocessors often permit data analysis programs to be written and modified to produce data formats specifically suited to end user requirements.

Data requiring manual recording, integration, and/or analysis may be converted to a more appropriate format prior to subsequent analyses. Through all stages and aspects of data processing, the data are double checked for translation or transcription errors and are initialed by both the recorder and the checker. The Laboratory QA Manager, or other designated individual not directly involved in the analysis, will review the data for acceptability.

1.8.2 Data Validation

Data validation is the process whereby data are determined to be of acceptable or unacceptable quality based on a set of predefined criteria. These criteria depend upon the type(s) of data involved and the purposes for which data are collected.

An independent, third-party review of 10 percent of the laboratory data will be performed to ensure compliance with: specified analytical QA criteria; data reduction procedures; data reporting requirements; and required accuracy, precision, and completeness measures. Versar may request additional information that may be necessary to verify the laboratory validation.

The following items should be reviewed by the third-party to validate the data:

- Chain of custody forms
- Holding times
- Method calibration limits
- Method blanks
- Laboratory verification of quantitation limits
- Preparation batch control limits
- Corrective actions
- Formulas used for analyte quantitation
- Examples of analyte quantitation
- Completeness of data

All data generated will be assessed for accuracy, precision, and completeness. Data assessment techniques will include routine quality control checks.

Precision will be assessed from analysis of duplicates and/or replicates of the same measurement at different times. Control charts will be maintained to provide a timely assessment of precision for measurement function.

Accuracy will be assessed from analysis of samples spiked with known concentrations of reference materials. The assessment for accuracy will be independent of the routine calibration process (i.e., reference materials will be obtained from independent sources and will be prepared independently).

1.8.3 Data Reduction

Data reduction frequently includes computation of analytical results from raw instrument data and summary statistics, including standard errors, confidence intervals, test of hypothesis relative to the parameters, and model validation.

Data reduction procedures used by the laboratory will address the reliability of computations and the overall correctness of the data reduction. The numerical transformation algorithms used for data reduction will be verified against a known problem set to ensure that the reduction methods are correct.

The equations and the typical calculation sequence that is followed to reduce the data to the acceptable format are instrument- and method-specific. Where standard methods are modified, data reduction techniques will be described in a report accompanying the data.

Auxiliary data produced for internal records and not reported as part of the analytical data include the following: laboratory worksheets, laboratory notebooks, sample tracking system forms, instrument logs, standard records, maintenance records, calibration records, and associated quality control records. These sources will document data reduction and will be available for inspection during audits and to determine the validity of data.

Outliers will be identified according to laboratory control charts, and the rationale used for data acceptance or rejection will be described and documented.

1.8.4 Data Reporting

Data will be reported in the appropriate unit of concentration depending upon the matrix and type of analysis. Generally, concentrations in liquids will be reported in mg/L or $\mu\text{g/L}$, and concentrations in solids will be reported $\mu\text{g/kg}$ or mg/kg. Laboratory data will be reported in concentrations to two significant figures. Premature rounding of intermediate results can significantly affect the final result. Therefore, the reported results will be rounded to the correct number of significant figures only after all calculations and manipulations are completed. As many significant figures as are warranted by the analytical method will be used in pre-reporting calculations.

In order to ensure comparability of data with historical site data, the following specific reporting units will be used for all field data:

- Explosimeter readings will be reported to within 1 percent.
- Photoionization detector readings will be reported to 0.2 ppm.
- pH will be reported to 0.1 standard unit.
- Specific conductance will be reported to two significant figures below 100 microhms per centimeter and three significant figures above 100 microhms per centimeter.
- Temperature will be reported to the nearest 0.5°C.

Prior to being released by the laboratory, all analytical data and quality control data generated by the laboratory will be reviewed by the analyst. The data are checked to determine if there are transcription errors, to verify calculations and dilution factors, and to check for compliance with quality control requirements. Failure to meet method performance quality control criteria will result in the reanalysis of the sample or lot. After the data have been reviewed and found acceptable, they are assembled into a data package. The final laboratory data package will be reviewed by the Laboratory QA Manager prior to delivery to the Contractor. Field measurements and documentation will be reviewed by the Project Manager and compared to completeness criteria.

1.9 INTERNAL QUALITY CONTROL CHECKS

Situations arising from failure to adhere to SOPs, policies, and protocols have the potential to adversely affect data quality. Out-of-control situations attributable to operator error will be investigated, and appropriate corrective actions instituted. All corrective actions should be documented thoroughly or an explanation given for not performing corrective action.

1.9.1 Out-of-Control Conditions

To ensure the validity of data gathered in conjunction with the OL-Q field activities, all situations need to be in control for all aspects of the project. Periodic audits will be conducted to monitor adherence to SOPs, quality control protocols, and general program policies and protocols.

Factors affecting out-of-control conditions can usually be traced to sampling and laboratory activities. The following sections define specific conditions that result in out-of-control situations. Corrective action requirements are discussed in Section 1.13.

1.9.2 Field Quality Control

Areas in which out-of-control situations have the potential for occurring in the field include:

- Improper sampling techniques
- Inappropriate sample identification
- Improper sample storage and preservation
- Nonconformance to appropriate COC protocols

To reduce out-of-control situations, field personnel will become thoroughly familiar with the procedures outlined in this QAPP before beginning field activities.

1.9.3 Laboratory Quality Control

Poor QA/QC practices contribute to out-of-control situations associated with laboratory activities. Items contributing to out-of-control laboratory situations include:

- Failure to achieve acceptable continuing calibration of analytical equipment
- Recordkeeping omissions
- Improper sample storage
- Poor analytical protocols
- Lack of document traceability

The detection of out-of-control conditions will result in the implementation of a corrective action (Section 1.13).

Laboratory QC data are necessary to determine precision and accuracy of the analyses. At least 10 percent of each data set generated will be composed of laboratory QC data. Laboratory QC samples will consist of method blanks, standards, laboratory control samples, matrix spikes, and surrogate spikes. A discussion of laboratory control samples, including frequency of analysis, is provided in the following sections. Field QC sampling requirements are discussed in Section 1.4.3.

1.9.3.1 Method Blanks

Method blanks are used to identify and document contamination resulting from the analytical process in the laboratory. A method blank consists of a volume of deionized or distilled laboratory water for water samples, or a purified solid matrix for soil/sediment samples, which is carried through the entire sample preparation and analytical process. The method blank volume or weight must be approximately equal to that of the samples being processed. Method blanks will be analyzed at a minimum frequency of one for every 20 samples. The concentration of target compounds in the blank must be less than or equal to the practical quantitation level. If the blank exceeds the above criteria, the source of the contamination must be identified and appropriate corrective action taken, including reanalysis of the sample group, if necessary.

1.9.3.2 Laboratory Control Samples

The laboratory control sample (LCS) is a method blank spiked with all the analytes of interest. Blank spikes are used to determine the accuracy of the analytical procedure by

measuring the percent recovery of all analytes of interest. The LCS will be analyzed at a minimum frequency of one per preparation batch.

1.9.3.3 Surrogate Spike Analysis

Surrogate spike analyses are used to determine the efficiency of analyte recovery in sample preparation and analysis. Surrogate standard determinations are performed for all samples, blanks, and QC samples. Each sample, including matrix spike, matrix spike duplicate, and blank, is spiked with surrogate compounds prior to purging or extraction. The surrogate compounds are used to spike the sample(s) with a known concentration that can be used to measure surrogate recoveries. Surrogate spike recoveries must fall within the limits established by the laboratory QA plan. If a surrogate spike recovery is outside of acceptable ranges, corrective action must be taken. Surrogate spiking is to be done for all organic samples. Inorganic samples are not spiked with surrogates.

1.9.3.4 Matrix Spike/Matrix Spike Duplicate

Matrix spike/matrix spike duplicate analyses evaluate the matrix effect of the sample on the analytical method. The MS/MSD consists of a pair of field samples with a known amount of analyte added in the laboratory. MS/MSD analyses must be performed at a minimum frequency of one per each group of 20 samples of the same matrix.

It is necessary to collect triplicate volume in the field for one sample out of every 20 to accomplish the MS/MSD analyses. Two volumes of the sample will be spiked with a standard solution containing all the target analytes, and the third sample volume will be analyzed normally, without spiking. The samples are analyzed, and the concentrations found in the spiked samples are compared to the concentrations found in the unspiked sample to determine the accuracy as measured by the percent recovery. The relative percent difference is also calculated to determine precision. If analytes in the MS/MSD are outside the LCS control limits, appropriate corrective action should be taken, including reanalysis if necessary.

1.10 PERFORMANCE AND SYSTEMS AUDITS

Audits are tools used to evaluate the effectiveness of the QA program with respect to the QA requirements of the sampling and analysis activities. A performance audit, system audit, or both, may be performed by personnel from inside or outside the data collection organization.

1.10.1 Performance Audits

Performance audits are normally conducted after the data production systems are operational and are generating data. Performance audits consist of the collection of measurement data by using performance evaluation samples to determine the accuracy of the total measurement system or portions thereof.

All laboratories participating in IRP projects contracted by AFCEE must be audited by AFCEE personnel. Performance audits will be conducted in accordance with the procedures outlined in *Guidance for AFCEE Quality Assurance/Quality Control Audits of Installation Restoration Program Contract Laboratories*, (USAF, 1991). Additionally, the Laboratory QA Manager will be responsible for verifying that standards, procedures, records, and charts are maintained properly and that QA records are filed adequately and maintained in a retrievable fashion.

1.10.2 System Audits

System audits are on-site qualitative inspections and reviews of the QA system and encompass all aspects of the project. System audits are concerned with evaluations of all components of the applicable measurement systems to determine if they have been selected properly and implemented. System audits typically consist of on-site reviews of both field and laboratory systems and facilities for sampling, calibration, and measurement protocols. System audits will not be performed for this project.

1.11 PREVENTIVE INSTRUMENT MAINTENANCE

A preventive maintenance plan allows for periodic instrument checks for problems that occur frequently. The objective of a preventive maintenance plan is to rectify equipment problems before they become serious. Preventive maintenance also brings attention to those areas of the instrument susceptible to degradation from aging, toxic/corrosive attack, and clogging due to environmental factors.

Procedures for preventive maintenance are contained in each instrument's manual under the maintenance/troubleshooting sections. Each piece of equipment will have an associated SOP detailing the calibration/maintenance instructions. Equipment failing calibration specifications will be identified with a red warning label and will not be used for sample analysis. In the event a piece of equipment must be taken out of service, a backup unit will be supplied.

Equipment requiring calibration will have an assigned record number that is permanently affixed to the instrument. A label containing the following information will be affixed to each instrument:

- Description
- Manufacturer
- Model Number
- Serial Number
- Date of last calibration or maintenance
- Name of person who performed calibration or maintenance
- Date of next scheduled service

1.12 DATA QUALITY INDICATORS

The routine procedures used to assess data are precision, accuracy, completeness, comparability, and representativeness. The procedures used to assess these data quality indicators, including specific formulas used to quantitatively define these parameters, are presented in the following sections.

1.12.1 Formulas

1.12.1.1 Precision

Precision is a measurement of the reproducibility of data under a specified set of conditions. If calculated from duplicate samples, precision is expressed as relative percent difference (RPD), defined as:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

where C_1 and C_2 are the larger and smaller of the two duplicate values, respectively

If calculated from replicates, precision is expressed as relative standard deviation (RSD), defined as:

$$RSD = \frac{s}{y_{mean}} \times 100\%$$

where s = standard deviation and y_{mean} = mean of replicate analyses

Acceptable levels of precision will vary with the sample matrix, analytical method, and sample concentration. EPA precision data should be used as a basis for developing acceptance criteria for assessing precision; however, laboratory control charts must be developed and used to determine acceptance criteria.

1.12.1.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systematic error. It, therefore, reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by determining the percent recovery of known target analytes that are spiked into an LCS. Surrogate compound recovery is reported and is used to assess method performance for each sample analyzed for volatile and semivolatile organic compounds.

Both accuracy and precision are calculated for preparation batches, and the associated sample results are interpreted by considering these specific measures. The formula for calculation of accuracy is defined as:

$$\%R = 100\% \times \frac{s - U}{C_{sa}}$$

where,

s = measured concentration of spiked aliquot

U = measured concentration of unspiked aliquot

C_{sa} = actual concentration of spike added

If a standard reference material (SRM) is used instead of or in addition to matrix spikes, accuracy is defined as:

$$\%R = 100\% \times \left(\frac{C_m}{C_{srn}} \right)$$

where,

C_m = measured concentration of SRM in the spiked sample

C_{srn} = actual concentration of SRM

The degree of accuracy and the recovery of the analyte is dependent on the matrix, method of analysis, and compound being measured. The objective for accuracy is to equal or exceed the accuracy demonstrated for the analytical method for samples of similar matrix and contaminant concentration.

1.12.1.3 Completeness

Completeness represents the percentage of measurements evaluated and judged to be valid measurements. Completeness is expressed as percent completeness and is defined as:

$$\%C = 100\% \times \left(\frac{V}{n} \right)$$

where,

V = number of measurements judged valid

n = total number of measurements required

The quality assurance objective for completeness is 90 percent.

1.12.1.4 Comparability

Comparability is a qualitative measure used to assess the confidence with which data sets obtained for similar samples and sample conditions can be correlated. This parameter is largely dependent upon the accuracy and precision of the analytical methods and procedures. Comparability will be assessed qualitatively through field auditing and comparing current activities with historical protocols.

1.12.1.5 Representativeness

Representativeness is a qualitative measure used to determine the degree to which obtained data correlate to the population sampled. Sample locations, sampling procedures, and analytical methods have been selected based on a detailed evaluation of historical site data in order to collect samples that are representative of site-wide conditions. Representativeness will be assessed qualitatively through field audits and QA reviews of sample collection and handling methodologies, equipment decontamination and use, sample custody procedures, and analytical method performance.

1.12.2 Control Limits

Acceptance criteria for control limits associated with field QC samples will be established in accordance with the procedures set forth in SW-846 and historical laboratory data. Laboratory control limits will generally be established by the laboratory in accordance with the procedures set forth in SW-846 on an analyte-specific basis. For methods where the laboratory has not established control limits for all analytes, control limits will be developed by the laboratory after the analysis of 20 samples.

1.13 CORRECTIVE ACTION

Corrective action will be initiated through the development and implementation of routine internal QC checks. Specific limits beyond which corrective action is required will be established for each system (e.g., laboratory control charts). Corrective action requirements will be implemented in response to deficiencies encountered during system audits or failure to adhere to the QAPP.

To enhance the timeliness of corrective action and thereby reduce the generation of unacceptable measurement data, problems identified by assessment procedures will be resolved at the lowest possible management level. Problems that cannot be resolved at this level will be reported to the Versar QA Manager for resolution. The QA Manager will determine at which management level the problem can best be resolved, and will notify the appropriate manager. Weekly progress reports will detail all problems and subsequent resolutions.

Steps comprising a closed-loop corrective action system include:

- Defining the problem

- Assigning responsibility for problem investigation
- Investigating and determining the cause of the problem
- Assigning responsibility for problem resolution
- Verifying that the resolution has corrected the problem

Documentation will be prepared and maintained on the corrective action requirements, the assignment of responsibility for corrective action, due dates for completion of corrective action, and validation of completion.

A summary of potential problems requiring corrective action and potential solutions is presented below:

- Sample holding times exceeded - resample if completeness criterion not met.
- Method-specific calibration criteria not met - reanalyze samples after calibration criteria have been met.
- Precision or accuracy criteria not met - qualify data or reanalyze samples.
- Sample container broken during shipment - resample if completeness criterion not met.
- Inappropriate field sampling techniques used - resample if completeness criterion not met.

1.14 QUALITY ASSURANCE REPORTS

The Laboratory QA Manager will be responsible for reporting any laboratory QA/QC issues to the Project QA Manager and/or Project Manager. For those issues that may adversely impact the quality of the project or require immediate corrective action, the Laboratory QA Manager will provide the Project QA Manager with a verbal report. In all cases, a written summary in the form of a memorandum, letter, or report of the laboratory QA/QC issues will be forwarded to the Project QA Manager. Laboratory QA/QC issues may include, but are not limited to: responses to findings of internal or external audits; missed holding times or problems with laboratory acceptance criteria; situations arising causing a deviation from the procedures specified in the QAPP; and out-of-control conditions and associated corrective actions.

It is the responsibility of the Site Operations Manager or appropriate designee to notify the QA Manager or Project Manager of: out-of-control events encountered in the field and corrective action taken, and conditions that require a modification of the procedures set forth in the QAPP.

The following QA/QC documents and deliverables will be submitted to AFCEE in support of the project work conducted at OL-Q:

- Audit reports
- Monthly status reports of QA/QC activities (including an assessment of DQOs, significant QA/QC problems and resolution, and changes in the QAPP)
- Laboratory data package (including QC data)

- Logbooks
- Final QA report

1.15 PROJECT ORGANIZATION

This section describes the organizational structure of the project team as it relates to quality assurance and quality control (see Figure 1-3), including the roles and responsibilities of Versar staff and the subcontractors that will be used for analytical data and field support.

1.15.1 Versar

Project Manager - The Project Manager, Mr. Mike Dorman, reports to the Versar Program Manager and is responsible for providing technical direction to the technical staff and assisting the Program Manager by managing the technical project activities. He has direct management responsibility and authority for cost, schedule, quality, and technical performance of all activities performed in support of this project and is responsible for implementing this QAPP. He is the primary point of contact with the AFBCA BRAC Environmental Coordinator at OL-Q and the AFCEE Team Chief for all project communication and correspondence.

Quality Control Monitor - The Quality Control Monitor, Mr. Carl Woehrle, also serves as Deputy Program Manager for this contract. He reports directly to the Versar Program Manager and provides direction and assistance to the project manager in establishing, implementing, and verifying compliance with the QAPP. He is responsible for technical reviews of all project deliverables. Mr. Woehrle is also responsible for assisting the project manager in the identification of problems and dispute resolution.

Field Leader - The Field Leader for this delivery order is Mr. Alan Esko. He will be responsible for all activities of Versar staff members in the field, as well as being responsible for oversight of all field support subcontractors. Specific roles and responsibilities include: planning and implementing field activities; implementing field-related portions of the QAPP and FSP; coordinating and overseeing direct push, drilling, and surveying subcontractors; identifying and resolving project-specific problems and issues with the assistance of the Project Manager and Quality Control Monitor.

IRPIMS Data Management - Data management will be handled by Mr. John Corley. He will coordinate sampling and labelling procedures with the Field Leader, provide QC checks of 100 percent of the analytical data, and oversee and coordinate the data validation activities.

1.15.2 Analytical Data Subcontractors

The analytical data subcontractors to be used during the groundwater assessments include an analytical laboratory and a data validation subcontractor. The following section describes the responsibilities of each of these subcontractors

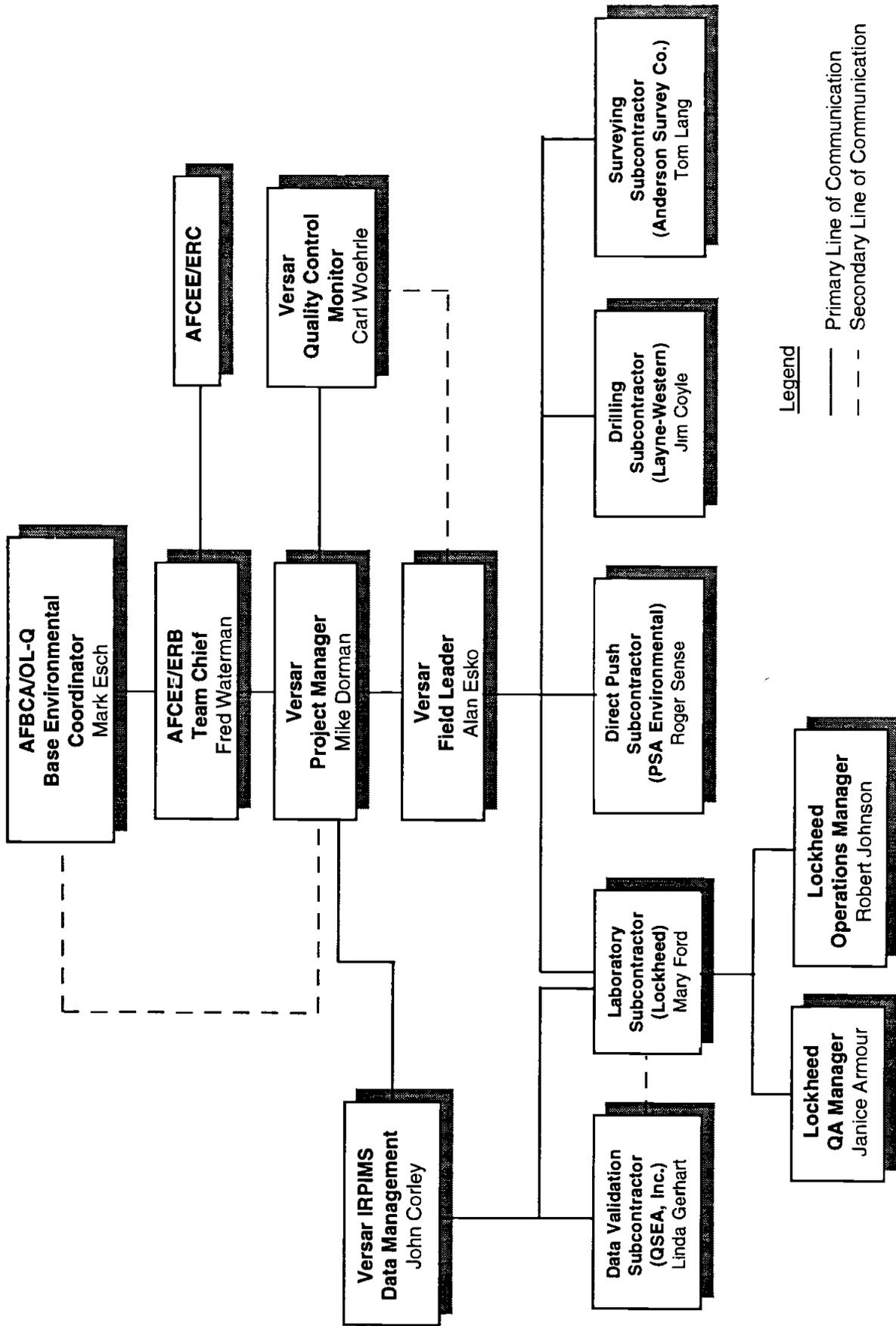


Figure 1-3. Quality Assurance/Quality Contr I Project Organization

Analytical Laboratory - Lockheed Environmental Systems & Technologies Co. (LESAT) will perform all the analytical sample analyses. LESAT, an AFCEE approved laboratory, will analyze groundwater samples for the analytes listed in Table 1-4. All results provided by LESAT will be definitive data. Acceptance criteria and control limits for LESAT are provided in Appendix A. If analysis of investigation derived wastes is required, LESAT will perform the necessary TCLP analyses. Since waste analysis is not required to meet AFCEE IRPIMS requirements, this data will be used for characterization purposes only.

Data Validation - QSEA, Inc. will perform third party data validation for 10 percent of the definitive analytical data packages, by method and matrix.

1.15.3 Field Support Subcontractors

Field support subcontractors will be used during the groundwater assessments at OL-Q to provide support for the following: groundwater sampling, lithologic logging, and temporary piezometer installation using direct push methods; monitoring well installation using drilling methods (if necessary); and surveying piezometer/monitoring well locations. These subcontractor and primary contacts are shown on Figure 1-3.

SECTION 2.0

FIELD SAMPLING PLAN

2.1 FIELD OPERATIONS

The Field Sampling Plan (FSP) provides guidance for all field activities relating to the Preliminary Groundwater Assessments of sites SS003, OWS704, SS004, SS006, and SS009. Field activities will include the use of direct-push technology to sample groundwater and to install temporary piezometers to be used to determine groundwater flow direction. If direct-push technology fails to yield adequate groundwater for sampling, permanent groundwater wells will be installed.

2.1.1 Site Scoping and Preparation

Before the field work for the Preliminary Groundwater Assessments of sites SS003, OWS704, SS004, SS006, and SS009 begins, areas designated for sampling will be inspected with respect to their layout and access. During this visit, areas for staging sampling will be determined and access to sampling locations will be inspected.

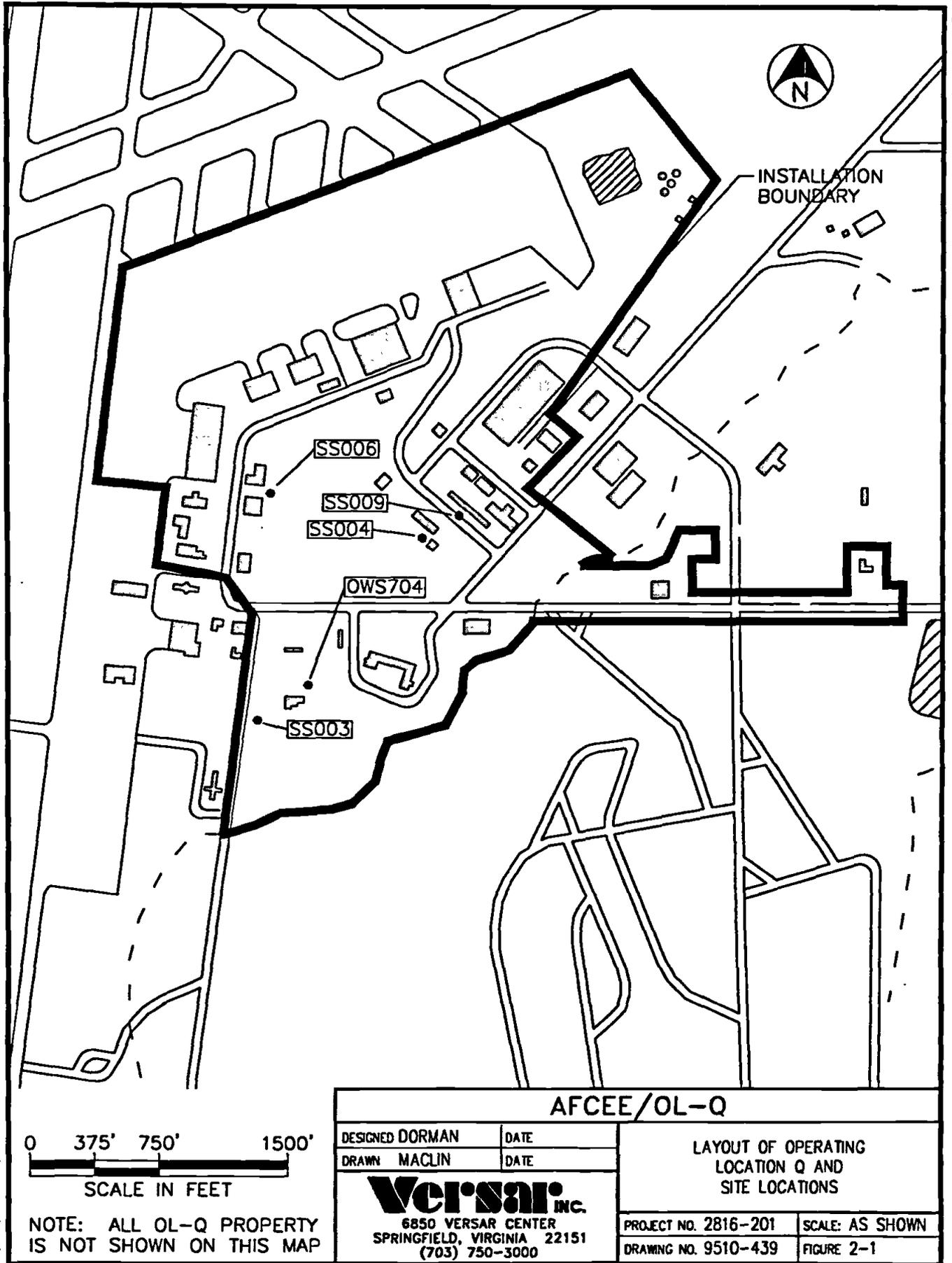
A centralized decontamination area for personnel and equipment will be set up at a location approved by OL-Q. The decontamination area will be approximately 50 feet by 50 feet in size, large enough to allow storage of cleaned equipment and materials prior to use, as well as to stage drums of decontamination waste. The decontamination area will be lined with a heavy gauge plastic sheeting.

Each work site or sampling location will be returned to its original condition when possible. Efforts will be made to minimize impacts to work sites and sampling locations, particularly those in or near sensitive environments such as wetlands. Following the completion of work at a site, all drums, trash and other waste will be removed. Decontamination and/or purge water and soil cuttings will be transported to a location designated by OL-Q.

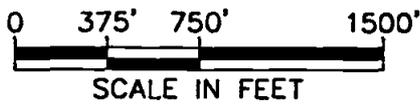
2.1.2 Direct Push Activities

As part of the Preliminary Groundwater Assessments of sites SS003, OWS704, SS004, SS006, and SS009, direct push technology will be used at each site to collect groundwater samples from three locations. At each boring location, a temporary piezometer will be installed to determine groundwater flow direction. Figure 2-1 shows the locations of the five sites at the base.

Soil samples will be collected continuously during direct-push activities using split-spoon barrel samplers fitted with removable Teflon® inner liners. Each temporary well will be completed to a depth of approximately 20 feet below existing grade (beg). Soil samples will be collected continuously throughout drilling activities in order to determine



\AFB\2816-201\9510-439.DWG PLOT DATE: 01-24-96



NOTE: ALL OL-Q PROPERTY IS NOT SHOWN ON THIS MAP

AFCEE/OL-Q			
DESIGNED DORMAN	DATE	LAYOUT OF OPERATING LOCATION Q AND SITE LOCATIONS	
DRAWN MACLIN	DATE		
Versar INC. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		PROJECT NO. 2816-201	SCALE: AS SHOWN
		DRAWING NO. 9510-439	FIGURE 2-1

lithology and depth to collect groundwater samples. The groundwater samples will be collected in the first water-bearing unit determined during drilling. Groundwater samples will be collected using the direct-push water sampling tool or other approved equipment, such as the use of tubing, a mini-bailer, or a double valve pump (or bladder pump) in order to efficiently collect larger volumes of samples and to reduce the loss of volatile organic compounds (VOCs) during sampling.

Groundwater samples will be analyzed for one or more of the following parameters based on contaminants encountered previously at each of the five sites: total petroleum hydrocarbons (TPH), VOCs, semivolatile organic compounds (SVOCs), RCRA metals, and polychlorinated biphenyls (PCBs).

Immediately following the collection of groundwater samples, a temporary groundwater measuring point will be installed either in or adjacent to and at the same depth as the groundwater sample in order to measure the potentiometric head of the shallow groundwater unit. The direct push borings will be fitted with a temporary disposable 1-inch inner diameter (ID) polyvinyl chloride (PVC) well screen (slot size of 0.010 inch). The measurement points will be sealed from surface water intrusion with a bentonite or similar seal. The groundwater in each measuring point will be allowed to reach static equilibrium 48 hours after installation. Static groundwater levels will be measured from the top of the temporary well casings to the nearest 0.01 foot with an electric water level indicating instrument. All static water level measurements, at each site, will be collected within 15 minutes of each other.

Following completion of groundwater sampling and measurement, the temporary piezometers will be removed and abandoned in accordance with Missouri Department of Natural Resources (MDNR) regulations. The piezometers will be disposed of according to Section 3.4.2 of the SOW (dated 26 July 1995), Worksite Maintenance.

2.1.3 Groundwater Well Installation Activities (Optional)

If the direct-push activities do not yield groundwater, monitoring wells, drilled using hollow stem augers and a mobile drill rig, will be installed. Three groundwater monitoring wells will be installed at sites SS003, SS006, and SS009, and one well each will be installed at sites OWS704 and SS004. These two wells will be installed downgradient. Due to the close proximity of sites SS003 and SS009 to sites OWS704 and SS004, the three wells installed at these sites can be used to determine groundwater gradients.

Soil borings for monitoring wells will be advanced with a truck or all-terrain vehicle (ATV) mounted drill rig equipped with standard 6.25-inch ID hollow stem augers. If bedrock is encountered before a depth of 20 feet is reached during direct-push activities, an air rotary drill rig will be used in place of the hollow stem auger drill rig, in order to penetrate the rock.

Undisturbed soil samples will be collected with 2-foot long split-barrel samplers in accordance with ASTM Standard D-1586. Split-barrel sampling will be performed continuously starting from 1 foot below until the water table is intercepted. Soil samples will

be described in detail on a standardized field soil boring log by an experienced Versar geologist/hydrogeologist. Soil textural descriptions will conform with ASTM Standard D-2488, commonly referred to as the Unified Soil Classification System (USCS).

Field screening for the presence of potential contamination in unsaturated soil samples will be performed by the on-site Versar geologist/hydrogeologist. Each split-spoon sample will be checked for the presence of unusual odors, coloration, or staining of the soil. Results from headspace measurements and visual observations will be noted on the field soil boring logs.

Decontamination procedures as specified in the AFCEE Handbook will be followed to prevent cross-contamination between sampling locations and horizons. Drilling equipment that comes in contact with potentially contaminated soil and groundwater (e.g., augers, rods, and split spoons) will, at a minimum, be steam cleaned between soil boring locations. Split-spoon samplers will be washed thoroughly between sampling horizons at each boring location in accordance with current MDNR and AFCEE protocols.

Soil cuttings from each well installation will be placed into designated and labeled 55-gallon drums and stored in a designated area prior to disposal. Samples will be collected from each drum (20 drums are estimated) and analyzed for parameters necessary for disposal characteristics (i.e., TCLP).

After well installation and development are completed, samples will be collected from each well according to selected parameters specified for each of the five sites.

2.1.4 Surveying

Each groundwater measuring point will be surveyed by a registered land surveyor using the state-plane coordinate system and national geodetic vertical datum. The surveyor will determine the horizontal coordinates, the top of casing elevation, and the ground surface elevation for each measuring point. From these measurements, a groundwater contour map will be generated for each site, indicating the location of the groundwater sampling points, elevation of the static groundwater, measurement date, and groundwater flow direction. Field correctness and accuracy of the measurements will be verified prior to completion of survey work.

2.1.5 Equipment Decontamination

This section outlines decontamination procedures for sampling equipment that may come in contact with contaminated environmental media.

A centralized decontamination area, at a location approved by the Base, will be set up for the Preliminary Groundwater Assessments. The decontamination area should have access to an approved potable water source. The water source will be tested prior to the start of field activities in order to provide background information relative to decontamination activities. The decontamination area will be large enough to allow storage of cleaned

equipment and materials prior to use, as well as to stage drums of waste resulting from decontamination activities. Liquid decontamination waste will be collected and stored in 55-gallon drums. These wastes will be disposed of in accordance with applicable regulations. Solid waste (i.e., soil cuttings) may be generated as a result of sampling activities if groundwater monitoring wells are installed in place of hydropunch/geoprobe temporary wells.

Sampling Equipment

Sampling equipment that can be hand-manipulated, and that comes in direct contact with sample media, will be decontaminated by the following procedure:

1. Scrub the equipment with a solution of potable water and Alconox, or equivalent laboratory-grade detergent.
2. Rinse the equipment with approved water followed by reagent grade water.
3. Decontaminate and air dry equipment on a clean surface or rack, such as stainless steel, or oil-free aluminum elevated at least 2 feet above ground. If the sampling device will not be used immediately after decontamination, wrap it in aluminum foil, or place it in a closed, stainless steel, or glass container, or sealed in polyethylene.

2.2 ENVIRONMENTAL SAMPLING

2.2.1 Sampling Locations

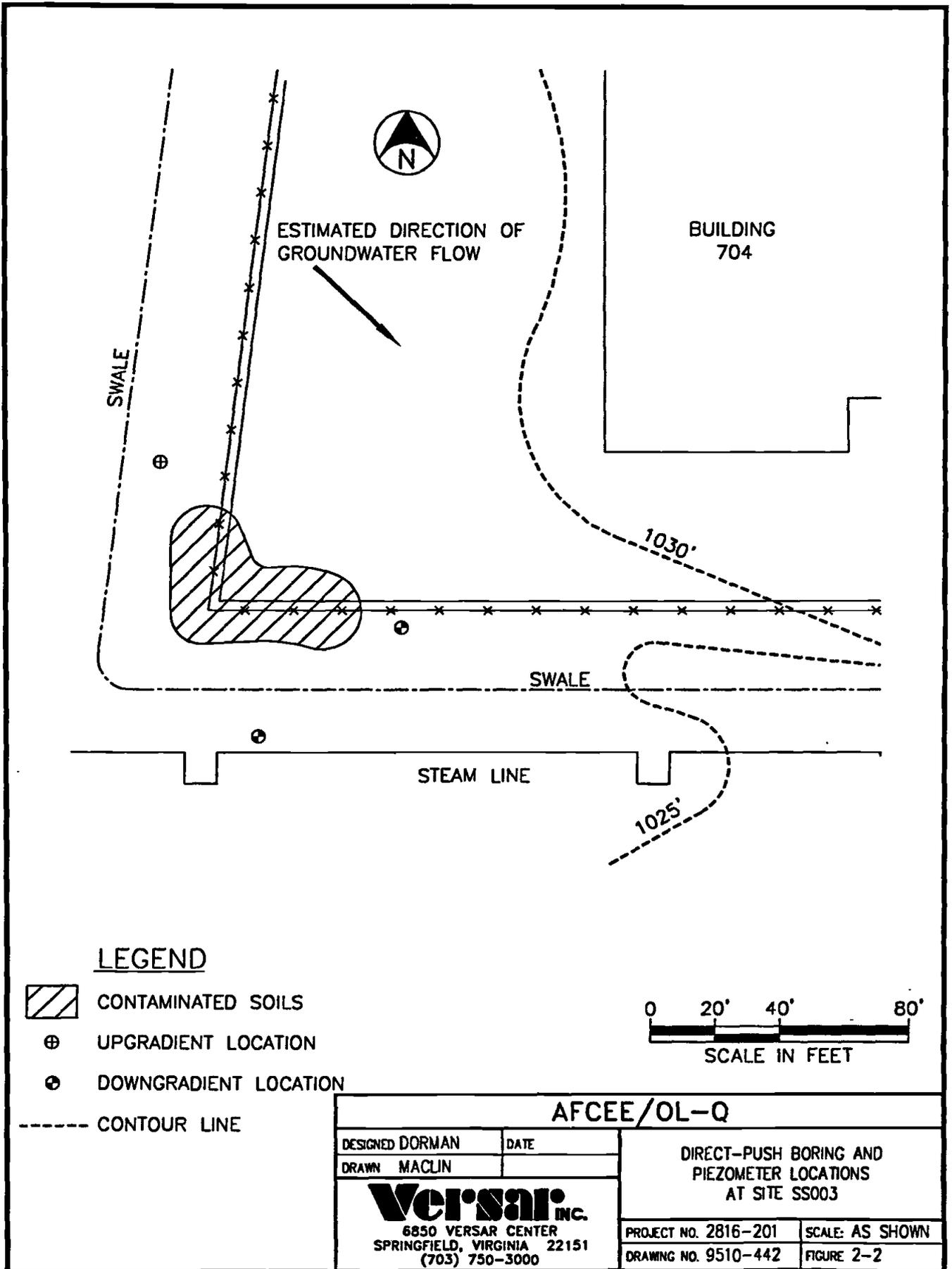
Figures 2-2 through 2-6 show the direct push locations for sites SS003, OWS704, SS004, SS006, and SS009.

2.2.2 Sample Handling

Sample containers, volumes, holding times, and preservation methods to be used are presented in Section 1.4.2 of the QAPP.

Sample Identification

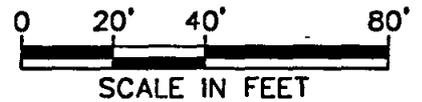
Sample identification will follow general Air Force protocol and contain data fields representing the following information: location, date, time, sampling company, sample matrix, sample method, beginning and ending depths, lot control number, and sample type. Each sample will be affixed with a sample label at the time of collection. Sample labels will include the project name, the unique sample number, the matrix sampled, the sample location and depth, the time and date, and name of the sample collector, at a minimum. Each sample will also be affixed with a custody seal, including the sample date, and name and signature of the sample collector. Figure 2-7 shows examples of a sample label and a custody seal.



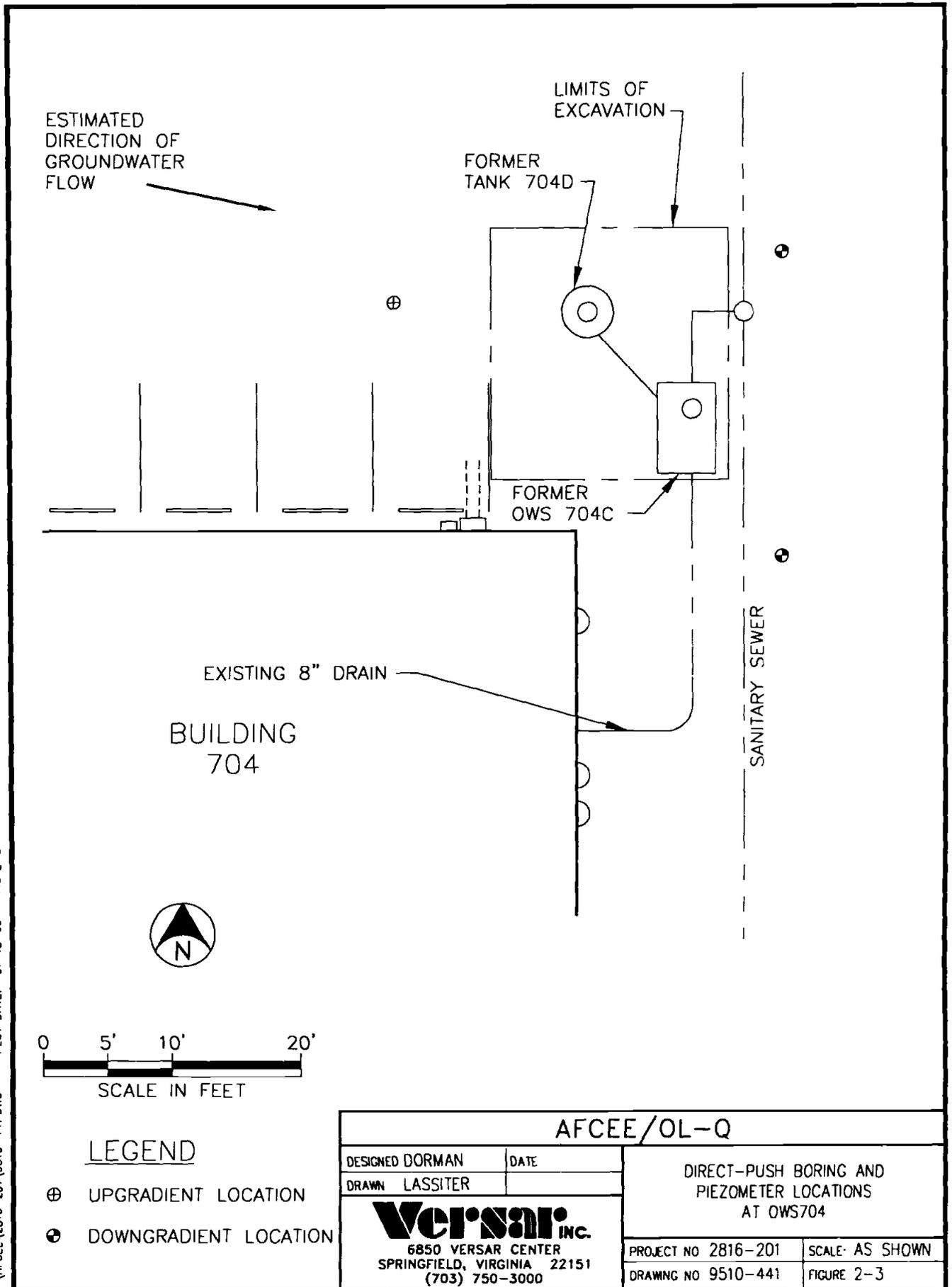
\AFCEE\2816-201\9510-442.DWG PLOT DATE: 01-18-96 FIG 2-2

LEGEND

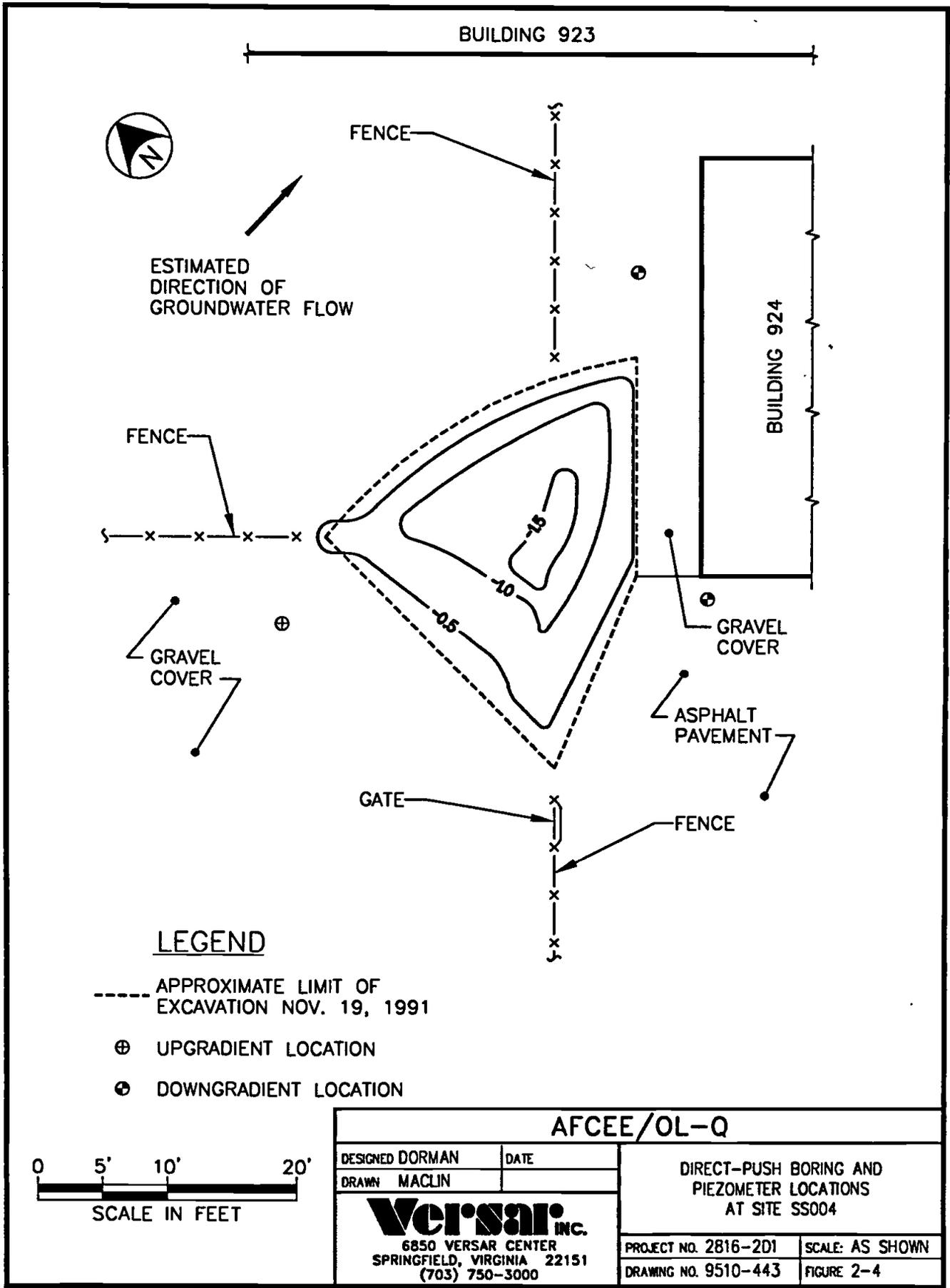
-  CONTAMINATED SOILS
-  UPGRADIENT LOCATION
-  DOWNGRADIENT LOCATION
-  CONTOUR LINE



AFCEE/OL-Q			
DESIGNED DORMAN	DATE	DIRECT-PUSH BORING AND PIEZOMETER LOCATIONS AT SITE SS003	
DRAWN MACLIN			
Versar INC. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		PROJECT NO. 2816-201	SCALE: AS SHOWN
		DRAWING NO. 9510-442	FIGURE 2-2



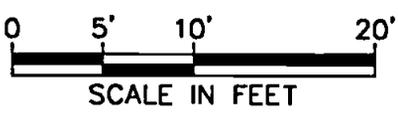
\AFCEE\2816-201\9510-441.DWG PLOT DATE: 01-18-96 FIG 2-3



\AFCEE\2816-201\9510-443.DWG PLOT DATE: 01-18-96 FIG 2-4

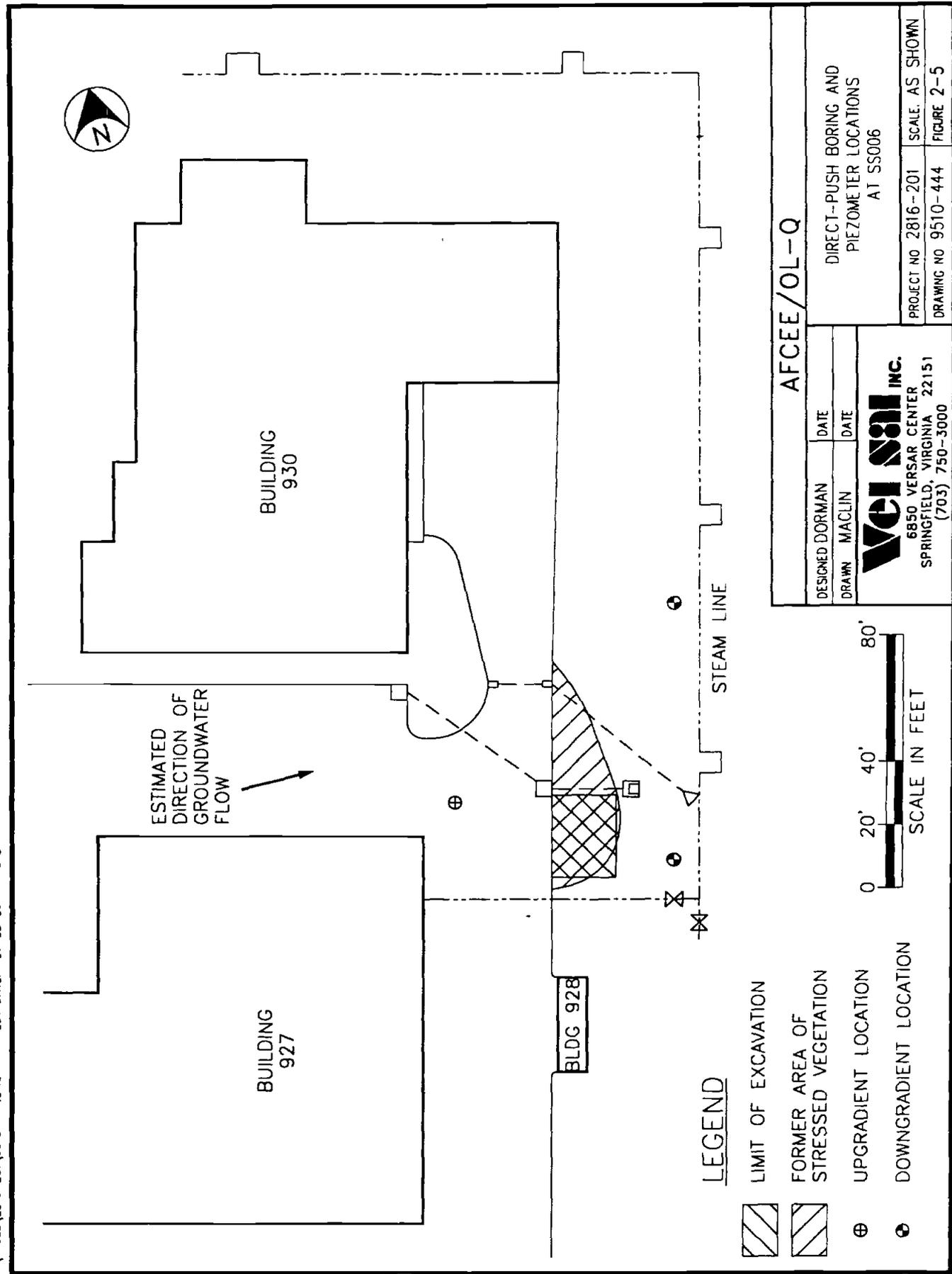
LEGEND

- APPROXIMATE LIMIT OF EXCAVATION NOV. 19, 1991
- ⊕ UPGRADIENT LOCATION
- ⊙ DOWNGRADIENT LOCATION



AFCEE/OL-Q		
DESIGNED DORMAN	DATE	DIRECT-PUSH BORING AND PIEZOMETER LOCATIONS AT SITE SS004
DRAWN MACLIN		
Versar INC. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		PROJECT NO. 2816-201
		SCALE: AS SHOWN
		DRAWING NO. 9510-443
		FIGURE 2-4

AFCEE\2816-201\9510-444.DWG PLOT DATE: 01-25-96 FIG 3-4

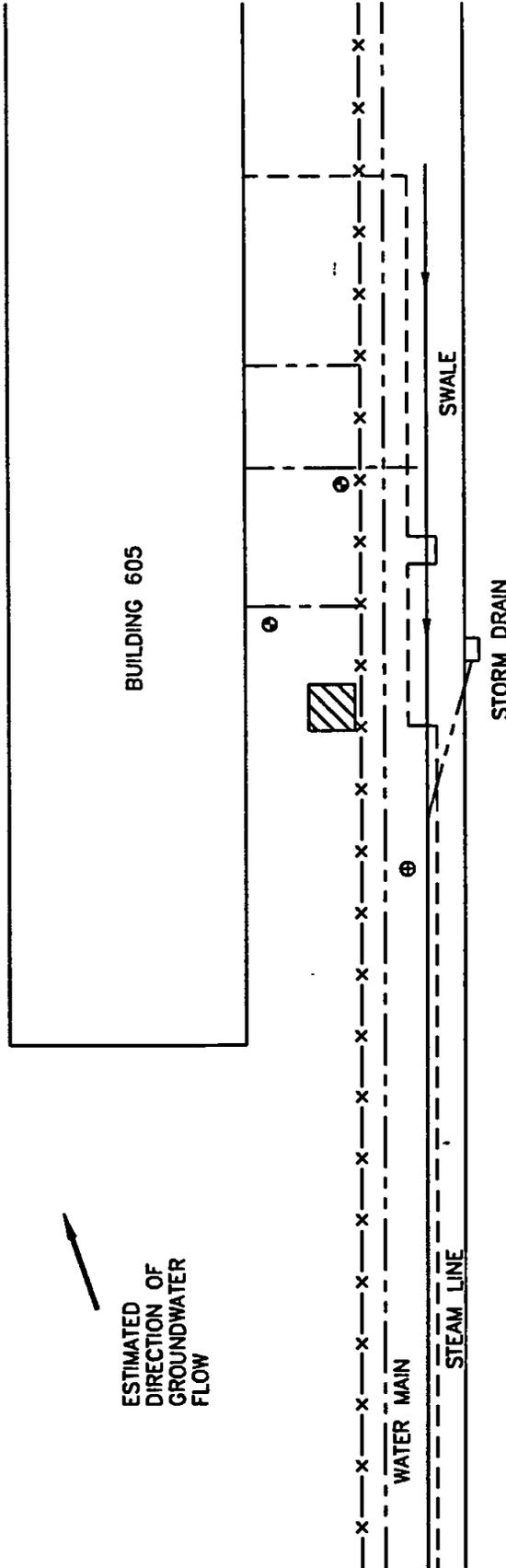


DESIGNED DORMAN		DATE	AFCEE/OL-Q	
DRAWN MACLIN		DATE	DIRECT-PUSH BORING AND PIEZOMETER LOCATIONS AT SS006	
wei sai inc. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		PROJECT NO 2816-201		SCALE AS SHOWN
		DRAWING NO 9510-444		FIGURE 2-5

\\AFCEE\2816-201\9510-440.DWG PLOT DATE: 01-25-96 FIG 3-5



ESTIMATED
DIRECTION OF
GROUNDWATER
FLOW



LEGEND

-  LIMITS OF EXCAVATION
-  UPGRADIENT LOCATION
-  DOWNGRADIENT LOCATION

AFCEE/OL-Q

DESIGNED DORMAN	DATE 10/03/95
DRAWN MACLIN	10/03/95

veisi inc.
6850 VERSAR CENTER
SPRINGFIELD, VIRGINIA 22151
(703) 750-3000

DIRECT-PUSH BORING AND
PIEZOMETER LOCATIONS
AT SITE SS009

PROJECT NO. 2816-201	SCALE: AS SHOWN
DRAWING NO. 9510-440	FIGURE 2-6

Each sample will require a unique sample number that is compatible with the IRPIMS data base. This number will consist of the location identifier, a sample type (identified by one or two letters), and a number. Location identifiers consist of monitoring well numbers, or borehole numbers. Up to six sample types could be collected during the Preliminary Groundwater Assessments: ambient condition blanks (AB#), equipment blanks (EB#), field duplicates (FD#), normal environmental samples (N#), regulatory duplicates (RD#), and trip blanks (TB#).

For sample identification purposes, the sample type code will be followed by a number. Samples with the same type and location will be numbered sequentially for each sampling event.

Sample Packaging and Delivery

All soil/sediment and water samples will be packed in coolers. A $4^{\circ}\pm 2^{\circ}$ C temperature will be maintained during shipment by adding either bagged ice or contaminant-free "blue ice" packages prior to shipment. Plastic bubble wrap, foam, or other packing materials will be placed in the cooler to prevent container breakage and excessive shifting during shipment.

Each sample cooler will be accompanied by a COC form that will list each of the samples in the shipment, the time and date of collection, identification of the sample medium, and supplementary information such as preservatives and analyses requested. An example of the COC form is shown in Figure 1-2. Prior to shipment or delivery, the COC form will be signed and dated by the sample custodian. When possession of the samples is transferred, the individuals receiving and relinquishing the samples must sign and date the COC form. When the COC form is completed and the appropriate copy retained, it will be sealed in a plastic bag and placed in the sample cooler. The cooler will then be taped securely shut with a shipping strength tape and sealed with custody seals. The custody seals are to be signed and dated by the sample custodian prior to shipment or delivery.

Samples will be transported to the contracted analytical laboratory daily, or every other day, as required. The frequency of sample shipments will depend on sample quantities and holding times. The laboratory will be made aware of the shipment prior to transport.

2.2.3 Sample Custody

Sample custody will be tracked through the use of sample labels, custody seals, and COC forms. All sample coolers will be accompanied by a COC form at all times, as described above. Field personnel will sign the COC form and remove the back copy prior to sealing the COC record in the sample cooler. This copy will then be maintained as part of the permanent field records by the Project Manager.

The original COC form will accompany the sample shipment to the laboratory. Upon receipt, a laboratory representative will sign the COC form and return the original to the Project Manager as part of the final analytical report. The original COC form documents the

transfer of sample custody from the field custodian to the laboratory. Following receipt, the laboratory will provide the Project Manager with a summary of the condition of the samples upon receipt, sample numbers received, and the estimated date of completion for laboratory analysis.

2.2.4 Quality Control Samples

Field QA/QC samples will be collected and analyzed as part of the field sampling activities. The following QA/QC samples may be collected during field activities:

Duplicate Samples

Duplicate samples will be collected for water samples subject to analyses for all analytes. The purpose of the duplicate samples is to provide checks of data generated by the laboratory. Duplicates are labeled so that the laboratory is unaware of which sample is being duplicated. A field duplicate sample is a second sample collected as close as possible to the same point in space and time as the sample it is intended to duplicate. These samples will be collected using the same protocol as other water samples.

Equipment Blanks

Equipment blanks consist of reagent grade water, or higher grade, that is poured through the decontaminated sampling equipment (i.e., split spoons or bailers) directly into a sampling container following final decontamination of the equipment. These samples are used to detect any contamination originating from the equipment. Equipment blanks will be analyzed for the same parameters as the samples collected using the equipment. One equipment blank per sampling team per sampling day will be collected.

Ambient Condition Blanks

Ambient condition blanks, also known as field blanks, are samples of reagent grade water collected in the field. These samples are used to test for contaminants that may be introduced into samples by ambient conditions. The water is poured directly into a sample container and analyzed for volatile organic compounds. One ambient condition blank will typically be collected for every sampling round or event. The field leader will attempt to select an area that is most likely to be affected by ambient conditions (i.e., worst case) and will authoritatively decide where this sample will be poured.

Trip Blanks

Trip blanks are samples of reagent grade water that accompany the sample bottles from the time they initially leave the lab until the time the filled sample bottles are returned to the lab for analysis. These samples are used to determine if samples have been contaminated during sampling, shipping, and handling activities. One trip blank will be included with each shipment of samples to be analyzed for VOCs.

2.2.5 Sample Analysis Summary

Table 2-1 shows the analytical methods to be used during the Preliminary Groundwater Assessments, the reporting units for each method, and the number of samples to be submitted for each analysis.

2.3 CALIBRATION, MAINTENANCE, AND DECONTAMINATION OF FIELD MEASUREMENT INSTRUMENTATION

If permanent groundwater monitoring wells are installed at the sites, field instruments will be used to collect water quality data during development and sampling activities. If Geoprobe technology is used, these samples will not be collected or measured. Information concerning instrument maintenance, calibration, and decontamination is presented in Table 2-2.

2.4 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) FOR FIELD INSTRUMENTS

Table 2-3 lists QA/QC information pertaining to control parameters, control check, control limits, and corrective action for field instruments.

2.5 RECORDKEEPING

Field log books will be assigned to and maintained by the Field Sampling Leader and other personnel during the field investigation. Records of each activity at every field location will be recorded in ink on sequentially numbered pages in bound, waterproof field books.

The field record will include information pertinent to the field activities. Entries will be as detailed and descriptive as practicable, so that a particular situation may be recalled without reliance on a person's memory. The cover of each book will have the person to whom it is assigned, the project name, and start and end dates. All entries into the log books will be signed and dated. Information to be included in the field log books will include the following, at a minimum:

General Information:

- Names of all personnel at the work site (including subcontractors)
- Location of work site
- Physical and environmental conditions (weather, temperature, etc.)
- Work to be conducted at site

Sampling Documentation:

- Sample descriptions (medium, location, depth)
- Sample identification

TABLE 2-1
Sample Analysis Summary

Analytes	Analytical Method	Medium	Sample Quantities*	Reporting Units
TPH	SW-846 8015 Modified	Water	15	µg/L
VOCs	SW-846 8240	Water	15	µg/L
SVOCs	SW-846 8270	Water	6	µg/L
PCBs	SW-846 8080	Water	3	µg/L
Metals	SW-846 6010/ 7000 Series	Water	30**	mg/L

* Does not include blanks, duplicates, or QC samples

** Includes both filtered and unfiltered samples

**TABLE 2-2
Calibration, Maintenance, and Decontamination of Field Measurement Instrumentation**

Equipment	Parameter	Calibration	Calibration Materials	Maintenance	Decontamination
pH-Temp-Conductivity Meter	pH	Initial, every 4 hours, final, using pH 4.00, 7.00 & 10.00 buffer solutions	Standard pH buffer solutions	Store probe in KCl solution or pH 4 buffer solution. Replace batteries as necessary.	Rinse probe with DI water after each use.
	Temperature (°C)	Calibrated by manufacturer. Check periodically with mercury thermometer.	N/A	Replace batteries as necessary.	Rinse probe with DI water after each use.
	Electrical Conductivity	Initial, every 4 hours, final, using standard solutions. Solutions should bracket anticipated field values.	Standard μmhos/cm solutions, premixed or unmixed.	Replace batteries as necessary.	Rinse probe with DI water after each use.
Mercury Thermometer	Temperature (°C)	Calibrated by manufacturer.	N/A	Replace if malfunctions.	Rinse thermometer with DI water after each use.
Nephelometer	Turbidity	Initial, every 4 hours, final, using standard premixed solution.	Standard premixed solution.	Follow manufacturer's instructions and recommendations.	Rinse instrument and sample beakers with DI water after each use.
Water Level Indicator	Water Level (ft)	Check length prior to start of work using a tape measure.	Tape measure.	Follow manufacturer's instructions and recommendations.	Rinse tape and probe with DI water after each use.
Flow Meter	Water Flow Rate (gpm)	Calibrated by manufacturer.	N/A	Follow manufacturer's instructions and recommendations.	Flush with DI water after each use.
MicroGrand Portable Alarm	Explosive Gases	Calibrated by manufacturer. Conduct initial operational checks per manufacturer's recommendations.	N/A	Follow manufacturer's instructions and recommendations. Recharge battery pack as necessary.	N/A
	Oxygen Level	Calibrated by manufacturer. Conduct initial operational checks per manufacturer's recommendations.	N/A	Follow manufacturer's instructions and recommendations. Recharge battery pack as necessary.	N/A
Flame Ionization Detector (FID)	Volatile Organics	Initial, every 4 hours and final.	Premixed methane standard.	Follow manufacturer's instructions and recommendations.	Purge fuel system with hydrogen.

NA = Not applicable
DI = Deionized

TABLE 2-3
Quality Assurance/Quality Control
for Field Instruments

PARAMETER	CONTROL CHECK FREQUENCY	CONTROL LIMITS	CORRECTIVE ACTION
pH	Initial, every 4 hours and final.	± 0.1 pH units of buffer of true values.	Check probe and batteries; recalibrate.
Temperature (°C)	Once per day.	$\pm 1^\circ\text{C}$	Check batteries and recalibrate instrument. Replace mercury thermometer, if necessary.
Electrical Conductivity	Initial, every 4 hours and final.	$\pm 5\%$ of true value	Check batteries and recalibrate. Check meter for redline and zero values.
Turbidity	Initial, every 4 hours and final.	Calibrate to read exact standard value.	Follow manufacturer's instructions and recommendations.
Water Level (ft)	Once per day.	± 0.01 foot	Replace tape or document actual tape length on instrument and in log book.
Lower Explosive Limit	Once per day.	Alarm must sound at 10% of lower explosive limit.	Follow manufacturer's instructions and recommendations. Check batteries.
Oxygen Level	Once per day.	Must read 19.5% $\pm 0.2\%$ in ambient air.	Follow manufacturer's instructions and recommendations. Check batteries.
Volatile Organics (FID)	Initial, every 4 hours and final.	$\pm 5\%$ of true value.	Follow manufacturer's instructions and recommendations. Check battery and purge fuel system.

- Field screening results
- Required analyses and containers

Other Information:

- General field observations
- Names and titles of observers/visitors
- Equipment used and calibration records
- Decontamination information
- Sample handling and shipping information

Field book entries will not be altered or erased. Any errors will be crossed out with a single line so that they remain legible. All corrections will be initialed and dated. The reason for the correction will be noted at the time at which it was made.

To the extent practicable and permissible within Base security requirements, sampling locations will be photographed to provide a visual record of sampling conditions. Additionally, core samples will be photographed prior to disposal. All photographs will be taken with 35-millimeter photograph or slide film, and recorded in the field log book. Sampling locations and core samples will be identified in the photographs using a minimum 8-1/2 inch by 11-inch board or paper labeled with the sample location or interval.

Field log forms required by other sections of the SAP will be maintained in three-ring binders. Field personnel will copy all forms generated during the day at the end of each day. The copies will be given to the Field Sampling Leader or other personnel as directed by the Project Manager.

2.6 SITE MANAGEMENT

The AFCEE Team Chief is Mr. Fred Waterman (AFCEE/ERB). Mr. Waterman's telephone number is (210) 536-5209. The Point of Contact (POC) at OL-Q is Mr. Mark Esch (AFBCA/OL-Q). Mr. Esch's telephone number is (816) 348-2514.

It is assumed that OL-Q will provide the following information, items, and services in support of the Preliminary Groundwater Assessments:

- Existing documents, data bases, engineering records, maps, aerial photographs, and other available site information.
- Personnel identification badges and vehicle passes, as required by OL-Q.

If any field activity or other situation involves deviation from normal working procedures, the POC will be notified.

SECTION 3.0**INVESTIGATION-DERIVED WASTE PLAN**

Wastes generated during the Preliminary Groundwater Assessments will include decontamination water. If the direct-push activities do not yield groundwater, the following additional wastes will be generated: soil cuttings from drilling activities; groundwater from monitoring well development, purging, and sampling; and decontamination water. This section addresses disposition of these wastes. The procedures for handling such wastes will follow guidance presented in the US EPA's *Management of Investigation-Derived Wastes During Site Inspections* (May 1991) and MDNR protocols.

3.1 SOIL CUTTINGS

Following the completion of drilling activities, soil samples will be composited from each container. The composite samples will be subjected to those laboratory analyses required to determine if the cuttings are classified as a RCRA hazardous waste. The soils will be disposed of appropriately based on the laboratory results. It is estimated that approximately 11 composite samples will be required to characterize the containerized cuttings.

3.2 FLUIDS**3.2.1 Well Development, Purging, and Testing Water**

If direct-push activities do not produce water, permanent wells will be installed. All water removed from permanent monitoring wells for well development and sampling will be containerized in 55-gallon drums. At the end of each day, water accumulated in the 55-gallon drums will be transferred to a designated waste storage area. Samples of the water will be collected for analysis and will be analyzed for RCRA hazardous waste characteristics. The water will then be disposed of in accordance with applicable regulations.

3.2.2 Decontamination Fluids

Fluids generated during the decontamination of equipment and personnel will initially be accumulated in 55-gallon drums labeled with the contents, source, and a contact. The contents of the drums will be transferred to the waste storage area described above for subsequent analysis and disposal.

3.3 OTHER WASTES

Other wastes that could be generated during decontamination activities, including discarded PPE, will be collected and containerized in 55-gallon drums. The drums will be labeled with the contents and a contact. The drums will then be stored in a staging area designated by OL-Q, pending results of laboratory analysis and appropriate disposal.

3.4 WASTE DISPOSAL

It is not known at this time whether the waste that will be generated during the course of the field activities will be characterized as hazardous or non-hazardous waste. When any waste is generated, composite samples will be collected and forwarded to the selected laboratory for analysis. Once the characterization has been made, Versar will subcontract an appropriate AFCEE approved disposal contractor to remove the waste to a regulatory acceptable facility. It is understood that the MDNR may require TCLP analysis for metals to be performed as part of the hazardous waste characterization.

SECTION 4.0

REFERENCES

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- Burns & McDonnell, 1992. Interim Remedial Action for SS003, Oil Saturated Area & SS004, Hazardous Waste Drum Storage, Final Closure Report, Richards-Gebaur Air Force Base, Missouri.
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- O'Brien & Gere, 1991. Handbook for the Preliminary Assessment for the Hazardous Material Storage Area (Site SS006), U.S. Army Corps of Engineers Kansas City District, Richards-Gebaur Air Force Base, Belton, Missouri.
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Appendix A

Calibration and QC Procedures for Analytical Methods

QUALITY CONTROL PROCEDURES

Project: LAS Default

EPA Method 8015M - TPH by GC-FID

Issued by QAD on 09/20/95

126124

	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Calibration	<ul style="list-style-type: none"> o Three-Point Initial Calibration o Prior to initial sample analysis. o Whenever major modifications are made to the system. o If continuing calibration acceptance criteria are not met. 	$r \geq 0.995$ or $r \geq 0.990$	<ul style="list-style-type: none"> 1) Reanalyze the standard(s). 2) Prepare and analyze new standard(s). 3) Recalibrate following system maintenance.
	<ul style="list-style-type: none"> o Continuing Calibrations o Beginning and end of each analytical set of ten or less client-submitted samples. 	$\%D \leq \pm 15\%$	<p>Beginning Continuing Calibration:</p> <ul style="list-style-type: none"> 1) Repeat continuing calibration. 2) Perform new initial calibration <p>Ending Continuing Calibration:</p> <ul style="list-style-type: none"> 1) Judge the validity of the data. 2) Initiate corrective action, which may include; reanalysis of the continuing calibration; reanalysis of all samples in the analytical batch performance of instrument maintenance (if the performance of instrument maintenance changes the analytical conditions, a new initial calibration must be performed.
Quality Control	<ul style="list-style-type: none"> o Method Blank o Each Sample Delivery Group or 1 for each QC batch containing up to 20 samples 	$\leq RDL$	<ul style="list-style-type: none"> 1) Reanalyze the Method Blank. 2) Evaluate the system and perform minor system maintenance. 3) If the concentration in the sample is ≥ 5 times the level in the Method Blank and above the RDL, report the sample results and flag with a "B". 4) Reextract and reanalyze all associated samples.

QUALITY CONTROL PROCEDURES

Issued by QAD on 09/20/95

Project: LAS Default

EPA Method 8015M - TPH by GC-FID

	FREQUENCY	CRITERIA			CORRECTIVE ACTION
		Analyte	Aqueous	Solid	
Surrogate Spikes	Every sample, standard, and QC sample.	Di-n-octylphthalate	56-156%	51-141%	If the sample is an LCS or MB: 1) Check calculations. 2) Reanalyze LCS and/or MB. 3) Reextract and reanalyze LCS and/or MB and all associated samples. If the sample is not an LCS or MB: 1) Judge the validity of the data. 2) Check the LCS and MB surrogate recoveries; if within QC limits, flag the recoveries as attributable to matrix effect and note in the case narrative. 3) Reanalyze the sample and report the best or both results. Flag the data as appropriate.
Matrix Spikes/ Matrix Spike Duplicates	Each SDG or 1 for each QC batch containing no more than 20 samples.	Analyte Gasoline Kerosene Diesel	Accuracy 30-138% 30-138% 30-138%	Solid Precision ≤30% ≤30% ≤30%	
Laboratory Control Sample (LCS)	Each SDG or 1 for each QC batch containing no more than 20 samples	Analyte Gasoline Kerosene Diesel	Accuracy 30-138% 30-138% 30-138%	Solid Precision 30-138% 30-138% 30-138%	1) Check calculations. 2) Reanalyze LCS 3) Reextract and reanalyze LCS and all associated samples.

Note: All corrective actions for retention time criteria are to be followed according to LAS IDC "LAS Policy for Establishing Retention Time Windows for Gas Chromatography Techniques" (Landers, Fischer, Aleckson, 23-AUG-95). Any corrective action taken or deviations from the corrective actions listed must be delineated in the analyst's notes. Any deviations from the corrective actions listed must be delineated in the case narrative.

QUALITY CONTROL PROCEDURES

Project: LAS Default

EPA Method 8260 - Volatile Organics by GC/MS

Issued by QAD on 09/20/95

	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Calibration	BFB System Tuning	Initially and every 12 hours prior to continuing calibration.	Refer to criteria listed in Method 8260.
	Five-Point Initial Calibration	<ul style="list-style-type: none"> o Prior to initial sample analysis. o Whenever major modifications are made to the analytical system. o If continuing calibration criteria are not met. 	% RSD for CCCs < 30%. Avg. RF > 0.300 for SPCCs (0.25 for Bromoform).
	Continuing Calibration	Every 12 hours prior to sample analysis.	% D for CCCs < 25%. RF for SPCCs must be ≥ 0.300 (0.25 for Bromoform).
Quality Control	Method Blank	Every 12 hrs., after compliant BFB tune and continuing calibration and before any samples are analyzed.	1) Evaluate system and perform minor system maintenance 2) Reanalyze continuing calibration 3) Perform new initial calibration.
			1) Evaluate system and perform minor system maintenance 2) Reanalyze method blank 3) If holding time requirement permits and if sufficient sample is available, reanalyze associated samples. Otherwise, qualify affected constituent data using a "B."

QUALITY CONTROL PROCEDURES

Project: LAS Default

EPA Method 8260 - Volatile Organics by GC/MS

Issued by QAD on 09/20/95

	FREQUENCY	CRITERIA				CORRECTIVE ACTION
		Analyte	Aqueous	Solid		
Surrogates	Each sample, spike, blank, LCS, and calibration standard	1,2-Dichloroethane-d, Toluene-d8 Bromofluorobenzene	84-122% 87-117% 83-118%	77-127% 84-120% 78-125%		If the sample is an LCS or MB: 1) Check calculations. 2) Reanalyze LCS and/or MB. 3) Reanalyze all samples associated with the LCS and/or MB. If the sample is not an LCS or MB: 1) Judge the validity of the data. 2) Check the LCS and MB surrogate recoveries; if within limits, flag the recoveries as attributable to matrix effect and note in the case narrative. 3) Reanalyze the sample and report the best or both results. Flag the data as appropriate. 1) Evaluate system 2) Check calculations 3) Check LCS; if recoveries within limits, note MS recoveries as attributable to matrix effects. If LCS recoveries are not within QC limits, reanalyze all associated samples.
Matrix Spike and Matrix Spike Duplicate	Each Sample Delivery Group or 1 every 20 samples.	Analyte 1,1-Dichloroethene Benzene Trichloroethene Toluene Chlorobenzene	Accuracy 62-124% 68-128% 65-125% 69-129% 68-128%	Precision ≤14% ≤14% ≤13% ≤13% ≤11%	Accuracy 54-138% 70-130% 57-132% 71-129% 72-128%	

QUALITY CONTROL PROCEDURES

Issued by QAD on 09/20/95

Project: LAS Default

EPA Method 8260 - Volatile Organics by GC/MS

QUALITY CONTROL		FREQUENCY	CRITERIA			CORRECTIVE ACTION
Laboratory Control Sample (LCS)	1 for each analytical batch containing up to 20 samples.	Analyte	Aqueous	Solid	1) Evaluate system. 2) Check calculations. 3) Reprepare and reanalyze LCS and all associated samples. If the sample is an LCS or MB: 1) Check calculations. 2) Reanalyze LCS and/or MB. 3) Reanalyze all samples associated with the LCS and/or MB If the sample is not an LCS or MB: 1) Judge the validity of the data 2) Check the LCS and MB IS recoveries. If within limits flag the recoveries as attributable to matrix effect and note in the case narrative. 3) Reanalyze the sample and report the best or both results. Flag the data as appropriate.	
		1,1-Dichloroethene	62-124%	54-138%		
		Benzene	68-128%	70-130%		
		Trichloroethene	65-125%	57-132%		
		Toluene	69-129%	71-129%		
Internal Standards	Every sample, blank, LCS, and standard.	Chlorobenzene	68-128%	72-128%		
		± 0.5 minute of retention time of continuing calibration. 50 - 200 % of EICP area from continuing calibration.				

Note: Any corrective action taken or deviations from the corrective actions listed must be delineated in the analyst's notes. Any deviations from the corrective action listed must be delineated in the case narrative.

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Lockheed Analytical Services

QUALITY CONTROL PROCEDURES

Project: LAS Default

EPA Method 8270 - Semivolatile Organics by GC/MS

Issued by QAD on 09/20/95

	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Calibration	DFTPP System Tuning	Initially and every 12 hours	Refer to criteria listed in Method 8270.
	Five-Point Initial Calibration	<ul style="list-style-type: none"> o Prior to initial sample analysis. o Whenever major modifications are made to the analytical system. o If continuing calibration criteria are not met. 	<ul style="list-style-type: none"> 1) % RSD for CCCs < 30%. 2) Avg. RF \geq 0.050 for SPCCs.
Quality Control	Continuing calibration	Every 12 hours	<ul style="list-style-type: none"> 1) % D for CCCs < 30%. 2) RF for SPCCs must be \geq 0.050.
	Method Blank	1 per QC batch containing up to 20 samples	<ul style="list-style-type: none"> 1) Check calculations and evaluate system. 2) Reanalyze blank. 3) If holding time requirement permits and if sufficient sample is available, reextract and reanalyze associated samples. Otherwise, qualify affected constituent data using a "B."

QUALITY CONTROL PROCEDURES

Issued by QAD on 09/20/95

Project: LAS Default

EPA Method 8270 - Semivolatile Organics by GC/MS

Quality Control	FREQUENCY	CRITERIA			CORRECTIVE ACTION
		Analyte	Aqueous	Solid	
Surrogates	Each sample, spike, blank, LCS, and standard	Nitrobenzene-d ₅ 2-Fluorobiphenyl Terphenyl-d ₁₄ Phenol-d ₄ 2-Fluorophenol 2,4,6-Tribromophenol	40-114% 41-111% 33-141% 27-111% 31-110% 34-147%	17-114% 29-114% 32-151% 21-110% 15-111% 33-136%	1) Check calculations If the sample is an LCS or MB: 1) Check calculations. 2) Reanalyze LCS and/or MB. 3) Reextract and reanalyze LCS and/or MB and all associated samples. If the sample is not an LCS or MB: 1) Judge the validity of the data. 2) Initiate corrective action, which may include: 2a) Check the LCS and MB surrogate recoveries; if within limits, flag the recoveries as attributable to matrix effect and note in the case narrative. 2b) Reanalyze the sample and report the best of both results. Flag the data as appropriate
Matrix Spike/ Matrix Spike Duplicate	Each Sample Delivery Group or 1 for each QC batch containing up to 20 samples	Analyte Phenol 2-Chlorophenol 1,4-Dichlorobenzene N nitro di-n-propylamine 1,2,4-Trichlorobenzene 4 Chloro 3 methylphenol Acenaphthene 4-Nitrophenol 2,4-Dinitrotoluene Pentachlorophenol Pyrene	Accuracy Precision Accuracy Precision Accuracy Precision Accuracy Precision Accuracy Precision Accuracy Precision	Accuracy Precision Accuracy Precision Accuracy Precision Accuracy Precision Accuracy Precision Accuracy Precision	1) Check calculations. 2) Evaluate system. 3) Check LCS; if LCS recoveries are within limits, note MS recoveries as attributable to "matrix effect".

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QUALITY CONTROL PROCEDURES

Project: LAS Default

EPA Method 8270 - Semivolatile Organics by GC/MS

Issued by QAD on 09/20/95

Quality Control	FREQUENCY	CRITERIA		CORRECTIVE ACTION	
		Analyte	Aqueous		Solid
Laboratory Control Sample (LCS)	Each Sample Delivery Group or 1 for each QC batch containing up to 20 samples	Phenol 2-Chlorophenol 1,4-Dichlorobenzene N-nitroso-di-n-propylamine 1,2,4-Trichlorobenzene 4-Chloro-3-methylphenol Acenaphthene 4-Nitrophenol 2,4-Dinitrotoluene Pentachlorophenol Pyrene	11-118 % 19-123 % 13-110 % 35-125 % 19-113 % 28-134 % 46-116 % 10-125 % 33-133 % 10-162 % 60-123 %	28-110 % 22-110 % 21-110 % 24-110 % 32-110 % 35-112 % 31-117 % 29-127 % 51-112 % 41-133 % 45-135 %	1) Evaluate system 2) Check calculations 3) Reanalyze LCS and evaluate data quality. 4) Re-extract and reanalyze LCS and all associated samples.
Internal Standards	Every sample, blank, LCS, and standard	± 0.5 minute of retention time of continuing calibration. 50 - 200 % of EICP area of the same I.S. compound in the continuing calibration.		If the sample is an LCS or MB: 1) Check all calculations 2) Reanalyze LCS and or MB 3) Reanalyze all samples associated with the LCS and or MB. If the sample is not an LCS or MB: 1) Judge the validity of the data. 2) Initiate corrective actions which may include; 2a) Check the LCS and MB internal standard area recoveries; if within limits, flag the recoveries and note in the case narrative. 2b) Reanalyze the sample and report the best or both results. Flag the data as appropriate. 2c) Check pH of the extract; if it is low, water-wash the extract and reanalyze the affected sample(s).	

NOTE: Any deviation from the criteria specified in this table must be delineated in the analyst's notes. Any deviations from the corrective actions listed must be delineated in the case narrative.

QUALITY CONTROL PROCEDURES

Issued by QAD on 07/01/94

Project: LAS Default
ICP-AES 6010

	FREQUENCY	CRITERIA	CORRECTIVE ACTION	
Calibration	Two-Point Initial Calibration	<ul style="list-style-type: none"> ○ Before initial sample analysis or every 24 hours ○ Whenever major modification are made to the system; or ○ If continuing calibration acceptance criteria are not met 	<ul style="list-style-type: none"> ○ Reanalyze the standard(s) ○ Prepare and analyze new standard(s) ○ Recalibrate following system maintenance 	
	Initial calibration verification	○ 90 - 110 %	1) Recalibrate	
	Initial calibration blank	○ < RDL	1) Recalibrate	
	Continuing calibration verification	Every 10 samples and at the end of the run.	<ul style="list-style-type: none"> ○ 90 - 110 % 	<ul style="list-style-type: none"> 1) Reanalyze CCV 2) Recalibrate 3) Reanalyze all samples back to last good CCV
	Continuing calibration blank	Every 10 samples after the CCV.	○ < RDL	<ul style="list-style-type: none"> 1) Reanalyze 2) Recalibrate 3) Reanalyze all affected samples
Quality Control	CRI	NONE specified	Not required	
	High Standard	○ 95 - 105 %	1) Recalibrate	
	Interference Check Standard	<ul style="list-style-type: none"> ○ 80 - 120 % of the true value (solution AB only) 	<ul style="list-style-type: none"> 1) Recalibrate 2) Reanalyze affected samples since the last acceptable ICS. Check interelement correction factors & adjust if needed. 	
	Method Blank	○ ≤ RDL for all analytes	<ul style="list-style-type: none"> 1) Reanalyze 2) If the concentration in the sample is ≥ 5 times the level in the method blank, then report the sample results and flag with an "C". 3) If the concentration in the sample is ≤ RDL, then note the blank contamination in the case narrative and report the sample results. 4) If the concentration in the sample is > RDL and < 5 times the level in the method blank, then redigest and reanalyze samples associated with method blank 	

QUALITY CONTROL PROCEDURES

Project: LAS DEAHK

ICP-AES 6010

Issued by QAD on 07/01/94

	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Matrix Spike (Predigest spike)	5% - One per batch of 20 samples or less	<ul style="list-style-type: none"> 75-125% Recovery 	<ol style="list-style-type: none"> 1) Check calculations 2) Evaluate the System. (instrument) 3) Check LCS; if LCS recoveries are within QC limits, flag data and note in the case narrative as attributable to matrix effects; if LCS recoveries are not within QC limits, redigest and reanalyze all affected samples.
Duplicate Analysis	5% - One per batch of 20 samples or less	Precision: < 20% RPD	<ol style="list-style-type: none"> 1) Evaluate the System (instrument) 2) Check Calculations 3) Flag the QC data as "e"
Laboratory Control Sample	5% or 1 for every 20 samples	Aqueous	<ol style="list-style-type: none"> 1) Redigest and reanalyze all samples in the batch. 2) Evaluate the System (instrument) 3) Check calculations 4) Reanalyze LCS
		Solid (lot #)	
		<ul style="list-style-type: none"> Sb: 43.6-436.2% Ba: 70.0-90.7% Be: 60.4-150.5% Cd: 50.6-159.3% Cr: 45.3-140.5% Cu: 48.4-149.4% Ni: 28.6-155.4% Ag: 49.9-139.6% Zn: 54.9-150.0% 	
		(LOT SPECIFIC)	

QUALITY CONTROL PROCEDURES

Project: LAS Default
GFAA 7000A Series

Issued by QAD on 03/23/95

125134

TYPE OF ANALYSIS	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Calibration Four-Point Initial Calibration (3 standards and a blank)	<input type="checkbox"/> Before initial sample analysis or every 24 hours <input type="checkbox"/> Whenever major modification are made to the system; or <input type="checkbox"/> If ICV or CCV acceptance criteria are not met	<input type="checkbox"/> $r \geq 0.995$	<input type="checkbox"/> Reanalyze the standard(s) <input type="checkbox"/> Reprepare and analyze new standard(s) <input type="checkbox"/> Recalibrate following system maintenance
Initial calibration verification (ICV)	<input type="checkbox"/> Immediately after initial calibration	<input type="checkbox"/> 90 - 110% Recovery	<input type="checkbox"/> Recalibrate
Initial calibration blank (ICB)	<input type="checkbox"/> Immediately after ICV	<input type="checkbox"/> $< RDL$	<input type="checkbox"/> Recalibrate
Continuing calibration verification (CCV)	<input type="checkbox"/> Every 10 samples and at the end of each analytical run	<input type="checkbox"/> 80 - 120%	<input type="checkbox"/> Reanalyze CCV <input type="checkbox"/> Recalibrate <input type="checkbox"/> Reanalyze all samples back to last acceptable CCV
Continuing calibration blank (CCB)	<input type="checkbox"/> Every 10 samples and after each CCV	<input type="checkbox"/> $\leq RDL$	<input type="checkbox"/> Reanalyze <input type="checkbox"/> Recalibrate <input type="checkbox"/> Reanalyze all affected samples
Quality Control Preparation Blank (PB)	<input type="checkbox"/> 5% - One per batch of 20 samples or less	<input type="checkbox"/> $\leq RDL$ for all analytes	<input type="checkbox"/> Reanalyze <input type="checkbox"/> If the concentration in the sample is ≥ 5 times the level in the method blank, then report the sample results and flag with an "C" <input type="checkbox"/> If the concentration in the sample is $\leq RDL$, then note the blank contamination in the case narrative and report the sample results. <input type="checkbox"/> If the concentration in the sample is $> RDL$ and < 5 times the level in the method blank, then redigest and reanalyze samples associated with method blank
Matrix Spike (MS) (Pre-digest spike)	<input type="checkbox"/> 5% - One per batch of 20 samples or less	<input type="checkbox"/> 75-125% Recovery	<input type="checkbox"/> Check calculations <input type="checkbox"/> Evaluate the System <input type="checkbox"/> Check LCS; if LCS recoveries are within QC limits, flag data and note in the case narrative as attributable to matrix effect; if LCS recoveries are not within QC limits, redigest and reanalyze all affected samples.

QUALITY CONTROL PROCEDURES

Issued by QAD on 03/23/95

Project: LAS Default
GFAA 7000A Series

TYPE OF ANALYSIS		FREQUENCY	CRITERIA	CORRECTIVE ACTION
Quality Control	Duplicate Analysis	o 5% - One per batch of 20 samples or less	RPD ≤ 20% RPD	<input type="checkbox"/> Evaluate the System <input type="checkbox"/> Check calculations <input type="checkbox"/> Flag the QC data as "***"
	Analytical Spike (Post-digest spike)	o Spike each sample and PB*	80 - 120%	<input type="checkbox"/> Check calculations <input type="checkbox"/> If spike recovery exceeds ± 20%, method of standard addition (MSA) is required for quantitation (See method for MSA requirements)
Laboratory Control Sample		o 5% or 1 for every 20 samples	Aqueous	<input type="checkbox"/> Reanalyze <input type="checkbox"/> Evaluate the System
			80-120%	<input type="checkbox"/> Check calculations <input type="checkbox"/> Redigest and reanalyze all affected samples in the batch.

Source: Method 7000A, SW-846 3rd Edition Update 1 (July 1992).

* LAS policy specifies that each sample and the PB be spiked (more stringent than method 7000A requirements). Method 7000A requires that post-digest spike be prepared on a sample in the batch.

NOTE 1: All analyses shall fall within the calibration range.

QUALITY CONTROL PROCEDURES

Issued by QAD on 07/15/94

Project: LAS Default
 METHOD 7470/7471 (BY CVAAS) - Mercury

	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Calibration	Minimum four points	$r \geq 0.995$	Recalibrate if appropriate
	Initial calibration check	$\pm 20\%$	1) Recalibrate as appropriate
	Continuing calibration check standard	$\pm 20\%$	1) Recalibrate as appropriate 2) Reanalyze affected samples
	Calibration blank	$\leq \text{RDL}$	1) Rerun once, if problem persists, identify and correct problem 2) Recalibrate and rerun samples back to the last acceptable CCB
Quality Control	Method blank	$\leq \text{RDL}$	1) Investigate 2) Reanalyze if appropriate 3) Recalibrate 4) Redigest and reanalyze samples if reanalysis fails
	Matrix spike sample	Aqueous: 75-125% Solid: 75-125%	1) Check calculations 2) Check Laboratory Control Sample (LCS); if recoveries are within limits, flag all associated data as attributable to matrix effects
	Unspiked duplicate sample	$\text{RPD} \leq 20\%$ for aqueous and solid	1) Reanalysis is not required but data must be flagged
	Laboratory Control Sample (LCS)	Aqueous: 80-120% Solid: Vendor's certified limit	1) Evaluate system 2) Check calculations 3) Reanalyze LCS 4) Redigest and reanalyze LCS and all affected samples

QUALITY CONTROL PROCEDURES

Project: LAS Default

EPA Method 8080 - Organochlorine Pesticides and PCBs by GC-ECD

Issued by QAD on 09/20/95

	FREQUENCY	CRITERIA	CORRECTIVE ACTION
Calibration	<ul style="list-style-type: none"> o Minimum five-point for pesticides and one-point for PCBs. o Prior to initial sample analysis. o Whenever major modifications are made to the system. o If continuing calibration acceptance criteria are not met. 	$r \geq 0.995$ or $r^2 \geq 0.990$	<ol style="list-style-type: none"> 1) Reanalyze the standard(s). 2) Prepare and analyze new standard(s). 3) Recalibrate following system maintenance.
Continuing Calibrations	<p>Beginning and end of each analytical set of ten or less client-submitted samples.</p>	$\%D \leq \pm 15\%$	<p>Beginning Continuing Calibration:</p> <ol style="list-style-type: none"> 1) Repeat continuing calibration. 2) Perform new initial calibration <p>Ending Continuing Calibration:</p> <ol style="list-style-type: none"> 1) Judge the validity of the data. 2) Initiate corrective action, which may include; reanalysis of the continuing calibration; reanalysis of all samples in the analytical batch; performance of instrument maintenance (if the performance of instrument maintenance changes the analytical conditions, a new initial calibration must be performed.
<p>If a PCB is detected in a sample, a 5-point initial calibration curve is established for quantification of the identified PCB.</p>	<p>As required.</p>	$r \geq 0.995$ or $r^2 \geq 0.990$	<ol style="list-style-type: none"> 1) Reanalyze the standard(s). 2) Prepare and analyze new standard(s). 3) Recalibrate following system maintenance.
Quality Control	<p>Each Sample Delivery Group or 1 for each QC batch containing up to 20 samples</p>	\leq RDL for all target compounds.	<ol style="list-style-type: none"> 1) Reanalyze the Method Blank. 2) Evaluate the system and perform minor system maintenance. 3) Report the sample results and flag with a "B". 4) Rextract and reanalyze all associated samples.

QUALITY CONTROL PROCEDURES

Project: LAS Default

EPA Method 8080 - Organochlorine Pesticides and PCBs by GC-ECD

Issued by QAD on 09/20/95

	FREQUENCY	CRITERIA			CORRECTIVE ACTION
		Analyte	Aqueous	Solid	
Surrogate Spikes	Every sample, standard, and QC sample.	TCMX DCB	21-110% 36-126%	39-117% 66-128%	If the sample is an LCS or MB: 1) Check calculations. 2) Reanalyze LCS and/or MB. 3) Reextract and reanalyze LCS and/or MB and all associated samples. If the sample is not an LCS or MB: 1) Judge the validity of the data. 2) Check the LCS and MB surrogate recoveries; if within QC limits, flag the recoveries as attributable to matrix effect and note in the case narrative. 3) Reanalyze the sample and report the best of both results. Flag the data as appropriate.
Matrix Spikes/ Matrix Spike Duplicates	Each SDG or 1 for each QC batch containing no more than 20 samples.	Analyte	Aqueous		1) Evaluate system 2) Check calculations 3) Check LCS; if recoveries are within QC limits, note recoveries as attributable to matrix effects.
			Accuracy	Precision	
Laboratory Control Sample (LCS)	Each SDG or 1 for each QC batch containing no more than 20 samples	Analyte	Aqueous		1) Check calculations. 2) Reanalyze LCS 3) Reextract and reanalyze LCS and all associated samples.
			Accuracy	Precision	

PCB-1260 is only spiked for analyses requiring results for PCBs only - not for normal pesticides analysis

Note: All corrective actions for retention time criteria are to be followed according to LAS IDC "LAS Policy for Establishing Retention Time Windows for Gas Chromatography Techniques" (Landers, Fischer, Aleckson, 23-AUG-95). Any corrective action taken or deviations from the corrective actions listed must be delineated in the analyst's notes. Any deviations from the corrective actions listed must be delineated in the case narrative.

TAB

HASP

United States Air Force

Environmental Restoration Program

F I N A L

Health and Safety Plan

**Preliminary Groundwater Assessment at
Sites SS003, OWS704, SS004, SS006, and SS009**

**Operating Location Q, Missouri
(Richards-Gebaur Air Force Base)**



**Contract No. F41624-94-D-8051
Delivery Order No. 0016
AFBCA Project No. UEBL 95-7011**

March 1996

F I N A L

**Operating Location Q
(Richards-Gebaur Air Force Base)**

HEALTH AND SAFETY PLAN

**Preliminary Groundwater Assessments at
Sites SS003, OWS704, SS004, SS006, and SS009**

March 1996

Prepared for

**Air Force Center for Environmental Excellence (AFCEE/ERB)
Base Closure Restoration Division
Brooks Air Force Base, Texas 78235-5328**

**USAF Contract No. F41624-94-D-8051, Delivery Order No. 0016
AFBCA Project No. UEBL 95-7011**

Prepared by

**Versar, Inc.
6850 Versar Center
Springfield, Virginia 22151**

EMERGENCY CONTACTS

CONTACTS	TELEPHONE NUMBER
Emergency (Police, Fire, Medical)	911 (External)
Belton Police Department	(816) 331-1500
Jackson County Sheriff	(816) 524-4300
Belton Fire Department	(816) 331-2121
Research Belton Hospital	(816) 348-1200
Site Contact (Mark Esch)	(816) 348-2514
Versar Project Manager (Michael Dorman)	(703) 642-6804
Security	(816) 322-0001

NOTICE

This plan has been prepared for the United States Air Force by Versar, Inc. for the purpose of aiding in the environmental investigation under the Air Force Environmental Restoration Program. Because this plan supports environmental investigations at the site, its release prior to an Air Force final decision on site conditions may be in the public's interest. The limited objectives of this plan and the ongoing nature of the investigations, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this plan because subsequent facts may become known that may make this plan premature or inaccurate. Acceptance of this plan in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1294, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503				
1 AGENCY USE ONLY (Leave Blank)	2 REPORT DATE March 1996	3 REPORT TYPE AND DATES COVERED Final		
4 TITLE AND SUBTITLE Operating Location Q Health and Safety Plan			5 FUNDING NUMBERS USAF Contract No. F41624-94-D-8051, Delivery Order No. 0016 AFBCA Project No. UEBL 95-7011	
6 AUTHOR(S) Michael E. Dorman				
7 PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Versar, Inc. 6850 Versar Center Springfield, Virginia 22151			8 PERFORMING ORGANIZATION REPORT NUMBER	
9 SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Center for Environmental Excellence (AFCEE/ERB) Base Closure Restoration Division Brooks Air Force Base, Texas 78235-5328			10 SPONSORING/MONITORING AGENCY REPORT NUMBER	
11 SUPPLEMENTARY NOTES				
12a DISTRIBUTION/AVAILABILITY STATEMENT			12b DISTRIBUTION CODE	
13 ABSTRACT (Maximum 200 words) The health and safety plan documents safety training, procedures, and safe work practices, and emergency response procedures and contacts to be used during the performance of groundwater assessments at Operating Location Q (formerly Richards-Gebaur AFB), Missouri.				
14 SUBJECT TERMS			15 NUMBER OF PAGES 57	
			16 PRICE CODE	
17 SECURITY CLASSIFICATION OF REPORT Unclassified	18 SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19 SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20 LIMITATION OF ABSTRACT Unclassified	

ACRONYMS & ABBREVIATIONS

Abs	Absorption
ADC	Air Defense Command
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Environmental Excellence
AFCS	Air Force Communications Service
AFRES	Air Force Reserve
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
BBP	bloodborne pathogens
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
Con	Skim or eye contact
COR	Contracting Officer's Representative
CPR	cardiopulmonary resuscitation
DB	dry bulb
DoD	Department of Defense
DOT	Department of Transportation
ev	electron volt
FSL	Field Sampling Leader
GT	globe temperature
HASP	Health and Safety Plan
HQ	Headquarters
Ing	ingestion
Inh	inhalation
IP	ionization potential
IRP	Installation Restoration Program
MAC	Military Airlift Command
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m ³	milligrams per cubic meter
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
NWB	natural wet bulb temperature
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
pCi/L	picoCuries per liter
PEL	permissible exposure limit
POC	Point of Contact
PPE	personal protective equipment
ppm	parts per million
RI/FS	Remedial Investigations and Feasibility Studies
S	soil
SED	sediment
SG	soil gas
SSO	Site Safety Officer

ACRONYMS & ABBREVIATIONS

TLV	threshold limit value
WBGT	wet bulb globe temperature
°C	degrees Celsius
°F	degrees Fahrenheit

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APPENDICES

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Appendix A. Forms

SECTION 1.0**INTRODUCTION**

This document is Versar, Inc.'s Health and Safety Plan (HASP) for Operating Location Q (OL-Q), Belton, Missouri. The HASP will be utilized for groundwater assessments to be conducted by Versar at the OL-Q.

This HASP sets forth health and safety protocols for the field activities to be conducted at OL-Q under Delivery Order 0016. The HASP establishes guidelines for health and safety practices and personal protection for all field work to be conducted by Versar. The intent of the implementation of this plan is to ensure the health and safety of the site personnel, the general public, and the environment. Although it is impossible to eliminate all risks, strict adherence to this plan by all personnel should aid in minimizing incidents and accidents by promoting safety, while maintaining productivity. This document is subject to modification, as warranted, if changes in activities and/or procedures are indicated.

SECTION 2.0

BACKGROUND

2.1 SITE LOCATION

Operating Location Q (OL-Q) is located in west-central Missouri, approximately 18 miles south of downtown Kansas City and about 3 miles east of the Kansas state line. OL-Q currently comprises approximately 428 acres of land. It is considered part of Jackson County; however, a portion of the property overlaps into Cass County. Airport runways exist along the western and part of the northern boundaries of the OL-Q.

2.2 SITE HISTORY

Richards-Gebaur AFB (now Operating Location Q) was established in 1953, but was not named as such until 1957. The Air Defense Command (ADC) had primary control until 1970, when the Air Force Communications Service (AFCS) relocated its headquarters from Scott AFB, Illinois. The Military Airlift Command (MAC) assumed command of Richards-Gebaur AFB in 1977, when AFCS returned to Scott AFB. During these years, hazardous substance related activities included: aircraft maintenance activities, munitions storage, bulk fuel storage, fuel hydrant system, and fire protection training.

Air Force Reserve (AFRES) assumed operational control of the Base in October 1980. In 1994, the Base was closed and came under the control of the Air Force Base Conversion Agency (AFBCA). At present, hazardous substance related activities continue as they had on the Base (now OL-Q) in previous years, except that the fuel hydrant system was decommissioned in 1977.

Following base closure, the AFBCA was tasked to transfer portions of base property from Air Force ownership. Transfer of property cannot occur until environmental concerns at each site on the Base are addressed. The AFBCA is the current point of contact (POC) at Operating Location Q for all environmental actions, including the Confirmatory Sampling.

Past practices at the Base may have left several areas on the OL-Q with varying degrees of contamination. The area associated with this HASP is the Central Drainage Area, which is scheduled to undergo Confirmatory Sampling.

This information about historical practices was obtained from the Quality Program Plan for the Richards-Gebaur Air Force Base Full Service Remedial Action, prepared by Dames & Moore in March 1995.

2.3 IDENTIFIED AREAS

Groundwater assessments will be performed at five locations at OL-Q. These locations are listed below:

- SS003 - Oil Saturated Area
- OWS704 - Former UST and Oil/Water Separator Excavation
- SS004 - Hazardous Waste Storage Area
- SS006 - Hazardous Material Storage
- SS009 - Fire Valve Area

Detailed descriptions of these sites can be found in the accompanying Work Plan (Versar, January 1996).

2.4 PLANNED ACTIVITIES

The purpose of the groundwater assessments of the five sites is to determine the potential impacts of contaminated soils on the shallow groundwater regime. All five sites have had contaminated soils removed under interim remedial actions. During these actions, soil samples were collected and, in most cases, no contaminated soils remained. Some minor residual soil contamination remained after removal of the oil/water separator at site OWS704. The activities planned during the groundwater assessments include: direct push borings, along with groundwater sampling and the installation of temporary groundwater piezometers; and, if necessary, the installation of permanent groundwater monitoring wells if the direct push borings are unsuccessful in yielding groundwater. Only groundwater will be sampled during this study.

2.5 CONCEPTUAL SITE MODEL

It is anticipated that, during site activities, field personnel may be exposed to contaminated soil and groundwater. The possible chemicals encountered during sampling include petroleum hydrocarbons, volatile and semi-volatile organic compounds, and heavy metals. The exposure routes possible during the site work consist of dermal contact, inhalation, and incidental ingestion.

SECTION 3.0

ORGANIZATION

3.1 ORGANIZATION STRUCTURE

The Versar project team responsible for managing the Confirmatory Sampling at Operating Location Q include the following personnel:

<u>Name</u>	<u>Assigned Task</u>
Tom Rooney	Program Manager
Carl Woehrle	Deputy Program Manager/Quality Assurance Officer
Michael Dorman	Project Manager
Allen Esko	Field Sampling Leader and Site Safety Officer (FSL/SSO)
Ken Talley	Corporate/Health and Safety Officer
Mark Brown	Project Health and Safety Officer

Contacts for the base include:

Mark Esch	AFBCA Point of Contact (OL-Q Contact)
Fred Waterman	AFCEE Team Chief

3.2 SAFETY PROGRAM MEMBERS AND RESPONSIBILITIES

The Health and Safety Officer, the FSL/SSO, and field technicians will work as a team in order to accomplish the health and safety goals for this project.

Versar's Corporate Health and Safety Officer is responsible for ensuring that all corporate health and safety programs are adhered to by all Versar employees and its subcontractors. The Corporate Health and Safety Officer has reviewed and approved this document.

The Project Health and Safety Officer will audit field operations to ensure that the health and safety protocols are followed at OL-Q. The Project Health and Safety Officer will report any problems in the field to the Program and Project Managers, as well as to the Corporate Health and Safety Officer, OL-Q Contact, and AFCEE Team Chief.

The FSL/SSO is responsible for ensuring that the day-to-day operations at the site are conducted in accordance with the HASP. The FSL/SSO will have the authority to stop operations if the actions or conditions at the site are judged to be unsafe or do not comply with the requirements of the HASP. Any deviations from the health and safety protocol will require documentation by the FSL/SSO and shall be reported to the Project Health and Safety Manager. The FSL/SSO will also act as the designated Incident Response Leader.

All site employees will be responsible for reading and complying with the HASP. In addition to the HASP, no personnel will be permitted to perform any activity at the site that they believe will endanger their health and safety or the health and safety of others.

3.3 EMERGENCY TELEPHONE NUMBERS FOR SAFETY PROGRAM PERSONNEL

The emergency telephone numbers for the Versar health and safety personnel are provided below.

<u>Name</u>	<u>Emergency Phone Number</u>
Project Health and Safety Officer	(703) 642-6840
Field Sampling Leader/Site Safety Officer	(703) 750-3000, ext. 722
Program Manager	(303) 452-5700
Deputy Program Manager	(210) 524-7750
Project Manager	(703) 642-6804
OL-Q Contact	(816) 348-2514
AFCEE Team Chief	(210) 536-5209
Kansas City Fire Department	911

SECTION 4.0

SITE MAP

4.1 SITE MAP

Figure 4-1 presents a site map of Operating Location Q, including the major streets, the fire department, and main entrance. The specific areas where work is to be conducted are also shown in Figure 4-1.

4.2 EMERGENCY RESPONSE EQUIPMENT AND LOCATION

The Kansas City Fire Department is located at OL-Q on Hangar Road, as shown on Figure 4-1. The Kansas City Fire Department will be provided with a list of any chemicals to be used on site and their specified locations, as well as a description of the work to be conducted at each site.

4.3 SITE ENTRANCES AND EXITS

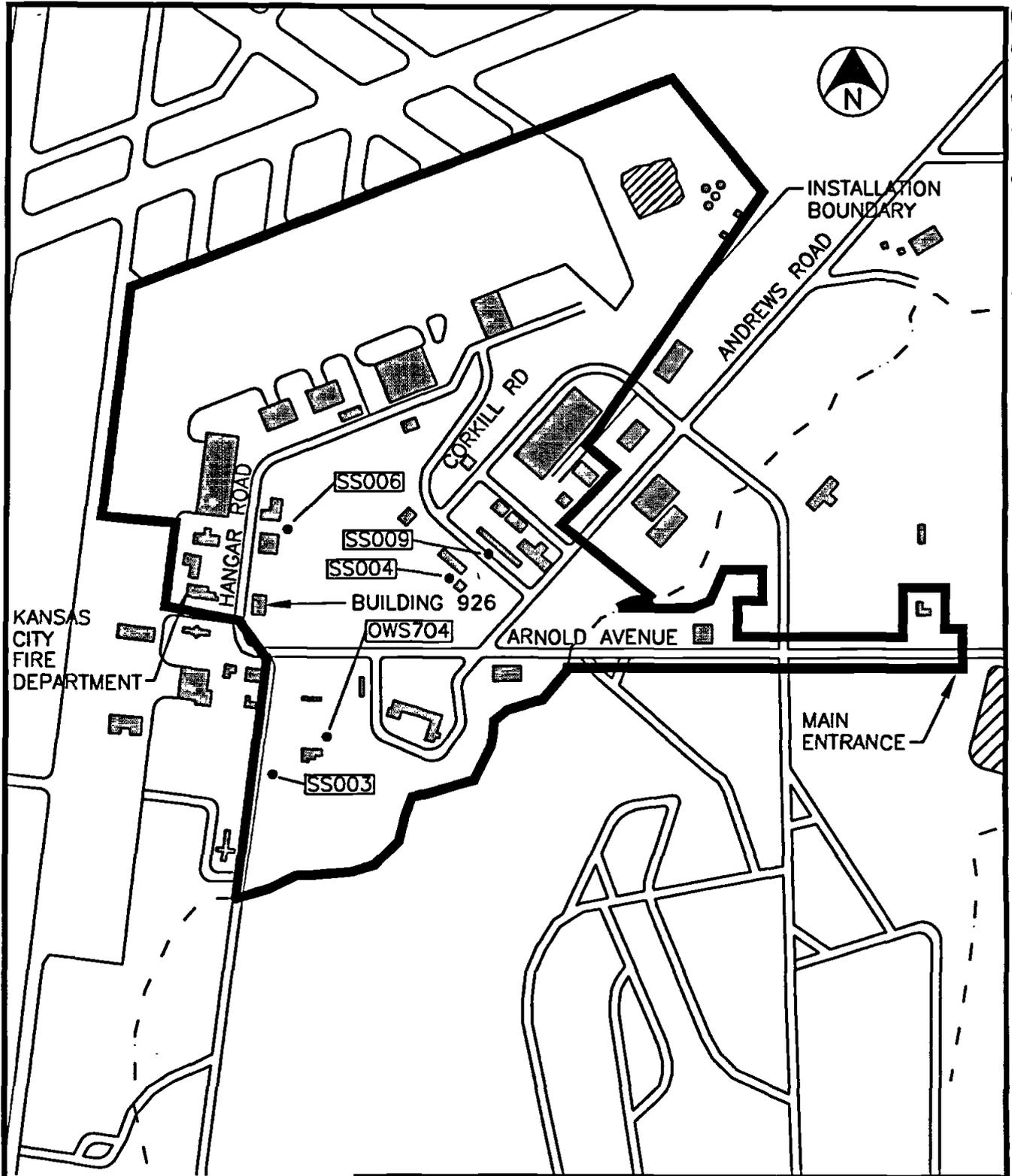
The main entrance to Operating Location Q is shown in Figure 4-1. This entrance is located on the east side of the OL-Q on County Line Road (155th Street). All five sites in the Preliminary Groundwater Assessment are in restricted areas open only during business hours.

4.4 EVACUATION ROUTE

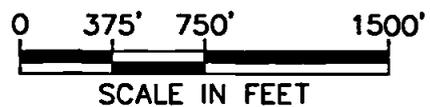
Medical evacuations will be made to Research Belton Hospital, which is located approximately 4 miles from the OL-Q. The Hospital's address is 17065 South U.S. Highway 71, Belton, Missouri 64012. From the OL-Q, take County Line Road (east) approximately 1¼ miles to U.S. Highway 71. Proceed south on Highway 71 approximately 2½ miles to the Missouri Highway 58 exit. The Research Belton Hospital is located immediately east of the Highway 58 exit. This evacuation route is shown in Figure 4-2.

4.5 TELEPHONE LOCATIONS

Versar's field personnel will be equipped with a cellular telephone to be made available to site personnel at all times. Other telephones located near work sites are available in Buildings 926 and 901.



VAFB\2816-103\9510-439.DWG PLOT DATE: 03-07-96 FIG 4_1



NOTE: ALL OL-Q PROPERTY IS NOT SHOWN ON THIS MAP

AFCEE/OL-Q		LAYOUT OF OPERATING LOCATION Q AND SITE LOCATIONS	
DESIGNED DORMAN	DATE 03/07/96		
DRAWN MACLIN	DATE 03/07/96	PROJECT NO. 2816-103	SCALE: AS SHOWN
Versar INC. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		DRAWING NO. 9510-439	FIGURE 4-1

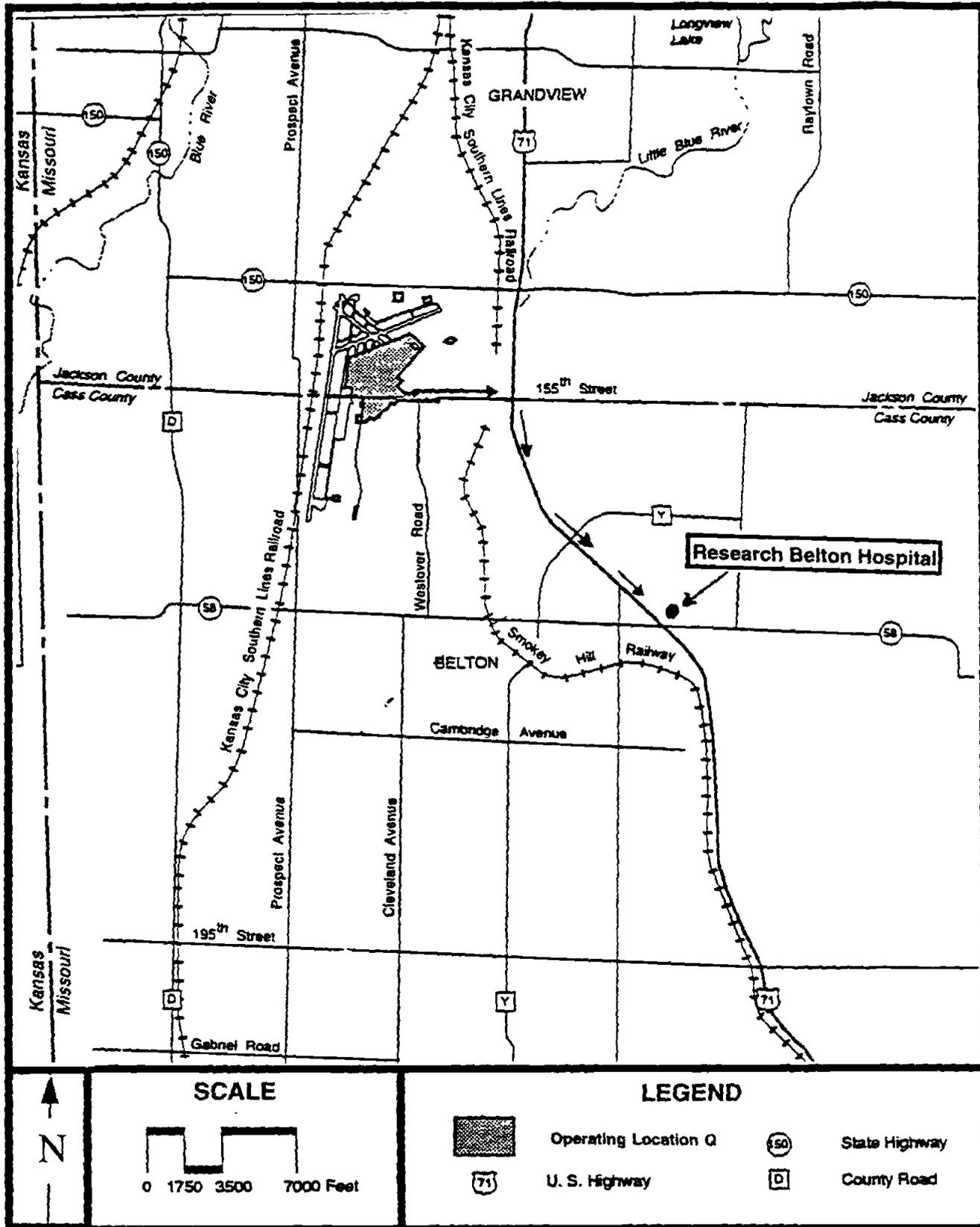


FIGURE 4-2 MEDICAL EVACUATION ROUTE

SECTION 5.0

HAZARD ANALYSIS

This section describes the risks and hazards associated with the work to be conducted at Operating Location Q. In particular, the risks involved in drilling and sampling are addressed. The anticipated hazards include chemical and physical hazards.

5.1 CHEMICAL HAZARDS

Several products containing hazardous chemicals may be used during the groundwater assessments. For all chemicals purchased for use at Operating Location Q, a material safety data sheet (MSDS) will be obtained and placed in a yellow binder for employee access. In addition, all potential hazardous contaminants of concern anticipated to be encountered during sampling at OL-Q and their hazards are presented in Table 5-1. These contaminants include: volatile and semi-volatile organic compounds, heavy metals, and petroleum hydrocarbons.

5.2 PHYSICAL HAZARDS

The physical hazards present at OL-Q include heat stress, cold stress, noise, and hazards associated with working around heavy equipment. Detailed discussions of heat stress and cold stress are presented in Sections 5.2.1 and 5.2.2, respectively.

There are risks of possible injury whenever working around stationary or moving equipment. Caution must always be practiced to avoid situations which may lead to unsafe conditions.

Many accidents are caused by stumbling or tripping over objects associated with a cluttered worksite. Personnel should always exercise "good housekeeping" practices, maintaining work places in a clean and orderly manner, to help minimize these types of hazards.

Other physical hazards that could be encountered at the site include inclement weather, vehicular hazards, and biological hazards. Weather hazards that may be encountered at OL-Q could include high winds or tornados, hail, and lightning. In the case of any of these hazards, personnel should immediately seek shelter in an established building. If shelter from high winds is not available, personnel should lay in any available ditch or other low area. Vehicular hazards may be encountered throughout the OL-Q. Personnel should always be aware of vehicular traffic, and shall provide readily visible barriers, such as bright colored cones or tape if working near active roads.

5.2.1 Heat-related Stress

Heat stress is the result of the body's inability to maintain a normal body temperature because of excessive heat. When heat production of the body increases and/or when the outside temperature increases, the body reacts with a greater need to dissipate heat by

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ¹ (ppm)	Threshold Limit Value ² (ppm)	Immediately Dangerous to Life or Health ³ (ppm)	Odor Threshold ⁴ (ppm)	Ionization Potential ⁵ (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ⁶
Benzene	10	10	3000	34-119	9.24	Irritates eyes, nose, respiratory system/giddiness, headache, nauseous, staggered gait, fatigue, bone marrow depression. Targets blood, central nervous system, skin, bone marrow, eyes and respiratory system. Carcinogen. Pathway: Inh, Abs, Ing, Con.
Bromodichloromethane	NA	NA	NA	1680 mg/m ³	10.88	Potential carcinogen.
Bromoform	0.5	0.5	NA	None	10.48	Irritates eyes and respiratory system; central nervous system depression; liver damage. Targets skin liver, kidneys, respiratory system, central nervous system. Pathway: Inh, Abs, Ing.
Carbon Tetrachloride	10	5	300	140-584	11.47	Central nervous system depression, nausea, vomiting, liver and kidney damage and skin irritant. Targets central nervous system, eyes, lungs, liver, kidneys, and skin. Carcinogen. Pathway: Inh, Abs, Ing, Con.
Chlorobenzene	75	75	2400	1.3	9.07	Irritates skin, eyes, nose, drowsiness, incoordination, in animal causes liver, lung, and kidney damage. Targets respiratory system, eyes, skin, central nervous system, and liver. Pathway: Inh, Ing, Con.
Chloroform	50	10	1000	133-276	11.42	Dizziness, mental dullness, nausea, disorientation, headache, fatigue, anesthesia, irritates eyes and skin. Targets liver, kidneys, heart, eyes and skin. Carcinogen. Pathway: Inh, Inj, Con.

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ^{1/} (ppm)	Threshold Limit Value ^{2/} (ppm)	Immediately Dangerous to Life or Health ^{3/} (ppm)	Odor Threshold ^{4/} (ppm)	Ionization Potential ^{5/} (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ^{6/}
Chloromethane	100	50 (skin)	10000	None	11.28	Dizziness, nausea, vomiting, visual disturbance, staggering, slurred speech, convulsions, coma, liver and kidney damage, frostbite. Targets central nervous system, liver, kidneys, and skin. Carcinogen. Pathway: Inh, Con.
1,2-Dichlorobenzene	50	50	1000	0.7	9.06	Irritates nose and eyes, liver and kidney damage, skin blistering. Targets liver, kidneys, skin, and eyes. Pathway: Inh, Abs, Ing, Con.
1,4-Dichlorobenzene	75	75	1000	0.12	8.98	Headache, eye irritant, swelling periorbital, profuse rhinitis, nausea, vomiting, jaundice, cirrhosis, in animals causes liver and kidney damage. Targets liver, respiratory system, eyes, kidneys, and skin. Carcinogen. Pathway: Inh, Inj, Con.
Dichlorodifluoromethane	1000	1000	50000	NA	11.75	Dizziness, tremors, unconsciousness, cardiac arrhythmia, cardiac arrest Targets cardiovascular system and peripheral nervous system. Pathway: Inh, Con.
1,1-Dichloroethane	100	200	4000	None	11.06	Central nervous system depression, skin irritant, liver and kidney damage. Targets skin, liver, and kidneys. Pathway: Inh, Inj, Con.
1,2-Dichloroethane	50	10	1000	6-111	11.05	Nausea, drunkenness, depression, liver and kidney damage. Targets liver and kidney Carcinogen. Pathway: Inh, Inj, Con.
Cis-1,2-Dichloroethene	200	200	4000	0.085-500	9.65	Irritates eyes, respiratory system, central nervous system depression. Targets respiratory system, eyes, and central nervous system. Pathway: Inh, Ing, Con.

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ¹ (ppm)	Threshold Limit Value ² (ppm)	Immediately Dangerous to Life or Health ³ (ppm)	Odor Threshold ⁴ (ppm)	Ionization Potential ⁵ (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ⁶
Trans-1,2-Dichloroethene	200	200	4000	0.085-500	9.65	Irritates eyes, respiratory system, central nervous system depression. Targets respiratory system, eyes, and central nervous system. Pathway: Inh, Ing, Con.
1,2-Dichloropropane	75	75	2000	0.26	10.87	Eye and skin irritant, drowsiness, light-headedness, in animals: liver and kidney disease. Target skin, eyes, respiratory system, liver, and kidney. Carcinogen. Pathway: Inh, Con, Ing.
Ethylbenzene	100	100	2000	None	8.76	Irritates eyes and mucous membranes, headache, dermatitis, narcosis, coma. Targets eyes, upper respiratory system, skin, central nervous system. Pathway: Inh, Ing, Con.
Methylene chloride	500	50	5000	160	11.3	Fatigue, weakness, sleepiness, light-headedness, numb and tingling limbs, nausea, eye and skin irritation. Target skin, central nervous system, cardiovascular system, eyes. Carcinogen. Pathway: Inh, Ing, Con.
Tetrachloroethene (PCE)	100	50	500	47	9.32	Irritates eyes, nose and throat, nausea, flushed face and neck, vertigo, dizziness, incoordination, headache, somnolence, skin erythema, liver damage. Targets liver, kidneys, eyes, upper respiratory system, and central nervous system. Carcinogen. Pathway: Inh, Ing, Con.
Toluene	200	100	2000	0.16-37	8.82	Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lacrimation, nervousness, muscle fatigue, insomnia, dermatitis. Targets central nervous system, liver, kidneys and skin. Pathway: Inh, Abs, Ing, Con.

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ¹ (ppm)	Threshold Limit Value ² (ppm)	Immediately Dangerous to Life or Health ³ (ppm)	Odor Threshold ⁴ (ppm)	Ionization Potential ⁵ (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ⁶
1,1,1-Trichloroethane	350	350	1000	390	11.00	Headache, lassitude, central nervous system depression, poor equilibrium, irritates eyes, dermatitis, cardiac arrhythmia. Targets skin central nervous system, cardiovascular system, and eyes. Pathway: Inh, Inj, Con.
1,1,2-Trichloroethane	10	10	500	NA	11.00	Irritates eyes and nose, central nervous system depression, liver and kidney damage. Targets central nervous system, eyes, nose, liver and kidneys. Carcinogen. Pathway: Inh, Abs, Ing, Con.
Trichloroethene (TCE)	100	50	1000	82	9.45	Headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, eye irritant, dermatitis, cardiac arrhythmia, paresthesia. Targets heart, respiratory system, liver, kidneys, central nervous system, and skin. Carcinogen. Pathway: Inh, Ing, Con.
Trichlorofluoromethane (based on previous CFCs)	1000	1000	50000	NA	NA	Based on Dichlorotetrafluoroethane, see above.
Vinyl Chloride	1 (29 CFR 1910 1017)	5	NA	3000	9.99	Weakness, abdominal pain, gastrointestinal bleeding, hepatomegaly, pallor or cyanosis of extremities. Targets liver, central nervous system, blood, respiratory system, lymphatic system Carcinogen Pathway: Inh.
Antimony	0.5 mg/m ³	0.5 mg/m ³	80 mg/m ³	NA	NA	Irritates nose, throat, skin, and mouth, coughing, dizziness, headache, nausea, vomiting, diarrhea, stomach cramps, insomnia. Targets respiratory system, cardiovascular system, skin and eyes. Pathway: Inh, Con.

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ¹¹ (ppm)	Threshold Limit Value ² (ppm)	Immediately Dangerous to Life or Health ³ (ppm)	Odor Threshold ⁴ (ppm)	Ionization Potential ⁵ (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ⁶
Arsenic	0.05 mg/m ³	0.2 mg/m ³	100 mg/m ³	NA	NA	Ulceration of the nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, and hyperpigmentation of skin. Targets liver, kidneys, skin, lungs, and lymphatic system. Carcinogen. Pathway: Inh, Abs, Con, Ing.
Beryllium	0.002 mg/m ³	0.002 mg/m ³	10 mg/m ³	NA	NA	Respiratory symptoms, weakness, fatigue, weight loss. Targets lungs, skin, mucous membranes. Carcinogen. Pathway: Inh.
Cadmium	0.2 mg/m ³	0.05 mg/m ³	50 mg/m ³	NA	NA	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, anosmia, emphysema, proteinuria, mild anemia. Target respiratory system, kidneys, prostate, blood. Carcinogen. Pathway: Inh, Inj.
Chromium Metal	1 mg/m ³	0.5 mg/m ³	NA	NA	NA	Histologic fibrosis of lungs. Targets respiratory system. Pathway: Inh, Inj.
Chromium (II) and (III) Compounds	0.5 mg/m ³	0.5 mg/m ³	NA	NA	NA	Sensitization of skin. Targets skin. Pathway: Ing, Con.
Copper (dust)	1 mg/m ³	1 mg/m ³	NA	NA	NA	Irritates nasal mucous membrane, eyes, and pharynx, nasal perforation, metallic taste, dermatitis, in animals: lung, liver and kidney damage, and anemia. Targets respiratory system, liver, kidneys, increased risk with Wilson's disease. Pathway: Inh, Ing, Con.

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ¹⁾ (ppm)	Threshold Limit Value ²⁾ (ppm)	Immediately Dangerous to Life or Health ³⁾ (ppm)	Odor Threshold ⁴⁾ (ppm)	Ionization Potential ⁵⁾ (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ³⁾
Lead	0.05 mg/m ³ (29 CFR 1910.1025)	0.15 mg/m ³	700 mg/m ³	NA	NA	Weakness, lassitude, insomnia, facial pallor, pal eye, malnutrition, constipation, abdominal pain, colic, anemia, gingival lead line, tremor, wrist and ankle paralysis, encephalopathy, nephropathy, eye irritation, hypotension. Targets gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue. Pathway: Inh, Ing, Con.
Mercury	0.1 mg/m ³ (skin) (ceiling)	0.05 mg/m ³	28 mg/m ³	NA	NA	Cough, chest pain, dyspnea, bronchial pneumonia, tremor, insomnia, irritability, indigestion, headache, fatigue, weakness, stomatitis, salivation, gastrointestinal disturbance, proteinuria, irritated eyes and skin. Target skin respiratory system, kidneys, and eyes. Pathway: Inh, Abs, Con.
Nickel - Soluble	0.1 mg/m ³	0.1 mg/m ³	NA	NA	NA	Headache, vertigo, nausea, vomiting, epigastric pain, substernal pain, cough, hyperpnea, cyanosis, weakness, leukocytosis, pneumonia, delirium, and convulsions. Targets lungs, paranasal sinus, central nervous system. Carcinogen. Pathway Inh, Inj, Con.
Nickel - Insoluble or Dust	1 mg/m ³	1 mg/m ³	NA	NA	NA	Same as Nickel - Soluble
Selenium	0.2 mg/m ³	0.2 mg/m ³	NA	0.0002 mg/m ³	NA	Irritates eyes, nose, throat, visual disturbances, headache, chills, fever, dyspnea, bronchitis, metallic taste, garlic breath, gastrointestinal disturbance, dermatitis, skin and eye burns, in animals: anemia, and liver and kidney damage. Targets upper respiratory system, eyes, skin, liver, kidneys and blood. Pathway: Inh, Abs, Ing, Con.

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ¹⁾ (ppm)	Threshold Limit Value ²⁾ (ppm)	Immediately Dangerous to Life or Health ³⁾ (ppm)	Odor Threshold ⁴⁾ (ppm)	Ionization Potential ⁵⁾ (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ⁶⁾
Silver	0.01 mg/m ³	0.1 mg/m ³	NA	NA	NA	Blue-gray eyes, nasal septum, throat, skin, irritates skin, ulceration, gastrointestinal disturbance. Targets nasal septum, skin and eyes. Pathway: Inh, Ing, Con.
Thallium	0.1 mg/m ³	0.1 mg/m ³	20 mg/m ³	NA	NA	Nausea, diarrhea, abdominal pain, vomiting, ptosis, strabismus, peripheral neuritis, tremor, retester tightness, chest pain, pulmonary edema, seizure, chorea, psychosis, liver and kidney damage, alopecia, paresthesia legs. Targets eyes, central nervous system, lungs, kidneys, gastrointestinal tract, body hair. Pathway: Inh, Abs, Ing, Con.
Zinc (oxide)	15 mg/m ³	10 mg/m ³	NA	NA	NA	Based on zinc oxide fume. Sweet metallic taste, dry throat, cough, chills, fever, tight chest, dyspnea, rales, reduced pulmonary function, headache, blurred vision, muscle cramps, lower back pain, nausea, vomiting, fatigue, lassitude, malnutrition. Targets respiratory system. Pathway: Inh.
Acenaphthene	0.2 mg/m ^{3 a)}	0.2 mg/m ^{3 a)}	700 mg/m ^{3 a)}	0.08	NA	Irritates eyes, skin, and mucous membranes. Targets respiratory system, eyes, and skin. Pathway: Inh, Con.
Acenaphthylene	0.2 mg/m ^{3 a)}	0.2 mg/m ^{3 a)}	700 mg/m ^{3 a)}	NA	NA	Irritates and burns eyes and skin, dizziness and suffocation. Targets skin, eyes, and respiratory system. Carcinogen. Pathway: Inh, Con.
Anthracene	0.2 mg/m ^{3 a)}	0.2 mg/m ^{3 a)}	700 mg/m ^{3 a)}	NA	NA	Irritates eyes, respiratory tract, and skin. Targets skin, eyes, and respiratory system. Pathway: Inh, Con.

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ^{1/} (ppm)	Threshold Limit Value ^{2/} (ppm)	Immediately Dangerous to Life or Health ^{3/} (ppm)	Odor Threshold ^{4/} (ppm)	Ionization Potential ^{5/} (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ^{6/}
Benzo(a)pyrene	0.2 mg/m ³	0.2 mg/m ³	700 mg/m ³	NA	NA	Irritates skin with rash, thickening and discoloration of skin. Targets skin. Mutagen, experimental carcinogen and teratogen. Pathway: Inh, Con.
Chrysene	0.2 mg/m ³	0.2 mg/m ³	700 mg/m ³	NA	NA	Burns skin and eyes. Targets skin and eyes. Carcinogen. Pathway: Inh, Con.
Fluoranthene	0.2 mg/m ^{3 a)}	0.2 mg/m ^{3 a)}	700 mg/m ^{3 a)}	NA	NA	Burns to skin and eyes, nausea, tachycardia, arrhythmias, liver injury, pulmonary edema, respiratory arrest. Targets cardiovascular system, liver, skin, eyes, respiratory system. Carcinogen. Pathway: Inh, Abs, Inj, Con.
Fluorene	0.2 mg/m ^{3 a)}	0.2 mg/m ^{3 a)}	700 mg/m ^{3 a)}	NA	NA	Irritates eyes and skin. Targets respiratory system, skin, eyes, bladder and kidneys. Carcinogen. Pathway: Inh, Abs, Inj, Con.
Naphthalene	10	10	500	NA	NA	Irritates eyes, headache, confusion, excitement, malaise, nausea, vomiting, abdominal pain, irritates bladder, profuse sweating, jaundice, hematopoietic, hemoglobinuria, renal shutdown, and dermatitis. Targets eyes, blood, kidneys, liver, skin, red blood cells, central nervous system. Pathway: Inh, Abs, Ing, Con.
Phenanthrene	0.2 mg/m ^{3 a)}	0.2 mg/m ^{3 a)}	700 mg/m ^{3 a)}	NA	NA	Burns skin and eyes. Targets skin and eyes. Carcinogen. Pathway: Inh, Con.

TABLE 5.1
HEALTH HAZARD VALUES FOR POTENTIAL CONTAMINANTS OF CONCERN AT OPERATING LOCATION Q

Chemical Name	OSHA Permissible Exposure Limit ¹ (ppm)	Threshold Limit Value ² (ppm)	Immediately Dangerous to Life or Health ³ (ppm)	Odor Threshold ⁴ (ppm)	Ionization Potential ⁵ (eV)	Symptoms/Effects of Acute Exposure and Exposure Pathways ³
Pyrene	0.2 mg/m ³ ^{a)}	0.2 mg/m ³ ^{a)}	700 mg/m ³ ^{a)}	NA	7.72	Irritates eyes, skin and throat. Targets eyes, skin, and upper gastrointestinal system. Carcinogen. Pathway: Inh, Con.

mg/kg - milligram per kilogram
 pCi/L - picoCuries per liter
 Con - Skin or Eye Contact
 CFC - Chlorofluorocarbon
 mg/L - milligram per liter
 eV - electron volts
 S - Soil
 OSHA - Occupational Safety and Health Administration
 NA - Not Available
 Inh - Inhalation
 GW - Groundwater
 ppm - parts per million
 Abs - Absorption
 SG - Soil Gas
 mg/m³ - milligram per cubic meter
 Ing - Ingestion
 SED - Sediment

¹ OSHA enforced average air concentration to which a worker may be exposed for an 8-hour workday without harm. Published in 29 CFR 1910.1000, 1993.
² Time weighted average as provided by the Guide to Occupational Exposure - 1990, American Conference of Industrial Hygienists, 1990.
³ Immediately Dangerous to Life or Health (IDLH) maximum concentration from which in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing and escape-impairing or irreversible health effects. Published by the National Institute for Occupational Safety and Health (NIOSH), June 1990.
⁴ 1993 Health and Safety Manual. Enserch Environmental 1993.
⁵ NIOSH, June 1990.

^{a)} Based on coal tar pitch volatiles (benzene soluble fraction).
^{b)} Based on Gamma BHC (Lindane)

accelerating the production of perspiration. The rate of perspiration may outstrip the rate of sweat evaporation, particularly when the humidity is high. The rate of evaporation depends on temperature, humidity, and convection (wind currents). Because the rate of evaporation declines with an increase in humidity, this mode of heat loss is compromised depending on climatological conditions. If high humidity is combined with high temperature, other thermoregulatory mechanisms, including conduction and radiation, will be compromised.

The protective garments that protect the skin from unwanted chemical exposure also insulate the body from the environment, preventing both heat transfer and the evaporation of perspiration from the skin because of the high humidity levels developed inside the garments.

5.2.1.1 Heat-related Problems

Heat Rash

Heat rash is a rash due to continuous exposure of the body to heat or humid air. This condition is generally considered to be a nuisance and will generally be aggravated by chaffing clothes.

Heat Cramps

Heat cramps are muscular pains and spasms due largely to loss of salt from the body through sweating or resulting from the body's inadequate intake of electrolytes. Heat cramps may be associated also with heat exhaustion. In general, in the case of heat cramps, the muscles of the legs and abdomen are likely to be affected first.

Heat Exhaustion

Heat exhaustion is a response to heat characterized by fatigue, weakness, and, often, collapse. Heat exhaustion occurs when, among other things, the intake of water is inadequate to compensate for loss of fluids through sweating. The signs and symptoms of heat exhaustion follow:

- Normal body temperature of 98.6°F (oral)
- Pale and clammy skin
- Profuse perspiration
- Tiredness and weakness
- Headache and possible cramps
- Nausea and dizziness (possible vomiting)
- Possible fainting

Heat Stroke

Heat stroke is the most severe heat stress disorder. It is characterized by extremely high oral body temperatures (106°F or higher) and discontinuance of sweating. Heat stroke is

a life-threatening emergency, and immediate medical care is always needed. The signs and symptoms follow:

- Body temperature is high (106°F or higher, oral)
- Skin is hot, red, and dry
- Pulse is rapid and strong
- Victim may be unconscious

5.2.1.2 Permissible Heat Exposure Threshold Limit Values

The threshold limit values (TLVs) listed in Table 5-2 will maintain a maximum deep body temperature below 100.4°F for most acclimatized workers, assuming that they are wearing light clothing and have an adequate water intake; however, heat tolerance will be reduced when protective garments are worn, because cooling by the evaporation of perspiration will be decreased. With the use of protective clothing, a microclimatic condition prevails under the garment that is not determinable from environmental measurements. The TLVs are to be used as initial guidance for evaluation of heat stress.

5.2.1.3 Monitoring Requirements and Prevention

Before beginning daily work activities, including protective garment usage, baseline parameters will be recorded for the following:

- Heart rate: (Normal is 60-100 beats/min.)
- Oral temperature: (Normal is 98.6°F ± 1°)
- Body weight:

A work/rest cycle shall be implemented at any time that heat stress poses a threat, and in accordance with Table 5-2. The work/rest cycle procedure follows:

- At the beginning of the work/rest cycle, the following parameters may be measured and compared to baseline measurements: body weight, oral temperature, and heart rate.
- At the end of the rest period, the heart rate should not exceed 100 beats per minute. If the heart rate is over 100 beats per minute, the person shall remain at rest until the heart rate is below 95 beats per minute.
- At the end of the rest period, oral body temperature will be measured. An elapsed time of 5 minutes shall be established between oral measurement of temperature and the consumption of cold liquids. The oral temperature will not exceed the baseline temperature. Workers will not be permitted to continue working when the oral temperature exceeds 100.4°F. If the oral temperature exceeds the baseline temperature, but is less than 100.4°F, the worker is to remain at rest until the oral temperature is equal to the baseline temperature.

**TABLE 5-2
PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES**

Work/Rest Schedule	Work Load and Temperature (°F WBGT)		
	Light	Moderate	Heavy
Continuous	86.0	80.0	77.06
75% work, 25% rest/hour	87.0	82.0	78.5
50% work, 50% rest/hour	88.5	85.0	82.0
25% work, 75% rest/hour	90.0	88.0	86.0

Wet bulb globe temperature (WBGT) values are calculated by the following equations.

Outdoors with solar load:

$$\text{WBGT} = 0.7 * \text{NWB} + 0.2 * \text{GT} + 0.1 * \text{DB}$$

Indoors or outdoors with no solar load:

$$\text{WBGT} = 0.7 * \text{NWB} + 0.3 * \text{GT}$$

WBGT - Wet bulb globe temperature index

NWB - Natural wet bulb temperature

GT - Globe temperature

DB - Dry bulb

The determination of WBGT requires the use of a black globe thermometer, a natural wet-bulb, and a dry-bulb thermometer.

- During the course of the work assignment, each worker must be monitored for signs of heat illness by the supervisor or a designated fellow worker.
- As a minimum for each 2-hour period worked, a 15-minute rest period is required.

Other general safety and health regulations to prevent heat stress include the following:

- Clean drinking water and containers shall be located at each work site in a designated clean area.
- Salt tablets shall not be used.
- Rest areas shall be located in a designated clean area away from the heat source(s), or shall be located in a shaded area with good ventilation.
- Small packets of ice shall be made available for cooling purposes.
- Field showers or a portable water supply may be used to help reduce body heat.
- Heavy work may be scheduled in the mornings or late afternoons, or when the sun is at its lowest intensity.
- Work will not be permitted during heat emergencies (i.e., heat waves) without the use of cooling jackets, vests, or suits.
- Supervisors not enforcing the work/rest requirements or not supplying workers with drinking water shall be relieved of their supervisory duties.
- Only electrolyte solutions (such as Squincher or other equivalent) approved by the FSL/SSO shall be used along with water.

5.2.2 Cold-related Stress

Cold stress is caused by constant exposure of the body to temperatures at or below freezing. Factors contributing to cold stress include:

- Improper clothing
- Exposed skin
- Wet or moist clothing on skin
- Immersion in water
- Poor physical condition
- Alcohol and drug abuse

- Excessive heating of the body
- Fatigue

Other conditions contributing to cold stress include:

- Handling evaporative liquids such as acetone and alcohol
- Use of metal tools and contact with cold surfaces
- Tightly fitting clothes or protective equipment
- Handling wet objects
- Wind

5.2.2.1 Cold-related Problems

Frostbite

Frostbite occurs when the epidermal cells of the body are subjected to cold temperatures and freeze. The three factors in determining the severity of a local cold-related stress injury are the duration of exposure, the temperature to which the skin is exposed, and the wind speed. The most commonly affected parts of the body are those that are farthest away from the heart and have a large surface area (i.e., feet, hands, ears, and nose). Frostbite can generally be classified on a scale of between one and three degrees as follows:

- First-degree frostbite usually involves the tips of the ears, nose, cheeks, chin, and toe tips. The skin suddenly blanches (becomes white).
- Second-degree frostbite involves the skin and the superficial tissue just beneath it. The skin also becomes white, waxy, and firm, although the tissue beneath it remains soft.
- Third-degree frostbite involves freezing, not only of the skin and subcutaneous tissue, but even muscle and bone. The tissues are cold, pale, and frozen to the touch.

General signs of frostbite include color change in skin to white or grayish-yellow, ice crystals observed on the skin, or affected area becomes cold and numb.

General symptoms of frostbite include:

- Prickling and itching of the skin
- Pain may be first felt, but later subsides
- Numbness of the affected area
- Stiffness and paralysis of muscles

If it is determined that frostbite has occurred, it is important of keep the victim warm, provide a warm drink if the victim is conscious, and place the frozen part of the body in lukewarm water (below 100°F). If no water is available, wrap the frozen body parts in a

clean sheet or blanket. Frostbite is a serious medical condition and requires immediate professional medical attention and care. The victim must always be observed for signs of respiration loss and shock.

The following list states actions that should not be administered to the victim:

- Do not rub the affected area
- Do not apply heat through the use of heat lamps or hot water bottles
- Do not place injured part near a hot stove or other direct heat sources
- Do not break blisters
- Do not allow victim to walk, if at all possible: if victim must walk, it is better to walk on a frozen foot than a partially thawed one

Hypothermia

Severe, progressive lowering of the body's core temperature is referred to as systemic hypothermia. Systemic hypothermia may be unrelated to outside temperature and may occur when outside temperatures are above or below freezing. It occurs when the core temperature of the body falls below 95°F (35°C), resulting from the body-temperature-controlling mechanism being overwhelmed.

The symptoms of hypothermia include:

- Shivering
- Difficult speech
- Loss of dexterity
- Drowsiness
- Mental confusion and disorientation
- Decrease in pulse rate, blood pressure, and body temperature
- Collapse
- Coma

Hypothermia is a medical emergency that can be accompanied by shock and loss of respiration. Professional medical care shall be administered immediately, in all cases. If medical attention is not immediately available, remove all wet and/or frozen clothing from the victim and warm the victim in warm blankets or a water bath. Transport the victim to a medical facility as soon as possible.

5.2.2.2 Prevention of Cold-related Stress

Cold-related stress can be prevented by keeping warm and dry, and by wearing appropriate layers of loose fitting clothes and a hat. In addition, overheating while working in the cold should be avoided. Allow evaporation of perspiration by opening the neck, waist, sleeves, etc. Clothing must be kept dry.

Preventive Work Guidelines:

- Exposure to cold shall be terminated immediately by the supervisor or employee when severe shivering becomes evident.
- Work will be arranged so that sitting or standing still for long periods of time is minimized.
- The buddy system should be used and fellow employees monitored for signs of frostbite and hypothermia.
- Adequate insulating clothing shall be worn while working in air temperatures below 40°F. The wind chill factor is critical and can significantly lower the perceived temperature.
- When air temperature falls below the 30°F dry bulb temperature, wind speed will be measured periodically. The wind chill factor will be calculated to determine the risks of cold stress and steps initiated to prevent it.
- Metal tool handles will be covered with thermal insulating material at temperatures below 30°F.
- When work is performed continuously in the cold at a wind chill factor below 20°F, heated shelter will be made available.
- A work rest regimen will be implemented when the actual temperature is below 0°F (advisory level) during normal working day schedules (8-hour day).

5.2.3 Biological Hazards

Snakes

Snakes do not usually attack unless they are disturbed (e.g., stepped on) or feel threatened. The copperhead is the only indigenous poisonous snake in the area. Local signs evident immediately after a snake bite range from hardly noticeable to very marked (i.e., intense pain and a hard, swollen area). More serious signs, such as drowsiness or anxiety, weakened or rapid pulse rate, respiratory difficulty, vertigo, faintness, and vomiting may develop within a few hours, but may take as long as 2 days.

Field personnel should wear proper foot and leg protection (e.g., high leather or thick rubber boots with heavy canvas long pants tucked in). When performing activities during which there exists a potential for encountering a snake (e.g., moving a fallen tree or branch), take extra precautions and carefully inspect the area before and during the work.

If a person is bitten, he/she should be transported to the nearest first-aid center. DO NOT attempt to apply a tourniquet, or employ the "cut and suck" method of treatment. It is

important that the bitten person make no unnecessary movement. The part of the body where the bite has occurred should be immobilized, and the affected area kept at an elevation below the heart. If possible, kill the snake, and bring it to the medical center (or give a good description of the snake), so that a specific antivenom may be administered.

Insects

Problems associated with ticks and chiggers are also possible. The use of personal protective equipment will offer some protection, but frequent use of insect repellent and wearing of light-colored clothing is also recommended. Close attention to one's skin and scalp will help to detect ticks and chiggers at an early stage, and individuals should search themselves thoroughly for insects during breaks and at the end of the day. Insect repellent should not be applied on skin areas that will directly contact sampling media.

Removal of a tick may be accomplished by using tweezers to gently pull the tick away from the skin. The bite area should be cleansed and treated with an antiseptic. If possible, save the tick in a closed container; if illness develops, identification may expedite treatment. Seek medical attention if skin rash, muscle aches, or flu-like symptoms occur.

Poisonous Plants

Poison Ivy (i.e., Poison Oak and Poison Sumac) may be present in the area. These plants have compound leaves, with three leaflets. The poison is transmitted by the sap from anywhere on the plant. Symptoms of poisoning are severe skin rash with blisters, swelling, itching, and burning. Prevention practices include the wearing of proper work clothing that covers the skin and prevents direct contact with the plants or trees. If skin does become contaminated and infection occurs, symptoms may be treated with topical lotions (e.g., calamine lotion). Contaminated clothing should be laundered separately prior to the next wearing.

5.2.4 Drilling Hazards

Numerous physical hazards are associated with drilling. Physical harm can be caused by improper or unsafe use of the drill rig or associated equipment, or faulty or poorly maintained drill rigs and equipment. Examples of unsafe use may include not properly stabilizing and leveling the rig prior to raising the mast, or failure to wear a hardhat. Electrical hazards include electrical shock from lightning, drilling into live utility lines, contacting live utility lines with the mast of the drill rig, or using small electric handtools grounded improperly. Location of utility lines at OL-Q will be coordinated through installation personnel. Fire or explosion hazards may include drilling into live gas lines, electrical lines, or buried containers, or drilling-induced releases of flammable or explosive contaminants from below the ground surface. A fire extinguisher (Type ABC) will be in close proximity to the work crews at all times work is in progress.

5.2.5 Sampling Hazards

Hazards associated with sampling are primarily chemical hazards. Hazardous substances may be encountered during sampling of surface water and soil. Other chemical hazards include the release of hazardous gases or vapors from preserved sample bottles and exposure to hazardous substances while decontaminating sampling equipment. All sampled media should be considered to be contaminated for handling purposes.

Physical hazards may be encountered when sampling in excavations, confined spaces, or hazardous atmospheres. Physical hazards may also exist if heavy equipment, such as a backhoe or hydraulic probe, is required for sample collection. All OSHA regulations shall be adhered to in addition to standard construction safety practices.

5.2.6 Noise

Hearing protection shall be worn in proximity to all noise sources with a sound level reading at or above 80 decibels. Hearing protection will be required when working around generators. It is not anticipated that hearing protection will be necessary during other site activities. Any activities, however, with noise levels approaching that of drill rigs will require use of hearing protection. When crew members have to raise their voices (at a 3-foot distance) to communicate with each other, then hearing protection will be required.

5.2.7 Dehydration

Dehydration can occur any time the body loses more fluids than it takes in. Because many field tasks are potentially labor intensive and will require the use of personal protective equipment (PPE), there will be a risk of dehydration. If dehydration is allowed to progress without treatment, it can contribute to heat stress and be potentially life-threatening. Symptoms of dehydration include thirst, dry mouth, weakness, or a tired feeling. Dehydration can generally be avoided by frequently drinking fluids during work activities. Breaks should be taken according to the work/rest intervals discussed in Section 5.2.1, and sufficient water should be consumed during these breaks. If dehydration symptoms are experienced, personnel should rest in a cool spot and drink plenty of water until the symptoms are eliminated.

5.2.8 Tripping Hazards

Tripping hazards can be effectively diminished by field personnel by wearing proper foot covering, properly storing equipment when not in use, and properly marking obstacles (e.g., trenches, ditches, etc.).

5.3 MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheets (MSDSs) will be acquired for all chemicals used in specific work areas. The MSDSs will be placed in a yellow three-ring binder along with the

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HASP and kept with the SSO. A copy will be maintained in Versar's field office and also provided to the Kansas City Fire Department. All field personnel will be responsible for familiarizing themselves with the MSDSs.

SECTION 6.0

SITE WORKER TRAINING

6.1 OSHA STATUS OF EACH WORKER

All personnel who will conduct sampling activities at OL-Q will be required to have successfully completed the Hazardous Waste Site Worker training required by 29 Code of Federal Regulations (CFR) 1910.120, which consists of 40 hours of classroom instruction, 3 days of field experience, and medical surveillance as described in Section 8.0. Annual training updating is also required and consists of 8 hours of classroom instruction review of such topics as toxicology, respiratory protection, and site decontamination controls. Documentation will be maintained for all site workers on the Site-Specific Training Record (Appendix A).

6.2 SITE WORKER TRAINING INFORMATION

All personnel conducting activities on site will comply with the health and safety protocols. A copy of the HASP will be provided for all site personnel for review. Site workers who enter the work site will also sign the Plan Acceptance Form (Appendix A) prior to entering.

6.3 SCHEDULE FOR PRE-ENTRY BRIEFING

A field activities meeting will be conducted on a daily basis, with all project personnel prior to commencement of field operations. Health and safety issues will be addressed each day as a component of this meeting. Procedural deficiencies will be identified and corrective measures will be implemented. Because these briefings will be operation-specific, every element to be incorporated will not be addressed; however, the following elements have been listed to provide a guideline for discussion:

- Review of planned activities
- Substances suspected on site
- Levels of protection
- Location of safety equipment
- Operation-specific hazards
- Emergency and evacuation procedures
- Decontamination procedures
- Communications
- Field team responsibilities

SECTION 7.0

PERSONNEL PROTECTION

7.1 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

The anticipated levels of PPE that will be required to perform drilling and sampling under this delivery order are Levels D and E. The following outlines these levels of protection, the equipment required at each level, and the rationale for choosing between the two levels.

7.2 LEVEL D PPE

Level D protection is designed for use when only skin and eye protection is needed and airborne contamination is unlikely. Personal equipment requirements for Level D include:

- Hard hat (or face shield)
- Goggles or safety glasses
- Work gloves
- Coveralls, long sleeve

7.3 LEVEL E PPE

Level E is primarily a work uniform. It will not be assigned at any site where respirator or skin hazards exist. The minimum clothing to be worn on a job site shall be steel-toed shoes, socks, long pants, and a long-sleeve shirt.

SECTION 8.0

MEDICAL SURVEILLANCE

Medical surveillance will be conducted in compliance with 29 CFR 1910.120 standards.

8.1 GENERAL DESCRIPTION OF PROGRAM

Versar personnel who are required to perform on-site work must participate in Versar's Occupational Medical Program. The Occupational Medical Program consists of a baseline medical examination, special examinations, annual examinations, and a termination examination. The medical monitoring program is designed to establish a baseline determination of health against which any future changes can be measured, identify any existing conditions or illnesses that could be preclusive of or detrimental to job performance, and allow for recognition of abnormalities so that any necessary corrective measures may be taken.

All personnel participating in field activities (including subcontractor employees) will be required to provide proof of participation in a medical monitoring program that is in compliance with 29 CFR 1910.120. The medical examinations must prove that subcontractor employees are certified as capable of working with hazardous substances and wearing a negative pressure respirator. This proof must be provided to the FSL/SSO and will be kept on file at the site until work activities are completed.

The baseline, annual, and termination examinations will include the following:

- Medical and occupational history questionnaire
- Physical examination by physician
- Vitals: height, weight, blood pressure, pulse
- X-Ray: chest
- Electrocardiogram
- Pulmonary function testing
- Vision screening
- Hearing screening
- Blood chemistry analysis
- Urinalysis
- Differential blood count
- Additional parameters at the discretion of the occupational physician

Special examinations will be scheduled if an employee believes (based on results obtained from monitoring, sampling results, lack of data, or ineffective protective devices and emergencies) that he or she may have been exposed to a hazardous substance. The employee will report this to his or her Division Health and Safety Officer, who will contact the occupational medicine consultant and arrange for a special exam.

8.2 SITE-SPECIFIC REQUIREMENTS

No additional site-specific medical surveillance is anticipated for the work to be performed at OL-Q. In the event of an exposure, a special examination will be given to define the extent of exposure. In addition, an Exposure or Injury Report (Appendix A) will be filed with the Versar Corporate Health and Safety Officer. A copy of the report will also be filed with the Program Manager and the Project Manager.

SECTION 9.0**SAFE WORK PRACTICES**

Personnel involved in work at the site will be informed of standing work orders regarding safe work practices, and will have adequate training, as well as understand the HASP. Standing orders for those entering the sampling area will include, but not be limited to the following:

- No smoking, eating, or drinking
- Do not wear contact lenses
- Use the buddy system
- No matches or lighters will be allowed in the zone
- Check in and out at points of access control
- Appropriate PPE will be worn
- Attend daily safety meetings
- Be cautious around heavy equipment and other tools
- Upon discovery of unusual or unexpected conditions, reevaluate site conditions, and health and safety practices

SECTION 10.0

EMERGENCY RESPONSE PLAN

10.1 EMERGENCY RECOGNITION

All personnel must read and be familiar with this Emergency Response Plan. Emergency telephone numbers and directions to the nearest medical facility are presented in this plan. Figure 4-2 and Section 4.4 show the evacuation routes at the OL-Q and provide directions to the nearest hospital, respectively.

Prior to initiation of work, the FSL/SSO will conduct a meeting to review all aspects of the HASP as well as review the emergency response procedures. Attendance at this meeting will be mandatory for all field personnel. Field personnel will be required to have an accessible copy of the emergency contacts and phone numbers, and to know the route to the nearest emergency medical facilities.

Any one of the following conditions or situations shall be considered to be an emergency condition:

- A crew member has a medical emergency, accident, or symptoms of overexposure to heat or cold.
- A crew member is involved in a heavy equipment accident or other type of accident resulting in a medical emergency.
- A crew member has been exposed to a chemical or hazardous substance release.
- Discovery of unanticipated hazardous conditions.

10.2 EMERGENCY RESPONSE PROCEDURES

In the event of an emergency, all available information must be evaluated properly, and the appropriate steps taken to implement the Emergency Response Plan. The FSL/SSO shall always be informed immediately of any emergency, and shall take command of the situation. He/she must call the appropriate emergency services, evacuate personnel to the pre-designated evacuation location, as needed, and take other steps necessary to gain control over the emergency. When reporting the emergency to the FSL/SSO, personnel should thoroughly describe the situation, including the following information:

- Time and location of the emergency
- Type of emergency (accident, medical, explosion, fire, or chemical release)
- Number of injured and type(s) of injuries
- Wind direction and speed

10.2.1 Medical Emergencies and Accidents

Safety Practices

- Personnel shall always be alert for signs and symptoms of illnesses related to chemical, physical, and disease factors on site.
- Personnel shall be aware of the signs and symptoms of heat stress, cold stress, and fatigue.
- Personnel shall work in pairs, when possible, and maintain visual contact between pairs to detect signs and symptoms of medical emergencies.
- A cellular telephone or radio and first-aid kit shall be provided at each work site.
- Personnel shall utilize "good housekeeping" practices at the job site.
- Personnel shall be aware of heavy equipment and other vehicular traffic at the site.
- Personnel shall be on the lookout for and rectify unsafe conditions that could result in injury (e.g., unprotected trenches or holes, exposed electrical wires, etc.)
- Personnel shall practice work procedures prior to conducting them in the field.

Emergency Procedures

In the case of a medical emergency or personal injury, lifesaving procedures should be administered only by trained personnel. Due to the close proximity of the Kansas City Fire Department, only personnel from the Kansas City Fire Department or local emergency medical services should administer lifesaving procedures such as CPR, etc. Any additional assistance shall be conducted so that those rendering assistance are not placed in a situation of unacceptable risk. The incident should be reported immediately to the FSL/SSO, who must then notify all personnel of the emergency situation, upon which all work must stop.

Following the use of lifesaving procedures, personnel currently trained in first aid will evaluate the nature of the injury and initiate first aid assistance. The FSL/SSO should decide if local Emergency Medical Services are necessary, and notify them immediately, if needed. Personnel shall transport victims to emergency medical facilities only if: (1) The site is so remote that timely response of medical professionals is not possible. (2) The injury does not pose an immediate threat to life, and transport to the emergency medical facility can be accomplished without the risk of further injury. The route to the nearest medical facility is shown in Figure 4-2.

10.2.2 Chemical Exposure Emergencies

Safety Practices

- Properly utilize the appropriate PPE.
- Provide a mobile telephone or two-way radio at each work site.
- Provide a first-aid kit, soap, and potable water supply at each work site.
- Use care when handling and working around chemicals.

Emergency Procedures

In the event of a chemical exposure (or potential exposure) emergency, victims must first be removed from the immediate area of contamination. Precautions must be taken to avoid exposure to other individuals, particularly those assisting the victims. If an apparent chemical exposure has occurred, personnel shall first grossly decontaminate the victim by using towels, cloth, and emergency shower, or other available means. The Kansas City Fire Department or emergency medical services should be notified immediately to administer lifesaving procedures, if necessary. Any assistance shall be conducted in a manner such that those rendering assistance are not placed in a situation of unacceptable risk. The FSL/SSO shall immediately notify all personnel of the emergency situation. The person calling the emergency medical services must inform the operator of the nature of the emergency, including the type of chemical exposure, if known.

If the chemical is on the victim's clothing, the clothing shall be removed by other personnel. If the skin has been exposed, it should be washed thoroughly with soap and water. The affected area should be washed and rinsed for a minimum of 15 minutes. If the eyes have been exposed, an emergency eye wash should be used to flush the eyes for at least 15 minutes. In the case of an inhalation exposure, the victim should be decontaminated, and emergency medical services contacted immediately. For a chemical exposure by ingestion, determine what was ingested and contact emergency medical services.

Personnel shall transport victims to emergency medical facilities only if the injury does not pose an immediate threat to life, or if transport to the emergency medical facility can be accomplished without the risk of further injury. In all other cases, the Kansas City Fire Department or ambulance service has to be used.

10.3 EMERGENCY CONTACTS

Communications will be by cellular phone or by telephones located at the OL-Q. In the case of an emergency situation, the closest and fastest method of communication should be used. The directions to the nearest telephone have been included in this document (Section 4.5). Telephone contact should be made with the FSL/SSO who will then contact the appropriate emergency response agencies. All field teams will be equipped with a cellular

telephone to assure communications between the field teams and site managers. Contacts and telephone numbers are as follows:

<u>Contacts</u>	<u>Telephone Number</u>
Kansas City Fire Department and Emergency Medical Services	911
AFBCA Point of Contact (Mark Esch)	(816) 348-2514
AFCEE Team Chief (Fred Waterman)	(210) 536-5209

Directions to Research Belton Hospital

Depart OL-Q using County Line Road (155th Street) traveling east. Continue for approximately 1¼ miles to U.S. Highway 71. Proceed south on Highway 71 approximately 2½ miles to the Missouri Highway 58 exit. Located immediately east of the Highway exit is the Research Belton Hospital. The address is 17065 South U.S. Highway 71, Belton, Missouri 64012.

10.4 EMERGENCY FOLLOW-UP

The FSL/SSO must complete an Accident Report Form (see Appendix A) and submit it to the Project Manager within 24 hours of the following types of incidents:

- All job related injuries and illnesses.
- All accidents resulting in more than \$25 loss or damage.
- All accidents in which there may have been no injury or property damage, but that have a high probability of recurring with a risk of injury or property damage.
- Any accident that results in a fatality or the hospitalization of three or more employees must be reported within 8 hours to the U.S. Department of Labor through the Project Manager.

Following an emergency, the FSL/SSO should review the emergency procedures and revise the procedures, if necessary. When reviewing the emergency response, items to be considered should include the cause of the emergency, possible methods to prevent a similar emergency, and possible ways to improve the emergency procedure. The emergency procedures should then be revised, if necessary, based on any new site conditions or lessons learned from the emergency response.

The FSL/SSO and/or Project Manager will initiate the investigation and documentation of any emergency situation. This could be especially important when the incident resulted in injury or property damage. Documentation could potentially be used to help avoid recurrence, as legal support, for assessment of liability, and for government review.

Documentation of accidents or other emergencies shall be completed as soon as possible following the incident.

At a minimum, documentation should include:

- Chronological history of the emergency
- Facts about the incident and when they became available
- Names and titles of all personnel involved
- Actions taken, orders given, and decisions made (who, what, where, and when)
- Any monitoring results or sample results that may be applicable
- Site personnel exposed to the hazard
- Summary of all injuries or illnesses that have occurred during, or resulting from, the incident
- Completion of an Exposure Report form in the case of chemical exposure

All documentation must be signed and dated by those making entries. All entries shall be made in ink. Any changes to the documentation must be initialed and dated. Copies of accident and exposure report forms are provided in Appendix A.

10.5 BLOODBORNE PATHOGENS

Exposure to bloodborne pathogens (BBP) is possible in the case of certain emergency situations. Personnel may be exposed to body fluids such as blood, saliva, vomitus, mucus, or others. These fluids could contain pathogens that have the potential for causing disease in humans. Should personnel be required to administer lifesaving procedures, such as CPR, the following procedures shall be followed to minimize the potential for exposure:

- Wear disposable gloves when hand contact with blood, mucous membranes, non-intact skin, or other potentially infectious materials could be involved.
- Use disposable mouthpieces, pocket masks, or other ventilation devices for administering artificial ventilation.
- Wash hands with soap and water after administering first aid.
- In the case of eye contact with body fluids, flush eyes using an eye wash for at least 15 minutes.
- Remove garments contacted by blood or other body fluids as soon as possible.

- Do not eat, drink, smoke, or handle contact lenses in work areas with possible BBP exposure.
- Persons cleaning up an accident scene should not pick up broken glass or other sharp objects by hand. All clothes and other items at the first-aid scene should be secured safely prior to leaving.
- Employees who may have been exposed to BBPs should report the incident to the SSO, at once.

SECTION 11.0**REFERENCES**

U.S. Air Force, 1993. Handbook for the Installation Restoration Program (IRP) - Remedial Investigations and Feasibility Studies (RI/FS).

Dames & Moore, March 1995. Quality Program Plan for the Richards-Gebaur Air Force Base Full Service Remedial Action.

Encyclopedia of Occupational Health and Safety Third (Revised) Edition, Volumes 1 and 2. 1983.

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**APPENDIX A
FORMS**

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EXPOSURE REPORT

NAME _____ DATE _____

JOB SITE. LOC. _____

TIME OF EXPOSURE _____ SUPERVISOR _____

SUBSTANCE(S) EXPOSED TO: _____

WAS SUBSTANCE IN: AIR ___ WATER ___ SOIL ___ OTHER ___

PROTECTIVE EQUIPMENT USED: _____

CAUSE OF EXPOSURE: _____

AREA OF BODY EXPOSED: _____

ACTION TAKEN TO DECONTAMINATE: _____

LIST CHANGES TO PREVENT EXPOSURE: _____

Supervisor: _____ Date: _____

- cc: Employee
- Supervisor
- Safety Officer
- Physician



PLAN ACCEPTANCE FORM

OPERATING LOCATION Q HEALTH AND SAFETY PLAN

This form is to be completed by each person conducting work at Operating Location Q and to be returned to the Corporate Health and Safety Manager.

I have read and agree to abide by the contents of the HASP for Operating Location Q for the following site(s):

Signed

Date

Return To:
Corporate Health and Safety Officer
Versar, Inc.
6850 Versar Center
Springfield, VA 22151

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**SITE-SPECIFIC TRAINING RECORD
OPERATING LOCATION Q**

Project: _____

Project Number: _____

Date: _____

Trainer: _____

On this date, the following individuals were provided with site-specific training in accordance with OSHA regulations contained in 29 CFR 1910.120(e).

Name (Print)

Employee Number

Employee Signature

Return To:

Corporate Health and Safety Officer
Versar, Inc.
Versar Center
Springfield, VA 22151

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**ACCIDENT REPORT FORM
OPERATING LOCATION Q**

Project: _____

EMPLOYER

Name: _____

Address: _____

INJURED OR ILL EMPLOYEE

Name: _____ Social Security Number: ____-____-____

Home Address: _____

Age: _____ Sex (M/F): ____

Occupation (Job Title): _____

Department of Employment: _____

THE ACCIDENT OR EXPOSURE TO OCCUPATIONAL ILLNESS

Location of exposure (street address, city, and state): _____

Did the accident take place on employer's premises (Yes/No): _____

What was the employee doing when the injury occurred? (Be specific as to tools or equipment being used): _____

How did the accident occur? (Fully describe the events leading up to the accident): _____

Time of the accident: _____

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**ACCIDENT REPORT FORM
(Continued)**

Witnesses:

Name: _____ Affiliation: _____ Phone No. _____

OCCUPATIONAL INJURY OR OCCUPATIONAL ILLNESS

Describe the injury or illness in detail and indicate affected part of the body: _____

Name the object or substance that directly injured the employee: _____

Date of injury or initial diagnosis of occupational illness: _____

Did the employee die? (Yes/No): _____

Name of physician: _____

Address of physician: _____

If hospitalized, name and address of hospital: _____

Date of Report: _____ Prepared by: _____

Official Position: _____