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FINAL RISK BASED ASSESSMENT, MANAGEMENT AND CLOSURE OF SOLID WASTE
MANAGEMENT UNITS AND AREA OF CONCERNS QUALITY PROGRAM PLAN NAS FORT
WORTH TX
12/1/1998
FANNING, PHILLIPS AND MOLNAR



**NAVAL AIR STATION
FORT WORTH JRB
CARSWELL FIELD
TEXAS**

**ADMINISTRATIVE RECORD
COVER SHEET**

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**RISK-BASED ASSESSMENT, MANAGEMENT, AND CLOSURE
OF SOLID WASTE MANAGEMENT UNITS AND AREAS OF CONCERN
AT NAVAL AIR STATION FORT WORTH, JOINT RESERVE BASE,
CARSWELL AIR FORCE BASE, TEXAS**

**FINAL
QUALITY PROGRAM PLAN**



**Contract No. F41624-95-D-8003-0023
Project No. DDPF 98-8125**

**December
1998**

TAB

WP

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OF SOLID WASTE MANAGEMENT UNITS AND AREAS OF CONCERN
AT NAVAL AIR STATION FORT WORTH, JOINT RESERVE BASE,
CARSWELL AIR FORCE BASE, TEXAS**

**FINAL
WORK PLAN**



**Contract No. F41624-95-D-8003-0023
Project No. DDPF 98-8125**

**December
1998**

WORK PLAN
CDRL A004

**Risk-Based Assessment, Management, and Closure
of Solid Waste Management Units and Areas of Concern
at Naval Air Station Fort Worth, Joint Reserve Base,
Carswell Air Force Base, Texas**

Contract No. F41624-95-D-8003-0023
Project No. DDPF 98-8125

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December 1998

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PREFACE

Fanning, Phillips and Molnar (FP&M), under contract with the Air Force Center for Environmental Excellence (AFCEE), is performing risk-based assessment, management, and closure of various solid waste management units (SWMUs) and Areas of Concern (AOCs) at Carswell Air Force Base (AFB), Fort Worth, Texas. The project will evaluate existing site data, refine conceptual site models, and fill data gaps to allow for the risk-based assessment of SWMUs and AOCs. The project will provide risk-based closure documentation that will determine site-specific target levels for contaminants and recommend closure, monitoring, or remediation to target levels. The individual SWMUs and AOCs to be addressed by the project include the following:

SWMUs

- 19 Fire Training Area 2
- 20 Waste Fuel Storage Tank
- 21 Waste Oil Tank
- 22 Landfill 4
- 23 Landfill 5
- 24 Waste Burial Area WP-07 (Waste Pit)
- 25 Landfill 8
- 58 Pesticide Rinse Area
- 59 B8503 Weapons Storage Area (WSA) Waste Accumulation Area
- 60 B8503 Radioactive Waste Burial Site (Groundwater)
- 64 French Underdrain System/Unnamed Stream
- 65 WSA Disposal Site
- 66 Sanitary Sewer System
- 67 B1340 Oil/Water Separator (OWS)
Permitted Treatment, Storage, and Disposal Facility (TSDF)

AOCs

- 5 Grounds Maintenance Yard
- 8 Aerospace Museum
- 9 Golf Course Maintenance Yard
- 14 Unnamed Stream

This plan may be adopted for other SWMUs and AOCs at the former Carswell AFB as needed. Supplemental plans or plan addenda will be submitted with relevant site-specific information for any sites not outlined in this plan which become part of the current project.

This Work Plan (WP) identifies the tasks to be accomplished for the risk-based assessment of these SWMUs and AOCs. The assessments will be conducted in accordance with provisions of

the Basic Contract #F41624-95-D-8003 and Delivery Order (DO) #23. Mr. Rafael Vasquez is the Air Force Base Conversion Agency (AFBCA) Base Environmental Coordinator (BEC) for Naval Air Station (NAS) Fort Worth, the former Carswell AFB. Mr. Alvin Brown is the AFBCA Field Engineer and Base Point of Contact (POC). Mr. Charles Rice serves as the AFCEE/ERB team chief and as Contracting Officer's Representative (COR). Mr. Joe Dunkle serves as the AFCEE/ERA team chief.

The principal FP&M personnel include Dr. Kevin J. Phillips, P.E., Program Manager, Mr. Gaby A. Atik, P.E., Project Manager, and Mr. Thomas Doriski. Mr. Doriski will also act as Health and Safety Officer. Additional personnel will be selected from FP&M staff as needed. Dr. Atul Salhotra of RAM Group will be the principal risk assessor.

The project will take place in a phased approach. The listed SWMUs and AOCs will initially require evaluation of existing site data. It is anticipated that some sites will proceed from data evaluation to risk-based closure documentation, while other sites will require collection of additional data to refine conceptual site models and fill data gaps before closure documentation can take place. Due to the number of sites addressed by the project, the phased approach will also help to maintain a balanced workload over the duration of the project, and avoid unnecessary delays to sites that are ready for closure documentation. The project schedule presents four phases. Phases I and III are sites which are anticipated to require no further evaluation or data collection; and Phases II and IV are sites which are anticipated to require additional data prior to closure.

It is anticipated that initial field work will commence in January 1998. Data evaluation and report preparation will occur throughout the risk-based assessment projects. Risk-based closure documentation will be submitted as completed for each site, with all draft submissions completed by April 1999 and all final submissions completed by July 1999.

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ACRONYMS AND ABBREVIATIONS

ACC	Air Combat Command
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Environmental Excellence
AFP	Air Force Plant
AMS	Aerospace Museum Site
AOC	Area Of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AST	Aboveground Storage Tank
BEC	Base Environmental Coordinator
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CDRLs	Contract Data Requirements Lists
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measures Study
COC	Contaminant Of Concern
COE	Corps Of Engineers
COR	Contracting Officer's Representative
CSM	Conceptual Site Model
CWA	Clean Water Act
DO	Delivery Order
DoD	Department of Defense
EBS	Environmental Baseline Survey
EOD	Explosive Ordinance Disposal
EPA	Environmental Protection Agency
ERPIMS	Environmental Restoration Program and Information Management System
FPM	Fanning, Phillips and Molnar
FSP	Field Sampling Plan
FTA	Fire Training Area
GCMY	Golf Course Maintenance Yard
GMY	Grounds Maintenance Yard
HSP	Health and Safety Plan

ACRONYMS AND ABBREVIATIONS (Cont'd.)

IRA	Interim Remedial Action
IRP	Installation Restoration Program
LAW	Law Environmental, Inc.
LLRW	Low-Level Radioactive Waste
LTM	Long Term Monitoring
MCL	Maximum Contamination Level
MDLs	Method Detection Limits
M&E	Metcalf & Eddy
Mg/Kg	Milligrams per Kilogram
Mg/L	Milligrams per Liter
MSC	Medium Specific Concentration
NAS	Naval Air Station
NCP	National Contingency Plan
NFA	No Further Action
OWS	Oil/Water Separator
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbons
PARSONS	Parsons Engineering-Science, Inc.
PCB	Polychlorinated Biphenyl
POC	Point Of Contact
PPM	Parts Per Million
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/ Quality Control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
RRS	Risk Reduction Standard
SAC	Strategic Air Command

ACRONYMS AND ABBREVIATIONS (Cont'd.)

SAI-Ind	Soil/Air and Ingestion Standard For Industrial Use
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SWMU	Solid Waste Management Unit
SOW	Statement Of Work
SPLP	Synthetic Precipitate Leaching Procedure
SVOC	Semi-Volatile Organic Compound
TCE	Trichloroethene
TDPW	Texas Department of Parks and Wildlife
TDS	Total Dissolved Solids
TEC	The Environmental Company
TNRCC	Texas Natural Resource Conservation Commission
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSDF	Treatment, Storage and Disposal Facility
USAF	United States Air Force
UST	Underground Storage Tank
UNSVTX	Unified Services of Texas, Inc.
VOC	Volatile Organic Compound
WBS	Work Breakdown Structure
WP	Work Plan
WSA	Weapons Storage Area

1.0 INTRODUCTION

1.1 THE U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM

The objective of the U.S. Air Force Installation Restoration Program (IRP) is to assess past hazardous waste disposal and spill sites at U.S. Air Force installations and to develop remedial actions consistent with the National Contingency Plan (NCP) for sites that pose a threat to human health and welfare or the environment. This section presents information on the program origins, objectives, and organization.

The 1976 Resource Conservation and Recovery Act (RCRA) is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require federal agencies to comply with local and state environmental regulations and provide information to the U.S. Environmental Protection Agency (EPA) concerning past disposal practices at federal sites. RCRA Section 3012 requires state agencies to inventory past hazardous waste disposal sites and provide information to the EPA concerning those sites.

Executive Order 12580, adopted in 1987, gave various federal agencies, including the Department of Defense (DoD), the responsibility to act as lead agencies for conducting investigations and implementing remediation efforts when the Federal agencies are the sole or co-contributor to contamination on or off their properties.

To ensure compliance with Executive Order 12580, the DoD developed the IRP, under the Defense Environmental Restoration Program, to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated sites. The DoD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP program in June 1980, and implemented the policies outlined in this memorandum in December 1980. The NCP was issued by EPA in 1980 to provide guidance on a process by which (1) contaminant release could be reported, (2) contamination could be identified and quantified, and (3) remedial actions could be selected. The NCP describes the responsibility of federal and state governments and those responsible for contaminant releases.

The DoD formally revised and expanded the existing IRP directives and amplified all previous directives and memoranda concerning the IRP through DEQPPM 81-5, dated 11 December 1981. The memorandum was implemented by an U.S. Air Force message dated 21 January 1982.

The IRP is the DoD's primary mechanism for response actions on U.S. Air Force installations affected by the provisions of the Superfund Amendments and Reauthorization Act (SARA). In November 1986, in response to SARA and other EPA interim guidance, the U.S. Air Force modified the IRP to provide for a Remedial Investigation/Feasibility Study (RI/FS) program.

The IRP was modified so that RI/FS studies could be conducted as parallel activities rather than serial activities. The program now includes applicable or relevant and appropriate requirements (ARAR) determinations, identification and screening of remedial technologies, and development of remedial alternatives. The IRP may include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure that DoD compliance with federal laws, such as RCRA, NCP, SARA, and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) can be met.

1.2 HISTORY OF PAST IRP WORK AT THE INSTALLATION

Carswell AFB is located in north-central Texas in Tarrant County, approximately 8 miles west of downtown Fort Worth (Figure 1-1). Carswell AFB property totals 2,555 acres and consists of a main station and two noncontiguous land parcels. The area surrounding the station is mostly suburban, including residential areas of the cities of Fort Worth, White Settlement, and Westworth Village. The main station totals 2,264 acres and is bordered on the north by Lake Worth, on the east by the Trinity River and Westworth Village, on the northeast and southeast by Fort Worth, on the west and southwest by White Settlement, and on the west by Air Force Plant (AFP) No. 4.

Prior to 1941, the area that is now Carswell AFB consisted of woods and pasture in an area called White Settlement. Carswell AFB was originally a modest dirt runway built to service the aircraft manufacturing plant now called AFP No. 4. The installation was established in 1942 and was referred to as the Tarrant Field Airdrome. Its mission was to provide training for B-24 bomber pilots. The Strategic Air Command (SAC) assumed control of Tarrant Field Airdrome in 1946 and the installation served as the Headquarters for the Eighth Air Force and as a heavy bomber base. In 1948, the base was renamed Carswell Air Force Base (AFB) in honor of Fort Worth native Major Horace S. Carswell. Carswell AFB became host base for its first B-52s and KC-135s in 1956. The Air Combat Command (ACC) assumed control of Carswell AFB in 1992 concurrent with the disestablishment of the SAC.

Pursuant to the Base Closure and Realignment Act of 1990, Carswell AFB was selected for closure and associated property disposal during Round II Base Closure Commission deliberations. The base officially closed on September 30, 1993. On October 1, 1994, the U.S. Navy assumed control of Carswell AFB; the base was renamed NAS Fort Worth, Joint Reserve Base, Carswell Field.

Because a wide variety of waste generating activities have occurred at the SWMUs and AOCs on base, a number of environmental investigations and studies have been conducted to identify sources of possible contamination, and to assess the extent and magnitude of contamination and

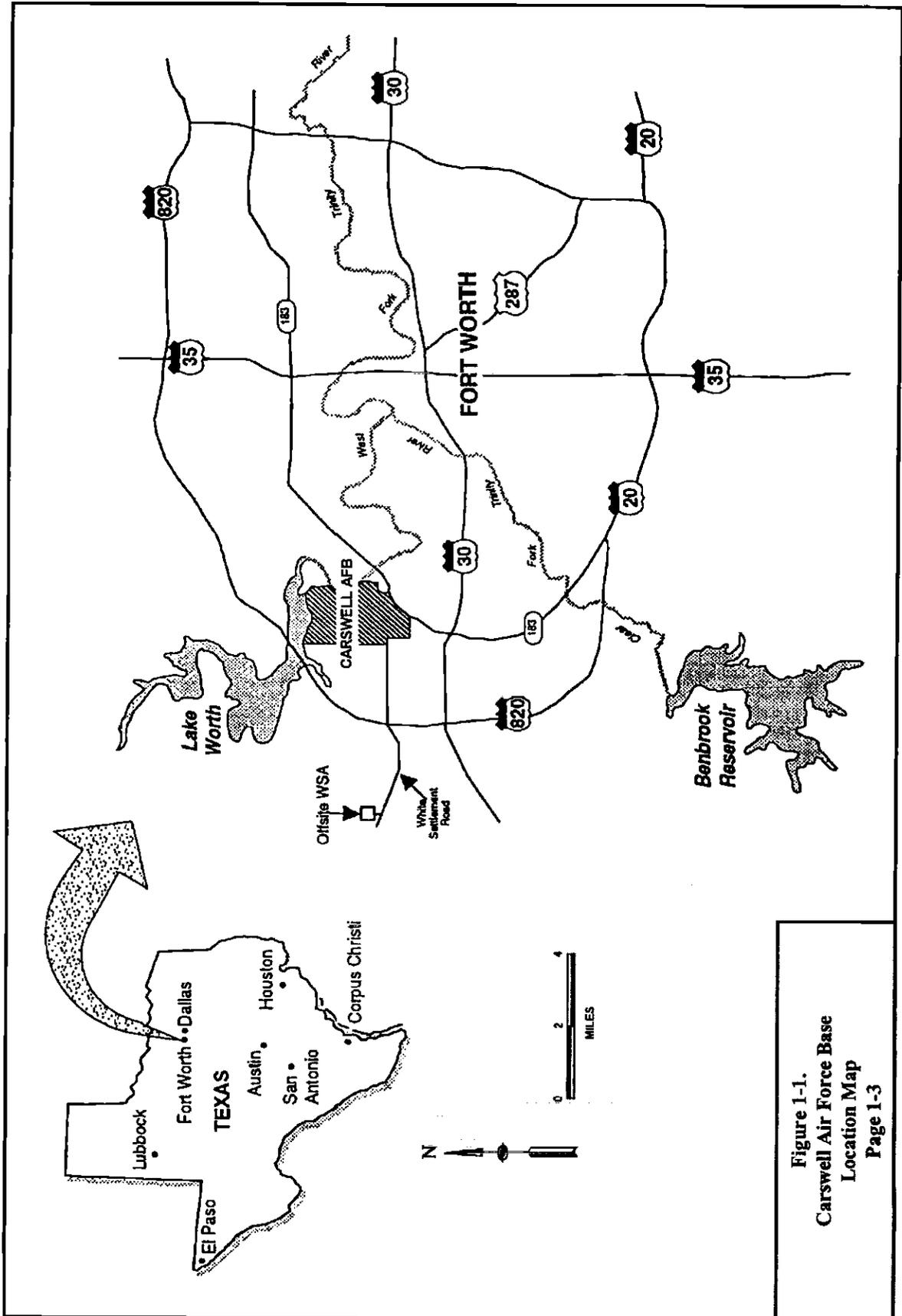


Figure 1-1.
Carswell Air Force Base
Location Map
Page 1-3

its potential impacts on human health and the environment. Applicable basewide studies include a Phase I – Preliminary Assessment/Records Search (PA) (CH2M Hill, 1984), a Phase II - Problem Confirmation/Quantification Report (SI) (Radian, 1986), a Remedial Investigation/Feasibility Study (RI/FS) Stage II investigation (Radian, 1989), a RCRA Facility Assessment (Kearney, 1989), a Basewide Environmental Baseline Survey (USAF, 1993), and a RCRA Facility Investigation for Parcel D and Background Study (Jacobs, 1997). These studies and any related investigations or remedial actions as they relate to individual SWMUs and AOCs are discussed in the applicable site-specific sections of this work plan.

1.3 DESCRIPTION OF CURRENT STUDY

1.3.1 Project Objectives

The overall goal of this project is to provide risk-based closure documentation for various SWMUs and AOCs, in accordance with RCRA Part B permit HW50289. The project will determine site-specific target levels for contaminants and recommend closure, monitoring, or remediation to target levels. Specific objectives needed to achieve this goal include:

- Collect and evaluate existing site data against appropriate risk-based closure criteria.
- Refine or develop, based on previous and newly collected data, conceptual site models (CSM).
- Collect site-specific data to fill data gaps identified in the initial data evaluation.
- Prepare management plans or determine corrective measures required to meet site-specific target cleanup levels.
- Implement incidental soil removal/interim removal actions to meet site-specific contaminant target levels that will allow for risk-based site closures.
- Prepare closure documentation for sites meeting risk-based closure criteria.

1.3.2 Project Scoping Documents

This WP constitutes one of the scoping documents required by the Statement of Work (SOW) for this contract and delivery order. Other scoping documents prepared for this contract and delivery order include a Sampling and Analysis Plan (SAP) and a Health and Safety Plan (HSP). The SAP consists of two deliverables: the Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). These scoping documents are referenced as necessary and appropriate.

2.0 SUMMARY OF EXISTING INFORMATION

The project encompasses several SWMUs and AOCs located throughout the base. Location figures for each site are provided at the end of Section 2. The installation environmental setting is presented below along with site-specific background information. After data evaluation and collection of data to fill data gaps identified during this project, final closure documentation will be presented which describes the site-specific environmental setting and exposure scenarios at each site. The site-specific environmental setting will be presented in the work plan addendum prepared after initial site data evaluation.

2.1 INSTALLATION ENVIRONMENTAL SETTING

2.1.1 Geology

Carswell AFB is built primarily on unconsolidated alluvium, referred to locally as the Terrace Alluvium, which lies unconformably on top of a sequence of lithified Cretaceous formations. These Cretaceous rock units are from youngest to oldest, (1) the Goodland Formation, composed of limestone with a few thin shale beds; (2) the Walnut Formation, a shelly limestone interbedded with thin shale and sandy clay beds; and (3) the Paluxy Formation, a poorly to moderately cemented sandstone with shale interbeds (Jacobs, 1997). The regional dip of the rocks in the vicinity of Carswell AFB ranges from 35 to 40 feet per mile to the east and southeast.

The Terrace Alluvium consists of Quaternary floodplain and fluvial terrace sediments of primarily sand, gravel, clay, and silt deposited by an abandoned meander of the Trinity River. Locally, it has been observed that the Trinity paleochannel and other smaller paleochannels have eroded the Goodland Formation to the extent that Terrace Alluvium sediments were deposited directly on the Walnut Formation. The local thickness of the Terrace Alluvium ranges from 0 to greater than 45 feet (Jacobs, 1997).

Underlying the Quaternary alluvium are the Goodland and Walnut Formations. The Goodland is a chalky-white, fossiliferous, dense limestone, interbedded with clay and marl. The Walnut Formation is a shell-agglomerate limestone with varying amounts of clay and shale. The Goodland is exposed on the southern portion of the base, south of White Settlement Road. The Walnut and Paluxy Formations are exposed in a small area in the northwestern corner of the base along the shores of Lake Worth. The thickness of the Goodland/Walnut formations is approximately 25 feet or greater beneath most of Carswell AFB; however, weathering may have eroded the thickness of the limestone in certain areas (Dames & Moore, 1995). These strata are generally dry, although small amounts of water are occasionally present in the shale and clay units (Radian, 1991).

Underlying the Goodland and Walnut Formations is the Paluxy Formation. Regionally, the Paluxy Formation is divided into upper and lower sand members by a shale unit. The Paluxy Formation thickness ranges from 140 to 190 feet, averaging 160 feet in Tarrant County (Radian, 1991). The Paluxy Formation is exposed along the southern shore of Lake Worth at the northern boundary of the facility and along the erosional channel of the Trinity River. The Paluxy Formation either is aerially exposed or is in contact with the overlying Walnut Formation. It is reported that the Paluxy Formation may be in contact with the overlying Quaternary alluvium at the eastern boundary of AFP-4, where the Goodland and Walnut Formations have been removed by erosion (Dames & Moore, 1995).

2.1.2 Groundwater

Three hydrogeologic units exist beneath Carswell AFB that are relevant to subsurface conditions. From the shallow to the deepest, they are: (1) the Quaternary alluvium aquifer containing unconfined groundwater associated with the Trinity River alluvial terrace deposits; (2) an aquitard of predominantly dry limestone of the Goodland and Walnut Formations; and (3) an aquifer in the Paluxy Formation.

The Quaternary alluvial groundwater is found under unconfined conditions at Carswell AFB. Low permeability is typical of the alluvium because of the large amounts of clay and silt. However, there are zones of greater permeability in the saturated sands and gravels of former channel deposits. Recharge to the water-bearing sediments is local, from rainfall and infiltration from stream channels and drainage ditches. The direction of groundwater flow is generally controlled either by bedrock topography or discharge zones at primary or secondary streams. Previous reports indicate that the groundwater flow in these sediments across the facility is generally toward Farmers Branch Creek or eastward toward the Trinity River at the eastern boundary of the facility. Groundwater leakage may occur to the Paluxy Formation in areas where the Walnut Formation aquitard is significantly thinned by erosion or eroded away.

The unconfined groundwater found in the Quaternary alluvium is generally separated from the underlying Paluxy Aquifer by the low permeability limestones and calcareous shales where the Goodland and Walnut Formations are present. The aquitard is composed of moist clay and shale layers interbedded with dry limestone beds. Hydrographs from paired upper zone Quaternary alluvium and Paluxy Formation monitoring wells indicate there is little flow from the overlying alluvial aquifer to the Paluxy Formation in those areas where the Walnut Formation is not deeply eroded.

The Paluxy Aquifer is the shallowest aquifer underlying Carswell AFB. In the area, water in the uppermost part of the Paluxy Formation would occur under confined conditions beneath the Goodland and Walnut Formations, except where these units have been eroded away. However, extensive groundwater pumping in the Fort Worth area, including the Cities of White Settlement

and Samson Park, has lowered the Paluxy Aquifer potentiometric surface below the top of the formation, resulting in unconfined conditions.

Recharge to the Paluxy Aquifer occurs where the formation crops out. The Paluxy Formation crops out west of AFP-4, and north of Carswell AFB in the bed of Lake Worth. Lake Worth is a major recharge area for the aquifer and creates a potentiometric high in its vicinity. Regional groundwater flow is southeastward in direction of the regional dip.

2.1.3 Surface Water

Carswell AFB and all of Tarrant County are located within the Trinity River watershed. Surface water resources in the vicinity of Carswell AFB include the West Fork and Kings Branch of the Trinity River, Farmers Branch Creek, Lake Worth, and two ponds in the golf course area.

Lake Worth, a man-made reservoir on the West Fork of the Trinity River, is located north of Carswell AFB and is owned and operated by the City of Fort Worth. These waters are used for public water supply and recreation. Lake Worth covers an area of 3,558 acres and is 12 miles long.

Surface water is the main source of potable water in the vicinity of Carswell AFB. The City of Fort Worth Water Department is the primary supplier to the areas surrounding and including Carswell AFB. Water from Farmers Branch Creek is used to irrigate the on-Base golf course. The nearby communities of White Settlement and Sansom Park obtain water from 12 and 9 groundwater wells, respectively, but when required, they purchase surface water from Fort Worth to supplement their water supplies.

Surface drainage at Carswell AFB is collected by the storm drainage system and routed into the sewer system, or as outfall into Lake Worth. An underground drainage culvert conducts surface runoff generated from areas west of Carswell AFB eastward to Farmers Branch Creek. Storm water runoff from Carswell AFB that is not routed to the Base or city sewer system is discharged into Lake Worth. The outfall is permitted under the National Pollutant Discharge Elimination System.

The potential for contamination of surface water is present at several locations on Carswell AFB. There is potential for migration of hazardous contaminants through the surface water at sites in proximity to the West Fork of the Trinity River, Farmers Branch Creek, and Lake Worth. In addition, shallow groundwater carrying dissolved contaminants may discharge to these surface waters (IT Corp., 1997)

2.1.4 Biology

Sensitive habitats include those areas that can potentially restrict the use of the land, such as wetlands under the jurisdiction of the Clean Water Act (CWA), plant communities that are designated as unusual or of limited distribution, and important seasonal use areas for wildlife (e.g., migration routes, breeding areas, or crucial summer/winter habitat that are of agency concern). This includes areas associated with a protected species, or those areas critical for a life need of a species or population.

The shore of Lake Worth is considered sensitive habitat due to its importance to migratory birds, including state- and federal-listed species. The great blue heron rookeries are sensitive nesting areas along the northern banks of Lake Worth. These rookeries are protected as sensitive wildlife areas by the Texas Department of Parks and Wildlife (TDPW).

Carswell AFB has a total of 0.6 acre of jurisdictional wetlands designated by the Corps of Engineers (COE). Jurisdictional wetlands areas on base are found in the natural drainage stream southeast of AFP-4, totaling approximately 0.5 acre, and on the west side of the Off-Site WSA, totaling approximately 0.1 acre.

The Air Force has conducted informal consultations with the U.S. Fish and Wildlife Service and the TDPW concerning threatened and endangered species potentially occurring in the vicinity of Carswell AFB. No state- or federal-listed threatened or endangered species is known to permanently live on Carswell AFB. None of the federal-listed plant species for Texas are known to occur within 100 miles of Tarrant County. Ten listed bird species occur in Tarrant County and are migrants attracted by Lake Worth. None of these migrants are expected to reside in the vicinity of the main base or at the Off-Site WSA. Two federal-listed candidate reptile species, the Texas horned lizard and the Texas garter snake, may occur in Tarrant County. There is slight potential these reptiles could be present in the horse pasture on the eastern side of the main base.

2.1.5 Demographics

Land uses west of Carswell AFB are predominantly residential, commercial, and industrial. These include single-family residences, commercial centers, AFP No. 4, and an industrial complex in White Settlement.

The predominant development south of Carswell AFB is the commercial area located at Interstate 30 and State Highway 183 interchange. This area includes a discount retail center, a regional shopping mall, and a convenience center.

Various types of residential development occur southeast of Carswell AFB, north of Interstate 30. South of River Oaks Boulevard and Roaring Springs Road are country club estates and

upscale townhouses. Further south are middle- to upper-income, single family housing, and multifamily units mixed with commercial office development. Single-family housing is also found on the eastern side of Carswell AFB, from the Kings Branch housing tract north to Meandering Road.

Public/recreational land uses occur north of Carswell AFB, surrounding Lake Worth. Public access along the southern shore of Lake Worth is currently restricted due to Carswell AFB activities. A fish hatchery, YMCA camp, and private recreational lands are located along the West Fork of the Trinity River, northeast of the Base.

2.2 CHARACTERIZATION OF BACKGROUND CONDITIONS

2.2.1 Golf Course Maintenance Yard (AOC 9) and Pesticide Rinse Area (SWMU 58)

The Golf Course Maintenance Yard (GCMY) is located in the south-central portion of the former Carswell AFB, north of White Settlement Road. It occupies approximately one-half acre in area. Prior to the Interim Remedial Action (IRA) in 1996, buildings at the GCMY included a metal/office storage building, a wooden pole barn and metal carport used for equipment storage, and an aboveground fuel storage tank. As part of the IRA, the wooden pole barn was demolished and disposed of offsite, and the metal carport was moved to the former location of the pole barn. A new metal storage shed was built next to the existing metal building as a replacement for the pole barn. The site is currently used, and likely to be used in the future, for golf course maintenance (Figure 2-1).

The 1996 IRA by Jacobs Engineering Group, Inc. (Jacobs) consisted of conducting soil sampling to determine the nature of impacts, identifying the chemicals of concern, excavating and removing impacted soil, and conducting confirmatory sampling. A total of 380 cubic yards of soil was disposed off-site, the excavations were backfilled with clean soil, and the surfaces were finished with gravel or a concrete slab. The Technical Report for the IRA (Jacobs, 1997) concluded that remaining pesticide concentrations in the soil were below Medium Specific Concentrations (MSCs), metals in soil represented background, and the site could be closed under Texas Risk Reduction Standard (RRS) No. 2.

2.2.2 Grounds Maintenance Yard (AOC 5)

The Grounds Maintenance Yard (GMY) (Figure 2-2) is located in the southeast corner of Carswell AFB near the Main Entrance. It is a predominantly graveled yard, with some areas of asphalt pavement, two small maintenance buildings, a pesticide storage shed, two 500-gallon aboveground storage tanks located on a concrete containment pad, and two office trailers. A site walk through by LAW Environmental, Inc. (LAW) and AFCEE personnel in October 1994 found some soil staining and areas suspected to have formerly contained chemical storage sheds

and/or petroleum storage tanks. Past operations at the GMY include storage and maintenance of grounds keeping equipment, and storage of pesticides, solvents, and fuels.

LAW conducted soil sampling activities at the GMY from October 22 to 24, 1995 as part of a Site Investigation/Site Characterization. Twenty-eight surface soil samples were collected from 0 to 2 feet using stainless steel hand augers following a grid layout of the site. Sampling locations occurred at approximately 60-foot intervals, but some locations were offset to include stained areas near the two maintenance buildings and former pesticide storage building, in the area of the petroleum storage tanks, and at locations where obvious soil staining was observed.

Unified Services of Texas, Inc. (UNSVTX) demolished and removed one structure and one concrete pad at the GMY in May 97. UNSVTX also disposed of twenty-three transformers of varying sizes located on a concrete pad to the northeast of the GMY. Laboratory analysis indicated that three of the transformers contained polychlorinated biphenyls (PCB) oil in concentrations in excess of 50 parts per million (PPM). These three transformers were appropriately labeled and transported for incineration. The other twenty transformers contained PCB oil in concentrations less than 50 PPM and were transported to an approved disposal facility. The GMY was backfilled and compacted at removal areas.

In 1997, Jacobs compared the results reported in the LAW *Site Investigation/Site Characterization Technical Report for the Aerospace Museum Site and Grounds Maintenance Yard*, against background concentrations as reported in the *NAS Fort Worth JRB, Texas Basewide Background Study* (Jacobs, 1997). The evaluation indicated that arsenic was the only metal analyte which exceeded the Soil/Air and Ingestion Standard for Industrial Use (SAI-Ind) MSCs. Arochlor 1254 was detected twice, and 4,4-DDE, 4,4-DDT, and dieldrin were each detected once at concentrations above the MSC. The evaluation recommended sampling for PCBs in the former vicinity of the transformers, sampling for pesticides along the west fence line of the GMY, and sampling for arsenic near one former sample location.

In May 1997, Jacobs collected thirty-two soil and sediment samples at the GMY in order to confirm the analytical results collected by LAW in October 1995. Samples were analyzed for selected metals, and pesticides and PCBs. All samples were first prepared using the synthetic precipitate leaching procedure (SPLP). The data evaluation concluded that endrin was detected below the RRS No. 2 concentration, lead was detected above the Practical Quantitation Limit (PQL) in one sample, and beryllium was detected below the PQL. All of the beryllium results received a "B" qualifier, indicating the detected concentrations were less than 5 times the lab blank concentrations. This qualifier indicates that beryllium is likely due to laboratory contamination and is not present in soil or sediment at these concentrations. Beryllium was detected in all seven lab blank samples at concentrations ranging from 0.0005 to 0.0162 mg/L, while the highest concentration in a soil sample was 0.0166 mg/kg. The evaluation noted that

the Method Detection Limits (MDLs) for antimony, lead, aldrin, and dieldrin were above the RRS No. 2 concentrations.

2.2.3 Aerospace Museum Site (AOC 8)

The Aerospace Museum Site (AMS) is located along Spur 341, west of the North-South primary instrument runway, south of AFP-4, and adjacent to Farmers Branch Creek (Figure 2- 3). The site is currently covered with grass and slopes gently from northwest to southeast. This 12.5-acre museum site has been used for display of various aircraft, vehicles, and storage equipment. A records search indicated that an asphalt batching plant was previously located at the site. Also, a B-52 bomber was previously stored and dismantled at the site, resulting in small chips of aircraft skin being buried in the surface soil. Carswell AFB personnel conducted a site survey on April 9, 1993, and reported the following:

- Several spots of stressed vegetation and dark oily spots near aircraft and ground vehicle displays.
- Stressed vegetation along the west fence line and randomly throughout the aircraft display area.
- A 55-gallon drum of material assumed to be waste grease.
- Discarded paint cans.
- A 55-gallon drum of cleaning compound.
- Several rusted and unidentifiable cans and drums.

In October, 1994, representatives of AFCEE and LAW met at the AMS and found that the debris listed above had been removed, and neither surface staining nor distressed vegetation were evident.

LAW conducted soil sampling activities at the AMS from October 22 to 24, 1995 as part of a Site Investigation/Site Characterization. Forty-nine surface soil samples were collected from 0 to 2 feet using stainless steel hand augers following a grid layout of the site. Sampling locations occurred at approximately 100-foot intervals. Samples were analyzed for metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). The Site Investigation/Site Characterization Technical Report (LAW, 1996) indicated that VOCs and SVOCs detected at the AMS were at concentrations less than the Texas RRSs. The background data collected for metals at this site were determined to not be representative of basewide background concentrations; therefore, a comparison of detected metals concentrations at the site to background were inconclusive.

UNSVTX demolished and removed nine small structures and concrete pads at the former AMS in May 97. These removed structures included a wooden shed, an electrical equipment box, two apparent old concrete blast shields, two concrete pads, one asphaltic concrete pad, a mobile fuel

test system, soil piles, a rubble pile, and loose railroad ties. The site was restored by clean backfilling, compacting, and reseeded with native grass.

In 1997, Jacobs compared the results reported in the *LAW Site Investigation/Site Characterization Technical Report for the Aerospace Museum Site and Grounds Maintenance Yard*, against background concentrations as reported in the *NAS Fort Worth JRB, Texas Basewide Background Study* (Jacobs, 1997). The evaluation indicated that toluene was detected throughout the AMS at relatively low concentrations, SVOCs were detected at concentrations below SAI-Ind MSCs, and lead was the only inorganic analyte that required further evaluation. The evaluation indicated that toluene and PAH concentrations likely represented anthropogenic background and VOCs and SVOCs did not require further sampling. A single sample exceeded background concentrations and MSCs for lead. The evaluation recommended sampling for lead in the area of a rubble pile in the southeast portion of the site (subsequently removed by UNSVTX).

In May 1997, Jacobs collected twenty-seven soil samples at the AMS in order to confirm the analytical results collected by LAW in October 1995. Samples were analyzed for selected metals, and were first prepared using the synthetic precipitate leaching procedure (SPLP). The data evaluation concluded that beryllium was detected below the PQL but was thought to be a lab contaminant, and lead was detected above the PQL in one sample. The evaluation noted that the MDL for lead was 0.016 mg/L compared to the RRS No. 2 of 0.015 mg/L.

2.2.4 Fire Training Area 2 (SWMU 19), Waste Fuel Storage Tank (SWMU 20), and Waste Oil Tank (SWMU 21)

This summary includes Fire Training Area (FTA) 2 (SWMU No. 19), the Waste Fuel Storage Tank (SWMU No. 20), and the Waste Oil Tank (SWMU No. 21) which were co-located. SWMU 19 is located between the north-south taxiway and the former radar facility (Figure 2-1). The site was used as a fire department training facility from 1963 to 1989. The fire ring was gravel-lined and bordered by two low earthen berms. Waste oils and recovered fuels, and possibly waste solvents, were the primary materials burned during fire training exercises. An on-site 8,500-gallon aboveground storage tank (AST), SWMU 20, was used to store clean or contaminated fuels before they were delivered to the fire ring via a pump and piping. Also on-site was a 9,500-gallon underground storage tank (UST), SWMU 21, used for storage of waste oils and solvents from the flightline shops (Radian, 1986). Past interviews of personnel indicated its contents were occasionally used in fire training exercises.

FTA-2 (SWMUs 19, 20, and 21) was investigated as part of the IRP Phase II-Confirmation/Quantification, Stage I (October 1986) and as part of the IRP RI/FS Stage II (April 1989) conducted by Radian. During these investigations, ten borings were drilled and sampled and five groundwater monitoring wells were installed and sampled in the area of FTA-2. Soil

samples indicated the presence of petroleum hydrocarbons. The following SVOCs were also detected: 2-methylnaphthalene, 4-methylphenol, phenol, and naphthalene. Groundwater samples indicated metals and VOCs were detected above Maximum Contaminant Levels (MCLs). The metals detected above MCLs include arsenic, lead, cadmium and chromium. The VOCs detected above MCLs include trichloroethene (TCE), tetrachloroethene, and vinyl chloride.

Dames & Moore conducted remediation activities at FTA-2 in 1993. The 9,500-gallon UST was reportedly removed prior to the remediation project. The remediation project included removal and disposal of the AST and its contents, concrete pad, and associated piping; removal of the fire training structures, piping, and valves; and soil sampling at each area to delineate excavation areas. Thirty soil samples were collected from nine locations at FTA-2 to depths of 0.5, 1.5, and 2.5 feet. One surface water sample was collected in the area. A total of three soil samples were collected in the immediate area of the AST. All samples were analyzed for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylenes (BTEX). Soils excavated from FTA-2 were placed in a biocell on base and remediated. Verification sampling after soil excavation indicated TPH concentrations ranging from below detection limits to 6,400 mg/kg and BTEX concentrations ranging from below detection limits to 74.3 mg/kg. A clay liner was constructed in the excavated areas to form a barrier between impacted soils and future backfill. After bioremediation, in June 1994 the excavated soils were backfilled at FTA-2 above the clay liner.

2.2.5 French Underdrain System (SWMU 64), Unnamed Stream (AOC 14), and Building 1340 OWS (SWMU 67)

The RCRA Part B Permit for Carswell AFB describes SWMU 64 as the French Underdrain System which is divided into two parts; a paved lot in the vicinity of an abandoned gasoline service station; and the Unnamed Stream, a small tributary of Farmers Branch Creek, located southeast of the abandoned service station. The small Unnamed Stream is the discharge from Building 1340 Oil/Water Separator (OWS) (SWMU 67) and receives its perennial flow from groundwater entering the separator. The OWS is connected to the french underdrain system which was installed to aid in the removal of fuel-contaminated groundwater from the abandoned service station (Figure 2-4).

The abandoned service station is removed and the only visible evidence of the station is the concrete pump island. No installation date or as-built drawings have been located for the french underdrain system. In 1996, Parsons Engineering-Science, Inc. (PARSONS) removed the OWS and portions of the french underdrain system. Prior to removal, the OWS had discharged into the unnamed stream, which flows about 200 feet east into Farmers Branch Creek, which in turn discharges to the Trinity River.

Stage I investigations included the collection of soil samples from three hand-augered borings near the unnamed stream, and three soil borings in the unpaved lot (abandoned station). Stage II investigations included collection of surface water samples from the Unnamed Stream and installation and sampling of four monitoring wells in the area of the stream.

Initial investigative activities conducted in 1985 revealed high levels of organic compounds in the groundwater under the paved lot (abandoned service station). Groundwater sampling in 1990 detected VOCs and metals, but at concentrations below MCLs. During groundwater sampling for the 1994 RCRA Facility Investigation (RFI), VOCs and metals were detected in concentrations above RRS No. 2 levels. Surface water data collected in 1986 and 1990 detected benzene and toluene.

Free petroleum product and detectable concentrations of petroleum hydrocarbons in both soil and groundwater were measured at the site during the 1990 IRP RI (Radian, 1991), the RFI (LAW, 1994) and the 1994 risk-based sampling events. Quarterly compliance monitoring events are being conducted at the sites in accordance with the Base-wide groundwater monitoring program.

As part of the interim removal actions by Parsons in 1996, portions of the french underdrain and its bedding material were removed and replaced with low permeability material. These activities halted the flow of groundwater into the OWS and the unnamed stream. The OWS was cleaned and removed, and soil samples taken from the resulting pit. Soil samples showed arsenic and lead concentrations of concern.

The Environmental Company (TEC) conducted an investigation in 1996 of two fuel distribution pipelines which happen to traverse the area of the unnamed stream. Soil borings revealed petroleum-related contamination in the area; however, hydrocarbon fingerprinting results indicated the contamination is not attributable to the pipelines.

Geo-Marine, Inc. conducted soil removal activities at the unnamed stream in 1997. Remedial actions included overexcavation of the entire Unnamed Stream channel for a width of six feet and to a depth of no less than one foot, and overexcavation of the west and south walls of the previously removed OWS. Confirmation sampling was performed as part of the project. The data from the Geo-Marine remedial action will be evaluated as part of the current project along with all previously collected data at these areas.

2.2.6 Landfill LF-04 (SWMU 22), Landfill LF-05 (SWMU 23), and Waste Burial Area WP-07 (SWMU 25)

Landfills LF-04, LF-05, and Waste Burial Area WP-07 are located in close proximity to one another (Figure 2-1), in an area generally referred to as the Landfill Area. This area is located east of the southern end of the flightline at Carswell AFB. The landfills were recently

investigated as one project and due to similar wastes, histories, and future uses, will be evaluated as one area.

LF-04 (SWMU 22) includes approximately six acres of land located east of the south end of Taxiway 197, and south of the west end of White Settlement Road on Carswell AFB. It was the main landfill during much of the history of Carswell AFB. While in active use, at least six large pits, approximately 12 feet deep, were filled with refuse which was reportedly burned and buried. Various potentially hazardous wastes including drums of waste liquids, partially full paint cans, and cadmium batteries were reported disposed of at this site.

LF-05 (SWMU 23) is located northwest of WP-07 between Fire Training Areas 1 and 2, and adjacent to a small tributary to Farmers Branch Creek. This landfill was constructed by building a clay berm next to the creek and filling the area behind the berm. The landfill received all types of flightline waste, including TCE containers, between 1963 and 1975.

WP-07 (SWMU 24) is located north of the west end of White Settlement Road on Carswell AFB, and between LF-04 and LF-05. Various types of hazardous materials, including drums of cleaning solvents, leaded sludge, and possibly ordnance materials were reportedly disposed of at this site during the 1960s. There are no visible signs of the boundaries of the former disposal area.

LF-04, LF-05, and WP-07 were investigated and characterized in the Site Investigation (SI) IRP Confirmation/Quantification Report completed by Radian in 1986. The SI showed that TCE contamination was present in the groundwater beneath the Landfill Area, and elevated concentrations of metals and vinyl chloride were present in surface water samples near the Landfill Area. Soil samples collected during the SI also revealed elevated concentrations of organic and inorganic compounds.

The Landfill Area was further investigated in the Phase II RI/FS by Radian in 1989. This investigation revealed that the TCE plume defined in the SI had not changed appreciably, and soil samples again indicated elevated levels of organic and inorganic compounds.

In 1991, the U.S. Army Corps of Engineers (COE) removed several drums containing TCE from nine excavations at WP-07. Soil samples collected from the excavations detected cadmium, chromium, and lead in addition to TCE, tetrachloroethene, and other VOCs.

A groundwater pump and treat system was installed by IT Corporation in the Landfill Area to recover TCE-contaminated groundwater for treatment. Thirteen groundwater extraction wells were installed as part of the treatment system. The system operated from 1993 until 1995, was restarted in early 1997 and is currently operational. Selected wells in the Landfill Area are

sampled as part of basewide groundwater monitoring, and also as part of long-term monitoring of the TCE plume originating from AFP4.

As part of the 1997 HydroGeologic Inc. investigation of the Landfill Area, surface and subsurface samples were collected from test pits excavated at LF-04 and LF-05, and from soil borings at WP-07.

HydroGeologic reported that inorganic compounds and SVOCs were above RRS No. 2 levels in surface soils at LF-04 and LF-05; inorganic compounds were above RRS No. 2 levels in surface soils at WP-07; and inorganic compounds were above RRS No. 2 levels in subsurface soils at LF-04.

The 1997 HydroGeologic report concluded that metals concentrations in surface waters in the Landfill Area were probably not representative of runoff specifically related to any of the units investigated. The report indicated that TCE concentrations in surface waters were above RRS No. 2 levels; however this was attributed to AFP4 surface water transported through the aqueduct to Farmers Branch Creek and groundwater discharging to surface waters. The report also indicated that metals concentrations in sediments were above RRS No. 2 levels; however, there was no evidence that this was a result of releases from the subject areas.

The 1997 HydroGeologic investigation also determined that groundwater beneath the Landfill areas has been impacted by chlorinated organic compounds migrating in groundwater from AFP4 located to the west. An increase in contaminant levels is noted in the area of WP-07.

2.2.7 Sanitary Sewer System (SWMU 66)

The sanitary sewer system was designated as SWMU 66 in a RCRA Facility Assessment (RFA) report by EPA (Kearney, 1989). The RFA reported the sanitary sewer system collects sanitary wastewater as well as some industrial wastewater from Carswell AFB facilities. The wastewater collected by the sanitary sewer system is discharged into the City of Fort Worth publicly-owned treatment works. The sanitary sewer system has been in operation since the base was activated in 1942.

An investigation of the sanitary sewer system in 1994 indicated that most of the oil/water separators (OWSs) at the base did discharge effluent through the sanitary sewer system (Carter and Burgess, 1994). LAW performed an investigation of 11 OWSs in 1995 to assess contamination and evaluate the condition of the OWSs. Of the OWSs connected to the sanitary sewer system at Carswell AFB, five have been submitted for no further action (NFA) status, and several others are expected to require no further action pending comparison to the basewide background study.

IT Corporation conducted a RCRA Facility Investigation (RFI) of the sanitary sewer system in 1997 for releases of effluent to the soil and groundwater. The investigation included collection of surface, near surface, and subsurface soils, groundwater, and surface water. The investigation included 24 OWSs connected to the sanitary sewer system. Collection of soil samples was performed along the sanitary sewer system at areas of greatest potential release of hazardous materials, including the industrial sector of the sanitary sewer and the OWSs. Samples were also collected near manholes, major bends, and at 250-foot intervals along the sewer system. The results of the 1997 IT RFI of the sanitary sewer system are pending review by the Texas Natural Resource Conservation Commission (TNRCC).

2.2.8 Treatment, Storage, and Disposal Facility

The Treatment, Storage, and Disposal Facility (TSDF) at Carswell AFB is located at Building 1347 and is operated under RCRA Part B Permit HW50289. The facility is actually a Permitted Container Storage Facility and no treatment or disposal activities have taken place at the facility. The facility is located in the far east area of the base (Figure 2-5). The facility was permitted in February 1991, and is authorized to operate for storage of up to 29,700 gallons of hazardous industrial waste. No wastes have been stored at the facility since November 14, 1995. In April 1996, 21 soil samples were collected around the building at each potential point of release during its previous operations. Samples were collected to a depth of 6 inches. After soil sampling, the facility was decontaminated in accordance with the permit closure plan, subsequent approved amendments, and applicable regulations referenced in the permit. Rinse water from the decontamination process was analyzed and the results submitted to the Fort Worth Water Department, Industrial Waste Section. The rinse water was discharged to the sanitary sewer system on September 16, 1996 with the approval of the Fort Worth Water Department. No equipment, waste, or rinse water remains at the site. Soil analytical results will be reviewed to determine if the site can receive clean closure certification.

2.2.9 Weapons Storage Area (SWMUs 59, 60, and 65)

The Offsite Weapons Storage Area (WSA) is a 247-acre off-site facility under ownership and control of Carswell AFB. The Offsite WSA is located about 4 miles west of the main base, just north of White Settlement Road (Figure 1-1). The facility, built in 1957, is surrounded by an additional 264 acres of easements. The Offsite WSA is primarily bordered by rural property, with some ranches and farms located nearby. A residential development is located south of White Settlement Road. Facilities included 2 munitions inspection shops, 16 ordnance storage buildings, 1 entry control building, a less than 90-day hazardous waste storage area (SWMU 59), and an emergency power plant. During its operational period, the site also maintained an Explosive Ordnance Disposal (EOD) Range, a small radioactive waste disposal facility (SWMU 60), a water storage tank, and two non-potable water wells (Figure 2-6).

A wide range of waste generating activities have occurred at the Offsite WSA and a number of environmental investigations and studies have been conducted at the site. Small quantities of waste cleaners and solvents were reported to be disposed of in a ditch west of Building 8503 (SWMU 65). An RI/FS Stage II investigation by Radian in 1989 collected soil samples in the ditch and analyses detected TCE, metals, PAHs, and VOCs.

The EOD range consisted of 83 acres. The range was surveyed by Air Force personnel in 1993 and was cleared by EOD personnel in 1995. All metallic items were excavated and removed.

A waste dump located 250 feet north of the north fence of the WSA contained debris which included wooden pallets, used crates, scrap metal, newspapers, loose sand, and other non-hazardous materials. Metcalf & Eddy (M&E) collected samples in the area which indicated all analytes were below regulatory levels. The debris was removed in 1993 as non-hazardous waste.

Armstrong Laboratories Health Physics Branch conducted radiological surveys and sampling of the Offsite WSA in 1995. The evaluations demonstrated that the Offsite WSA meets the release criteria in accordance with the United States Nuclear Regulatory Commission, and the Offsite WSA is considered releasable for public use.

The low-level radioactive waste (LLRW) burial area (SWMU 60) was located 400 feet west of Building 8503 at the Offsite WSA. The site was used between 1957 and 1969, and consisted of radium-painted aircraft instrument dials that were disposed of in 18-foot long sealed tubes buried vertically in the ground. The three tubes and adjacent soil were excavated in May 1996. No evidence of release was observed and soil samples were obtained and analyzed for selected radionuclides. The Interim Remedial Action LLRW Burial Site technical report (M&E, 1996) indicated that the TNRCC issued an approval for closure of SWMU 60 under RRS No. 1 on November 5, 1996.

Five USTs have been installed and removed at the Offsite WSA. These reportedly contained fuel oil and diesel and were used for power generation, heating and vehicle fueling. Documentation of the UST removal activities was not found.

Groundwater from the on-site supply well was reported to contain total radium at 8.5 picocuries per liter (pCi/L), in excess of federal drinking water standards of 5 pCi/L. Jacobs Engineering conducted a background study which focused on previously detected radionuclides in groundwater. Existing wells were sampled and deep upgradient wells were installed to determine whether the radionuclides are naturally occurring or the result of disposal practices at the Offsite WSA.

The Environmental Company (TEC) conducted an RFI of the Offsite WSA in 1997. The project was to determine the nature and extent of contamination associated with maintenance and

disposal activities at the Offsite WSA. Specific objectives were to determine the nature and extent of contamination associated with SWMU 59, characterize potential contamination related to the removed USTs, sample for residual explosive contamination at the EOD range, conduct asbestos and lead-based paint surveys at the site structures, assess potential contamination at the munitions igloos, and characterize all areas that may have been impacted by maintenance and disposal activities at the site including drainageways and ditches. The results of the 1997 TEC RFI of the Offsite WSA are pending review by the TNRCC.

2.2.10 Landfill LF-08 (SWMU 25)

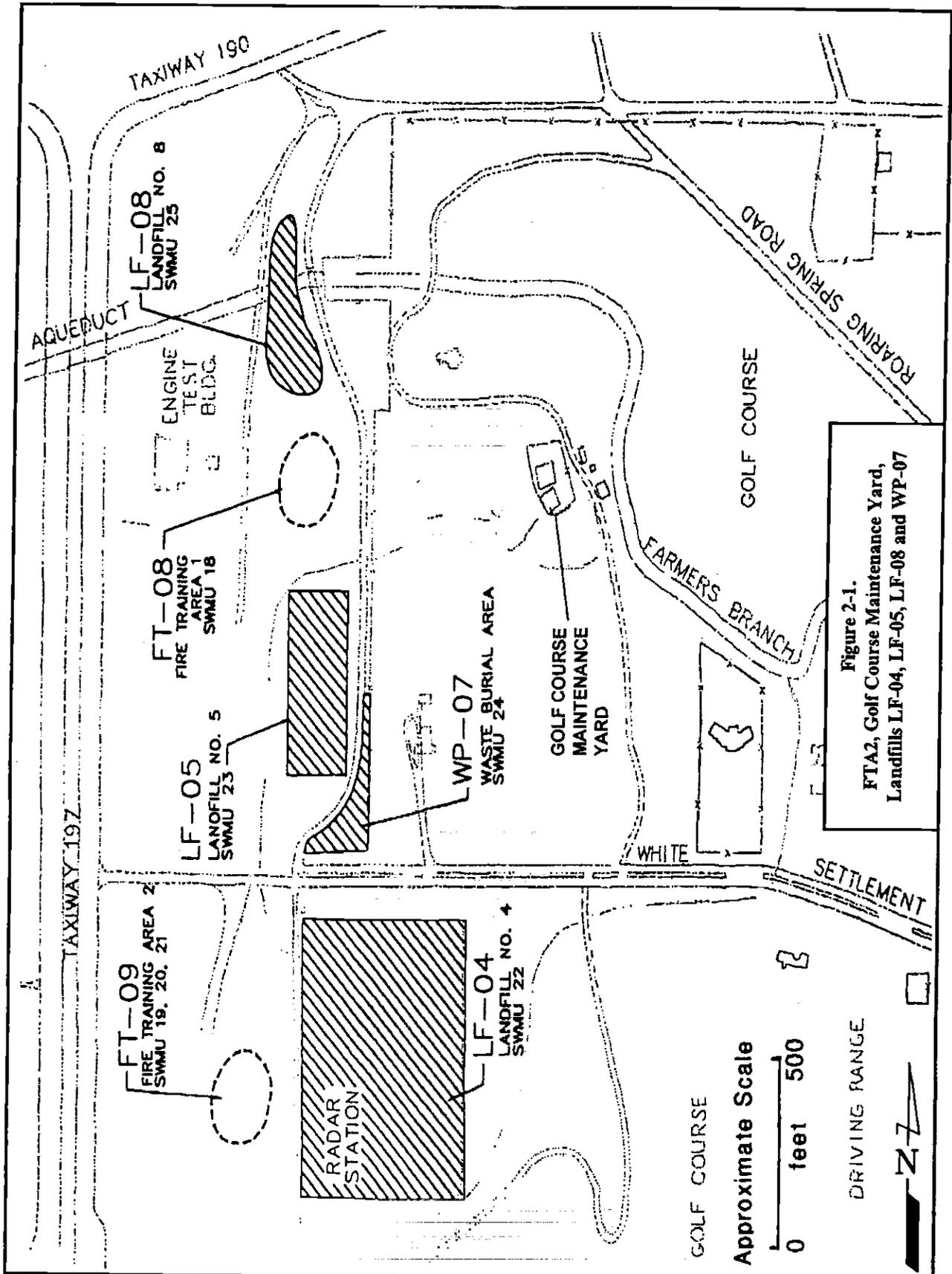
LF-08 (SWMU 25) appears as a grass-covered mound and is located adjacent to, and east of, the north-south Taxiway 197 and south of Taxiway 190 (Figure 2-1). The RCRA Facility Assessment (Kearney, 1989) reported the area's operational history existed only during the mid 1960's and has not been used since the late 1960's. Debris that was reportedly accepted by the landfill included wood, metal, construction rubble, asphalt, concrete, and trees. No evidence suggests that any hazardous materials were disposed of at this site. However, Kearney reported that some of the materials disposed of at this site may have contained hazardous materials (HydroGeologic, 1997).

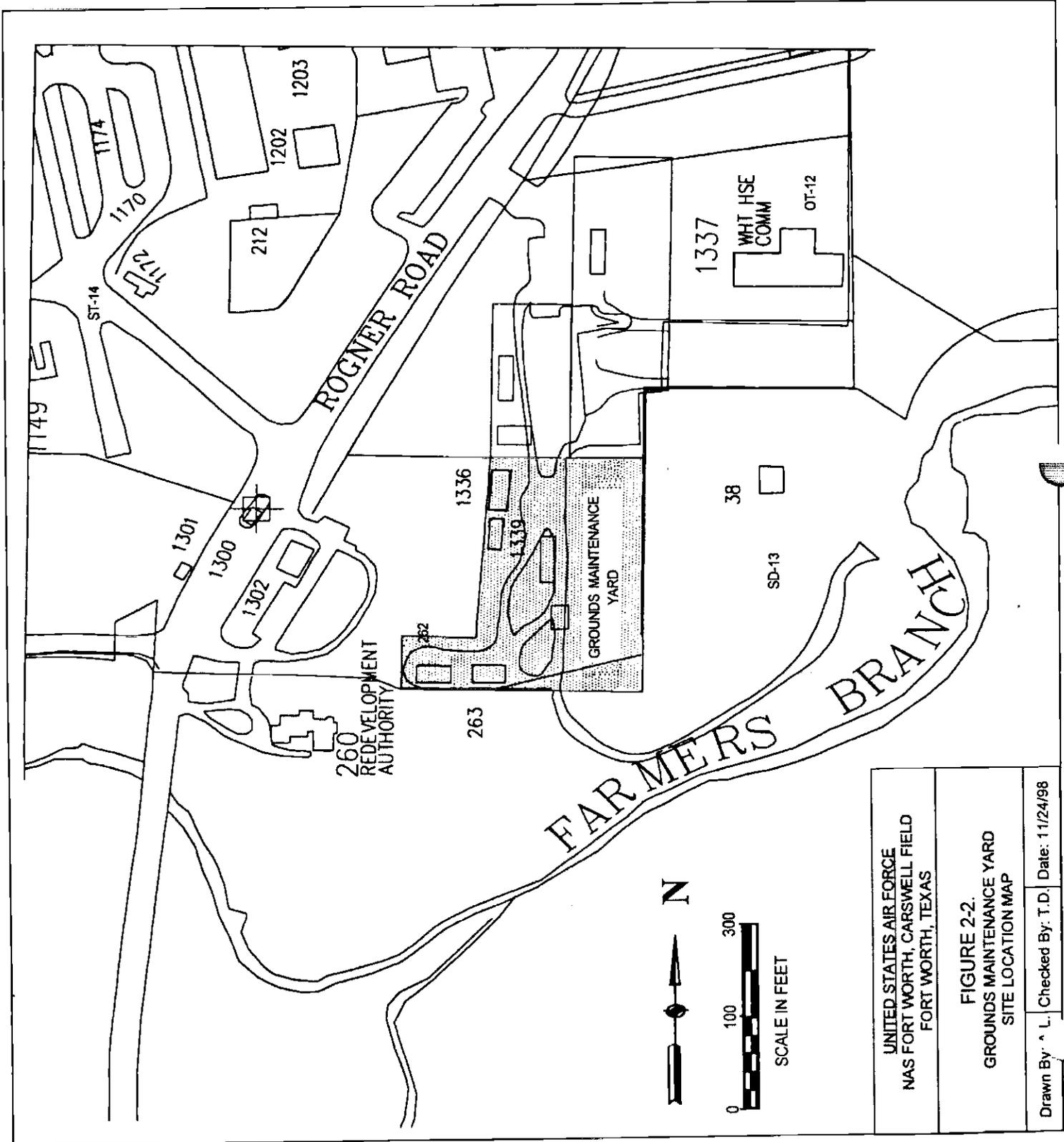
In 1997, HydroGeologic performed two geophysical surveys to evaluate the extent of the landfill. Following the reduction of survey data, eight test pits were excavated to investigate identified anomalies. Surface soil samples were collected at the test pit locations and subsurface soil samples were collected from virgin soil beneath the landfill debris. The draft report for the investigation indicated that several inorganics in surface and subsurface soils exceeded background and/or RRS No. 2 levels, and several SVOCs in surface soils exceeded PQLs and/or RRS No. 2 levels.

The 1997 HydroGeologic investigation also determined that groundwater beneath the Landfill areas has been impacted by chlorinated organic compounds migrating in groundwater from AFP4 located to the west. One newly installed well at LF-08 detected higher concentrations of TCE than the well that is upgradient from LF-08 (HydroGeologic, 1997).

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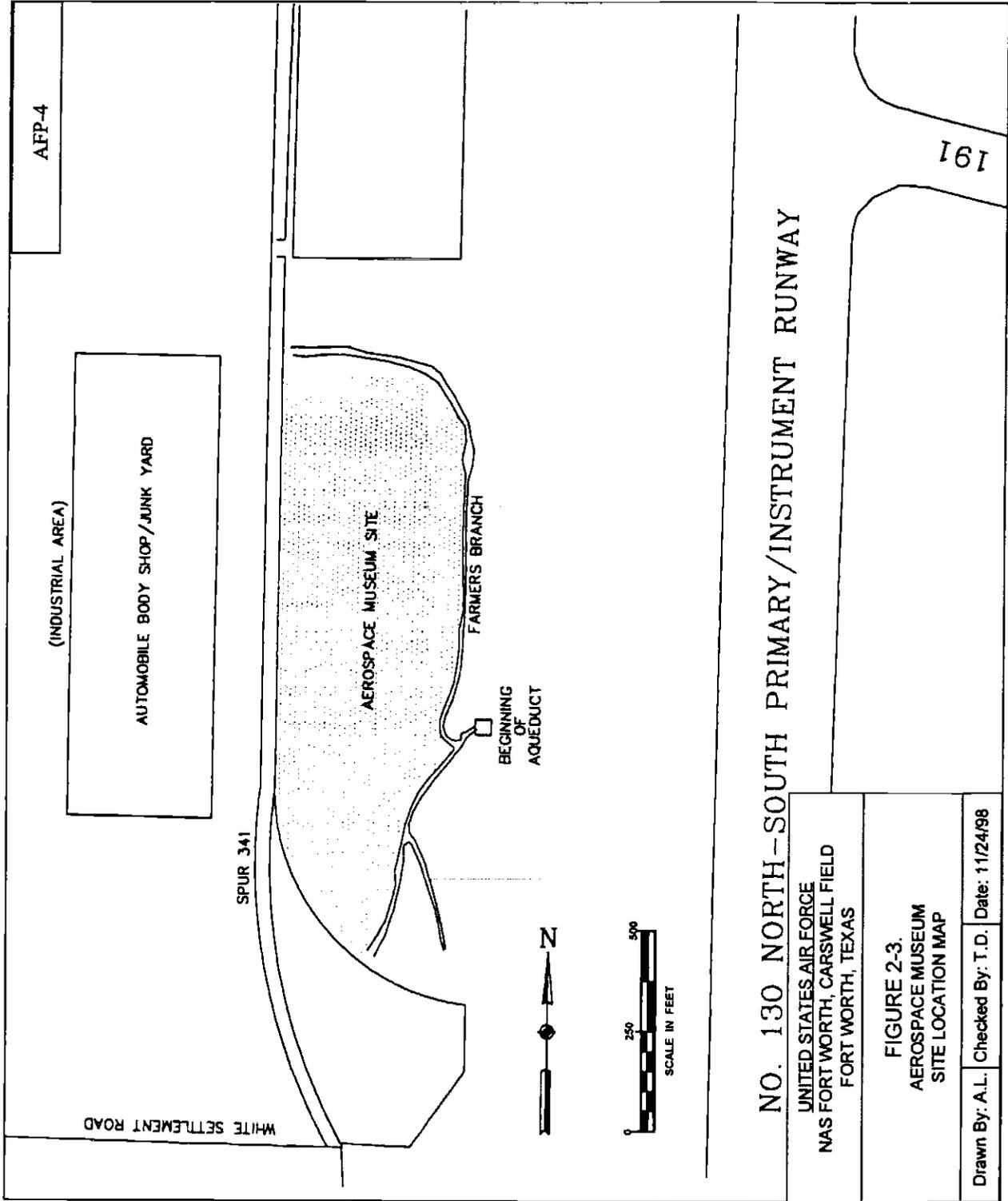




UNITED STATES AIR FORCE
NAS FORT WORTH, CARSWELL FIELD
FORT WORTH, TEXAS

FIGURE 2-2.
GROUNDS MAINTENANCE YARD
SITE LOCATION MAP

Drawn By: ^ L. Checked By: T.D. Date: 11/24/98

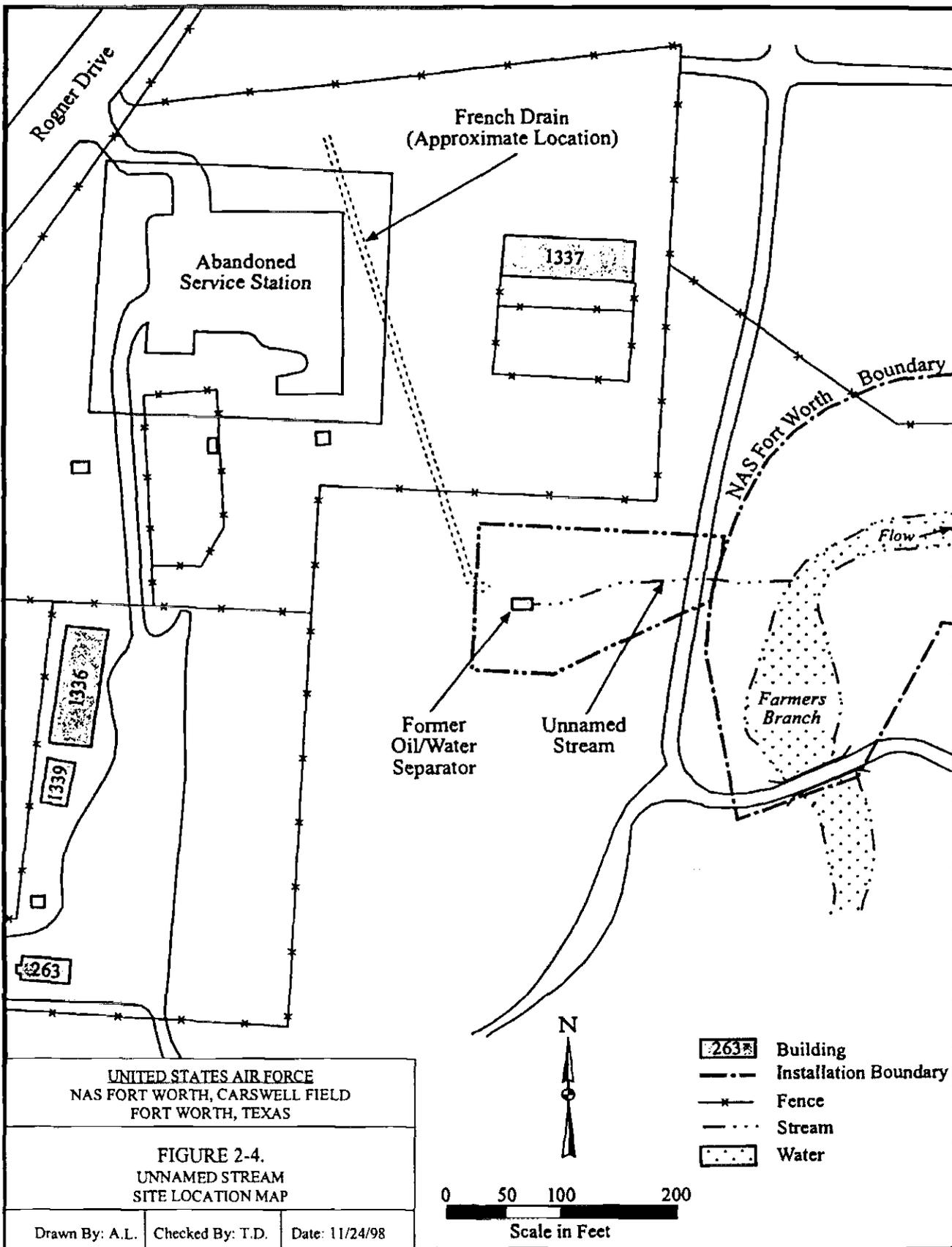


NO. 130 NORTH-SOUTH PRIMARY/INSTRUMENT RUNWAY

UNITED STATES AIR FORCE
NAS FORT WORTH, CARSWELL FIELD
FORT WORTH, TEXAS

FIGURE 2-3.
AEROSPACE MUSEUM
SITE LOCATION MAP

Drawn By: A.L. Checked By: T.D. Date: 11/24/98



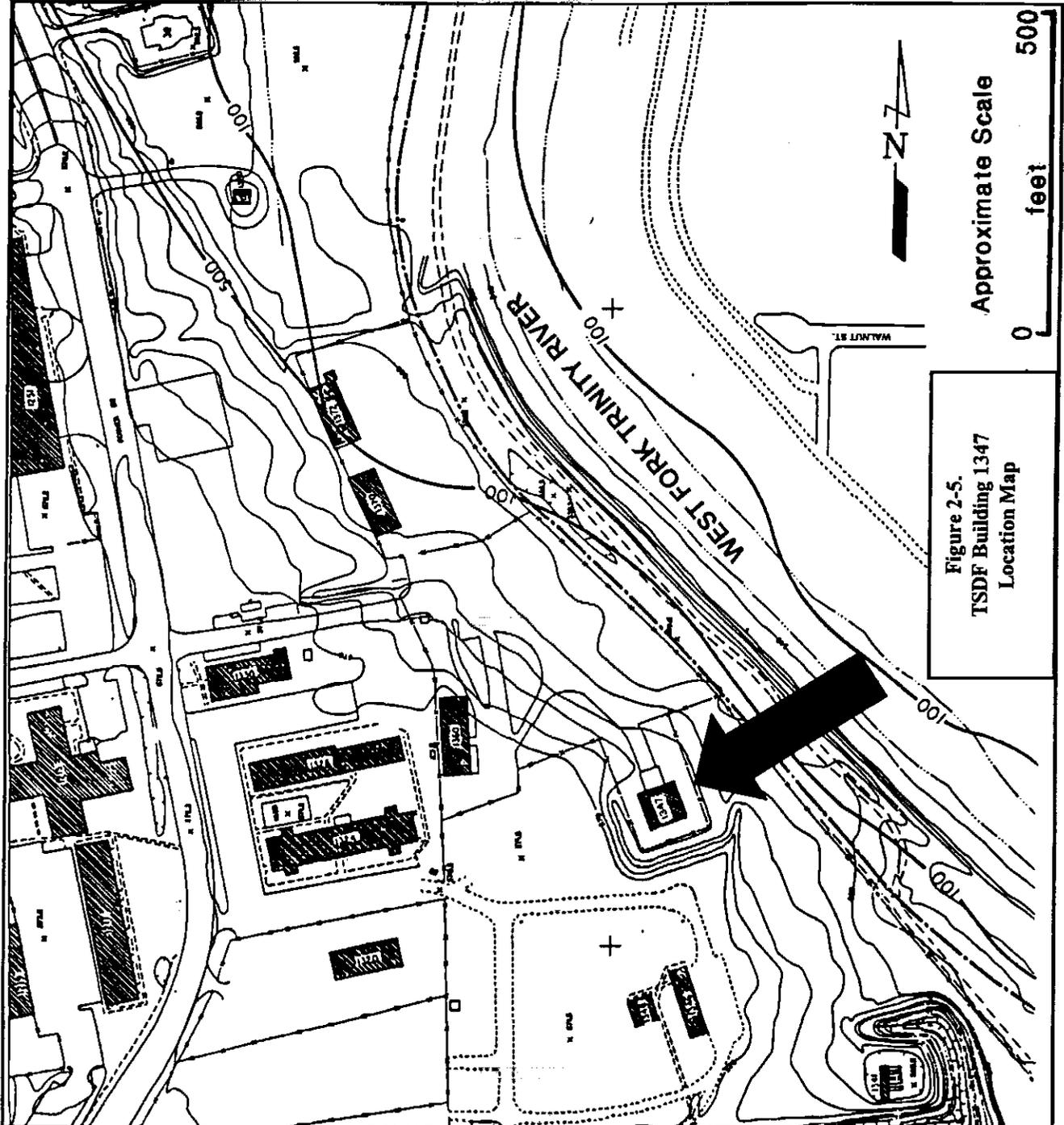


Figure 2-5.
TSDF Building 1347
Location Map

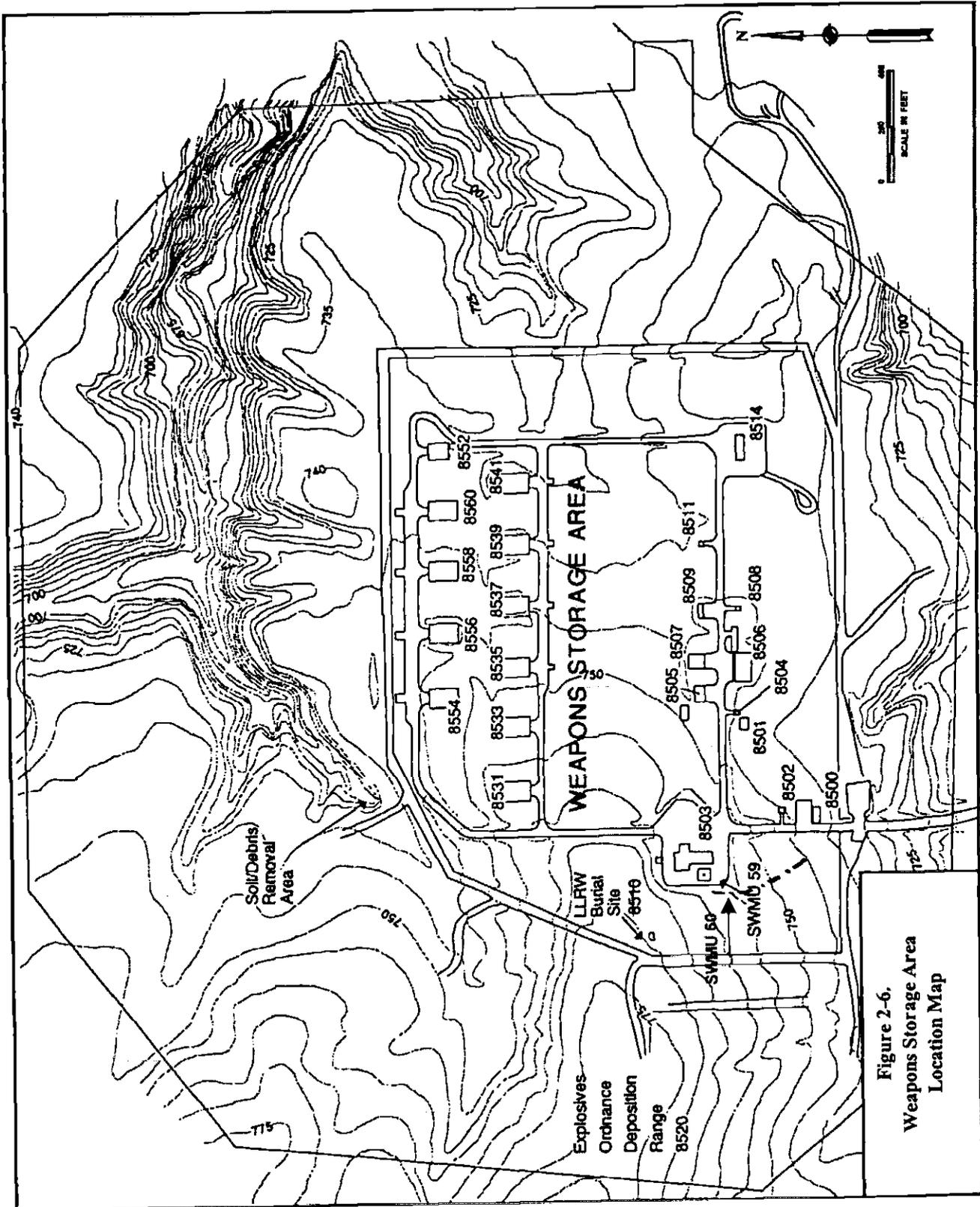


Figure 2-6.
Weapons Storage Area
Location Map

3.0 PROJECT TASKS

3.1 CONCEPTUAL SITE MODEL DEVELOPMENT

Conceptual site models (CSMs) shall be developed or existing models refined for each site after a review of all existing site information. The CSM shall describe contaminant sources, geologic and hydrogeologic conditions, background concentrations, contaminants and contaminated media, migration pathways and potential receptors, and the risk presented to exposed populations at each site. The CSM shall provide the basis for risk-based closures or developing target remediation goals at each site. Data gaps identified during CSM development will guide data collection for this project. The CSMs shall then be further refined or revised based on the additional data obtained. The project objectives include identifying and filling existing data gaps in the CSM to provide risk-based closure documentation for each site or develop risk-based target remediation goals for each site.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) IDENTIFICATION

All federal, state, and local laws, regulations, criteria, advisories, and guidance shall be considered in identifying contaminant-specific, location-specific, and action-specific ARARs. The Texas Risk Reduction Rules (30 TAC 335 Subchapter S) will be the primary guidance for determining site-specific risk-based target cleanup levels for each site and for documenting that each site meets those levels as applicable. The TSDF will be closed in accordance with the requirements of Permit No. HW-50289, Permit for Municipal Hazardous Waste Management Site. Based on Permit No. HW-50289, facility closure shall be completed in accordance with the requirements of 31 TAC 335.152 and 40 CFR Part 264 Subpart G, and the September 6, 1989 closure plan and amendments.

3.3 RISK ASSESSMENT

A risk assessment consistent with 30 TAC Chapter 335, Subchapter S will be conducted for each site or zone of sites. The risk assessments will comply with the provisions set forth for the attainment of Risk Reduction Standard No. 2: Closure/remediation to health-based standards and criteria. Compliance with Risk Reduction Standard No. 2 will assure that any substantial present or future threat to human health or the environment is eliminated.

Data on environmental media collected during previous investigations and during the current project will be compiled and evaluated for each site. The data will be used to identify the chemicals potentially posing a risk to human health and the environment, select environmental media of concern, determine exposure factors, and develop cleanup levels.

Compounds that are detected below background concentrations will be eliminated from further evaluation in the risk assessment. Exposure scenarios used to develop cleanup levels will be selected based on potential current and future exposure pathways and receptors identified at or near the site. Land use, zoning restrictions, and property transfer plans will be evaluated in selecting exposure scenarios. Toxicity factors will be compiled for each Contaminant of Concern (COC).

Cleanup levels will be derived for each COC in each medium of concern. Specifically, Texas or Federally promulgated health-based standards or criteria represent the primary basis for site cleanup levels. When these values are not available for a COC, MSCs will be derived. MSCs are health-based concentrations and will be derived from exposure and toxicity factors identified in the risk assessment and from the acceptable risk levels required by Subchapter S. Cleanup levels that are lower than the PQLs or natural background concentrations will be adjusted upwards to the greater of the PQL or background level.

A risk reduction evaluation will be provided to determine whether site concentrations meet the cleanup levels developed under the provisions of RRS No. 2. Exposure concentrations derived in the exposure assessment will be compared to the identified cleanup levels. For those sites that do not meet cleanup levels, conclusions and recommendations regarding attainment of cleanup levels will be discussed.

3.4 DATA NEEDS IDENTIFICATION

The objectives of the project are defined in Section 1.3.1 of this WP. Existing site data will be collected and evaluated against appropriate risk-based closure criteria. Data gaps identified during the initial data evaluations will guide additional data collection for this project. Data needed to accomplish the project objectives include:

- *Soil and Sediment Characteristics Data.* Soil characteristics data is necessary to understand the geologic conditions in areas of potential contamination. Lithologic data will be recorded during all subsurface sampling activities conducted in relation to filling identified data gaps at specific sites. Soil properties data (grain size, moisture content, organic carbon, porosity, etc.) will be collected as required to fill identified data gaps at specific sites.
- *Soil Contamination Data.* Soil contamination data is necessary in areas of potential contamination to identify the types and concentrations of contaminants present in surface and subsurface soils. Soil sample locations and analyses will be selected to fill identified data gaps at specific sites.
- *Sediment and Surface Water Contamination Data.* Sediment and surface water contamination data is necessary to identify the types and concentrations of contaminants

present in drainageways at applicable sites. Sediment and surface water sample locations and analyses will be selected to fill identified data gaps at specific sites.

- *Groundwater Characteristics Data.* Groundwater characteristics data is necessary in areas of potential contamination to understand the hydrogeologic conditions. Data will be collected to fill identified data gaps involving groundwater characteristics, such as depth to groundwater and direction of groundwater flow. Identified data gaps at specific sites may require the installation of additional groundwater monitoring wells.
- *Groundwater Contamination Data.* Groundwater contamination data is necessary to identify the types and concentrations of contaminants present in groundwater. Groundwater sample locations and analyses will be selected to fill identified data gaps at specific sites. Identified data gaps at specific sites may require the installation of additional groundwater monitoring wells.
- *Land Survey Data.* Land survey data is necessary to accurately locate property boundaries, easements, soil boring and sample locations, and groundwater monitoring well locations. Survey data will be required to fulfill deed certification requirements for site closures under Risk Reduction Standard No. 2.

3.5 FIELD INVESTIGATION TASKS

Field activities required to fulfill project objectives will include those identified as necessary to fill data gaps and implement selected interim actions to meet site-specific target cleanup levels. The initial data evaluation and risk-based closure evaluations based on the provisions of Risk Reduction Standard No. 2 will determine the field tasks required to achieve the project objectives. Field activities will take place at those sites listed in Section 2.0 of the WP only if required following the initial data evaluation. A summary of the specific tasks, and locations and types of sampling required at each site will be specified in work plan addenda for each site and as each site is evaluated.

After obtaining all necessary permits for ground penetration, mobilizing personnel and field equipment, and establishing a temporary on-site field office, environmental media sampling and selected interim actions will begin. Potential field activities expected to be required to fill data gaps and implement interim actions are described below.

3.5.1 Sampling and Analysis

Surface and subsurface soil samples, sediment and surface water samples, and groundwater samples will be collected as required to refine conceptual site models, fill identified data gaps, resample previously invalidated data, further define the extent of contamination, and demonstrate

the attainment of cleanup levels. The sampling activities will be conducted under the protocol described in detail in the FSP. A summary table of samples and analyses to be performed at each site will be specified in work plan addendum as each site is evaluated.

3.5.2 Well Installations

Additional permanent monitoring wells, temporary monitoring wells, and piezometers will be installed as required to provide data required to refine conceptual site models, fill identified data gaps, further define the extent of contamination, and demonstrate the attainment of cleanup levels. The well installations will be conducted under the protocol described in detail in the FSP. The locations of any required well installations will be specified in each work plan addendum as each site is evaluated.

3.5.3 Land Surveys

Field activity survey information will be recorded as described in detail in the FSP. For those sites submitted for closure under Risk Reduction Standard No. 2, survey data outlining the property location and boundaries will be obtained to fulfill deed certification requirements.

3.5.4 Excavations

Excavations will be conducted as necessary to provide data required to refine conceptual site models, fill identified data gaps, further define the extent of contamination, and demonstrate the attainment of cleanup levels. Excavations may take place as selected interim actions for soils to meet site-specific target cleanup levels. The excavations will be conducted under the protocol described in detail in the FSP. The locations of any required excavations will be specified in work plan addendum as each site is evaluated.

3.5.5 Waste Management

Wastes that may be generated during the project activities include: (1) purged groundwater; (2) decontamination water; (3) drill cuttings; (4) excavated soils; (5) expendable personal protective equipment; and (6) general trash.

Waste disposal activity will be coordinated with Carswell AFB authorities and they are responsible for signing all transportation manifests as the generator. Any hazardous waste disposal will be at a site selected by Carswell AFB authorities. All waste management practices will follow the guidelines established by the TNRCC. Detailed waste handling procedures are presented in the FSP.

4.0 DATA ASSESSMENT, RECORDS, AND REPORTING REQUIREMENTS

4.1 DATA ASSESSMENT

A review of field records will be conducted to determine completeness, validity of samples collected, and the correlation of field data. Any anomalies in data will be identified and evaluated.

All laboratory analysis data generated from sampling during this project will be reviewed and validated in accordance with Section 8.0 of the *Basewide Quality Assurance Project Plan* (CH2M Hill, August 1996).

An evaluation of valid environmental data will be conducted. Based on the data reviews, data generated through poor field or laboratory practices will not be considered in the evaluation. Historical data that is not supported by proper documentation will also not be considered in the evaluation. Report documents will include a discussion regarding any environmental data found to be invalid.

4.2 RECORD KEEPING

Documentation of field sampling will be performed to ensure data validity and facilitate evaluation. Field logbooks will be maintained to contain information pertinent to the field sampling program and the equipment preparation efforts. Field logbooks will be maintained in accordance with Section 8.0 of the Field Sampling Plan. Field personnel will complete and maintain standard field data forms for all field activities. Examples of field data forms are collectively presented in the FSP. The field data forms to be utilized include:

- Chain-of-Custody Form;
- Boring Logs;
- Monitoring Well Construction Details and Abandonment Forms;
- Monitoring Well Development Records;
- Monitoring Well Purging Forms;
- Monitoring Well Static Water Level Forms;
- Instrument Calibration Log Sheets; and
- Waste Inventory Tracking Forms.

4.3 REPORTING REQUIREMENTS

This section details project reporting requirements. All deliverable products/reports will be prepared and submitted in accordance with the SOW and the applicable Contracts Data Requirements Lists (CDRLs).

4.3.1 Project Scoping Documents

This WP constitutes one of the project scoping documents required by the SOW for this contract and delivery order. Other scoping documents include a HSP and a SAP. The SAP will consist of a FSP and QAPP.

4.3.2 Project Reporting Requirements

Reporting requirements for this project include preparing closure documents for sites posing minimal or no threat to human health, welfare, or the environment and for which no further action is appropriate. For those sites requiring further action, a site-management plan will be prepared establishing target cleanup levels and remedial action objectives. Conceptual site models (CSMs) will be developed or refined for each site evaluated, and risk-based evaluations will be conducted for each site. The CSMs and risk-based evaluations will be included as components of the closure documents or site-management plans.

The closure documents and site-management plans will be submitted in draft and final formats. The documents will summarize all previous site activities, investigations, and data; describe all activities completed during this project; and interpret and analyze all valid data. The documents will address the requirements of the TNRCC Subchapter S, Risk Reduction Standards (30 TAC 335) and other ARARs.

4.3.3 Monthly Status Reports

FPM will complete and submit monthly financial and management reports. The monthly status reports will describe the status of expenditure of funds correlated with the progress of the work completed. Reports shall indicate the progress of the work and the status of the program and assigned tasks.

4.3.4 Project Schedules

FPM has prepared a computer-generated network analysis that is a detailed task plan for all WBS tasks. The network analysis is in the form of a Gantt chart to appropriately indicate the percentage of work scheduled for completion by any given date during the period of the delivery order.

4.3.5 ERPIMS Data

Preparation of data for submission to the ERPIMS database shall be in accordance with the SOW.

5.0 PROJECT MANAGEMENT

This task includes coordinating among other project participants, as well as tracking schedules and budgets and preparing monthly status reports to AFCEE. Table 5-1 presents point-of-contact information for key project personnel. Figure 5-1 is a project organizational chart that identifies key project personnel.

Table 5-1. Key Personnel and Point-of-Contact Listing

Name	Address	Phone Number
Mr. Charles Rice AFCEE TC/COR	AFCEE/ERB 3207 North Road, Building 532 Brooks AFB, TX 78235	(210) 536-6452 (210) 536-3609 Fax
Mr. Alvin Brown AFBCA Field Engineer	AFBCA/OL-H 6550 White Settlement Road Fort Worth, TX 76114	(817) 731-8973, Ext. 10 (817) 731-8137 Fax
Mr. Kevin Phillips FPM Program Manager	Fanning, Phillips and Molnar 909 Marconi Avenue Ronkonkoma, NY 11779	(516) 737-6200 (516) 737-2410 Fax
Mr. Joseph Comanzo FPM Quality Assurance	Fanning, Phillips and Molnar 909 Marconi Avenue Ronkonkoma, NY 11779	(516) 737-6200 (516) 737-2410 Fax
Mr. Thomas Doriski FPM Health and Safety Officer	Fanning, Phillips and Molnar 9311 San Pedro Avenue, Suite 700 San Antonio, TX 78216	(210) 524-7737 (210) 524-7738 Fax
Mr. Gaby Atik FPM Project Manager	Fanning, Phillips and Molnar 909 Marconi Avenue Ronkonkoma, NY 11779	(516) 737-6200 (516) 737-2410 Fax
Ms. Anne Le FPM Project Engineer	Fanning, Phillips and Molnar 9311 San Pedro Avenue, Suite 700 San Antonio, TX 78216	(210) 524-7737 (210) 524-7738 Fax
Mr. Atul Salhotra Project Risk Assessor	RAM Group 7457 Harwin Drive, Suite 308 Houston, TX 77036	(713) 784-5151 (713) 784-6105Fax

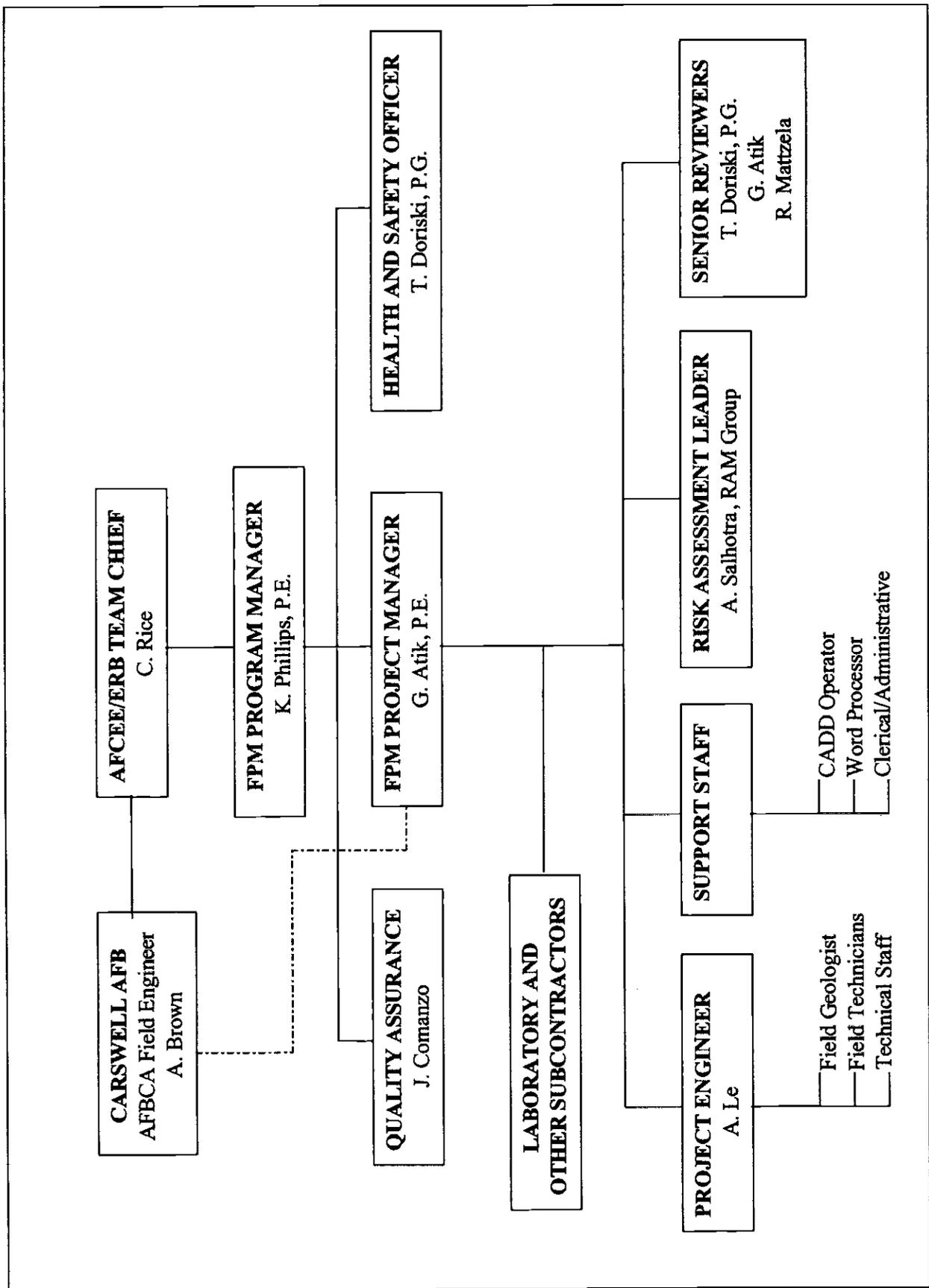
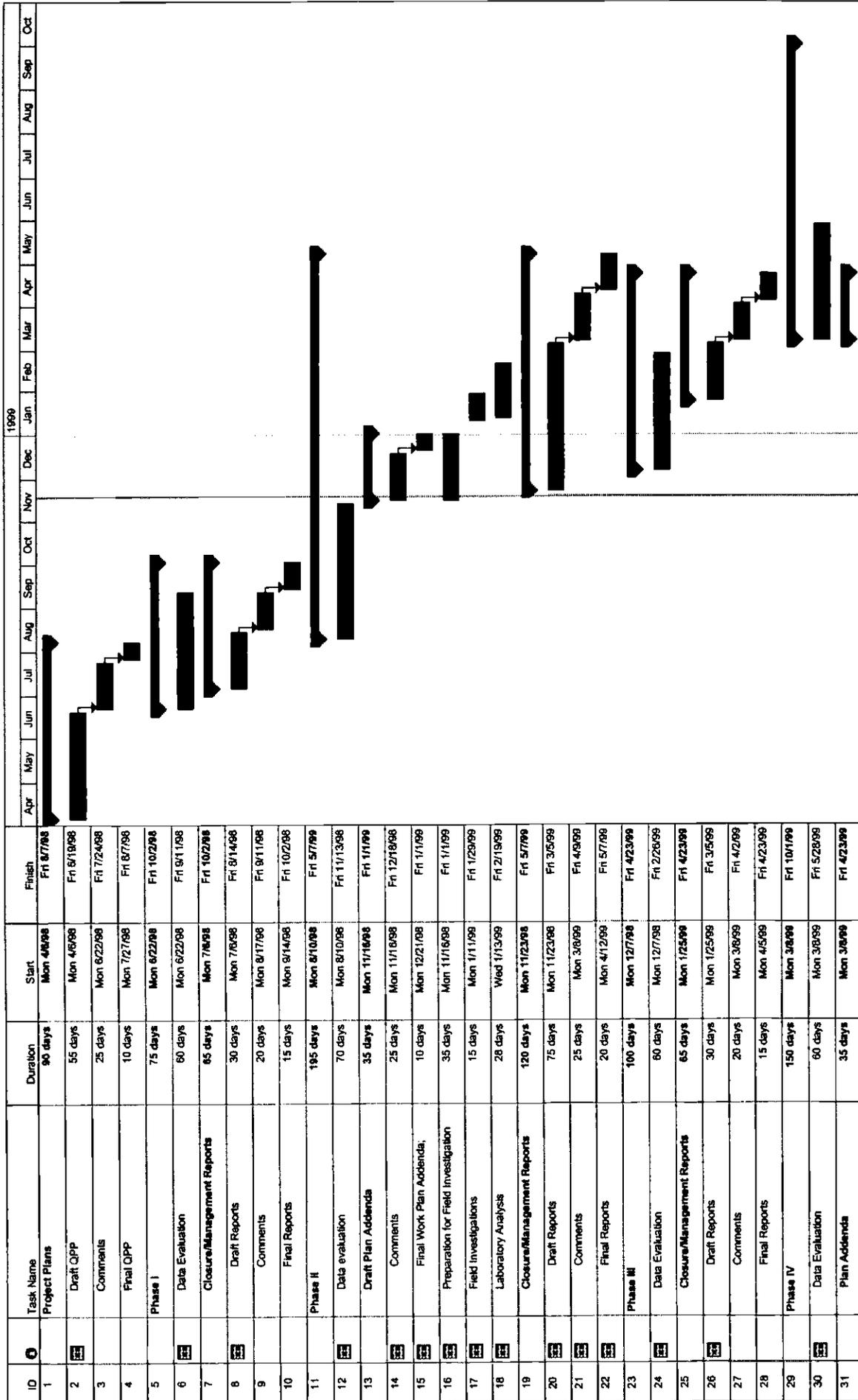


Figure 5-1. Organizational Chart
Page 5-2

6.0 PROJECT SCHEDULE

The project schedule is shown on Figure 6-1. The project schedule is presented in the form of a Gantt Chart.

FIGURE 6-1
PROJECT SCHEDULE



Project Schedule
Date: June 98, Revised November 98

Task
Split
Progress

Milestone
Summary
Rolled Up Task

Rolled Up Split
Rolled Up Milestone
Rolled Up Progress

External Tasks
Project Summary

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7.0 REFERENCES

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- Dames & Moore, 1995, Volume I, Final Summary Report Remediation Project, SWMUs 19, 20 and 53, Carswell Air Force Base, Fort Worth, Texas.
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- IT Corporation, 1997, Final Work Plan, Site Characterization of the Sanitary Sewer System, NAS Fort Worth, Carswell Field, Texas.
- Jacobs Engineering Group Inc., 1997, Draft Basewide Background Study, Volume 1.
- Jacobs Engineering Group Inc., 1997, Final Technical Report, Interim Remedial Action at the Golf Course Maintenance Yard.
- Jacobs Engineering Group Inc., 1997, Draft Letter Report, Results of Sampling at the Aerospace Museum Site, NAS Fort Worth, Texas.
- Jacobs Engineering Group Inc., 1997, Draft Letter Report, Results of Sampling at the Grounds Maintenance Yard, NAS Fort Worth, Texas.
- LAW Environmental, Inc., 1995, Installation Restoration Program RCRA Facility Investigation Report.
- LAW Environmental, Inc., 1996, Final Site Characterization / Risk Assessment Technical Report Fire Training Area 2 for NAS Fort Worth, Carswell Field, Texas.
- LAW Environmental, Inc., 1996, Installation Restoration Program Final Site Investigation / Site Characterization Technical Report for the Aerospace Museum Site and Grounds Maintenance Yard for NAS Fort Worth, Carswell Field, Texas.
- Parsons Engineering Science Inc., 1997, Final Remedial Action Plan for the Risk-Based Remediation of Site ST14 (SWMU 68) LPSTID 104819; the Former Base Refueling Area (AOC 7); the French Underdrain System (SWMU 64); and the North Oil/Water Separator (SWMU 67).
- Radian Corporation, 1986, Installation Restoration Program Phase II, Confirmation / Quantification, Stage I, Volume I-Final Report.

Radian Corporation, 1989, Installation Restoration Program RI/FS, Stage II, Draft Final Technical Report, Carswell Air Force Base, Volume I.

Radian Corporation, 1991, Remedial Investigation for the East Area, Draft Report for Carswell AFB, Texas.

Texas Natural Resource Conservation Commission, 1996, Texas Administrative Code, Chapter 335 Industrial Solid Waste and Municipal Hazardous Waste, Risk Reduction Standards.

The Environmental Company Inc., 1996, Draft Work Plan, RCRA Facility Investigation of the Offsite Weapons Storage Area at NAS Fort Worth, Carswell Field, Texas.

The Environmental Company Inc., 1997, Site Characterization Report for the Recreational Vehicle Family Camping and Fuel Pipeline Areas.

United Services of Texas, Inc., Final Report, Demolition and Removal of Structures/ Disposal of Transformers with PCB Oil.

U.S. Air Force Center for Environmental Excellence, 1993, The AFCEE Handbook for Installation Restoration Program Remedial Investigation and Feasibility Studies.

U.S. Army Corps of Engineers, 1991, Carswell Air Force Base, Texas, RCRA Permit Part B Number HW50289, Summary of Permit Sites.

TAB

HSP

**RISK-BASED ASSESSMENT, MANAGEMENT, AND CLOSURE
OF SOLID WASTE MANAGEMENT UNITS AND AREAS OF CONCERN
AT NAVAL AIR STATION FORT WORTH, JOINT RESERVE BASE,
CARSWELL AIR FORCE BASE, TEXAS**

**FINAL
HEALTH AND SAFETY PLAN**



**Contract No. F41624-95-D-8003-0023
Project No. DDPF 98-8125**

**December
1998**

**HEALTH AND SAFETY PLAN
CDRL A002**

**Risk-Based Assessment, Management, and Closure
of Solid Waste Management Units and Areas of Concern
at Naval Air Station Fort Worth, Joint Reserve Base,
Carswell Air Force Base, Texas**

**Contract No. F41624-95-D-8003-0023
Project No. DDPF 98-8125**

**Prepared for:
AFCEE/ERB
3207 North Road
Brooks AFB, TX 78235-5673**

**Prepared by:
Fanning, Phillips and Molnar
9311 San Pedro Avenue, Ste. 700
San Antonio, TX 78216**

December 1998

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PREFACE

Fanning, Phillips and Molnar (FP&M), under contract with the Air Force Center for Environmental Excellence (AFCEE), is performing risk-based assessment, management, and closure of various solid waste management units (SWMUs) and Areas of Concern (AOCs) at Carswell Air Force Base (AFB), Fort Worth, Texas. The project will evaluate existing site data, refine conceptual site models, and fill data gaps to allow for the risk-based assessment of SWMUs and AOCs. The project will provide risk-based closure documentation which will determine site-specific target levels for contaminants and recommend closure, monitoring, or remediation to target levels. The individual SWMUs and AOCs to be addressed by the project include the following:

SWMUs

- 19 Fire Training Area 2
- 20 Waste Fuel Storage Tank
- 21 Waste Oil Tank
- 22 Landfill 4
- 23 Landfill 5
- 24 Waste Burial Area WP-07 (Waste Pit)
- 25 Landfill 8
- 58 Pesticide Rinse Area
- 59 B8503 Weapons Storage Area (WSA) Waste Accumulation Area
- 60 B8503 Radioactive Waste Burial Site (Groundwater)
- 64 French Underdrain System/Unnamed Stream
- 65 WSA Disposal Site
- 66 Sanitary Sewer System
- 67 B1340 Oil/Water Separator (OWS)
Permitted Treatment, Storage, and Disposal Facility (TSDF)

AOCs

- 5 Grounds Maintenance Yard
- 8 Aerospace Museum
- 9 Golf Course Maintenance Yard
- 14 Unnamed Stream

This plan may be adopted for other SWMUs and AOCs at the former Carswell AFB as needed. Supplemental plans or plan addenda will be submitted with relevant site-specific information for all sites not outlined in this current plan.

This Health and Safety Plan (HSP) identifies the minimum health and safety requirements for the risk-based assessment of these SWMUs and AOCs. The assessments will be conducted in accordance with provisions of the Basic Contract #F41624-95-D-8003 and Delivery Order (DO) #23. Mr. Rafael Vasquez is the Air Force Base Conversion Agency (AFBCA) Base

Environmental Coordinator (BEC) for Naval Air Station (NAS) Fort Worth, the former Carswell AFB. Mr. Alvin Brown is the AFBCA Field Engineer and Base Point of Contact (POC). Mr. Charles Rice serves as the AFCEE/ERB team chief and as Contracting Officer's Representative (COR). Mr. Joe Dunkle serves as the AFCEE/ERA team chief.

The principal FP&M personnel include Dr. Kevin J. Phillips, P.E., Program Manager, Mr. Gaby A. Atik, P.E., Project Manager, and Mr. Thomas P. Doriski. Mr. Doriski will also act as Health and Safety Officer. Additional personnel will be selected from FP&M staff as needed. Dr. Atul Salhotra of RAM Group will be the principal risk assessor.

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APPENDIX A – PLAN ACCEPTANCE FORM AND INCIDENT REPORT FORM

ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AOC	Area Of Concern
BBP	Bloodborne Pathogens
CPR	Cardiopulmonary Resuscitation
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
dB	decibel
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
FPM	Fanning Phillips and Molnar
HSO	Health and Safety Officer
HSP	Health and Safety Plan
IDLH	Immediately Dangerous to Life and Health
IRP	Installation Restoration Program
JRB	Joint Reserve Base
KV	KiloVolt
l/m	Liters per minute
LEL	Lower Explosive Limit
MCL	Maximum Contaminant Level
MSDS	Material Safety Data Sheet
NAS	Naval Air Station
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective Equipment

ACRONYMS AND ABBREVIATIONS (Cont'd)

REL	Recommended Exposure Limit
SCBA	Self Contained Breathing Apparatus
SSO	Site Safety Officer
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit
TCE	Trichloroethene
TLV	Threshold Limit Value
VOC	Volatile Organic Compound

SECTION 1.0 INTRODUCTION

1.1 OBJECTIVE

The Health and Safety Plan (HSP) establishes guidelines for health and safety practices and personal protection of Fanning Phillips and Molnar (FPM) personnel, subcontractors, and authorized visitors during field investigations at the Naval Air Station (NAS) Fort Worth, Joint Reserve Base (JRB), formerly Carswell Air Force Base (AFB) Texas.

The objective of this plan is to provide a mechanism for the establishment of safe working conditions during field activities. 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 safe working practices. This document is subject to modification, as warranted, if changes in activities and/or procedures are encountered.

1.2 SCOPE

This HSP prescribes basic procedures and minimum equipment requirements for worker protection for personnel, subcontractors and authorized visitors who enter the work areas. Each subcontractor is responsible for the health and safety of their employees and for compliance with applicable regulations and the content of this HSP.

Work conditions can change as operations progress; therefore the Project Manager (PM) will provide written addenda to this HSP when changes warrant. No changes to the plan will be implemented without prior approval of the PM or his authorized representative.

1.3 REFERENCES

This HSP complies with applicable Occupational Safety and Health Administration (OSHA) and U.S. Environmental Protection Agency (EPA) regulations. This plan follows the guidelines established in the following documents:

- *Standard Operating Safety Guidelines* (Office of Solid Waste and Emergency Response, 1988)
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (National Institute of Occupational Safety and Health [NIOSH] 85-115)
- Title 29 of the Code of Federal Regulations (CFR), Part 1910.120 (U.S. Department of Labor/OSHA).

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SECTION 2.0 BACKGROUND

2.1 LOCATION AND DESCRIPTION

Carswell AFB is located in north-central Texas in Tarrant County, 8 miles west of downtown Fort Worth (Figure 2-1). The base property, totaling 2,555 acres, consists of the main base and two, noncontiguous parcels. The main base comprises 2,264 acres and is bordered by Lake Worth to the north, the West Fork of the Trinity River and Westworth Village to the east, Fort Worth to the northeast and southeast, White Settlement to the west and southwest, and Air Force Plant 4 to the west. The area surrounding Carswell AFB is mostly suburban, including the residential areas of the cities of Fort Worth, Westworth Village, and White Settlement.

2.2 HISTORY

Carswell AFB, now known as NAS Fort Worth JRB, was established in 1942. Since the beginning of industrial operation, in 1942, wastes have been generated and disposed at Carswell AFB. Major industrial operations include maintenance of jet engines, aerospace ground equipment, fuel systems, weapon systems, pneumatic systems; maintenance of general and special purpose vehicles; aircraft corrosion control; and non-destructive inspection activities. The generated wastes are primarily oils, lubricants, recoverable fuels, spent solvents and cleaners.

In 1984, the Installation Restoration Program (IRP) was initiated at Carswell AFB. Since then, Air Force IRP studies have been conducted by several contractors and have focused on the identification and characterization of waste disposal areas and solid waste management units (SWMU). Twenty of these sites have undergone investigation and/or remedial action and require closure. Under this current project in pursuit of closure for these sites, data may be collected which may include geological, geophysical, and geotechnical investigations, hydrogeological studies, and the collection, testing, and analysis of contaminants present in soil and water.

A description of the Carswell AFB sites under investigation is presented in Section 2 of the Work Plan. Please refer to this section for the site description information and contaminant history.

2.3 PROJECT ACTIVITIES

Planned or potential activities taking place during this project:

- Soil borings/Geoprobe
- Excavations
- Monitoring Well Installation
- Land Surveys
- Soil Sampling
- Groundwater Sampling Surface
- Water and Sediment Sampling

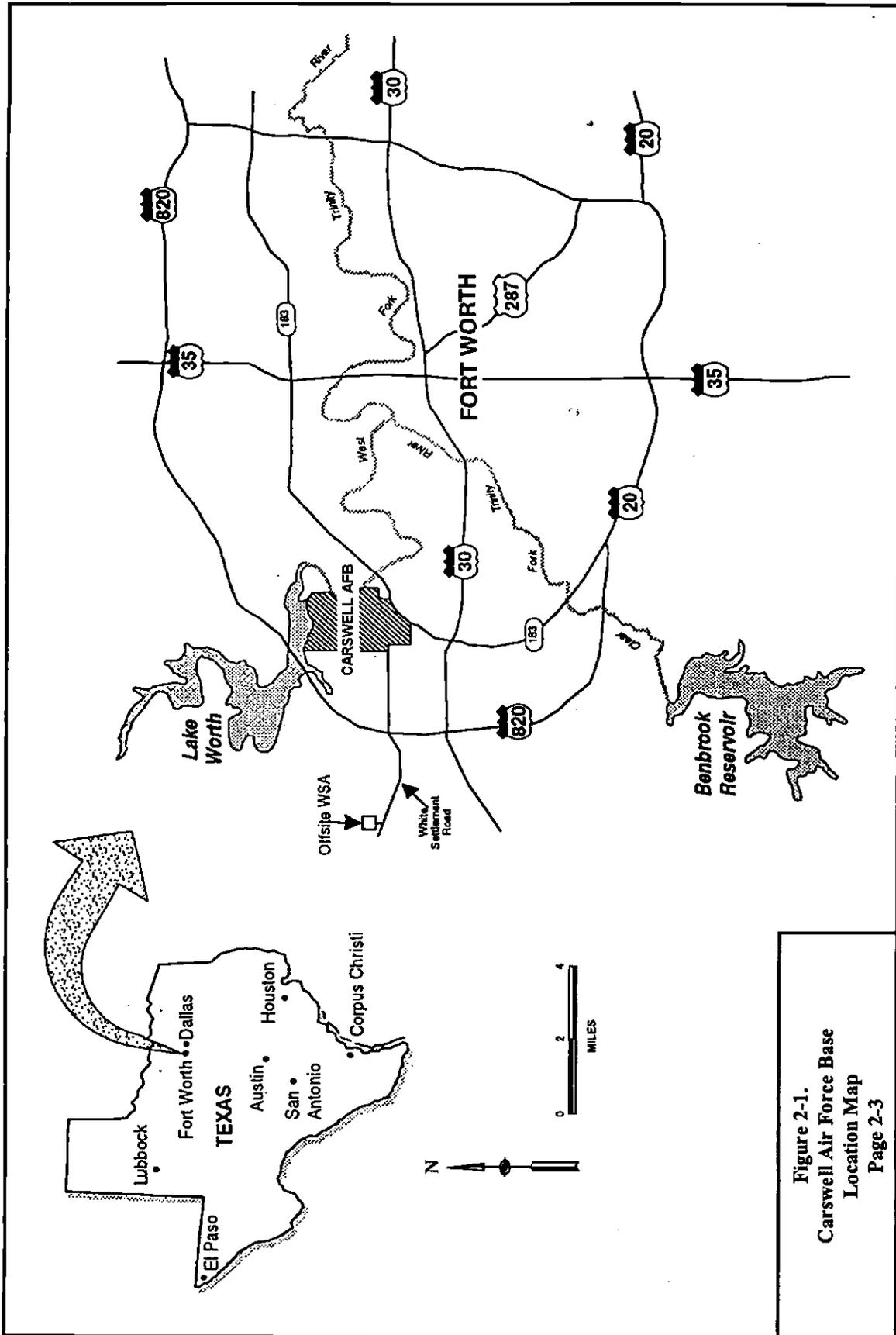


Figure 2-1.
Carswell Air Force Base
Location Map
Page 2-3

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SECTION 3.0 ORGANIZATION

3.1 KEY PERSONNEL AND RESPONSIBILITIES

Title	Name
Program Manager	Dr. Kevin Phillips, P.E.
Project Manager	Gaby A. Atik, P.E.
Site Manager/Site Safety Officer	Anne Le
Health and Safety Officer	Thomas Doriski, P.G.

The Program Manager is responsible for ensuring that all work is performed in compliance with the Air Force Center for Environmental Excellence (AFCEE) contract and that all work is performed to the satisfaction of AFCEE personnel.

The Project Manager (PM) will be the primary point of contact between AFCEE and the Contractor. The PM has primary responsibility for plan development, plan implementation, and report production, including data assessment. The PM has the authority to initiate corrective actions on any level of the work subject to Program Manager approval.

The Site Safety Officer (SSO) is responsible for ensuring that the day-to-day operations at the site are conducted in accordance with the HSP. The SSO has the authority to stop operations if actions or conditions at the site are judged unsafe or do not comply with the requirements of the HSP. Any deviations from the health and safety protocol require documentation by the SSO and shall be reported to the PM.

The Health and Safety Officer (HSO) is responsible for enforcing the company health and safety program. He performs audits at project sites to ensure health and safety guidelines are being followed. He has the authority to stop operations if actions or conditions at the site are judged unsafe or do not comply with the requirements of the HSP. He can arrange for medical examination of employees if he/she suspects that they may have been exposed to hazardous chemicals and he reports all incidents to the EPA.

3.2 EMERGENCY TELEPHONE NUMBERS

Table 3-1. Emergency Contacts and Telephone Numbers

Contact	Telephone Number
Anne Le	(210)-524-7737
Thomas Doriski	(210)-524-7737
Gaby A. Atik	(516)-737-6200
AFCEE (Charles Rice)	(210)-536-6452
AFBCA (Alvin Brown)	(817) 731-8973, ext. 10
Fire Department	911
Emergency Medical Service	911
Medical Plaza Hospital	(817)- 336-2100
National Spill Response Center	1-800-424-8802
Chemtrec	1-800-424-9300

SECTION 4.0 HAZARD ANALYSIS

This section describes the risks and hazards associated with the field investigations at Carswell AFB. The anticipated hazards include chemical and physical hazards.

4.1 CHEMICAL HAZARDS

4.1.1 Sampling and Equipment Decontamination Chemicals

Products containing hazardous chemicals may be used during the sampling of soil and groundwater, primarily cleaning agents used to decontaminate sampling equipment. For all chemicals brought on site for use at the former Carswell AFB, a material safety data sheet (MSDS) will be obtained and placed in a binder which will be maintained at the job site for employee access. Appropriate Personal Protective Equipment (PPE) must be worn when handling hazardous chemicals. The specific level of PPE required will be governed by the chemicals used.

4.1.2 Petroleum Hydrocarbons and Chlorinated Hydrocarbons

Table 4-1 lists the exposure limits and health hazards of the compounds that potentially exist at the sites that will be investigated at Carswell AFB. The Recommended Exposure Limits (REL), Permissible Exposure Limit (PEL) and Threshold Limit Value (TLV) for hazardous substances are all time-weighted average concentrations for a 40-hour work week. These values were developed by different institutions to recommend workplace exposure limits to reduce or eliminate adverse health effects and accidental injuries. The ceiling value for these exposure limits must not be exceeded at any time or potential adverse health symptoms such as the ones presented in the Table 4-1 will likely occur. Immediately dangerous to life and health (IDLH) concentrations as defined by NIOSH, represent the maximum concentration from which, in the event of a respirator failure, one could escape within 30 minutes without experiencing any impairing or irreversible health effects.

4.1.3 Explosion Hazard Action Levels

Monitoring of atmospheric conditions is necessary to identify and quantify airborne contaminants in order to determine the level of protection needed and if necessary, to evacuate an area. Planned field investigations that require air monitoring are intrusive activities such as excavation of contaminated soils and characterization, verification, or confirmation of soil and groundwater contamination levels by soil sampling and well drilling. However, air monitoring may include any changes in site conditions or work activities that could affect worker safety.

The explosivity action level is 20 percent (20%) of the Lower Explosive Limit (LEL). The LEL of a substance is the minimum concentration of gas or vapor in air below which the substance will not burn when exposed to a source of ignition. The Combustible Gas Indicator (CGI) meter must be set to sound at the action level. Refer to Section 9.0 for calibration guidelines. When

CGI measurements indicate the presence of combustible gas or vapor levels which meet or exceed the explosivity level, the following actions must be taken:

1. Extinguish all possible ignition sources and shut down all powered equipment.
2. Evacuate personnel to at least 100 feet from the work area.
3. Contact the SSO.
4. After waiting 15 minutes for vapors to dissipate, the SSO may use the CGI to cautiously and with prudence, approach the worksite to determine the extent and concentration of vapor emissions.
5. Workers shall not be allowed back into the work area so long as the CGI readings exceed explosivity levels. Workers shall not enter the work area until the cause of the emission has been determined and the source abated.
6. The PM/SSO shall prepare an incident report and submit to the Health and Safety Officer.

Site conditions and thus atmospheric chemical conditions may change following initial characterization. For this reason, monitoring should be repeated periodically, and at the discretion of the SSO, especially when:

- Work begins on a different portion of the site.
- Different contaminants are being handled.
- A markedly different type of operation is initiated.
- Workers are handling leaking drums or working in areas with obvious liquid contamination.

Explosivity monitoring with the detector should be set at a location near and downwind of the probable source of emission.

4.1.4 Possible Exposure Routes

During site activities field personnel may be exposed to petroleum and solvent contaminated soil and groundwater in addition to free product (gasoline/aviation fuel) measured from the existing monitoring wells. The exposure routes possible during the site work consist of dermal contact and incidental ingestion. Inhalation, although not anticipated, of volatile organics is another exposure route.

Table 4-1. Exposure Limits for Possible Hazardous Compounds Existing on Site

Contaminant	PEL, REL, or TLV	IDLH	Symptoms and Effects of Exposure
Benzene	1 ppm	3,000 ^{Ca}	Irritated eyes, nose, respiratory system; giddy; headache, nausea, staggered gait; fatigue, anorexia, lags; dermatitis; bone marrow depression; [carcinogen]
Chlorobenzene	10 ppm	2,400	Irritated eyes, skin, nose; drowsiness, incoordination
Arsenic	0.01 mg/m ³	100 ^{Ca}	Ulceration of nasal septum, dermatitis, GI disturbance, peripheral neuropathy, respiratory irritation, hyper pigmentation of skin, [carcinogen]
Dioxins/Furans	NL	NL ^{Ca}	Potential human carcinogen
Petrachloroethene (PCE)	25 ppm	500 ^{Ca}	Irritable eyes, nose, throat; nausea; flush face, neck; vertigo, dizziness, incoordination; head, somnolence; skin erythema; liver damage; [carcinogen]
Vinyl Chloride	1 ppm	Ca	Weak; abdominal pain, Gastrointestinal bleeding, hepatopoietic, pallor or cyanosis of extremities; [carcinogen]
Chromium (Limits as Cr III)	0.5 mg/m ³	NE	Sensitization, dermatitis
Dichloroethane (Limit as 1,2-DCA)	10 ppm	1,000 ^{Ca}	Central Nervous System depression; nausea, vomit; dermatitis; irritable eyes, corneal opacity; [carcinogen]
Xylene	100 ppm	1,000	Dizziness, excitement, drowsiness, incoordination, staggering gait; irritable eyes, nose, throat; corneal vacuolization; anorexia, nausea, vomit, abdominal pain, dermatitis
Dieldrin	0.25 mg/m ³	450 ^{Ca}	Head, dermatitis, dizziness; nausea, vomit, malaise, sweat; limb jerks; tonic convulsion; coma; [carcinogen]

Note 1: Appropriate value of PEL, TLV, or REL used.

Note 2: IDLH are same units as PEL for each contaminant.

Note 3: Symptoms and effects source is "NIOSH Pocket Guide to Chemical Hazards," June 1990.

Ca = Carcinogen	ppm = parts per million	mg/m ³ = milligram per cubic meter
NA = Not applicable	PEL = Permissible exposure limit	IDLH = Immediately dangerous to life and health
NE = Not established	REL = Recommended exposure limit	TLV = Threshold Limit Value

4.2 PHYSICAL HAZARDS

Hazard	Engineering or Administrative Controls
Flying debris/objects	Provide shielding and PPE.
Noise >85 decibels (dB) (A-weighted)	Noise protection if conversations have to be shouted at a distance of 3 feet (ft.).
Steep terrain/unstable surface	Brace and shore equipment or move location.
Build-up explosive gases	Provide 20-lb A, B, C fire extinguisher & ventilation.
Suspended loads	Work not permitted under suspended loads.
Moving vehicles	Backup alarm required for heavy equipment. Observer remains in contact with operator and signals safe backup. Personnel to remain outside of turning radius.
Slip, trip, fall hazards due to muddy work areas	Personnel to wear boots with good tread. Use wood pallets or similar devices in muddy work areas if necessary.
Back injury	Use proper lifting techniques, or provide mechanical lifting aides.
Protruding objects	Flag visible objects.
Build-up of static electricity	No spark sources within 50 ft. of an excavation, heavy equipment, or underground storage tank (UST) removal. Ground as appropriate.
Gas cylinders	Make certain gas cylinders are properly anchored and chained. Keep cylinders away from ignition sources.
High pressure hose rupture	Check to see that fitting and pressurized lines are in good condition before using.
Electrical shock	Make certain 3rd wire is properly grounded. Do not tamper with electrical wiring unless qualified to do so.
Overhead electrical wires	Heavy equipment (e.g. drill rig) to remain at least the height of the mast plus 15 ft. from overhead powerline for powerlines of 50 KiloVolt (KV) or less. For each KV>50 increase distance 1/2 foot.
Buried utilities, drums, tanks, and underground structures	Locate buried utilities, drums, tanks, etc., before digging or drilling and mark locations. No work is to be performed without a digging permit issued by the AFB.
Confined space entry	NOT ALLOWED UNDER THIS PLAN. Permit and specific safety plan required.

4.2.1 Heat and Cold Stress

Heat or Cold Stress	Symptoms	Treatment
Heat Stroke	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high body temperature.	Cool victim rapidly by soaking in cool (not cold) water. Get medical attention immediately!
Heat Exhaustion	Pale, clammy, moist skin; profuse sweating; weakness; normal temperature; headache; dizzy; vomiting; heat cramps	Remove victim to a cool, air-conditioned place. Loosen clothing, place head in low position. Have victim drink cool (not cold) water.
Heat Cramps	Muscular pains and spasms in the legs and abdomen	Restore electrolytes to the body, rest in a cool place.
Frostbite	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Remove victim to a warm place. Warm injured area quickly in warm (not hot) water. Have victim drink warm fluids-not coffee or alcohol. Do not break any blisters. Elevate the injured area and get medical attention.
Hypothermia	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration	Remove victim to a warm place. Have victim drink warm fluids-not coffee or alcohol. Get medical attention.

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4.2.1.1 Guidelines For Working in Extreme Temperature

As a minimum for each 2-hour period worked, a 15-minute rest period is required. A work-rest cycle shall be implemented at any time that heat stress or cold stress poses a threat. As a minimum rate of consumption for liquids when the temperature is greater than 90°F, drink 8 ounces of cool water before beginning work and 4 more ounces during breaks. Workers also should try to take seated breaks in shaded areas during hot working conditions and may wear cooling vests to keep the core body temperature down. A resting radial (wrist) pulse may be taken at the beginning of the day and at the rest period to determine if pulse is over 110 beats per minute. If pulse exceeds this criteria, reduce work load and or shorten the work cycle to reduce the pulse rate to under 100. In cold stress conditions, breaks will be taken in heated areas, with warm liquid ingested.

4.2.1.2 Dehydration

Dehydration occurs any time the body loses more fluids than it intakes. Because many field tasks are labor intensive and may require the use of PPE, there is 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 provided in section 4.2.1.1 and sufficient water consumed during these breaks. If dehydration symptoms are experienced, personnel will rest in a cool spot and drink plenty of water until the symptoms are eliminated.

4.3 BIOLOGICAL HAZARDS

The potential for biological hazards at Carswell AFB exists, therefore all field personnel shall be made aware of potential hazards common to the Texas area and care will be taken to avoid such hazards.

4.3.1 Snakes

Snakes do not usually attack unless they are disturbed (e.g., stepped on) or if they are threatened. Local signs 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 two days.

Field personnel shall wear proper foot and leg protection (high leather or thick rubber boots with heavy long canvas pants/snake chaps) tucked in if they know they will be working in an area suspected of having snakes. If a person is bitten, he or she will be transported to the nearest emergency medical center. DO NOT attempt to apply a tourniquet, or employ the "cut and suck" method of treatment. It is important that the bitten person does not make any unnecessary movements. The part of the body where the bite has occurred must be immobilized, and the affected area kept 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.

4.3.2 Insects

Problems associated with ticks and chiggers may be encountered during field investigations. The use of personal protective equipment will offer some protection, but frequent use of insect repellent and wearing of light-colored clothing is recommended. Close attention to one's skin and scalp helps 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 appear.

4.3.3 Poisonous Plants

Poison Ivy (i.e., Poison Oak and Poison Sumac) may be present in the work area. These plants have compound leaves, with three leaflets. The poison is transmitted by sap from anywhere on the plant. Symptoms of poisoning are severe skin rash with blisters, swelling, itching, and burning. Prevention practices include wearing 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.

4.4 OTHER HAZARDS

4.4.1 Noise Hazards

The SSO will monitor noise levels with a Realistic hand-held sound level meter or equivalent in areas where there are extreme noise conditions (e.g., near taxiways, industrial machinery, automobile traffic, etc.). Noise levels will be monitored in decibels (dBs) in the A-weighted, slow-response mode. Noise level readings which exceed the 29 CFR 1910.95 permissible noise exposure limits will require hearing protection (Table 4-2).

Table 4-2. Permissible Noise Exposure

Duration Per Day (Hours)	Sound Level (dBA) Slow Response
8	90
6	92
4	95
3	97
2	100
1	102
0.5	105

Note: Standards derived from 29 CFR 1910.95

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: $C_1/T_1 + C_2/T_2 + \dots + C_n/T_n$ exceeds unity, then, the mixed exposure should be considered to exceed the limit value. C_n indicates the total time of exposure at a specified noise level, and T_n indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

Hearing protection will be available to all site personnel. The hearing protection will consist of foam, expansion-fit ear plugs (or other approved hearing protection) with an Environmental Protection Agency noise reduction rating of at least 29 dB. Hearing protection must alleviate worker exposure to noise to an eight-hour time-weighted average of 85 dB or below. In the event that the hearing protection is inadequate, work will cease until a higher level of hearing protection can be incorporated.

4.4.2 Potential Electrical Hazards

Potential electrical hazards consist mainly of underground power lines. Underground potential electrical hazards will be minimized by having a utility markout performed for each site. A digging permit, issued by the Base, will be required at each location after review of the sampling locations and Base utility plans by the Base engineer. In addition to Base clearance, clearance from utility companies will be obtained, where applicable.

4.5 MATERIAL SAFETY DATA SHEET

Material Safety Data Sheets (MSDSs) are required for all chemicals used in the work areas. The MSDS will be placed in a three ring binder along with the HSP and kept with the SSO. All field personnel are responsible for familiarizing themselves with the MSDSs.

SECTION 5.0 SITE WORKER TRAINING

5.1 OSHA STATUS OF EACH WORKER

All personnel who will conduct field activities at Carswell AFB will be required to have successfully completed the Hazardous Waste Site Worker training required by 29 Code of Federal Regulations (CFR) 1910.120. This consists of 40 hours of classroom instruction, 3 days of field experience, and medical surveillance as described in Section 7.0. Annual training and refresher courses are also required and consists of 8 hours of classroom instruction review of such topics as toxicology, respiratory protection, and site decontamination controls.

5.2 SITE WORKER TRAINING INFORMATION

All personnel conducting activities on site will comply with health and safety protocols. A copy of the HSP will be provided for all site personnel for review. Prior to entering the work site, workers will sign the Plan Acceptance Form presented in Appendix A.

5.3 SCHEDULE FOR PRE-ENTRY BRIEFING

A field activities meeting with all project personnel will be conducted on a daily basis 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. The following elements have been listed to provide a guideline for discussion:

- Review of planned activities for the day,
- Potential chemical hazards at the site,
- Levels of protection required,
- Emergency and evacuation procedures
- Decontamination procedures
- Communications
- Field team responsibilities

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SECTION 6.0 PERSONNEL PROTECTION

6.1 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

The anticipated levels of personal protective equipment (PPE) required for performance of field investigations at the former Carswell AFB are Levels C and D. The following paragraphs outlines these levels of protection, the equipment required at each level, and the rationale for choosing between PPE levels.

6.1.1 Level A PPE

Level A protection provides the highest level of respiratory, skin, and eye protection. It should be used when the chemical substance has been identified and requires the highest level of protection or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates that are harmful to the body. Personal equipment requirements for Level A include:

- Full-facepiece Self Contained Breathing Apparatus (SCBA)
- Fully encapsulating, chemical resistant suit
- Inner and outer chemical resistant gloves
- Chemical resistant safety boots/shoes
- Two-way communication
- Hard hat

6.1.2 Level B PPE

Level B protection provides the same level of respiratory protection but less skin protection than Level A. It is the minimum level recommended for initial site entries until the hazards have been further identified. It should be used when the type and atmospheric concentrations of substances have been identified and require a high level of respiratory protection, but less skin protection. This involves atmospheres with IDLH concentrations of specific substances that do not represent a severe skin hazard or chemicals harmful to skin or capable of being absorbed through the intact skin. Personal equipment requirements for Level B include:

- Full-face piece Self Contained Breathing Apparatus (SCBA)
- Chemical resistant clothing
- Inner and outer chemical resistant gloves
- Chemical resistant safety boots/shoes
- Two-way communication
- Hard hat

6.1.3 Level C PPE

Level C protection provides the same skin protection as Level B, but a lower level of respiratory protection. It should be used when the atmospheric contaminants, liquid splashes, or other direct

contact will not adversely affect any exposed skin or the type of air contaminants have been identified and concentrations measured. Personal equipment requirements for Level C include:

- Full face-piece, air purifying, canister-equipped respirator
- Chemical resistant clothing
- Inner and outer chemical-resistant gloves
- Hard hat
- Two-way communications

6.1.4 Level D PPE

Level D protection provides no respiratory protection and minimal skin protection. It should be used when the atmosphere contains no known hazard and work preclude splashes, immersion or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals. Personal equipment requirements for Level D include:

- Hard hat if head hazard exists (and if necessary, splash shield),
- Goggles or safety glasses,
- Safety boots/shoes
- Gloves
- Coveralls or work clothes

6.2 REASONS TO UPGRADE OR DOWNGRADE LEVEL OF PROTECTION

Upgrade:

- Request of individual performing task.
- Occurrence or likely occurrence of gas or vapor emission.
- Known or suspected presence of dermal hazards.
- Instrument action levels exceeded.
- Change in work task that will increase contact or potential contact with hazardous materials.

Downgrade:

- New information indicating that situation is less hazardous than originally thought.
- Change in site conditions that decrease the hazard.
- Change in work task that will reduce contact with hazardous materials.

SECTION 7.0 MEDICAL SURVEILLANCE

7.1 GENERAL DESCRIPTION OF PROGRAM

Personnel required to perform work on site at Carswell AFB must participate in an 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. It is also a method to 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) are required to provide proof of participation in a medical monitoring program that is in compliance with 29 CFR 1910.120 standards. The medical examination 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 PM/SSO and will be kept on file at the site until work activities are completed.

7.2 MEDICAL EXAMINATION REQUIREMENTS

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

- Medical and occupational history questionnaire
- Physical examination by physician
- Vital statistics such as height, weight, blood pressure and pulse rate
- X-Ray of 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 conducted if an employee believes that she or he may have been exposed to a hazardous substance. The employee will report to her or his health and safety officer. The health and safety officer will contact the occupational medicine consultant and arrange for a more thorough examination.

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7.3 SITE SPECIFIC REQUIREMENTS

No additional site specific medical surveillance is anticipated for the work to be performed at the Carswell AFB. In the event of an exposure, a special examination will be given to define the extent of exposure. In addition, an Incident Report (Appendix A) will be immediately filed with the Health and Safety Officer. A copy of the report will also be filed with the PM and the Program Manager.

SECTION 8.0 MONITORING REQUIREMENTS

8.1 AIR MONITORING SPECIFICATION

A list of air monitoring specifications for different tasks is presented in Table 8-1.

Table 8-1. Air Monitoring Specifications for Different Tasks

Instrument	Tasks	Action Levels	Frequency	Calibration
PID; HNu w/10.2 eV probe, or equivalent or FID; OVA-128	Well inventory/inspection Water level measurements Groundwater sampling Well installation Soil and sediment sampling	0-5 ppm Level D >5 ppm Stop work and re-evaluate, may require Level C or B	Initial when opening well and periodically throughout task	Daily
Colorimetric tube: Vinyl chloride Draeger tube "vinyl chloride 0.5/a" (0.25 - 6 ppm), or equivalent	At locations where vinyl chloride is known or suspected to be present, and there is a potential for exposure Well inventory Water level measurements Groundwater sampling Soil and Sediment sampling	0<0.5 ppm Level D or C (depending on PID/FID readings) 0.5 ppm Provide controls (i.e., ventilation) to reduce levels; Level B required	Initially and periodically thereafter	Not applicable
Colorimetric tube: Benzene Draeger tube "benzene 0.5/a" (0.5 - 10 ppm), or equivalent	At locations where benzene is known or suspected to be present, and there is a potential for exposure Well inventory Water level measurements Groundwater sampling Soil and sediment sampling	0<0.5 ppm Level D or C (depending on PID/FID readings) 0.5-1.0 ppm Provide controls (i.e., ventilation) to reduce levels; Level C required >1.0 ppm Provide controls (i.e., ventilation) to reduce levels; Level B required	Initially and periodically thereafter	Not applicable
Hydrogen sulfide: ISC HS265, or equivalent	At locations where hydrogen sulfide is known or suspected to be present, and there is a potential for exposure	0-5 ppm Level D 5-10 ppm Level D -- Provide controls to reduce levels >10 ppm Stop work and re-evaluate; Level B required	Continuously	Daily
CGI: MSA 260, or equivalent	Drilling and excavation activities	0-10% LEL No explosion hazard 10-20% LEL Potential explosion hazard <20% LEL Explosion hazard; evacuate or vent	Initial and 5-foot intervals	Daily
Dust: Visible	Tasks where dust is a potential	No visible dust Level D Visible dust Level C	Continuously	Not applicable

Action levels are for breathing zone readings, above background.

Where control measures are used (i.e., industrial fan) collect breathing zone measurements to ensure effectiveness of controls. Increased levels of protection may not be required when controls measures effectively reduce breathing zone concentrations to levels below action levels.

PID-Photoionization Detector FID-Flame Ionization Detector LEL-Lower explosive limit

Monitoring with the photoionization detector (PID) or equivalent shall be conducted prior to sampling and when there is potential for atmospheric change within the work area. Monitoring will be initiated at any potential source emissions, then moved to the worker's breathing zone if positive indications are observed at the source. Monitoring with the CGI shall be conducted within the boreholes and the headspace of samples to detect potential flammable conditions.

8.2 INSTRUMENT CALIBRATION SPECIFICATION

All monitoring instrumentation used on-site will be calibrated and maintained in accordance with the manufacturer's recommendations. On a daily basis, before site work is to begin, background readings will be obtained for instruments that will be used for the fieldwork and recorded in the field log book or calibration log book. To obtain a background reading, the instrument is operated in a clean environment. The indication observed on the meter is considered the initial or background level. From this background level, the appropriate action level, as described in Table 8-1, will be observed. Calibration specifications for a list of monitoring instrumentation is presented in Table 8-2. Also included in the table are the calibration gases for the instrument and the typical calibration method.

Table 8-2. Instrument Calibration Specification

Instrument	Gas	Span	Reading	Method
PID: HNu, 10.2 eV probe	100 ppm isobutylene	5.0 ± 2.0	100 ppm	1.5 l/m regulator T-tubing 0.25 l/m regulator direct tubing
PID: OVM, 10.6 eV lamp	100 ppm isobutylene	N/A	100 ppm	1.5 l/m regulator T-tubing
FID: OVA-128	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 l/m regulator T-tubing
H ₂ S: ISC HS265	10 ppm hydrogen sulfide	NA	10 ppm	1.5 l/m regulator with cal. cup
CGI:	50/50 blend of methane and carbon dioxide and 5/96 blend of oxygen and carbon dioxide	NA	NA	1/4 inch T-tubing

SECTION 9.0 SITE CONTROL

The activities required during responses to incidents involving hazardous substances may contribute to the unwanted movement of contaminants from the site to uncontaminated areas. Response personnel and equipment may become contaminated and transfer the material into clean areas. Material may become airborne because of its volatility. To minimize the transfer of hazardous substances from the site, contamination control procedures are needed. Two general methods are used: establishing site work zones and implementing standard work procedures.

9.1 WORK ZONES

One method of preventing or reducing the migration of contaminants is to delineate zones on the site in which prescribed operations occur. Movement of personnel and equipment between zones and onto the site itself would be limited by access control points. Three contiguous zones are recommended.

- Zone 1: Exclusion Zone
- Zone 2: Contamination Reduction Zone
- Zone 3: Support Zone

9.1.1 Zone 1: Exclusion Zone

The Exclusion Zone, the innermost of three areas, is the zone in which contamination does or could occur. All people entering the Exclusion Zone must wear prescribed levels of protection. An entry and exit check point must be established at the periphery of the Exclusion Zone to regulate the flow of personnel and equipment into and out of the zone and to verify that the procedures established to enter and exit are followed. The outer boundary of Zone 1, the Hotline, is initially established by visually surveying the immediate environs of the incident and determining where the hazardous substances involved are located; where any drainage, leachate, or spilled material may be present; and whether any discolorations are visible. Guidance in determining the boundaries is also provided by data from the initial site survey indicating the presence of organic or inorganic vapors/gases or particulates in the air, combustible gases, and radiation or by the results of water and soil sampling.

Additional factors that should be considered include the distances needed to prevent fire or an explosion from affecting personnel outside the zone, the physical area necessary to conduct site operations, and the potential for contaminants to be blown from the area. Once the Hotline has been determined, it should be physically secured, fenced, or well-defined by landmarks. During subsequent site operations, the boundary may be modified and adjusted as more information becomes available.

9.1.2 Zone 2: Contamination Reduction Zone

Between the Exclusion Zone and the Support Zone is the Contamination Reduction Zone, which provides a transition between contaminated and clean zones. Zone 2 serves as a buffer to further reduce the probability of the clean zone becoming contaminated or being affected by other existing hazards. It provides additional assurance that the physical transfer of contaminating substance on people or equipment or in the air is limited through a combination of decontamination, distance between the Exclusion and Support Zones, air dilution, zone restrictions, and work functions.

Initially the Contamination Reduction Zone is considered to be a noncontaminated area. At the boundary between the Exclusion and Contamination Reduction Zones, Contamination Reduction Corridors (decontamination stations) are established: one for personnel and one for heavy equipment. Depending on the size of the operation, more than two corridors may be necessary. Exit from the Exclusion Zone is through a Contamination Reduction Corridor. As operations proceed, the area around the decontamination station may become contaminated, but to a much lesser degree than the Exclusion Zone. On a relative basis, the amount of contaminants should decrease from the Hotline to the Support Zone as a result of the distance involved and the decontamination procedures used.

The boundary between the Support Zone and the Contamination Reduction Zone, the Contamination Control Line, separates the possible low contamination area from the clean Support Zone. Access to the Contamination Reduction Zone from the Support Zone is through a control point. Personnel entering there would wear the prescribed PPE, if required, for working in the Contamination Reduction Zone. Entering the Support Zone requires removal of any protective equipment worn in the Contamination Reduction Zone.

9.1.3 Zone 3: Support Zone

The Support Zone, the outermost part of the site, is considered a noncontaminated or clean area. Support equipment (command post, equipment trailer, etc.) is located in the zone; vehicular traffic is restricted to authorized response personnel. Because normal work clothes are appropriate within the zone, potentially contaminated personnel clothing, equipment, and samples are not permitted but are left in the Contamination Reduction zone until they have been decontaminated.

The location of the command post and other support facilities in the Support Zone depends on a number of factors, including those listed below.

- **Accessibility-** topography, open space available, locations of highways and railroad tracks, or other limitations.

- **Wind direction**- preferably the support facilities should be located upwind of the Exclusion Zone; however, shifts in wind direction and other conditions may be such that an ideal location based on wind direction alone does not exist.
- **Resources**- adequate roads, power lines, water, and shelter.

9.2 SAFE WORK PRACTICES

- Provide ventilation (i.e., industrial fan) at locations where vinyl chloride and/or benzene are suspect or known to be present. Monitor as specified in Section 9.0.
- No spark sources within exclusion or decontamination zones.
- Avoid visibly contaminated areas.
- No eating, drinking, gum chewing, tobacco chewing, or smoking, etc., in contaminated areas, or in the exclusion and decontamination zones.
- SSO to establish areas for eating, drinking, smoking.
- No contact lenses in exclusion or decontamination zones.
- No facial hair that would interfere with respirator fit if Level C or B is anticipated.
- Site work will be performed during daylight hours whenever possible. Any work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."
- Practice good "housekeeping". All work areas must be kept free of clutter.
- Areas must be designated for chemical storage. Acids, bases, and flammables shall be stored separately. Storage areas must be labeled to indicate the contents of the storage area.

9.3 SITE CONTROL MEASURES

- SSO to conduct site safety briefing (see below) before starting field activities, or as tasks and site conditions change.
- SSO records safety briefing attendance in logbook, and documents topics discussed.
- Post OSHA job site poster in a central and conspicuous location at the site.
- Determine wind direction.
- Establish work zones: support, decontamination, and exclusion zones, and delineate work zones with flagging or cones as appropriate. Support zone is upwind of exclusion zone.
- Establish decontamination procedures, including respirator decontamination procedures, and test.
- Utilize access control at the entry and exit from each work zone.
- Chemicals to be stored in properly labeled containers.
- MSDSs are available for onsite chemicals to which employees are exposed.
- Establish onsite communications. These should consist of:
 - line of sight/hand signals,
 - air horn, and
 - two-way radio or cellular phone if available.

- Establish emergency signals. For example:
 - grasping throat with hand - EMERGENCY-HELP ME
 - grasping buddy wrist - LEAVE AREA NOW
 - thumbs up - OK, UNDERSTOOD
 - two short blasts on air horn - ALL CLEAR
 - continuous air horn - EMERGENCY-EVACUATE
- Establish offsite communications.
- Establish "buddy" system.
- Establish procedures for disposal of material generated onsite.
- Initial air monitoring conducted by SSO in appropriate level of protection.
- SSO to conduct periodic inspections of work practices to determine effectiveness of this plan. Deficiencies to be noted, reported to HSO, and corrected.
- Site safety briefing topics: general discussion of health and safety plan; site specific hazards; location of work zones; PPE requirements; equipment; special procedures; emergencies.

9.4 THE BUDDY SYSTEM

All activities in contaminated or potentially contaminated areas will be conducted by pairing off the site workers in groups of two (or three if necessary). Each person will be able to:

- Provide his or her partner with assistance,
- Observe his or her partner for signs of chemical or heat exposure,
- Periodically check the integrity of his or her partner's protective clothing, and
- Notify the HSO or others if emergency help is needed.

The buddy system will be instituted at the beginning of each work day. If new workers arrive on site, a buddy will be chosen prior to the new worker entering the work zone.

9.5 SITE COMMUNICATIONS

Two sets of communication systems will be established at the site, internal communication among personnel on-site, and external communication between on-site and off-site personnel.

Internal communication will be used to:

- Alert team members to emergencies,
- Provide safety information such as heat stress, protective clothing, etc.,
- Communicate changes in the work to be accomplished, and
- Maintain Site control.

Due to ambient noise, verbal communications may be difficult at times. The SSO will carry a whistle (and compressed air horn if hearing protection is being worn) to signal site workers. A

single continuous whistle blast will be the signal to immediately evacuate the work zone through the access control point. This signal will be discussed with all site workers prior to commencement of work.

An external communication system between on-site and off-site personnel will be established to:

- Coordinate emergency response,
- Report to the Project Manager, and
- Maintain contact with essential off-site personnel.

A field telephone will be available at all times in the SSO's vehicle. In addition, the nearest stationary phone will be identified prior to the commencement of site operations and this location will be relayed to all site workers.

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SECTION 10.0 DECONTAMINATION PROCEDURES

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. It is critical to health and safety at hazardous waste sites. Decontamination protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment used on site; it protects all site personnel by minimizing the transfer of harmful materials into clean areas; it helps prevent mixing of incompatible chemicals; and it protects the community by preventing uncontrolled transportation of contaminants from the site. Table 10-1 is a general outline of the steps to take to decontaminate personnel at Level A, B, C, or D, sample equipment and heavy equipment. Refer to the Field Sampling Plan for more detailed procedures on decontaminating sampling equipment.

Table 10-1. General Decontamination Steps

Personnel	Sample Equipment	Heavy Equipment
step 1. Boot wash/rinse	step 1. Wash/rinse equipment	step 1. Power wash
step 2. Glove wash/rinse	step 2. Solvent rinse equipment	step 2. Steam clean
step 3. Outer glove removal	step 3. Solvent disposal method: drummed and disposed of at a suitable location.	step 3. Water disposal method: drummed and disposed of at a suitable location
step 4. Body suit removal		
step 5. Inner glove removal		
step 6. Respirator removal		
step 7. Hand wash/rinse		
step 8. Face wash/rinse		
step 9. Shower ASAP		
step 10. PPE disposal method: drummed		
step 11. Water disposal method: drummed and disposed of at a suitable location.		
<p>Note: For Personnel Decontamination, follow the steps in the order they appear, skip those steps that do not apply to the level of protection your are wearing. ASAP: As Soon As Possible</p>		

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<p><i>Note: For Personnel Decontamination, follow the steps in the order they appear, skip those steps that do not apply to the level of protection you are wearing.</i></p> <p>ASAP: As Soon As Possible</p>		

**SECTION 11.0
CONFINED SPACE ENTRY PROCEDURES**

Confined space entry is not anticipated or permitted under this Health and Safety Plan. Confined space entry requires a specific health and safety plan and a permit.

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Health and Safety Plan
Carswell AFB, TX
Risk-Based Assessment, Management, and Closure of SWMUs and AOCs
Contract #F41624-95-D-8003 / Delivery Order 0023
December 1998
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SECTION 11.0
CONFINED SPACE ENTRY PROCEDURES

Confined space entry is not anticipated or permitted under this Health and Safety Plan.
Confined space entry requires a specific health and safety plan and a permit.

SECTION 12.0 EMERGENCY RESPONSE PLAN

12.1 EMERGENCY RECOGNITION

All personnel must read and be familiar with the Emergency Response Plan of the Health and Safety Plan. Emergency telephone numbers and direction to the nearest medical facility are presented in this plan. Figure 12-1 provide directions to the nearest hospital. Route to hospital will be driven by on-site personnel once before commencement of field activities for familiarization purposes.

- Prior to initiation of work, the PM/SSO will conduct a meeting to review all aspects of the HSP as well as review the emergency response procedures. Attendance at this meeting is mandatory for all field personnel. It is the PM/SSO's responsibility to confirm and post emergency telephone numbers and route to hospital where they can be easily accessible.
-
- Any of the following situations shall be considered an emergency situation:
 -
 - A field personnel has a medical emergency, accident, or symptoms of overexposure to heat and cold (as discussed in Section 4.0).
 - A field personnel is involved in a heavy equipment accident or other type of accident resulting in a medical emergency.
 - A field personnel has been exposed to a chemical or hazardous substance release.
 - Discovery of unanticipated hazardous conditions.

12.2 EMERGENCY RESPONSE EQUIPMENT AND LOCATION

The SSO marks the locations of emergency equipment on the site map and posts the map in the support zone. The following is a list of equipment that should be present at the work area.:

- ABC fire extinguisher (Underwriter's Laboratories [UL] rating of 1:10:1, minimum dry chemical capacity is 2.5 lb.)
- Industrial first aid kit
- Snake first aid kit (optional)

12.3 TELEPHONE LOCATIONS

Field personnel will be equipped with a cellular telephone or radio at all times. Other telephones should be noted and located at the work sites.

12.4 HOSPITAL LOCATION

Name of Hospital:	Medical Plaza Hospital
Telephone Number:	817-336-2100
Address:	900 8 th Ave., Fort Worth, Texas 76104
Directions:	<ul style="list-style-type: none"> • Exit Carswell AFB to 183. • Take 183 south to Interstate (IH) 30. • Take IH 30 east to the W. Rosedale exit. • Go east on W. Rosedale to 8th Street. • Turn left on 8th Street. • The hospital is at 900 8th Avenue.

Figure 12-1. Directions to Hospital

12.5 EMERGENCY RESPONSE PROCEDURES

In the event of an emergency, all available information must be properly evaluated, and the appropriate steps taken to implement the Emergency Response Plan. The PM/SSO shall always be immediately informed of any emergency, and shall take command of the situation. He or she will call the appropriate emergency services and let them know in advance what to expect, evacuate personnel to the pre-designated evacuation location, and take other steps necessary to gain control over the emergency. When reporting the emergency to the PM/SSO, personnel should thoroughly describe the situation and include the following information:

gain control over the emergency. When reporting the emergency to the PM/SSO, personnel should thoroughly describe the situation and include 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 injury
- Wind direction and speed
- Other details the personnel deems important

12.5.1 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 phone or radio, first aid kit, and fire extinguisher shall be provided at the job site at all times.
- 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 (unprotected trenches or holes, exposed electrical wires, etc.)

Emergency Procedures

In case of a medical emergency or personal injury, life saving procedures should be administered only by trained personnel. Field personnel currently trained in first aid will evaluate the nature of the injury and initiate first aid assistance. The SSO will decide if local emergency Medical Services are necessary, and notify them immediately. Field personnel shall transport the victim(s) 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 threat to life, and injury. The route to the nearest medical facility is shown in Figure 12-1.

12.5.2 Chemical Exposure Emergencies

Safety Practices

- Properly utilize the appropriate PPE.
- A cellular phone or radio, first aid kit, and fire extinguisher shall be provided at the job site at all times.
- A potable water supply shall be provided at each site (including eye wash station)
- Personnel should use care and common sense when handling and working around chemicals

Emergency Procedures

In the event of a chemical exposure (or potential exposure) emergency, victim(s) must first be removed from the immediate area of contamination. Precaution 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 SSO shall immediately notify all personnel of the emergency situation. When notifying the emergency medical service, inform the operator of the nature of the emergency and 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 thoroughly washed 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 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.

Field personnel shall transport the victim(s) 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 threat to life, and injury. The route to the nearest medical facility is shown in Figure 12-1.

12.5.3 Evacuation Procedures

- Evacuation routes will be designated by SSO prior to beginning of work. Onsite and offsite assembly points will be designated prior to beginning of work. Personnel will exit the exclusion zone and assemble at the onsite assembly point upon hearing the emergency signal for evacuation of the exclusion zone. Personnel will assemble at the offsite point upon hearing the emergency signal for a site evacuation. The SSO and a "buddy" will remain onsite after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident. SSO accounts for all personnel in the onsite assembly zone. A person designated by the SSO (prior to work) will account for personnel at the offsite assembly area. The SSO is to write up the incident as soon as possible after it occurs, and submit a report to the Health and Safety Officer.

Evacuation routes and assembly points will in general be on an upwind or crosswind route in event of an evacuation. The specific route and assembly point will be identified by the SSO at specific work sites before the work begins on the identified tasks. If there is an evacuation in the exclusion zone, grab buddy's wrist to indicate to leave the area immediately or use verbal communication.

12.6 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, vomit, mucus, or others. These fluids could contain pathogens which have the potential for causing disease in humans. Should personnel be required to administer life saving procedures, such as cardiopulmonary resuscitation (CPR), the following procedures shall be used 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 safely secured prior to leaving.
- Personnel who may have been exposed to BBPs should report the incident to the SSO, at once.

12.7 EMERGENCY FOLLOW-UP

The SSO must complete an Accident Report Form and submit it to the Project Manager and Program Manager within 24 hours of the following types of accidents:

- All job related injuries and illnesses.
- All accidents resulting in more than \$25 loss of damage.
- All accidents in which there may have been no injury or property damage, but which 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 SSO will review the emergency procedures and revise if necessary. When reviewing the emergency response, items considered include the cause of the emergency, possible methods to prevent a similar emergency, and possible ways to improve the emergency procedure. The emergency procedures will be revised, if necessary, based on new site conditions or lessons learned from the emergency response.

The SSO and/or Project Manager will initiate the investigation and documentation of any emergency situation. This is especially important when the incident resulted in injury or

property damage. Documentation will 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 will 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, decisions made (who, what, why, when, and where),
- 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, and
- Completion of an Incident Report Form.

All documentation must be signed and dated by those making entries. All entries shall be made in ink. Any changes in the documentation must be initialed and dated. Copies of the incident report form is provided in Appendix A.

APPENDIX A

INCIDENT REPORT FORM

Name (print): _____ Social Security Number: - -

Home Address:

Home Phone Number: _____ Age: _____ Sex: ___(M)___(F)

2. EMPLOYER INFORMATION

Employer Name: _____ Occupation (Job Title): _____

Address:

Phone Number: _____

3. ACCIDENT OR EXPOSURE INFORMATION

Time of incident: _____ Date of incident: _____

Describe weather conditions at time of accident:

Location of incident, accident, or exposure (be specific as possible):

What was the worker doing at the time of the incident? (Be specific as to tools or equipment being used).

What kind of protective equipment was used?

List any monitoring results or sample results that may be applicable

INCIDENT REPORT FORM (cont'd)

How did the incident occur? (Fully describe the events, in chronological order, leading up to the incident, attach additional sheets if necessary):

List name of witnessess, their affiliation and phone numbers:

4. DESCRIPTION OF INJURY OR ILLNESS

Describe the injury or illness on detail and indicate affected part of the body. Describe any physical symptoms, if any:

Name the substance or object which directly injured the worker:

5. PROPERTY/ENVIRONMENTAL DAMAGE INFORMATION

Was any property damaged due to the incident? Describe in detail the extent of damage.

INCIDENT REPORT FORM (cont'd)

Was there any known releases of hazardous chemicals to the environment due to the incident? If so, what control measures were taken?

6. MEDICAL INFORMATION

Was the worker taken to the hospital? If yes, give hospital name and address.

How was worker taken to hospital, ambulance or driven by whom?

Who attended the injured or ill worker to the hospital?

Name of caring physician:

Diagnosis of illness or describe treatment of injury:

7. FOLLOW UP PROCEDURES

When was the Project Manager/ Program Manager/ Health and Safety Officer notified of incident?

Recommend changes to work practices that may have prevented the incident from occurring.

Report prepared by: _____ Date: _____

TAB

FSP

**RISK-BASED ASSESSMENT, MANAGEMENT, AND CLOSURE
OF SOLID WASTE MANAGEMENT UNITS AND AREAS OF CONCERN
AT NAVAL AIR STATION FORT WORTH, JOINT RESERVE BASE,
CARSWELL AIR FORCE BASE, TEXAS**

**FINAL
FIELD SAMPLING PLAN**



**Contract No. F41624-95-D-8003-0023
Project No. DDPF 98-8125**

**December
1998**

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FIELD SAMPLING PLAN
CDRL A003

**Risk-Based Assessment, Management, and Closure
of Solid Waste Management Units and Areas of Concern
at Naval Air Station Fort Worth, Joint Reserve Base,
Carswell Air Force Base, Texas**

Contract No. F41624-95-D-8003-0023
Project No. DDPF 98-8125

Prepared for:
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Version 1.1
December 1998

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PREFACE

Fanning, Phillips and Molnar (FPM), under contract with the Air Force Center for Environmental Excellence (AFCEE), is performing risk-based assessment, management, and closure of various solid waste management units (SWMUs) and Areas of Concern (AOCs) at Carswell Air Force Base (AFB), Fort Worth, Texas. The project will evaluate existing site data, refine conceptual site models, and fill data gaps to allow for the risk-based assessment of SWMUs and AOCs. The project will provide risk-based closure documentation that will determine site-specific target levels for contaminants and recommend closure, monitoring, or remediation to target levels. The individual SWMUs and AOCs to be addressed by the project include the following:

SWMUs

- 19 Fire Training Area 2
- 20 Waste Fuel Storage Tank
- 21 Waste Oil Tank
- 22 Landfill 4
- 23 Landfill 5
- 24 Waste Burial Area WP-07 (Waste Pit)
- 25 Landfill 8
- 58 Pesticide Rinse Area
- 59 B8503 Weapons Storage Area (WSA) Waste Accumulation Area
- 60 B8503 Radioactive Waste Burial Site (Groundwater)
- 64 French Underdrain System/Unnamed Stream
- 65 WSA Disposal Site
- 66 Sanitary Sewer System
- 67 B1340 Oil/Water Separator (OWS)
Permitted Treatment, Storage, and Disposal Facility (TSDF)

AOCs

- 5 Grounds Maintenance Yard
- 8 Aerospace Museum
- 9 Golf Course Maintenance Yard
- 14 Unnamed Stream

This plan may be adopted for other SWMUs and AOCs at the former Carswell AFB as needed. Supplemental plans or plan addenda will be submitted with relevant site-specific information for any sites not outlined in this plan which become part of the current project.

This Field Sampling Plan (FSP) presents the requirements and procedures for conducting field operations and investigations for the risk-based assessment of these SWMUs and AOCs. The assessments will be conducted in accordance with provisions of the Basic Contract #F41624-95-

D-8003 and Delivery Order (DO) #23. Mr. Rafael Vasquez is the Air Force Base Conversion Agency (AFBCA) Base Environmental Coordinator (BEC) for Naval Air Station (NAS) Fort Worth, the former Carswell AFB. Mr. Alvin Brown is the AFBCA Field Engineer and Base Point of Contact (POC). Mr. Charles Rice serves as the AFCEE/ERB team chief and as Contracting Officer's Representative (COR). Mr. Joe Dunkle serves as the AFCEE/ERA team chief.

The principal FP&M personnel include Dr. Kevin J. Phillips, P.E., Program Manager, Mr. Gaby A. Atik, P.E., Project Manager, and Mr. Thomas Doriski. Mr. Doriski will also act as Health and Safety Officer. Additional personnel will be selected from FP&M staff as needed. Dr. Atul Salhotra of RAM Group will be the principal risk assessor.

The project will take place in a phased approach. The listed SWMUs and AOCs will initially require evaluation of existing site data. It is anticipated that some sites will proceed from data evaluation to risk-based closure documentation, while other sites will require collection of additional data to refine conceptual site models and fill data gaps before closure documentation can take place. Due to the number of sites addressed by the project, the phased approach will also help to maintain a balanced workload over the duration of the project, and avoid unnecessary delays to sites that are ready for closure documentation. The project schedule presents four phases. Phases I and III are sites which are anticipated to require no further evaluation or data collection; and Phases II and IV are sites which are anticipated to require additional data prior to closure. It is anticipated that initial field work will commence in January 1998.

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ACRONYMS AND ABBREVIATIONS

AA	Atomic Absorption
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Environmental Excellence
AFP-4	Air Force Plant 4
AMS	Aerospace Museum Site
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AST	Aboveground Storage Tank
ASTM	American Society for Testing and Materials
BEC	Base Environmental Coordinator
BGS	Below Ground Surface
Br	Bromide
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
°C	Degrees Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
Cl	Chloride
CM/SEC	Centimeters per Second
COC	Chain of Custody
COE	Corps of Engineers
COR	Contracting Officer Representative
CSM	Conceptual Site Model
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DOD	Department of Defense
DOT	Department of Transportation
DNAPL	Dense Non-Aqueous Phase Liquid
DQO	Data Quality Objective
EC	Electrical Conductivity
	ACRONYMS AND ABBREVIATIONS (cont'd.)
EDB	Ethylene bromide

EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
F	Fluoride
FID	Flame Ionization Detector
FPM	Fanning, Phillips and Molnar
FSP	Field Sampling Plan
FT	Foot or Feet
FTA	Fire Training Area
G	Glass
G/CM³	Grams per Cubic Centimeter
GAL/FT³	Gallons per cubic Foot
GCMY	Golf Course Maintenance Yard
GMY	Grounds Maintenance Yard
GPR	Ground Penetrating Radar
H₂SO₄	Sulfuric acid
HCl	Hydrochloric acid
HNO₃	Nitric acid
HSP	Health and Safety Plan
IAW	In Accordance With
IRA	Interim Remedial Action
IRP	Installation Restoration Program
IRPIMS	IRP Information Management Systems
LBS/GAL	Pounds per Gallon
LLRW	Low Level Radioactive Waste
LNAPL	Light Non-Aqueous Phase Liquid
M&E	Metcalf & Eddy
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
M&E	Metcalf & Eddy
Mg/Kg	Milligrams per Kilogram
Mg/L	Milligrams per Liter
ML	Milliliter
ACRONYMS AND ABBREVIATIONS (cont'd.)	

ML/L Milliliters per Liter

MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSC	Medium Specific Concentration
NAS	Naval Air Station
Na₂S₂O₃	Sodium thiosulfate
NCP	National Contingency Plan
NFA	No Further Action
NO₂⁻	Nitrite
NO₃⁻	Nitrate
NTU	Nephelometric Turbidity Unit
OD	Outside Diameter
OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer
OWS	Oil Water Separator
P	Polyethylene
PAH	Polynuclear Aromatic Hydrocarbon
PARSONS	Parsons Engineering-Science, Inc.
PCB	Polychlorinated Biphenyl
PCI/L	Picocuries per Liter
PID	Photoionization Detector
PO₄⁻³	Phosphate
POC	Point Of Contact
PPE	Personal Protective Equipment
PQL	Practical Quantitation Limit
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
RRS	Risk Reduction Standard
SAI-Ind	Soil/Air Ingestion Standard for Industrial Use
ACRONYMS AND ABBREVIATIONS (cont'd.)	

SAP	Sampling and Analysis Plan
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SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SO₄⁻²	Sulfate
SOW	Statement Of Work
SP	Spontaneous Potential
SPLP	Synthetic Precipitate Leaching Procedure
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
T	California brass
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Program
TNRCC	Texas Natural Resource Conservation Commission
TPH	Total Petroleum Hydrocarbon
TSDF	Treatment, Storage, and Disposal Facility
UNSVTX	Unified Services of Texas
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WP	Work Plan
WSA	Weapons Storage Area
μM	Micrometer
3-D	Three-Dimensional

1.0 INTRODUCTION

The Field Sampling Plan (FSP) presents, in specific terms, the requirements and procedures for conducting field operations and investigations. This project specific FSP has been prepared to ensure (1) the data quality objectives specified for this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and defensible. *In accordance with the Statement of Work (SOW) for this delivery order, the existing Base-wide Quality Assurance Project Plan (QAPP) for Carswell AFB and this site specific FSP shall constitute the Sampling and Analysis Plan (SAP). Carswell AFB location is shown on Figure 1-1.*

The National Contingency Plan (NCP) specifies circumstances under which a FSP is necessary for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions. For cleanup actions at the remedial investigation/feasibility study (RI/FS) stage, the NCP requires lead agents to develop sampling and analysis plans which provide a process for obtaining data of sufficient quality and quantity to satisfy data needs. Such sampling and analysis plans must include a field sampling plan. 40 CFR 300.430 (b)(8)(ii).

Guidelines followed in the preparation of this plan are set out in the *Data Quality Objectives Process for Superfund, Interim Final Guidance* (U.S. Environmental Protection Agency [EPA], 1993).

This FSP is required reading for all staff participating in the work effort. The FSP shall be in the possession of the field teams collecting the samples. All contractors and subcontractors shall be required to comply with the procedures documented in this FSP in order to maintain comparability and representativeness of the collected and generated data.

Controlled distribution of the FSP shall be implemented by the prime contractor to ensure the current approved version is being used. A sequential numbering system shall be used to identify controlled copies of the FSP. Controlled copies shall be provided to applicable Air Force managers, regulatory agencies, remedial project managers, project managers, and quality assurance (QA) coordinators. Whenever Air Force revisions are made or addenda added to the FSP, a document control system shall be put into place to assure (1) all parties holding a controlled copy of the FSP shall receive the revisions/addenda and (2) outdated material is removed from circulation. The document control system does not preclude making and using copies of the FSP; however, the holders of controlled copies are responsible for distributing additional material to update any copies within their organizations. The distribution list for controlled copies shall be maintained by the prime contractor.

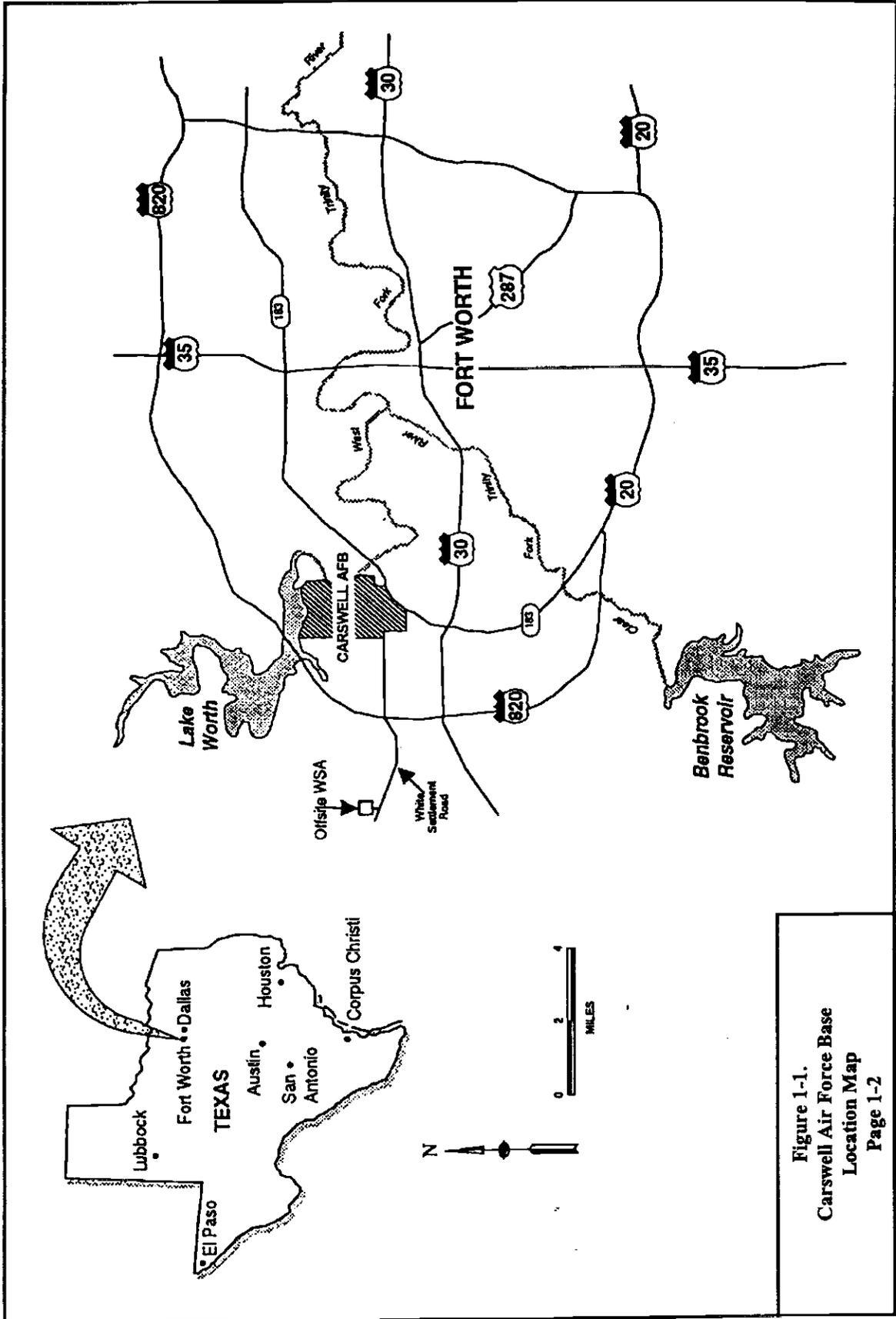


Figure 1-1.
 Carswell Air Force Base
 Location Map
 Page 1-2

2.0 PROJECT BACKGROUND

All figures for this section are located at the end of the section.

2.1 THE U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM

The objective of the U.S. Air Force Installation Restoration Project (IRP) is to assess past hazardous waste disposal and spill sites at U.S. Air Force installations and to develop remedial actions consistent with the NCP for sites that pose a threat to human health and welfare or the environment. This section presents information on the program origins, objectives, and organization.

The 1976 Resource Conservation Recovery Act (RCRA) is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require federal agencies to comply with local and state environmental regulations and provide information to the EPA concerning past disposal practices at federal sites. RCRA Section 3012 requires state agencies to inventory past hazardous waste disposal sites and provide information to the EPA concerning those sites.

In 1980, Congress enacted CERCLA (Superfund). CERCLA outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. The CERCLA legislation identifies the EPA as the primary policy and enforcement agency regarding contaminated sites.

The 1986 Superfund Amendments and Reauthorization Act (SARA) extends the requirements of CERCLA and modifies CERCLA with respect to goals for remediation and the steps that lead to the selection of a remedial process. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the contaminant. SARA also provides for greater interaction with public and state agencies and extends the EPA's role in evaluating health risks associated with contamination. Under SARA, early determination of Applicable or Relevant and Appropriate Requirements (ARARs) is required, and the consideration of potential remediation alternatives is recommended at the initiation of an RI/FS. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

Executive Order 12580, adopted in 1987, gave various federal agencies, including the Department of Defense (DOD), the responsibility to act as lead agencies for conducting investigations and implementing remediation efforts when they are the sole or co-contributor to contamination on or off their properties.

To ensure compliance with CERCLA, its regulations, and Executive Order 12580, the DOD developed the IRP, under the Defense Environmental Restoration Program, to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated facilities. The DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP program in June 1980, and implemented the policies outlined in this memorandum in December 1980. The NCP was issued by the EPA in 1980 to provide guidance on a process by which (1) contaminant release could be reported, (2) contamination could be identified and quantified, and (3) remedial actions could be selected. The NCP describes the responsibility of federal and state governments and those responsible for contaminant releases.

The DOD formally revised and expanded the existing IRP directives and amplified all previous directives and memoranda concerning the IRP through DEQPPM 81-5, dated 11 December 1981. The memorandum was implemented by a U.S. Air Force message dated 21 January 1982.

The IRP is the DOD's primary mechanism for response actions on U.S. Air Force installations affected by the provisions of SARA. In November 1986, in response to SARA and other EPA interim guidance, the U.S. Air Force modified the IRP to provide for an RI/FS program. The IRP was modified so that RI/FS studies could be conducted as parallel activities rather than serial activities. The program now includes ARAR determinations, identification and screening of technologies, and development of alternatives. The IRP may include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure that DOD compliance with federal laws, such as RCRA, NCP, CERCLA, and SARA, can be met.

2.2 PROJECT PURPOSE AND SCOPE

The overall goal of this project is to provide risk-based closure documentation for various SWMUs and AOCs, which will determine site-specific target levels for contaminants and recommend closure, monitoring, or remediation to target levels. Specific field objectives needed to achieve this goal include:

- *Collecting site-specific data to fill data gaps identified in the initial data evaluation.*
- *Implementing incidental soil removal/interim removal actions to meet site-specific contaminant target levels that will allow for risk-based site closures.*

Data collection and corrective measures activities will be determined after the initial data evaluations that are part of this project. These activities may include excavations, groundwater sampling, installation of groundwater monitoring wells, surface water and sediment sampling,

and surface and subsurface soil sampling. In accordance with the project SOW, the AFCEE Model FSP describes specific field procedures, field measurements, and record keeping requirements for the field effort.

2.3 PROJECT SITE DESCRIPTION

NAS Fort Worth (formerly Carswell AFB) is located in north-central Texas in Tarrant County, approximately 8 miles west of downtown Fort Worth (Figure 1-1). Carswell AFB property totals 2,555 acres and consists of a main base and two noncontiguous land parcels. The area surrounding the former base is mostly suburban, including residential areas of the cities of Fort Worth, White Settlement, and Westworth Village. The main base totals 2,264 acres and is bordered on the north by Lake Worth, on the east by the Trinity River and Westworth Village, on the northeast and southeast by Fort Worth, on the west and southwest by White Settlement, and on the west by Air Force Plant No. 4. The project encompasses several SWMUs and AOCs located throughout the base.

2.4 PROJECT SITE CONTAMINATION HISTORY

Because a wide variety of waste generating activities have occurred at the SWMUs and AOCs on base, a number of environmental investigations and studies have been conducted to identify sources of possible contamination, and to assess the extent and magnitude of contamination and its potential impacts on human health and the environment. These studies and any related investigations or remedial actions as they relate to individual SWMUs and AOCs are discussed in the applicable site-specific sections below.

2.4.1 Golf Course Maintenance Yard (AOC 9) and Pesticide Rinse Area (SWMU 58)

The Golf Course Maintenance Yard (GCMY) is located in the south-central portion of the former Carswell AFB, north of White Settlement Road. It occupies approximately one-half acre in area. Prior to the Interim Remedial Action (IRA) in 1996, buildings at the GCMY included a metal/office storage building, a wooden pole barn and metal carport used for equipment storage, and an aboveground fuel storage tank. As part of the IRA, the wooden pole barn was demolished and disposed of offsite, and the metal carport was moved to the former location of the pole barn. A new metal storage shed was built next to the existing metal building as a replacement for the pole barn. The site is currently used, and likely to be used in the future, for golf course maintenance (Figure 2-1).

The 1996 IRA by Jacobs Engineering Group, Inc. (Jacobs) consisted of conducting soil sampling to determine the nature of impacts, identifying the chemicals of concern, excavating and removing impacted soil, and conducting confirmatory sampling. A total of 380 cubic yards of soil was disposed off-site, the excavations were back-filled with clean soil, and the surfaces

were finished with gravel or a concrete slab. The Technical Report for the IRA (Jacobs, 1997) concluded that remaining pesticide concentrations in the soil were below Medium Specific Concentrations (MSCs), metals in soil represented background, and the site could be closed under Texas Risk Reduction Standard (RRS) No. 2.

2.4.2 Grounds Maintenance Yard (AOC 5)

The Grounds Maintenance Yard (GMV) (Figure 2-2) is located in the southeast corner of Carswell AFB near the Main Entrance. It is a predominantly graveled yard, with some areas of asphalt pavement, two small maintenance buildings, a pesticide storage shed, two 500-gallon aboveground storage tanks located on a concrete containment pad, and two office trailers. A site walk through by LAW Environmental, Inc. (LAW) and AFCEE personnel in October 1994 found some soil staining and areas suspected to have formerly contained chemical storage sheds and/or petroleum storage tanks. Past operations at the GMV include storage and maintenance of grounds keeping equipment, and storage of pesticides, solvents, and fuels.

LAW conducted soil sampling activities at the GMV from October 22 to 24, 1995 as part of a Site Investigation/Site Characterization. Twenty-eight surface soil samples were collected from 0 to 2 feet using stainless steel hand augers following a grid layout of the site. Sampling locations occurred at approximately 60-foot intervals, but some locations were offset to include stained areas near the two maintenance buildings and former pesticide storage building, in the area of the petroleum storage tanks, and at locations where obvious soil staining was observed.

Unified Services of Texas, Inc. (UNSVTX) demolished and removed one structure and one concrete pad at the GMV in May 97. UNSVTX also disposed of twenty-three transformers of varying sizes located on a concrete pad to the northeast of the GMV. Laboratory analysis indicated that three of the transformers contained polychlorinated biphenyls (PCB) oil in concentrations in excess of 50 parts per million (ppm). These three transformers were appropriately labeled and transported for incineration. The other twenty transformers contained PCB oil in concentrations less than 50 ppm and were transported to an approved disposal facility. The GMV was backfilled and compacted at removal areas.

In 1997, Jacobs compared the results reported in the LAW Site Investigation/Site Characterization Technical Report for the Aerospace Museum Site and Grounds Maintenance Yard, against background concentrations as reported in the NAS Fort Worth JRB, Texas Basewide Background Study (Jacobs, 1997). The evaluation indicated that arsenic was the only metal analyte which exceeded the Soil/Air and Ingestion Standard for Industrial Use (SAI-Ind) MSCs. Arochlor 1254 was detected twice, and 4,4-DDE, 4,4-DDT, and dieldrin were each detected once at concentrations above the MSC. The evaluation recommended sampling for PCBs in the former vicinity of the transformers, sampling for pesticides along the west fence line of the GMV, and sampling for arsenic near one former sample location.

In May 1997, Jacobs collected thirty-two soil and sediment samples at the GMY in order to confirm the analytical results collected by LAW in October 1995. Samples were analyzed for selected metals, and pesticides and PCBs. All samples were first prepared using the synthetic precipitate leaching procedure (SPLP). The data evaluation concluded that endrin was detected below the RRS No. 2 concentration, lead was detected above the Practical Quantitation Limit (PQL) in one sample, and beryllium was detected below the PQL. All of the beryllium results received a "B" qualifier, indicating the detected concentrations were less than 5 times the lab blank concentrations. This qualifier indicates that the beryllium is likely due to laboratory contamination and is not present in soil or sediment at these concentrations. Beryllium was detected in all seven lab blank samples at concentrations ranging from 0.0005 to 0.0162 mg/L, while the highest concentration in a soil sample was 0.0166 mg/kg. The evaluation noted that the Method Detection Limits (MDLs) for antimony, lead, aldrin, and dieldrin were above the RRS No. 2 concentrations.

2.4.3 Aerospace Museum Site (AOC 8)

The Aerospace Museum Site (AMS) is located along Spur 341, west of the North-South primary instrument runway, south of AFP-4, and adjacent to Farmers Branch Creek (Figure 2-3). The site is currently covered with grass and slopes gently from northwest to southeast. This 12.5-acre museum site has been used for display of various aircraft, vehicles, and storage equipment. A records search indicated that an asphalt batching plant was previously located at the site. Also, a B-52 bomber was previously stored and dismantled at the site, resulting in small chips of aircraft skin being buried in the surface soil. Carswell AFB personnel conducted a site survey on April 9, 1993, and reported the following:

- Several spots of stressed vegetation and dark oily spots near aircraft and ground vehicle displays.
- Stressed vegetation along the west fence line and randomly throughout the aircraft display area.
- A 55-gallon drum of material assumed to be waste grease.
- Discarded paint cans.
- A 55-gallon drum of cleaning compound.
- Several rusted and unidentifiable cans and drums.

In October, 1994, representatives of AFCEE and LAW met at the AMS and found that the debris listed above had been removed, and neither surface staining nor distressed vegetation were evident.

LAW conducted soil sampling activities at the AMS from October 22 to 24, 1995 as part of a Site Investigation/Site Characterization. Forty-nine surface soil samples were collected from 0 to 2 feet using stainless steel hand augers following a grid layout of the site. Sampling locations

occurred at approximately 100-foot intervals. Samples were analyzed for metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). The Site Investigation/Site Characterization Technical Report (LAW, 1996) indicated that VOCs and SVOCs detected at the AMS were at concentrations less than the Texas RRSs. The background data collected for metals at this site were determined to not be representative of basewide background concentrations; therefore, a comparison of detected metals concentrations at the site to background were inconclusive.

UNSVTX demolished and removed nine small structures and concrete pads at the former AMS in May 97. These removed structures included a wooden shed, an electrical equipment box, two apparent old concrete blast shields, two concrete pads, one asphaltic concrete pad, a mobile fuel test system, soil piles, a rubble pile, and loose railroad ties. The site was restored by clean backfilling, compacting, and reseeding with native grass.

In 1997, Jacobs compared the results reported in the LAW Site Investigation/Site Characterization Technical Report for the Aerospace Museum Site and Grounds Maintenance Yard, against background concentrations as reported in the NAS Fort Worth JRB, Texas Basewide Background Study (Jacobs, 1997). The evaluation indicated that toluene was detected throughout the AMS at relatively low concentrations, SVOCs were detected at concentrations below SAI-Ind MSCs, and lead was the only inorganic analyte that required further evaluation. The evaluation indicated that toluene and PAH concentrations likely represented anthropogenic background and VOCs and SVOCs did not require further sampling. A single sample exceeded background concentrations and MSCs for lead. The evaluation recommended sampling for lead in the area of a rubble pile in the southeast portion of the site (subsequently removed by UNSVTX).

In May 1997, Jacobs collected twenty-seven soil samples at the AMS in order to confirm the analytical results collected by LAW in October 1995. Samples were analyzed for selected metals, and were first prepared using the synthetic precipitate leaching procedure (SPLP). The data evaluation concluded that beryllium was detected below the PQL but was thought to be a lab contaminant, and lead was detected above the PQL in one sample. The evaluation noted that the MDL for lead was 0.016 mg/L compared to the RRS No. 2 of 0.015 mg/L.

2.4.4 Fire Training Area 2 (SWMU 19), Waste Fuel Storage Tank (SWMU 20), and Waste Oil Tank (SWMU 21)

This summary includes Fire Training Area (FTA) 2 (SWMU No. 19), the Waste Fuel Storage Tank (SWMU No. 20), and the Waste Oil Tank (SWMU No. 21) which were co-located. SWMU 19 is located between the north-south taxiway and the former radar facility (Figure 2-1). The site was used as a fire department training facility from 1963 to 1989. The fire ring was gravel-lined and bordered by two low earthen berms. Waste oils and recovered fuels, and

possibly waste solvents, were the primary materials burned during fire training exercises. An on-site 8,500-gallon aboveground storage tank (AST), SWMU 20, was used to store clean or contaminated fuels before they were delivered to the fire ring via a pump and piping. Also on-site was a 9,500-gallon underground storage tank (UST), SWMU 21, used for storage of waste oils and solvents from the flightline shops (Radian, 1986). Past interviews of personnel indicated its contents were occasionally used in fire training exercises.

FTA-2 (SWMUs 19, 20, and 21) was investigated as part of the IRP Phase II-Confirmation/Quantification, Stage I (October 1986) and as part of the IRP RI/FS Stage II (April 1989) conducted by Radian. During these investigations, ten borings were drilled and sampled and five groundwater monitoring wells were installed and sampled in the area of FTA-2. Soil samples indicated the presence of petroleum hydrocarbons. The following SVOCs were also detected: 2-methylnaphthalene, 4-methylphenol, phenol, and naphthalene. Groundwater samples indicated metals and VOCs were detected above Maximum Contaminant Levels (MCLs). The metals detected above MCLs include arsenic, lead, cadmium and chromium. The VOCs detected above MCLs include trichloroethene (TCE), tetrachloroethene, and vinyl chloride.

Dames & Moore conducted remediation activities at FTA-2 in 1993. The 9,500-gallon UST was reportedly removed prior to the remediation project. The remediation project included removal and disposal of the AST and its contents, concrete pad, and associated piping; removal of the fire training structures, piping, and valves; and soil sampling at each area to delineate excavation areas. Thirty soil samples were collected from nine locations at FTA-2 to depths of 0.5, 1.5, and 2.5 feet. One surface water sample was collected in the area. A total of three soil samples were collected in the immediate area of the AST. All samples were analyzed for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylenes (BTEX). Soils excavated from FTA-2 were placed in a biocell on base and remediated. Verification sampling after soil excavation indicated TPH concentrations ranging from below detection limits to 6,400 mg/kg and BTEX concentrations ranging from below detection limits to 74.3 mg/kg. A clay liner was constructed in the excavated areas to form a barrier between impacted soils and future backfill. After bioremediation, in June 1994 the excavated soils were backfilled at FTA-2 above the clay liner.

2.4.5 French Underdrain System (SWMU 64), Unnamed Stream (AOC 14), and Building 1340 OWS (SWMU 67)

The RCRA Part B Permit for Carswell AFB describes SWMU 64 as the French Underdrain System which is divided into two parts; a paved lot in the vicinity of an abandoned gasoline service station; and the Unnamed Stream, a small tributary of Farmers Branch Creek, located southeast of the abandoned service station. The small Unnamed Stream is the discharge from Building 1340 Oil/Water Separator (OWS) (SWMU 67) and receives its perennial flow from groundwater entering the separator. The OWS is connected to the French underdrain system,

which was installed to aid in the removal of fuel-contaminated groundwater from the abandoned service station (Figure 2-4).

The abandoned service station is removed and the only visible evidence of the station is the concrete pump island. No installation date or as-built drawings have been located for the French underdrain system. In 1996, Parsons Engineering-Science, Inc. (PARSONS) removed the OWS and portions of the French underdrain system. Prior to removal, the OWS had discharged into the unnamed stream, which flows about 200 feet east into Farmers Branch Creek, which in turn discharges to the Trinity River.

Stage I investigations included the collection of soil samples from three hand-augered borings near the unnamed stream, and three soil borings in the unpaved lot (abandoned station). Stage II investigations included collection of surface water samples from the Unnamed Stream and installation and sampling of four monitoring wells in the area of the stream.

Initial investigative activities conducted in 1985 revealed high levels of organic compounds in the groundwater under the paved lot (abandoned service station). Groundwater sampling in 1990 detected VOCs and metals, but at concentrations below MCLs. During groundwater sampling for the 1994 RCRA Facility Investigation (RFI), VOCs and metals were detected in concentrations above RRS No. 2 levels. Surface water data collected in 1986 and 1990 detected benzene and toluene.

Free petroleum product and detectable concentrations of petroleum hydrocarbons in both soil and groundwater were measured at the site during the 1990 IRP RI (Radian, 1991), the RFI (LAW, 1994) and the 1994 risk-based sampling events. Quarterly compliance monitoring events are being conducted at the sites in accordance with the Base-wide groundwater-monitoring program.

As part of the interim removal actions by Parsons in 1996, portions of the French underdrain and its bedding material were removed and replaced with low permeability material. These activities halted the flow of groundwater into the OWS and the unnamed stream. The OWS was cleaned and removed, and soil samples taken from the resulting pit. Soil samples showed arsenic and lead concentrations of concern.

The Environmental Company (TEC) conducted an investigation in 1996 of two fuel distribution pipelines that happen to traverse the area of the unnamed stream. Soil borings revealed petroleum-related contamination in the area; however, hydrocarbon fingerprinting results indicated the contamination is not attributable to the pipelines.

Geo-Marine, Inc. conducted soil removal activities at the unnamed stream in 1997. Remedial actions included over-excavation of the entire Unnamed Stream channel for a width of

six feet and to a depth of no less than one foot, and over-excavation of the west and south walls of the previously removed OWS. Confirmation sampling was performed as part of the project. The data from the Geo-Marine remedial action will be evaluated as part of the current project along with all previously collected data at these areas.

2.4.6 Landfill LF-04 (SWMU 22), Landfill LF-05 (SWMU 23), and Waste Burial Area WP-07 (SWMU 25)

Landfills LF-04, LF-05, and Waste Burial Area WP-07 are located in close proximity to one another (Figure 2-1), in an area generally referred to as the Landfill Area. This area is located east of the southern end of the flightline at Carswell AFB. The landfills were recently investigated as one project and due to similar wastes, histories, and future uses, will be evaluated as one area.

LF-04 (SWMU 22) includes approximately six acres of land located east of the south end of Taxiway 197, and south of the west end of White Settlement Road on Carswell AFB. It was the main landfill during much of the history of Carswell AFB. While in active use, at least six large pits, approximately 12 feet deep, were filled with refuse which was reportedly burned and buried. Various potentially hazardous wastes including drums of waste liquids, partially full paint cans, and cadmium batteries were reported disposed of at this site.

LF-05 (SWMU 23) is located northwest of WP-07 between Fire Training Areas 1 and 2, and adjacent to a small tributary to Farmers Branch Creek. This landfill was constructed by building a clay berm next to the creek and filling the area behind the berm. The landfill received all types of flightline waste, including TCE containers, between 1963 and 1975.

WP-07 (SWMU 24) is located north of the west end of White Settlement Road on Carswell AFB, and between LF-04 and LF-05. Various types of hazardous materials, including drums of cleaning solvents, leaded sludge, and possibly ordnance materials were reportedly disposed of at this site during the 1960s. There are no visible signs of the boundaries of the former disposal area.

LF-04, LF-05, and WP-07 were investigated and characterized in the Site Investigation (SI) IRP Confirmation/Quantification Report completed by Radian in 1986. The SI showed that TCE contamination was present in the groundwater beneath the Landfill Area, and elevated concentrations of metals and vinyl chloride were present in surface water samples near the Landfill Area. Soil samples collected during the SI also revealed elevated concentrations of organic and inorganic compounds.

The Landfill Area was further investigated in the Phase II RI/FS by Radian in 1989. This investigation revealed that the TCE plume defined in the SI had not changed appreciably, and soil samples again indicated elevated levels of organic and inorganic compounds.

In 1991, the U.S. Army Corps of Engineers (COE) removed several drums containing TCE from nine excavations at WP-07. Soil samples collected from the excavations detected cadmium, chromium, and lead in addition to TCE, tetrachloroethene, and other VOCs.

A groundwater pump and treat system was installed by IT Corporation in the Landfill Area to recover TCE-contaminated groundwater for treatment. Thirteen groundwater extraction wells were installed as part of the treatment system. The system operated from 1993 until 1995, was restarted in early 1997 and is currently operational. Selected wells in the Landfill Area are sampled as part of basewide groundwater monitoring, and also as part of long-term monitoring of the TCE plume originating from AFP4.

As part of the 1997 HydroGeologic Inc. investigation of the Landfill Area, surface and subsurface samples were collected from test pits excavated at LF-04 and LF-05, and from soil borings at WP-07.

HydroGeologic reported that inorganic compounds and SVOCs were above RRS No. 2 levels in surface soils at LF-04 and LF-05; inorganic compounds were above RRS No. 2 levels in surface soils at WP-07; and inorganic compounds were above RRS No. 2 levels in subsurface soils at LF-04.

The 1997 HydroGeologic report concluded that metals concentrations in surface waters in the Landfill Area were probably not representative of runoff specifically related to any of the units investigated. The report indicated that TCE concentrations in surface waters were above RRS No. 2 levels; however this was attributed to AFP4 surface water transported through the aqueduct to Farmers Branch Creek and groundwater discharging to surface waters. The report also indicated that metals concentrations in sediments were above RRS No. 2 levels; however, there was no evidence that this was a result of releases from the subject areas.

The 1997 HydroGeologic investigation also determined that groundwater beneath the Landfill areas has been impacted by chlorinated organic compounds migrating in groundwater from AFP4 located to the west. An increase in contaminant levels is noted in the area of WP-07.

2.4.7 Sanitary Sewer System (SWMU 66)

The sanitary sewer system was designated as SWMU 66 in a RCRA Facility Assessment (RFA) report by EPA (Kearney, 1989). The RFA reported the sanitary sewer system collects sanitary wastewater as well as some industrial wastewater from Carswell AFB facilities. The

wastewater collected by the sanitary sewer system is discharged into the City of Fort Worth publicly owned treatment works. The sanitary sewer system has been in operation since the base was activated in 1942.

An investigation of the sanitary sewer system in 1994 indicated that most of the oil/water separators (OWSs) at the base did discharge effluent through the sanitary sewer system (Carter and Burgess, 1994). LAW performed an investigation of 11 OWSs in 1995 to assess contamination and evaluate the condition of the OWSs. Of the OWSs connected to the sanitary sewer system at Carswell AFB, five have been submitted for no further action (NFA) status and several others are expected to require no further action pending comparison to the basewide background study.

IT Corporation conducted a RCRA Facility Investigation (RFI) of the sanitary sewer system in 1997 for releases of effluent to the soil and groundwater. The investigation included collection of surface, near surface, and subsurface soils, groundwater, and surface water. The investigation included 24 OWSs connected to the sanitary sewer system. Collection of soil samples was performed along the sanitary sewer system at areas of greatest potential release of hazardous materials, including the industrial sector of the sanitary sewer and the OWSs. Samples were also collected near manholes, major bends, and at 250-foot intervals along the sewer system. The results of the 1997 IT RFI of the sanitary sewer system are pending review by the Texas Natural Resource Conservation Commission (TNRCC).

2.4.8 Treatment, Storage, and Disposal Facility

The Treatment, Storage, and Disposal Facility (TSDF) at Carswell AFB is located at Building 1347 and is operated under RCRA Part B Permit HW50289. The facility is actually a Permitted Container Storage Facility and no treatment or disposal activities have taken place at the facility. The facility is located in the far east area of the base (Figure 2-5). The facility was permitted in February 1991, and is authorized to operate for storage of up to 29,700 gallons of hazardous industrial waste. No wastes have been stored at the facility since November 14, 1995. In April 1996, 21 soil samples were collected around the building at each potential point of release during its previous operations. Samples were collected to a depth of 6 inches. After soil sampling, the facility was decontaminated in accordance with the permit closure plan, subsequent approved amendments, and applicable regulations referenced in the permit. Rinse water from the decontamination process was analyzed and the results submitted to the Fort Worth Water Department, Industrial Waste Section. The rinse water was discharged to the sanitary sewer system on September 16, 1996 with the approval of the Fort Worth Water Department. No equipment, waste, or rinse water remains at the site. Soil analytical results will be reviewed to determine if the site can receive clean closure certification.

2.4.9 Weapons Storage Area (SWMUs 59, 60, and 65)

The Offsite Weapons Storage Area (WSA) is a 247-acre off-site facility under ownership and control of Carswell AFB. The Offsite WSA is located about 4 miles west of the main base, just north of White Settlement Road (Figure 1-1). The facility, built in 1957, is surrounded by an additional 264 acres of easements. The Offsite WSA is primarily bordered by rural property, with some ranches and farms located nearby. A residential development is located south of White Settlement Road. Facilities included 2 munitions inspection shops, 16 ordnance storage buildings, 1 entry control building, a less than 90-day hazardous waste storage area (SWMU 59), and an emergency power plant. During its operational period, the site also maintained an Explosive Ordnance Disposal (EOD) Range, a small radioactive waste disposal facility (SWMU 60), a water storage tank, and two non-potable water wells (Figure 2-6).

A wide range of waste generating activities has occurred at the Offsite WSA and a number of environmental investigations and studies have been conducted at the site. Small quantities of waste cleaners and solvents were reported to be disposed of in a ditch west of Building 8503 (SWMU 65). An RI/FS Stage II investigation by Radian in 1989 collected soil samples in the ditch and analyses detected TCE, metals, PAHs, and VOCs.

The EOD range consisted of 83 acres. The range was surveyed by AF personnel in 1993 and was cleared by EOD personnel in 1995. All metallic items were excavated and removed.

A waste dump located 250 feet north of the north fence of the WSA contained debris which included wooden pallets, used crates, scrap metal, newspapers, loose sand, and other non-hazardous materials. Metcalf & Eddy (M&E) collected samples in the area, which indicated all analytes were below regulatory levels. The debris was removed in 1993 as non-hazardous waste.

Armstrong Laboratories Health Physics Branch conducted radiological surveys and sampling of the Offsite WSA in 1995. The evaluations demonstrated that the Offsite WSA meets the release criteria in accordance with the United States Nuclear Regulatory Commission, and the Offsite WSA is considered releasable for public use.

The low-level radioactive waste (LLRW) burial area (SWMU 60) was located 400 feet west of Building 8503 at the Offsite WSA. The site was used between 1957 and 1969, and consisted of radium-painted aircraft instrument dials that were disposed of in 18-foot long sealed tubes buried vertically in the ground. The three tubes and adjacent soil were excavated in May 1996. No evidence of release was observed and soil samples were obtained and analyzed for selected radionuclides. The Interim Remedial Action LLRW Burial Site technical report (M&E, 1996) the TNRCC issued an approval for closure of SWMU 60 under RRS No. 1 on November 5, 1996.

Five USTs have been installed and removed at the Offsite WSA. These reportedly contained fuel oil and diesel and were used for power generation, heating and vehicle fueling. Documentation of the UST removal activities was not found.

Groundwater from the on-site supply well was reported to contain total radium at 8.5 picocuries per liter (pCi/L) in excess of federal drinking water standards of 5 pCi/L. Jacobs Engineering conducted a background study which focused on previously detected radionuclides in groundwater. Existing wells were sampled and deep upgradient wells were installed to determine whether the radionuclides are naturally occurring or the result of disposal practices at the Offsite WSA.

The Environmental Company (TEC) conducted an RFI of the Offsite WSA in 1997. The project was to determine the nature and extent of contamination associated with maintenance and disposal activities at the Offsite WSA. Specific objectives were to determine the nature and extent of contamination associated with SWMU 59, characterize potential contamination related to the removed USTs, sample for residual explosive contamination at the EOD range, conduct asbestos and lead-based paint surveys at the site structures, assess potential contamination at the munitions igloos, and characterize all areas that may have been impacted by maintenance and disposal activities at the site including drainageways and ditches. The results of the 1997 TEC RFI of the Offsite WSA are pending review by the TNRCC.

2.4.10 Landfill LF-08 (SWMU 25)

LF-08 (SWMU 25) appears as a grass-covered mound and is located adjacent to, and east of, the north-south Taxiway 197 and south of Taxiway 190 (Figure 2-1). The RCRA Facility Assessment (Kearney, 1989) reported the area's operational history existed only during the mid 1960's and has not been used since the late 1960's. Debris that was reportedly accepted by the landfill included wood, metal, construction rubble, asphalt, concrete, and trees. No evidence suggests that any hazardous materials were disposed of at this site. However, Kearney reported that some of the materials disposed of at this site may have contained hazardous materials (HydroGeologic, 1997).

In 1997, HydroGeologic performed two geophysical surveys to evaluate the extent of the landfill. Following the reduction of survey data, eight test pits were excavated to investigate identified anomalies. Surface soil samples were collected at the test pit locations and subsurface soil samples were collected from virgin soil beneath the landfill debris. The draft report for the investigation indicated that several inorganics in surface and subsurface soils exceeded background and/or RRS No. 2 levels, and several SVOCs in surface soils exceeded PQLs and/or RRS No. 2 levels.

The 1997 HydroGeologic investigation also determined that groundwater beneath the Landfill areas has been impacted by chlorinated organic compounds migrating in groundwater from AFP4 located to the west. One newly installed well at LF-08 detected higher concentrations of TCE than the well that is upgradient from LF-08 (HydroGeologic, 1997)

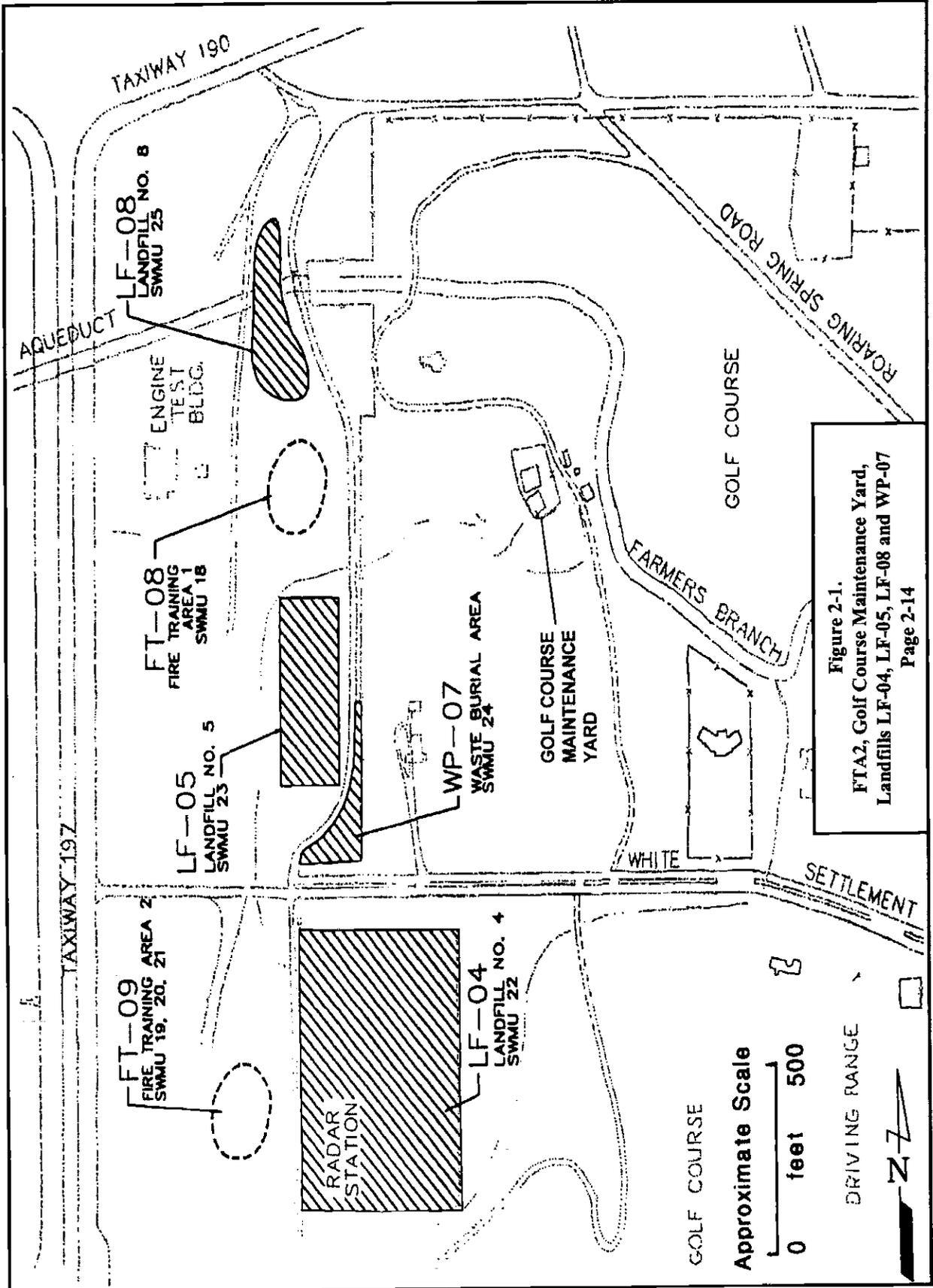


Figure 2-1.
 FTA2, Golf Course Maintenance Yard,
 Landfills LF-04, LF-05, LF-08 and WP-07
 Page 2-14

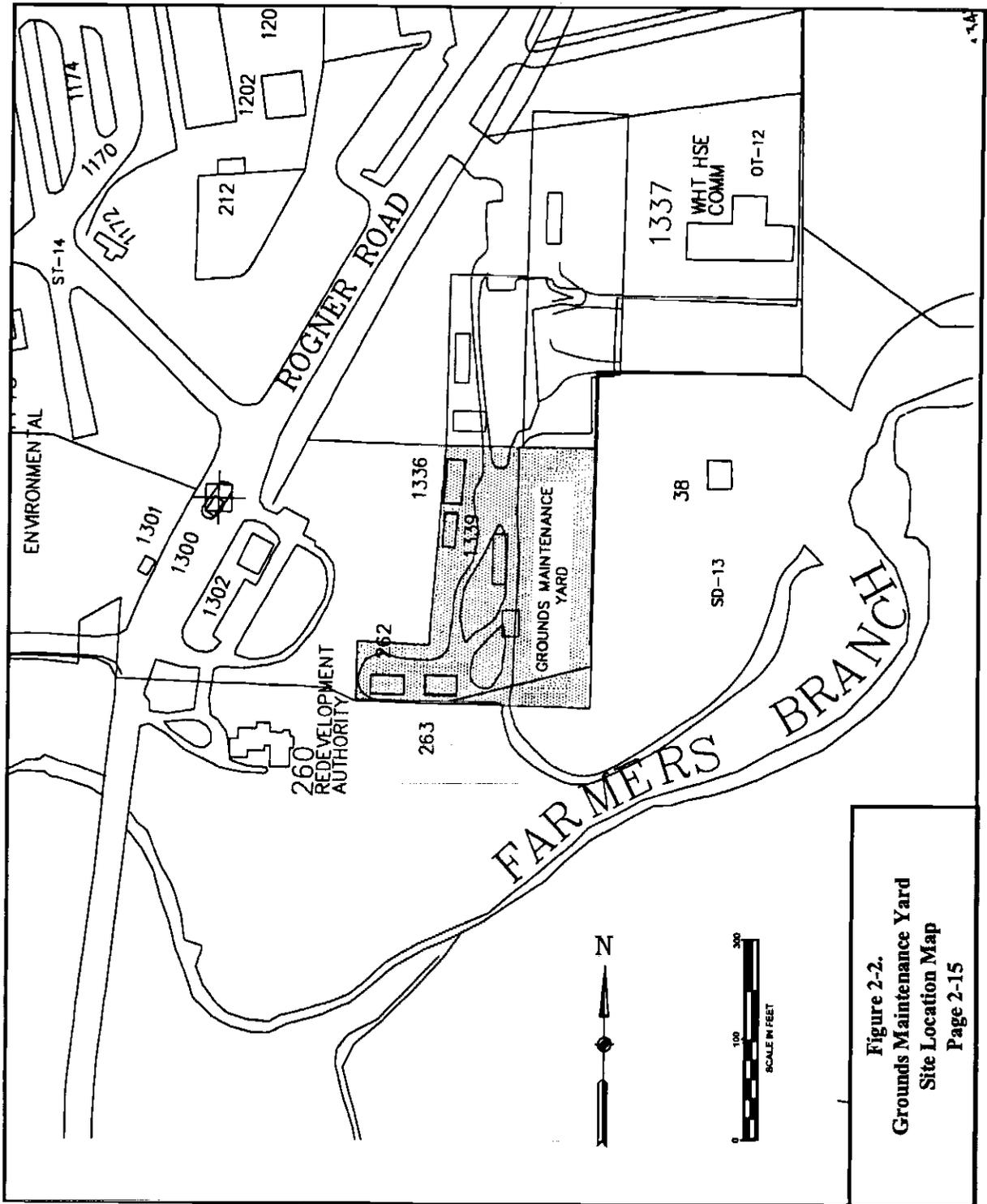
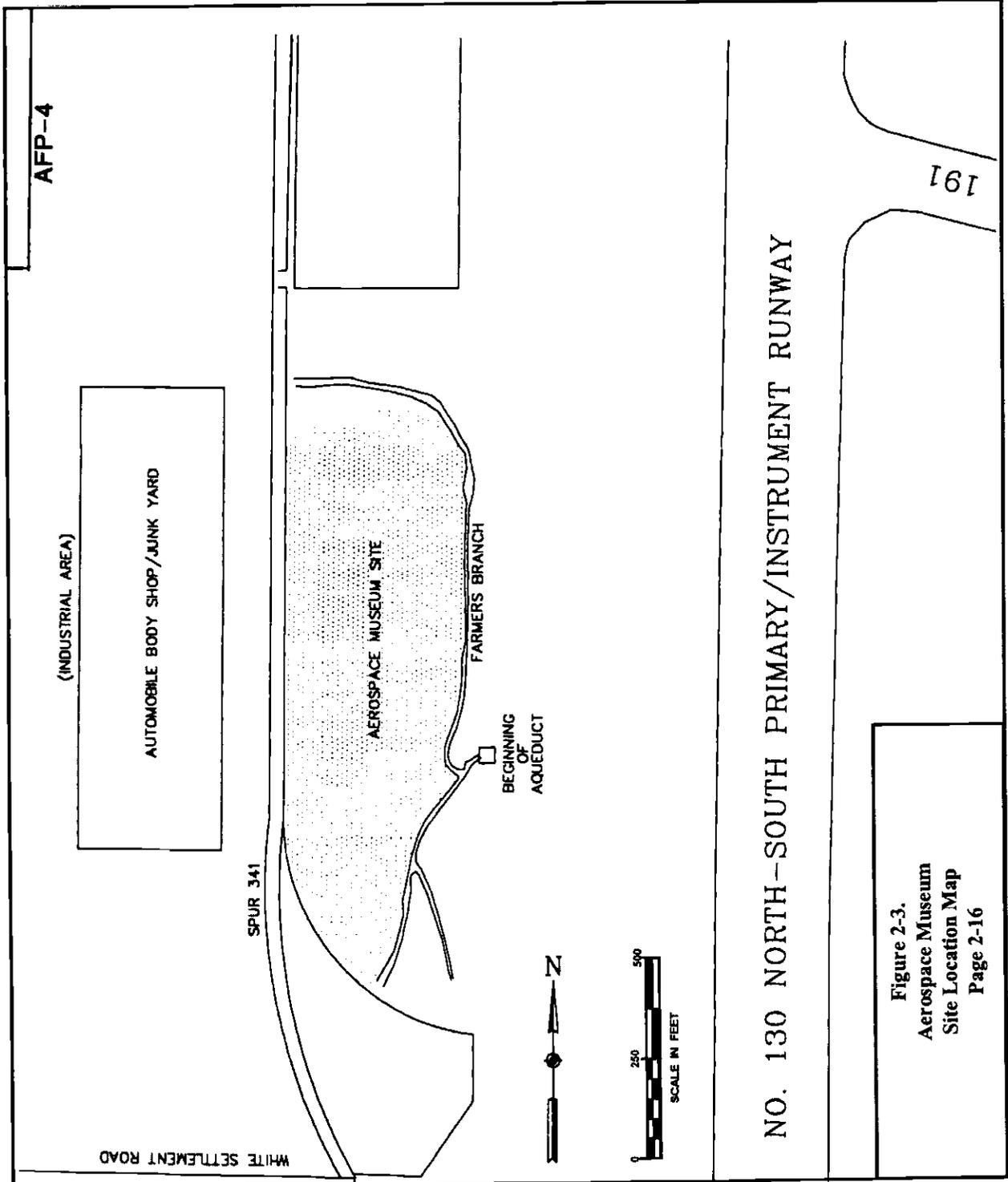


Figure 2-2.
Grounds Maintenance Yard
Site Location Map
Page 2-15



AFP-4

(INDUSTRIAL AREA)

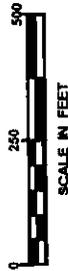
AUTOMOBILE BODY SHOP/JUNK YARD

SPUR 341

AEROSPACE MUSEUM SITE

FARMERS BRANCH

BEGINNING OF AQUEDUCT



NO. 130 NORTH-SOUTH PRIMARY/INSTRUMENT RUNWAY

191

Figure 2-3.
Aerospace Museum
Site Location Map
Page 2-16

443 132

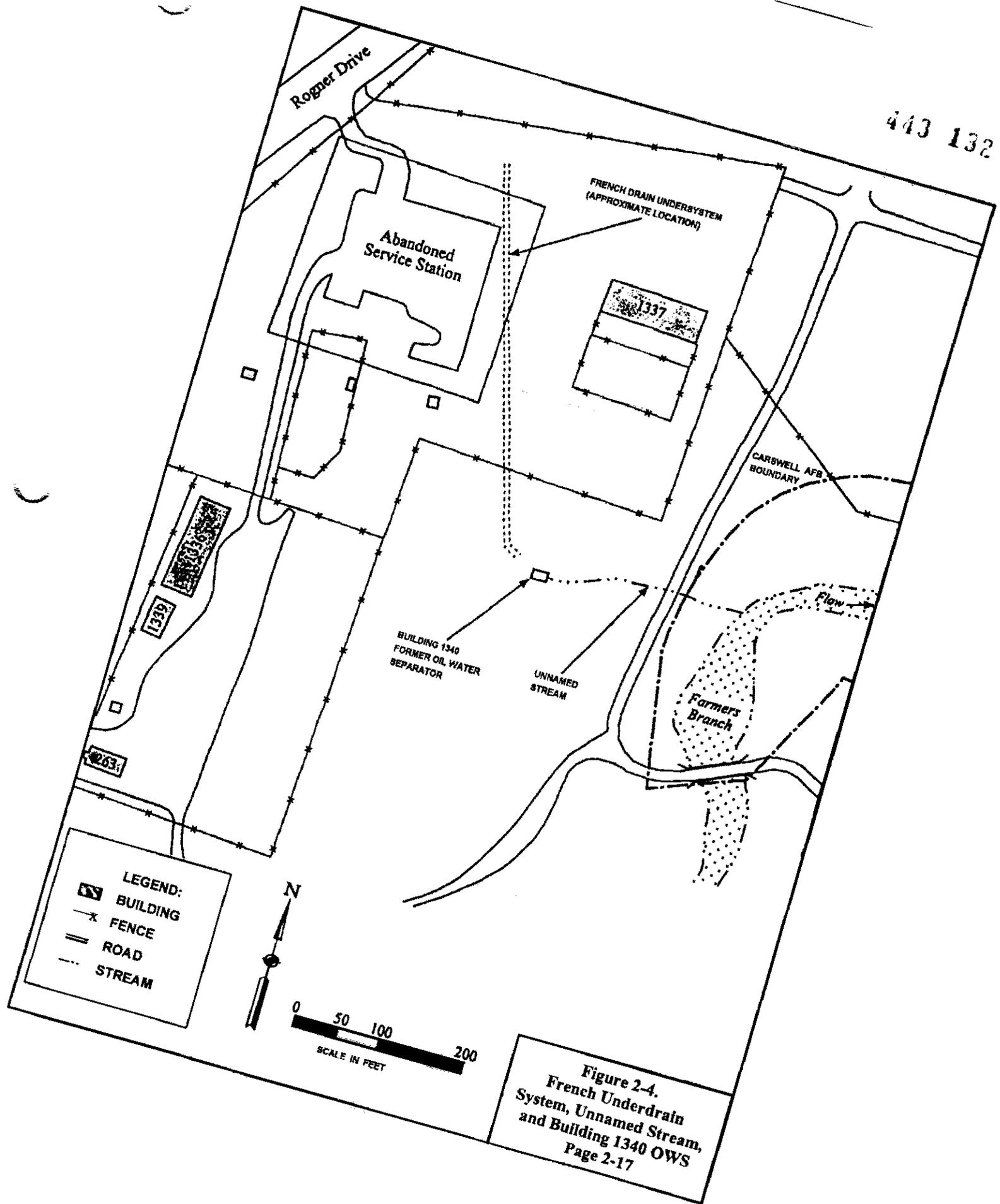


Figure 2-4.
French Underdrain
System, Unnamed Stream,
and Building 1340 OWS
Page 2-17

443 133

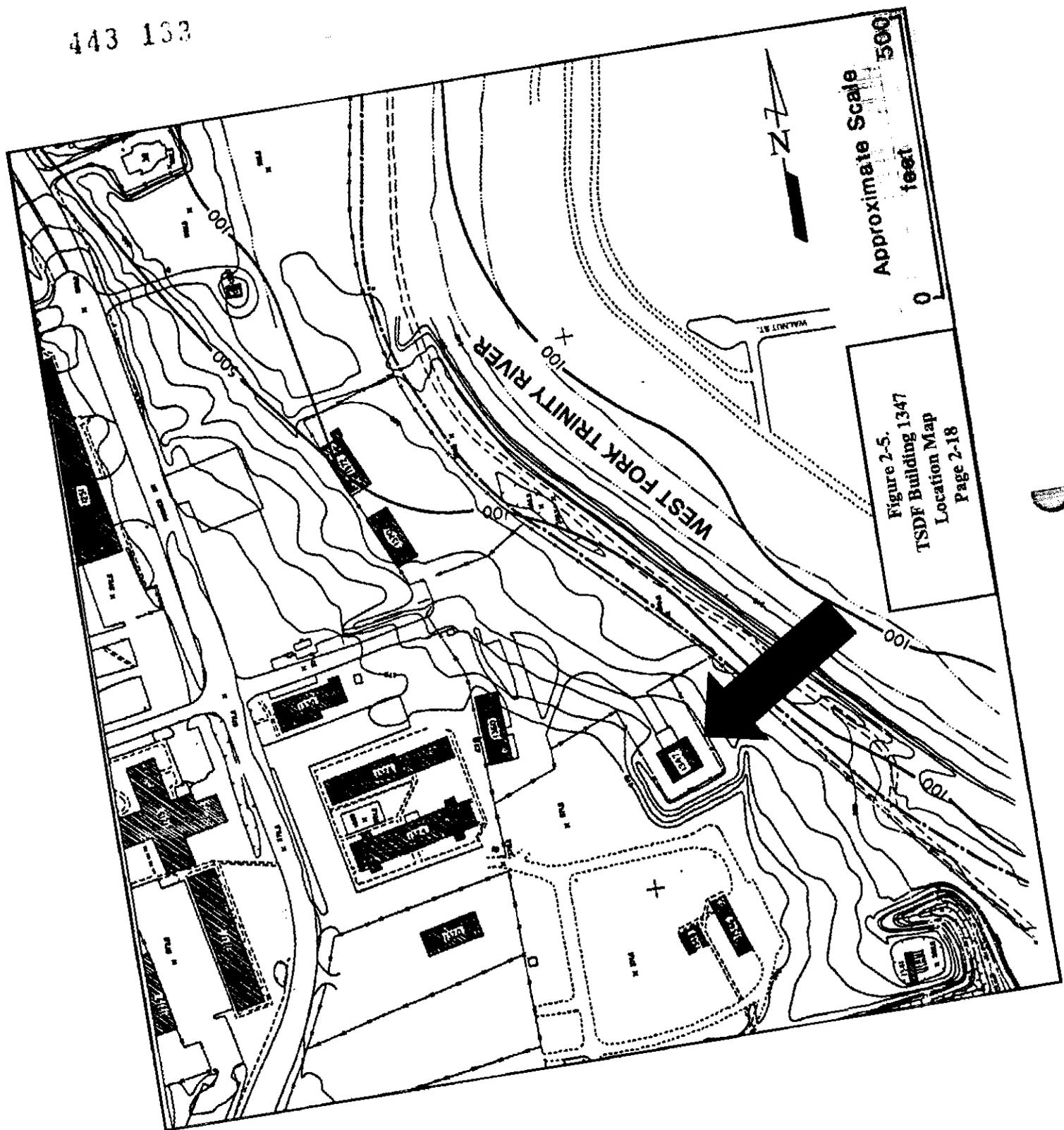


Figure 2-5.
TSDF Building 1347
Location Map
Page 2-18

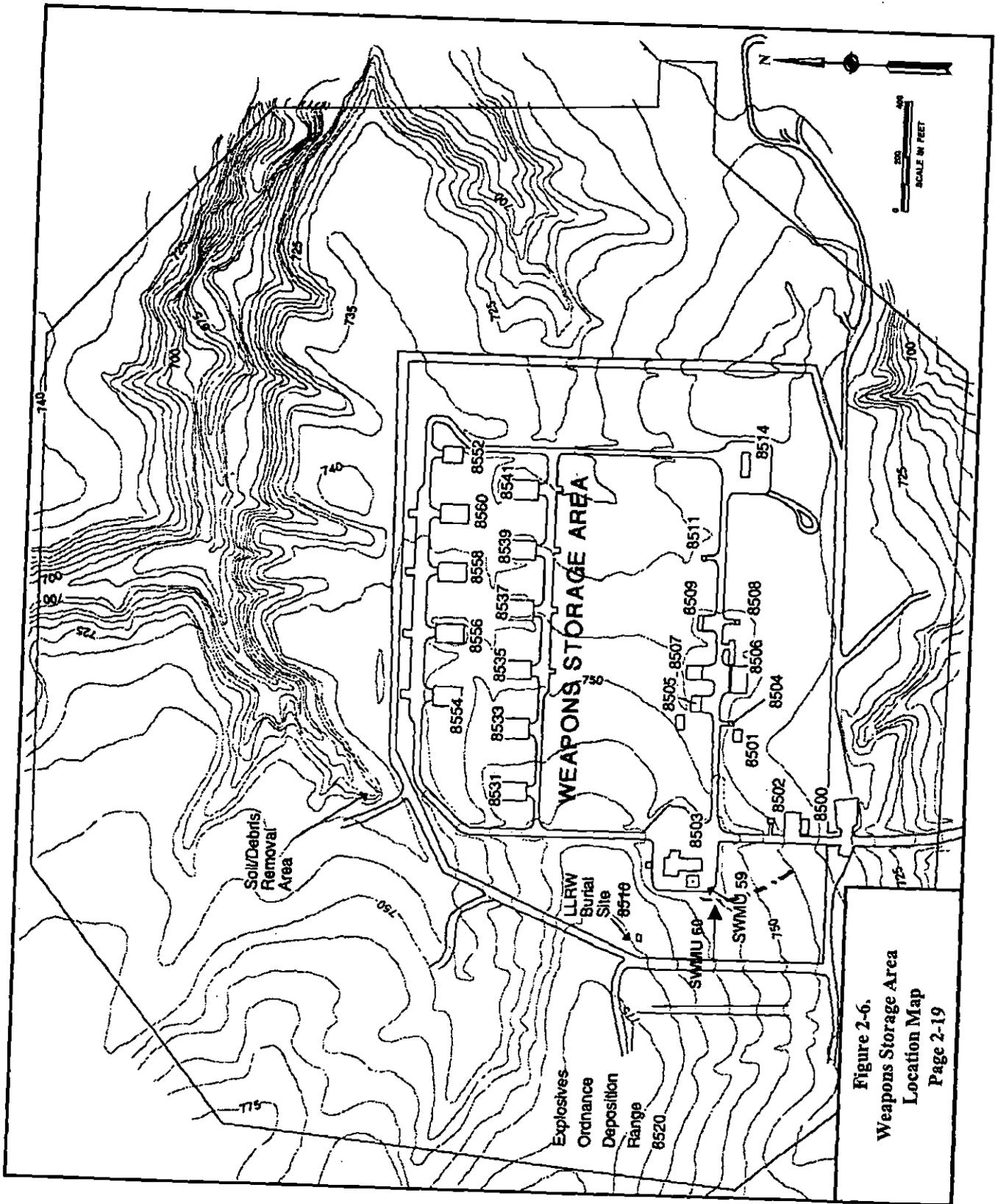


Figure 2-6.
Weapons Storage Area
Location Map
Page 2-19

443. 13413

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3.0 PROJECT SCOPE AND OBJECTIVES

3.1 OBJECTIVES

The overall goal of this project is to provide risk-based closure documentation for various SWMUs and AOCs, which will determine site-specific target levels for contaminants and recommend closure, monitoring, or remediation to target levels. Specific objectives needed to achieve this goal include:

- *Collect and evaluate existing site data against appropriate risk-based closure criteria.*
- *Refine or develop, based on previous and newly collected data, conceptual site models (CSM).*
- *Collect site-specific data to fill data gaps identified in the initial data evaluation.*
- *Prepare management plans or determine corrective measures required to meet site-specific target cleanup levels.*
- *Implement incidental soil removal/ interim removal actions to meet site-specific contaminant target levels that will allow for risk-based site closures.*
- *Prepare closure documentation for sites meeting risk-based closure criteria.*

Existing site data will be collected and evaluated against appropriate risk-based closure criteria. Data gaps identified during the initial data evaluations will guide additional data collection for this project. The number, type, and locations of samples required will be outlined in FSP addenda. Data needed to accomplish the project objectives may include at various sites:

- *Soil and Sediment Characteristics Data. Soil characteristic data is necessary to understand the geologic conditions in areas of potential contamination. Lithologic data will be recorded during all subsurface sampling activities conducted in relation to filling identified data gaps at specific sites. Soil property data (grain size, moisture content, organic carbon, porosity, etc.) will be collected as required to fill identified data gaps at specific sites.*
- *Soil Contamination Data. Soil contamination data is necessary in areas of potential contamination to identify the types and concentrations of contaminants present in surface and subsurface soils. Soil sample locations and analyses will be selected to fill identified data gaps at specific sites.*
- *Sediment and Surface Water Contamination Data. Sediment and surface water contamination data is necessary to identify the types and concentrations of contaminants*

present in drainage ways at applicable sites. Sediment and surface water sample locations and analyses will be selected to fill identified data gaps at specific sites.

- *Groundwater Characteristics Data. Groundwater characteristic data is necessary in areas of potential contamination to understand the hydrogeologic conditions. Data will be collected to fill identified data gaps involving groundwater characteristics, such as depth to groundwater and direction of groundwater flow. Identified data gaps at specific sites may require the installation of additional groundwater monitoring wells.*
- *Groundwater Contamination Data. Groundwater contamination data is necessary to identify the types and concentrations of contaminants present in groundwater. Groundwater sample locations and analyses will be selected to fill identified data gaps at specific sites. Identified data gaps at specific sites may require the installation of additional groundwater monitoring wells.*

3.2 SAMPLE ANALYSIS SUMMARY

The overall goal of this project is to provide risk-based closure documentation for various SWMUs and AOCs, which will determine site-specific target levels for contaminants and recommend closure, monitoring, or remediation to target levels. Each SWMU or AOC will require the collection and evaluation of existing site data to determine which, if any, field activities are required to complete the evaluations and fill data gaps. After the completion of the initial evaluations, addenda to the FSP shall be prepared that include a sample analysis summary. The sample analysis summary shall, for each analytical method, on a site-by-site basis list (1) the number of analyses, by site and total, (2) the total number of environmental samples for all matrices, (3) the number of trip blanks, (4) the number of ambient condition blanks, (5) the number of equipment blanks, and (6) the number of field duplicate samples, (7) the number of screening samples (if screening samples are taken) to be confirmed and, (8) identify any deviations from the sampling activities specified in the SOW. The sample analysis summary form that shall be used is shown in Table 3-1.

3.3 FIELD ACTIVITIES

After the completion of the initial evaluations, addenda to the FSP shall be prepared that include a field activities summary. The addenda will summarize, in tabular form as shown in Table 3-2, the type and number of field activities to be conducted at each site, the number of monitor wells to be constructed, the type and number of aquifer tests, frequency of sampling, etc. The addenda will include site maps showing all planned field activities.

443 137B

5:1 3:0

**Field Sampling Plan
Carswell AFB, TX
Risk-Based Assessment, Management, and Closure of SWMUs and AOCs
Contract #F41624-95-D-8003 / Delivery Order 0023
December 1998
Page 3-4**

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4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Table 4-1 presents point-of-contact information for key project personnel. Figure 4-1 is a project organizational chart that identifies key project personnel.

Table 4-1. Key Personnel and Point-of-Contact Listing

Name	Address	Phone Number
Mr. Charles Rice AFCEE TC/COR	AFCEE/ERB 3207 North Road, Building 532 Brooks AFB, TX 78235	(210) 536-6452 (210) 536-3609 Fax
Mr. Alvin Brown AFBCA Field Engineer	AFBCA/OL-H 6550 White Settlement Road Fort Worth, TX 76114	(817) 731-8973, Ext. 10 (817) 731-8137 Fax
Mr. Kevin Phillips FPM Program Manager	Fanning, Phillips and Molnar 909 Marconi Avenue Ronkonkoma, NY 11779	(516) 737-6200 (516) 737-2410 Fax
Mr. Joseph Comanzo FPM Quality Assurance	Fanning, Phillips and Molnar 909 Marconi Avenue Ronkonkoma, NY 11779	(516) 737-6200 (516) 737-2410 Fax
Mr. Thomas Doriski FPM Health and Safety Officer	Fanning, Phillips and Molnar 9311 San Pedro Avenue, Suite 700 San Antonio, TX 78216	(210) 524-7737 (210) 524-7738 Fax
Mr. Gaby Atik FPM Project Manager	Fanning, Phillips and Molnar 909 Marconi Avenue Ronkonkoma, NY 11779	(516) 737-6200 (516) 737-2410 Fax
Mr. Richard Magee FPM Project Geologist	Fanning, Phillips and Molnar 9311 San Pedro Avenue, Suite 700 San Antonio, TX 78216	(210) 524-7737 (210) 524-7738 Fax
Mr. Atul Salhotra Project Risk Assessor	RAM Group 7457 Harwin Drive, Suite 308 Houston, TX 77036	(713) 784-5151 (713) 784-6105 Fax

4.1 SUBCONTRACTORS

FPM's subcontractors for this project will be determined by past performance and cost effectiveness. Subcontractors necessary for this project will include: drilling, backhoe/tracker operators, surveyors, waste disposal, and laboratory

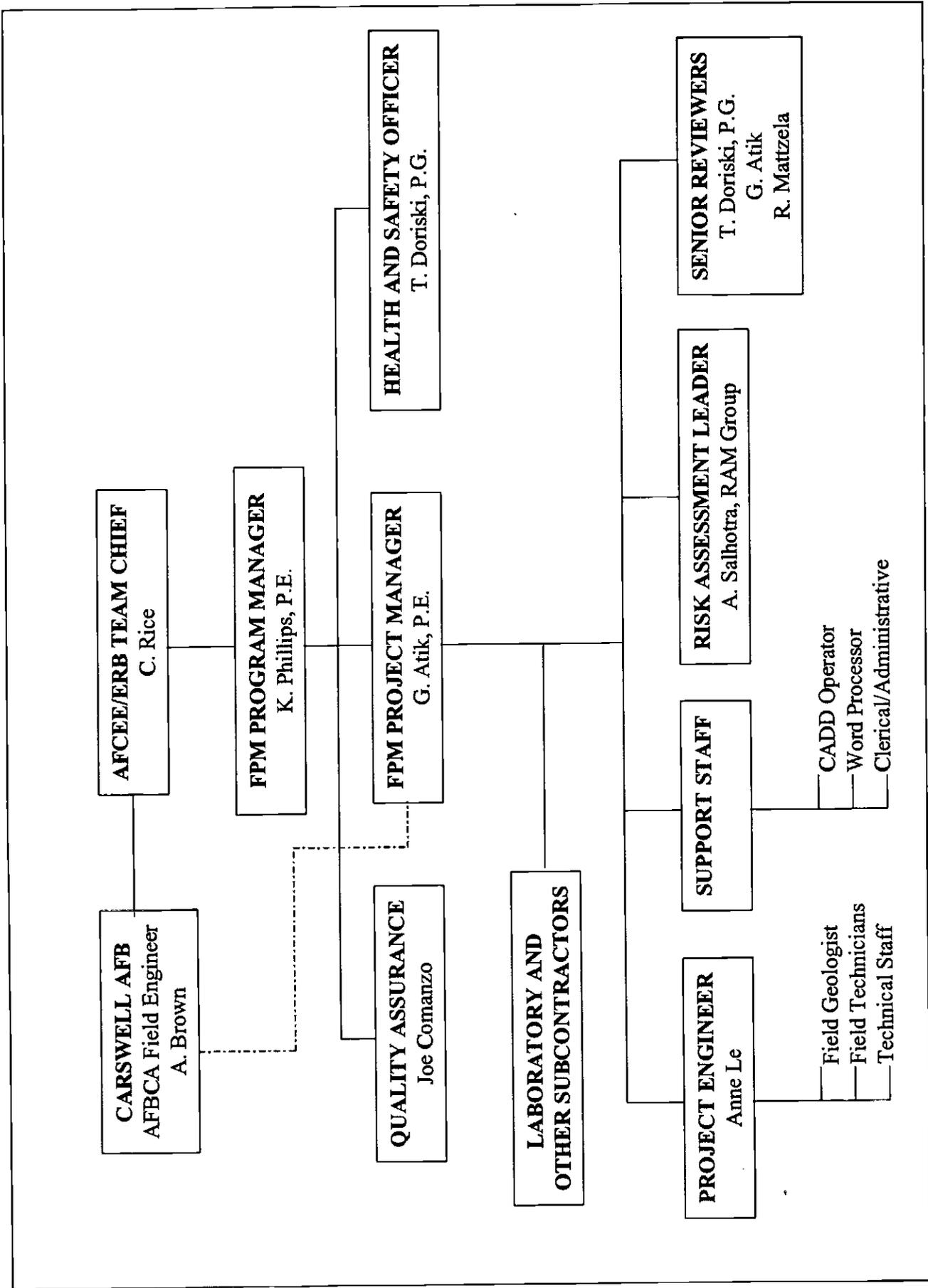


FIGURE 4-1. Organizational Chart

5.0 FIELD OPERATIONS

All field operations have been previously summarized in detail in section 3.0.

5.1 GEOLOGIC STANDARDS

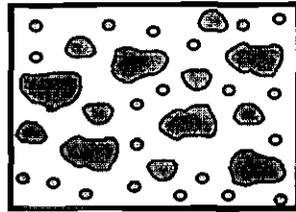
The lithologic descriptions for consolidated materials (igneous, metamorphic, and sedimentary rocks) shall follow the standard professional nomenclature (cf. Tonnissen, A.C., 1983, *Nature of Earth Materials*, 2nd Edition, p. 204-348), with special attention given to describing fractures, vugs, solution cavities and their fillings or coatings, and any other characteristics affecting permeability. Colors shall be designated by the Munsell Color System.

The lithologic descriptions for unconsolidated materials (soils [engineering usage] or deposits) shall use the name of the predominant particle size (e.g., silt, fine sand, etc.). The dimensions of the predominant and secondary sizes shall be recorded using the metric system. The grain size and name of the deposit shall be accompanied by the predominant mineral content, accessory minerals, color, particle angularity, and any other characteristics. The clastic deposit descriptions shall include, as a supplement, symbols of the Unified Soil Classification System

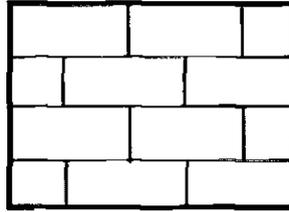
The sedimentary, igneous, and metamorphic rocks and deposits shall be represented graphically by the patterns shown in Figure 5-1. Columnar sections, well and boring logs, well construction diagrams, cross sections, and three-dimensional (3-D) diagrams shall use these patterns. Supplementary patterns shall follow Swanson, R. G., 1981, *Sample Examination Manual*, American Association of Petroleum Geologists, p IV-41 and 43. Geologic structure symbols shall follow *American Geological Institute Data Sheets*, 3d Edition, 1989, sheets 3.1 through 3.8.

Figure 5-1
Lithologic Patterns for Illustration

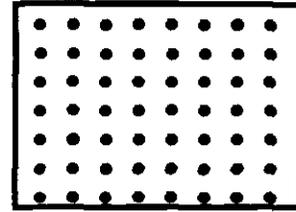
Sediments and Sedimentary Rocks



Gravel and Conglomerate



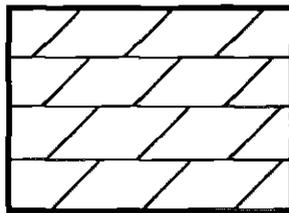
Limestone



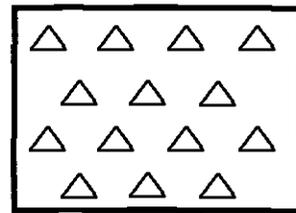
Sand and Sandstone



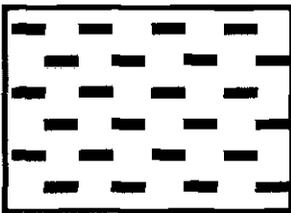
Silt and Siltstone



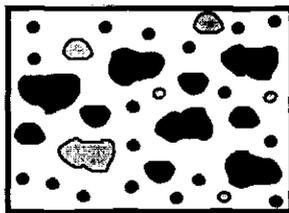
Dolomite



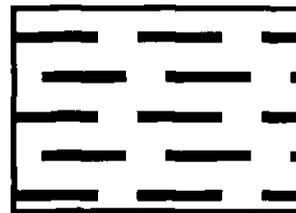
Chert



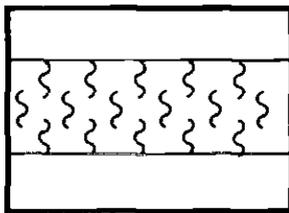
Clay



Glacial Till



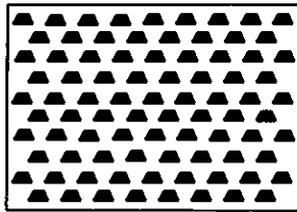
Shale



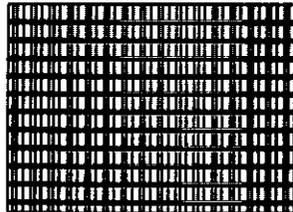
Loess

Figure 5-1
Lithologic Patterns for Illustration

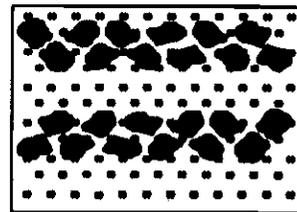
Igneous Rocks



Undifferentiated
Intrusive

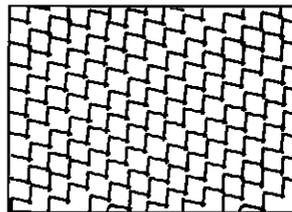


Basalt



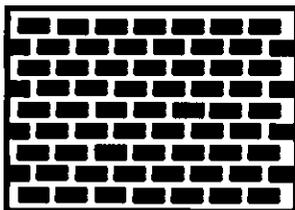
Volcanic Breccia
and Tuff

Metamorphic Rocks

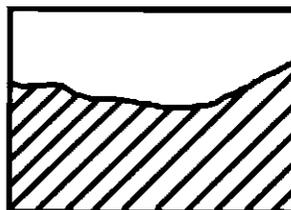


Undifferentiated

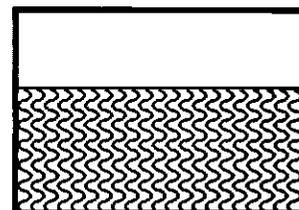
Miscellaneous



Fill



Undifferentiated
Bedrock



Residium

The scales for maps, cross sections, or 3-D diagrams shall be selected in accordance with the geologic and hydrologic complexity of the area and the purposes of the illustrations. Geophysical logs shall be run at a constant vertical scale of 1 inch equals 20 feet. When geophysical logs are superimposed on geologic logs, cross sections, or 3-D diagrams, the scales shall be the same. If defining geological conditions requires other scales, additional logs at those scales shall be provided.

For orientation, the cross sections shall show the Northern end on the viewer's right. If the line of cross section is predominantly East-West, the Eastern end is on the right. Maps shall be oriented with North toward the top, unless the shape of the area dictates otherwise. Indicate orientation with a North arrow.

5.2 SITE RECONNAISSANCE, PREPARATION, AND RESTORATION PROCEDURES

Areas designated for intrusive sampling shall be surveyed for the presence of underground utilities. Utility locations are determined using existing utility maps, and in the field, are verified using a hand-held magnetometer or utility probe. *Prior to commencement of drilling activities, the Base civil engineer will be contacted to verify that selected locations are free of underground utilities. No work will be performed at any location until a digging permit is issued for that site.* Vehicle access routes to sampling locations shall be determined prior to any field activity.

A centralized decontamination area shall be provided for drilling rigs and equipment. The decontamination area shall be 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 shall be lined with a heavy gauge plastic sheeting, and designed with a collection system to capture decontamination waters. Solid wastes shall be accumulated in 55-gallon drums and subsequently transported to a waste storage area designated by the Air Force. Smaller decontamination areas for personnel and portable equipment shall be provided as necessary. These locations shall include basins or tubs to capture decontamination fluids, which shall be transferred to a large accumulation tank as necessary. *These designated areas of decontamination shall be designated by the Base POC.*

The field office and the primary staging area for field equipment and supplies will be located in the building west of the AFBCA office at 6550 White Settlement Road.

Each work site or sampling location shall be returned to its original condition when possible. Efforts shall 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 shall be removed. Decontamination and/or purge water and soil cuttings shall be transported to the designated locations as described in Section 5.12.

5.3 GEOPHYSICAL SURVEYS

Not applicable.

5.4 SOIL GAS SURVEYS

Not applicable.

5.5 BOREHOLE DRILLING, LITHOLOGIC SAMPLING, LOGGING, AND ABANDONMENT

5.5.1 General Drilling Procedures

All drilling activities shall conform with state and local regulations and shall be supervised by a *FPM professional geologist or engineer*. The contractor shall obtain and pay for all permits, applications, and other documents required by state and local authorities.

The location of all borings shall be coordinated, in writing, with the base civil engineer or equivalent before drilling commences. When drilling boreholes through more than one water bearing zone or aquifer, the contractor shall take measures to prevent cross-connection or cross-contamination of the zones or aquifers.

The drill rig shall be cleaned and decontaminated in accordance with (IAW) the procedure in Section 5.12. The drill rig shall not leak any fluids that may enter the borehole or contaminate equipment placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable.

Drilling fluids shall consist of air, water, or mud. If air is used, it shall be filtered to remove organic vapors, and filters shall be changed daily. The effectiveness of the air filter shall be checked at least every 4 hours using a photoionization detector (PID) or flame ionization detector (FID). If organic vapors are detected in air passing through the downstream end of the air line or drill stem, their source (i.e., filter, contaminated line, etc.) shall be decontaminated or replaced. If water is used, the contractor shall provide chemical analyses of the water for AFCEE approval. Only water from a pre-approved source shall be used as a drilling fluid and the water quality shall be monitored daily for suspected analytes of concern. Drilling mud, if used, shall consist of 100 percent sodium bentonite and shall be approved by the AFCEE. The prime contractor shall provide AFCEE with the chemical analyses of any drilling mud additive or substitute proposed for use prior to the start of drilling. The additives or substitutes shall be analyzed for all analytes of concern at the site. The analyses shall be delivered to the AFCEE for written approval prior to drilling system mobilization. Mud or other additives shall only be used as a last resort. *The most*

likely drilling method to be used for this project is hollow-stem auger drilling which will not require the use of drilling fluids.

Lubricants shall not introduce or mask contaminants. The contractor shall provide chemical analyses of all lubricants proposed for downhole use. Chemical detection limits shall be equivalent to those used in analyzing project ground-water samples. Lubricants with constituents that are toxic or that increase, decrease, or mask the target chemical species of the investigation shall not be permitted. The contractor shall provide the analysis results to the AFCEE prior to drilling mobilization.

A log of drilling activities shall be kept in a bound field notebook. Information in the log book shall include location, time on site, personnel and equipment present, down time, materials used, samples collected, measurements taken, and any other observations or information that would be necessary to reconstruct field activities at a later date. At the end of each day of drilling the drilling supervisor shall complete a Daily Drilling Log. An example of the Daily Drilling Log is shown in Section 8.0. All items on the log must be completed, if known.

The contractor shall dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the base civil engineer or representative.

5.5.2 Sampling and Logging

The lithology in all boreholes shall be logged. The boring log form, in Section 8.0, shall be used for recording the lithologic logging information. Information on the boring log sheet includes the borehole location; drilling information; sampling information such as sample intervals, recovery, and blow counts; and sample description information.

Unconsolidated samples for lithologic description shall be obtained at each change in lithology or every five (5) foot interval, whichever is less or as specifically stated in the SOW. Lithologic descriptions of unconsolidated materials encountered in the boreholes shall generally be described in accordance with American Society for Testing and Materials (ASTM) D-2488-90 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM, 1990). Descriptive information to be recorded in the field shall include: (1) identification of the predominant particles size and range of particle sizes, (2) percent of gravel, sand, fines, or all three, (3) description of grading and sorting of coarse particles, (4) particle angularity and shape, and (5) maximum particle size or dimension.

Plasticity of fines description include: (1) color using Munsell Color System, (2) moisture (dry, wet, or moist), (3) consistency of fine grained soils, (4) structure of consolidated materials, and (4) cementation (weak, moderate, or strong).

Identification of the Unified Soil Classification System (USCS) group symbol shall be used. Additional information to be recorded includes the depth to the water table, caving or sloughing of the borehole, changes in drilling rate, depths of laboratory samples, presence of organic materials, presence of fractures or voids in consolidated materials, and other noteworthy observations or conditions, such as the locations of geologic boundaries.

Lithologic descriptions of consolidated materials encountered in the boreholes shall generally be described in accordance with Section 5.1. Consolidated samples for lithologic description shall be obtained at each change in lithology or at five-foot intervals, whichever is less, or as specified in the SOW. All samples shall be monitored with an organic vapor monitor (e.g., PID, organic vapor analyzer [OVA]). The samples shall be handled in such a way as to minimize the loss of volatiles, and these procedures shall be described in Section 6.0. Cuttings shall be examined for their hazardous characteristics. Materials suspected to be hazardous because of abnormal color, odor, or organic vapor monitor readings shall be containerized in conformance with the Resource Conservation and Recovery Act (RCRA) and the state and local requirements. Rock cores shall be stored in standard core boxes, and missing sections of core shall be replaced with spacers.

Lithologic descriptions of consolidated materials shall follow the specifications in Section 5.1.

5.5.3 Abandonment

Boreholes that are not converted to monitor wells shall be abandoned in accordance with applicable federal, state or local requirements. If a slurry is used, a mud balance and/or Marsh Funnel shall be used to ensure the density (lbs/gal) of the abandonment mud mixture conforms with the manufacturer's specifications. The slurry shall be emplaced from the bottom to the top of the hole using a tremie pipe.

All abandoned boreholes shall be checked 24 to 48 hours after mud/solid bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications may be recommended by the manufacturer and shall be followed. If settling has occurred, a sufficient amount of mud/solid bentonite shall be added to fill the hole to the ground surface. These curing checks and any addition of mud/solid bentonite shall be recorded in the field log.

5.6 MONITORING WELL CONSTRUCTION

The on-site field manager shall supervise the drilling, soil boring, lithologic sampling, and monitor well construction and shall be a *professional geologist or engineer*. The supervising field manager shall affix his/her signature to all drilling logs, as-built well construction diagrams,

lithologic logs, sampling records, and similar documents. When there is a possibility that floating petroleum products (i.e., light non-aqueous phase liquids, LNAPLs) may be encountered, shallow monitor wells shall be screened across the water table. The length of the screen shall be such that tidal and seasonal water table fluctuations shall not cause water levels to rise above or fall below the screened interval. If dense petroleum products (i.e., dense non-aqueous phase liquids [DNAPLs]) may be encountered, monitor wells shall be screened at the bottom of the aquifer to capture the DNAPL.

5.6.1 Drilling Requirements

All drilling and well installations shall conform to state and local regulations, and the contractor shall obtain and pay for all permits, applications, and other documents required by state and local authorities. The location of all borings shall be coordinated in writing with the base civil engineer or equivalent before drilling commences.

The rig shall be cleaned and decontaminated according to the guidelines described in Section 5.12. The rig shall not leak any fluids that may enter the borehole or contaminate equipment that is placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable. The only acceptable drilling fluids are air, water, and mud. The air used shall be filtered to remove organic vapors, and if water is used, the prime contractor shall provide chemical analyses of the water showing the purity. The water quality shall be monitored daily for suspected analytes of concern. The mud used shall be 100 percent sodium bentonite, and the contractor shall provide chemical analyses of any drilling mud additive or substitute (e.g., foam, biodegradable material, etc.) proposed for use. The additives or substitutes for drilling shall be analyzed for all analytes of concern at the site and they shall be approved prior to drilling mobilization.

When air is used, the effectiveness of the air filter shall be checked at least every four hours. The air passing through the downstream end of the air line shall be monitored with an organic vapor monitor (e.g., PID, OVA), and if organic vapors are detected, their source (filter, contaminated line, etc.) shall be decontaminated or replaced.

Drilling lubricants shall not introduce or mask contaminants at the site. The contractor shall provide, to AFCEE, chemical analyses of all lubricants proposed for downhole use prior to the start of drilling. Chemical detection limits shall be equivalent to those used in analyzing the project ground-water samples. Lubricants with constituents that are toxic or that increase, decrease, or mask the target chemical species of the investigation shall not be permitted. The contractor shall provide the analysis results prior to drilling mobilization.

The contractor shall dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the base civil engineer or representative. When installing wells through more

than one water-bearing zone or aquifer, the contractor shall take measures to prevent cross-connection or cross-contamination of the zones or aquifers.

5.6.2 Borehole Requirements

Borehole diameters shall be at least four inches larger than the outside diameter of the casing and well screen. In the case of a hollow stem auger, the inside diameter of the auger shall be at least four inches larger than the outside diameter of the casing and well screen.

A completed monitor well shall be straight and plumb. The monitor well shall be sufficiently straight to allow passage of pumps or sampling devices. The monitor well shall be plumb within 1 degree of vertical where the water level is greater than 30 feet below land surface unless otherwise approved by AFCEE. AFCEE may waive a plumbness requirement. Any request for a waiver from straightness or plumbness specifications shall be made, in writing, to AFCEE in advance of mobilization for drilling. The contractor shall use a single-shot declination tool to demonstrate plumbness. Monitor wells not meeting straightness or plumbness specifications shall be redrilled and/or reconstructed.

Formation samples for lithologic description shall be obtained at each change in lithology or at five-foot intervals, whichever is less, or as specified in the SOW. All samples shall be monitored with an organic vapor monitor (e.g., PID, OVA). The samples shall be handled in such a way as to minimize the loss of volatiles, and these procedures shall be described in Section 6.0. Cuttings shall be examined for their hazardous characteristics. Materials that are suspected to be hazardous because of abnormal color, odor, or organic vapor monitor readings shall be containerized in conformance with RCRA and the state and local requirements. Rock cores shall be stored in standard core boxes, and missing sections of core shall be replaced with spacers.

The documentation record and forms, Section 8.0, shall document the following information for each boring: (1) boring or well identification (this identification shall be unique, and the contractor is responsible for ensuring it has not been used previously at the installation.), (2) purpose of the boring (e.g., soil sampling, monitor well), (3) location in relation to an easily identifiable landmark, (4) names of drilling contractor and logger, (5) start and finish dates and times, (6) drilling method, (7) types of drilling fluids and depths at which they were used, (8) diameters of surface casing, casing type, and methods of installation, (9) depth at which saturated conditions were first encountered, (10) lithologic descriptions and depths of lithologic boundaries, (11) sampling-interval depths, (12) zones of caving or heaving, (13) depth at which drilling fluid was lost and the amount lost, (14) changes in drilling fluid properties, (15) drilling rate, and (16) drilling rig reactions, such as chatter, rod drops, and bouncing.

In addition to the above, the following information shall be recorded when rock core samples are collected: (1) the depth interval and top and bottom of each core shall be marked on the core box, (2) percentage of core recovered, (3) number of fractures per foot, (4) angle of fractures relative to the core axis, and (5) breaks due to coring and core handling shall be distinguished from naturally occurring fractures. *Rock coring is not expected to be required for this project.*

A standard penetration test shall be performed each time a split spoon sample is taken. The test shall be performed in accordance with ASTM D-1586.

5.6.3 Casing Requirements

The casing requirements that shall be followed are: (1) all casing shall be new, unused, and decontaminated according to the specifications of Section 5.12, (2) glue shall not be used to join casing, and casings shall be joined only with compatible welds or couplings that shall not interfere with the planned use of the well, (3) all polyvinyl chloride (PVC) shall conform to the ASTM Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe System), (4) all metal casing shall be seamless stainless steel casing, and the casing "mill" papers shall be included in the appendix of the technical report, (5) the casing shall be straight and plumb within the tolerance stated for the borehole, and (6) the driller shall cut a notch in the top of the casing *on the north side* to be used as a measuring point for water levels. *Monitoring wells are expected to be constructed using flush-threaded, two-inch diameter, Schedule 40 PVC casing.*

5.6.4 Well Screen Requirements

Well screen requirements are: (1) all requirements that apply to casing shall also apply to well screen, except for strength requirements, (2) monitor wells shall not be screened across more than one water-bearing unit, (3) screens shall be factory slotted or wrapped, (4) screen slots shall be sized to prevent 90 percent of the filter pack from entering the well, and for wells where no filter pack is used, the screen slot size shall be selected to retain 60 to 70 percent of the formation materials opposite the screen, and (5) the bottom of the screen is to be capped, and the cap shall be joined to the screen by threads.

The contractor may propose open-hole wells in bedrock where cave-in is unlikely. Prior approval for such wells shall be obtained, in writing, from AFCEE.

5.6.5 Annular Space Requirements

The annular space requirements are the following: (1) the annular space shall be filled with a filter pack, a bentonite seal, and casing grout between the well string and the borehole wall, (2) any drilling fluids shall be thinned with potable water of known acceptable quality to a density

less than 1.2 g/cm³ (10 lbs/gal) before the annular space is filled, and a mud balance or Marsh Funnel shall be kept on site to allow measurement of drilling fluid density, and (3) as the annular space is being filled, the well string shall be centered and suspended such that it does not rest on the bottom of the hole, and for wells greater than 50 feet deep, at least two centralizers shall be used, one at the bottom and one at the top of the screen. Additional centralizers shall be used as needed.

5.6.6 Filter Pack Requirements

The filter pack shall consist of silica sand or gravel and shall extend from the bottom of the hole to at least two feet above the top of the well screen. After the filter pack is emplaced, the well shall be surged with a surge block for ten minutes. The top of the sand pack shall be sounded to verify its depth during placement. Additional filter pack shall be placed as required to return the level of the pack to two feet above the screen. Surge the well for five minutes. Again, place additional filter pack as required to bring its level to two feet above the screen. If gravel is used, six inches of coarse sand shall be placed on top of the gravel.

The filter pack material shall be clean, inert, and well-rounded and shall contain less than two percent flat particles. The sand or gravel shall be certified free of contaminants by vendor or contractor. If decontamination is necessary, the methods shall be approved in writing by AFCEE.

The filter pack shall have a grain size distribution and uniformity coefficient compatible with the formation materials and the screen, as described in Chapter 12, *Ground Water and Wells*, 2nd Edition, 1986. The filter pack shall not extend across more than one water-bearing unit. In all wells (deep or shallow), the filter pack shall be emplaced with a bottom-discharge tremie pipe of at least 1-1/2 inches in diameter. The tremie pipe shall be lifted from the bottom of the hole at the same rate the filter pack is set. The contractor shall record the volume of the filter pack emplaced in the well. Potable water may be used, with the approval of the regulatory agency providing oversight, to emplace the filter pack so long as no contaminants are introduced. The contractor may use formation materials as a filter pack when they are compatible with the slot size of the screen, such as in glacial outwash gravel deposits.

5.6.7 Bentonite Seal Requirements

The bentonite seal requirements that shall be followed are the following: (1) the bentonite seal shall consist of at least two feet of bentonite between the filter pack and the casing grout, (2) the bentonite shall be hydrated before placement and shall be installed by pump tremie methods, and (3) only 100 percent sodium bentonite shall be used.

For wells less than fifteen feet, the contractor may propose alternate sealing methods. Prior approval for any alternate method shall be obtained, in writing, from AFCEE before well construction begins.

5.6.8 Casing Grout Requirements

The casing grout requirements are the following: (1) the casing grout shall extend from the top of the bentonite seal to ground surface, (2) the grout shall be mixed in the following proportions: 94 pounds of neat Type I Portland or American Petroleum Institute Class A cement, not more than 4 pounds of 100 percent sodium bentonite powder, and not more than 8 gallons of potable water, (3) all grout shall be pump tremied using a side-discharge tremie pipe, and pumping shall continue until 20 percent of the grout has been returned to the surface, and (4) in wells where the bentonite seal is visible and within 30 feet of the land surface, the 20 percent return is not necessary so long as the tremie pipe is pulled back as the grout is emplaced.

5.6.9 Surface Completion Requirements

For flush-mounted completions, cut the casing about three inches below the land surface and provide a water-tight casing cap to prevent surface water from entering the well. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole shall be placed in the upper portion of the casing, or a ventilated well cap shall be used. A freely draining valve box with a locking cover shall be placed over the casing. The top of the casing shall be at least one foot above the bottom of the box. The valve box lid shall be centered in a three-foot diameter, four-inch thick concrete pad that slopes away from the box at 1/4 inch per foot. The identity of the well shall be permanently marked on the valve box lid and the casing cap. Where heavy traffic may pass over the well or for other reasons, the concrete pad and valve box/lid assembly shall be constructed to meet the strength requirements of surrounding surfaces.

When above-ground surface completion is used, extend the well casing two or three feet above land surface. Provide a casing cap for each well, and shield the extended casing with a steel sleeve that is placed over the casing and cap and seated in a 3-foot by 3-foot by 4-inch concrete surface pad. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole shall be placed in the well casing, or a ventilated well cap shall be used. The concrete surface pad shall be reinforced with steel reinforcing bars at least 1/4 inch in diameter. The ground surface shall be freed of grass and scoured to a depth of two inches before setting the concrete pad. The diameter of the sleeve shall be at least six inches greater than the diameter of the casing. Slope the pad away from the well sleeve. Install a lockable cap or lid on the guard pipe. The identity of the well shall be permanently marked on the casing cap and the protective sleeve. Install three 3-inch diameter concrete-filled steel guard posts. The guard posts shall be five feet in total length and installed radially from each well head. Recess the guard posts approximately two feet into the ground and set in concrete. Do not install the guard posts in the concrete pad placed at

the well base. The protective sleeve and guard posts shall be painted with a color specified by the installation civil engineer

All wells shall be secured as soon as possible after drilling. Provide corrosion-resistant locks for both flush and above-ground surface completions. The locks must either have identical keys or be keyed for opening with one master key. Deliver the lock keys to the appropriate Air Force personnel following completion of the field effort. *A Monitoring Well Construction Form (Section 8.0) will be completed for each newly installed well.*

5.6.10 Piezometer Requirements

A piezometer is a small diameter cased borehole primarily used for water level measurements. The piezometers' requirements are the following: (1) piezometers shall be constructed using methods or materials that do not contaminate groundwater or allow hydraulic communication between water-bearing units or between the ground surface and water-bearing units, (2) piezometers that penetrate more than one water-bearing unit shall be constructed in a manner that allows fluid from only one unit to enter them, and (3) the straightness and plumbness of piezometers shall be the same as for boreholes and monitor wells, Section 5.6.2. *Piezometer installations are not anticipated for this project.*

5.6.11 Well/Piezometer Completion Diagrams

A completion diagram shall be submitted for each monitor well or piezometer installed. It shall include the following information: (1) well identification (this shall be identical to the boring identification described), (2) drilling method, (3) installation date(s), (4) elevations of ground surface and the measuring point notch, (5) total boring depth, (6) lengths and descriptions of the screen and casing, (7) lengths and descriptions of the filter pack, bentonite seal, casing grout, and any back-filled material, (8) elevation of water surface before and immediately after development, and (9) summary of the material penetrated by the boring.

5.7 MONITOR WELL DEVELOPMENT

The monitor well development requirements are: (1) all newly installed monitor wells shall be developed no sooner than 24 hours after installation to allow for grout curing, (2) all drilling fluids used during well construction shall be removed during development, (3) wells shall be developed using surge blocks and bailers or pumps (prior approval for any alternate method shall be obtained, in writing, from AFCEE before well construction begins), and wells shall be developed until: (a) the suspended sediment content of the water is less than 0.75 mL/L, as measured in an Imhoff cone according to method E160.5; (b) the turbidity remains within a 10 nephelometric turbidity unit (NTU) range for at least 30 minutes; and (c) the stabilization criteria

in Section 6.1.1.1.3 are met, (4) discharge water color and volume shall be documented, (5) no sediment shall remain in the bottom of the well, (6) no detergents, soaps, acids, bleaches, or other additives shall be used to develop a well, and (7) all development equipment shall be decontaminated according to the specifications of Section 5.12. *If a well does not provide a sediment-free sample, development will stop when: (1) a maximum of ten well volumes have been removed, and (2) criteria b and c noted above are met. A monitoring well development log (Section 8.0) will be completed for each newly installed well.*

5.8 ABANDONING MONITOR WELLS

All abandonment of monitor wells, when directed to do so by the SOW, shall be performed in accordance with state and local laws and regulations. If slurry is used, a mud balance and/or Marsh Funnel shall be used to ensure that the density (lbs/gal) of the abandonment mud mixture conforms with the manufacturer's specification. All abandoned monitor wells shall be checked 24 to 48 hours after mud/solid bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications or quality assurance checks may be recommended by the manufacturer and shall be followed. Additionally, if significant settling has occurred, a sufficient amount of mud/solid bentonite shall be added to attain its initial level. These slurry/solid bentonite curing checks and any addition of mud/solid bentonite shall be recorded in the field logs. *The abandonment of monitoring wells is not anticipated for this project.*

5.9 AQUIFER TESTS

Not applicable.

5.10 TEST PIT EXCAVATION

A test pit is an opening in soil, unconsolidated deposit, or bedrock having at least one lateral dimension greater than the depth of the opening, which is used for scientific purposes. The location of each test pit shall be coordinated in writing with the base civil engineer before digging begins. The contractor shall follow Occupational Safety and Health Administration (OSHA) rules for excavation and confined space entry. The excavated material shall be screened for hazardous properties. Nonhazardous excavated material shall be backfilled immediately after the required information has been recorded. The first soils out shall be the last in when filling the pit. No test pit shall be left open overnight unless adequate safety precautions are employed. In vegetated areas, backfilled test pits shall be reseeded with native grasses. In addition to the general information required for all field activities listed in Section 8.0, the following shall be recorded for each test pit: (1) the total depth, length, and width, (2) the depth and thickness of distinct soil or lithologic units, (3) a lithologic description of each unit, and (4) a description of any man-made materials or apparent contamination encountered.

Excavation shall occur by using a backhoe/trackhoe. Decontamination of all equipment shall occur after an excavation is completed or daily following the procedures described in Section 5.12. Any shoring that is required shall be described and documented. The *locations and dimensions* for all test pits that shall be excavated shall be described in *addenda to the FSP*.

For excavations which may occur as part of interim removal actions, the excavated material will be sampled for disposal, and the excavations backfilled with clean imported fill.

5.11 SURVEYING

All surveying locations of field activities shall be measured by a certified land surveyor as the distance in feet from a reference location that is tied to the state plane system. The surveys shall be third order (cf. Urquhart, L.C., *1962 Civil Engineering Handbook*, 4th Edition, p. 96 and 97). An XY-coordinate system shall be used to identify locations. The X-coordinate shall be the East-West axis; the Y-coordinate shall be the North-South axis. The reference location is the origin. All surveyed locations shall be reported using the state plane coordinate system. The surveyed control information for all data collection points shall be recorded and displayed in a table. The table shall give the X and Y coordinates in state plane coordinate values, the ground elevation, and the measuring point elevation if the location is a ground-water monitor well. The elevation of all newly installed wells and piezometers shall be surveyed at the water level measuring point (notch) on the riser pipe. Include the elevation of the ground surface in the survey.

5.12 EQUIPMENT DECONTAMINATION

All equipment that may directly or indirectly contact samples shall be decontaminated in a designated decontamination area. This includes casing, drill bits, auger flights, the portions of drill rigs that stand above boreholes, sampling devices, and instruments, such as slugs and sounders. In addition, the contractor shall take care to prevent the sample from coming into contact with potentially contaminating substances, such as tape, oil, engine exhaust, corroded surfaces, and dirt.

The following procedure shall be used to decontaminate large pieces of equipment, such as casings, auger flights, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casing, auger flights, pipe, or rods. The external surfaces of equipment shall be *steam-cleaned or washed with high-pressure hot water and Alconox, or equivalent laboratory-grade detergent, and if necessary, scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed.* The equipment shall then be rinsed with potable water. The inside surfaces of casing, drill rod, and auger flights shall also be washed as described.

The following procedure shall be used to decontaminate sampling and drilling devices, such as split spoons, bailers, and augers that can be hand-manipulated. For sampling and smaller drilling devices, scrub the equipment with a solution of potable water and Alconox, or equivalent laboratory-grade detergent. Then rinse the equipment with copious quantities of potable water followed by a ASTM Type II Reagent Water. High-pressure liquid chromatograph-grade water and distilled water purchased in stores are not acceptable substitutes for ASTM Type II Reagent-Grade Water. (If equipment has come in contact with oil or grease, rinse the equipment with pesticide-grade methanol followed by pesticide-grade hexane.) Air dry the equipment on a clean surface or rack, such as Teflon[®], stainless steel, or oil-free aluminum elevated at least two feet above ground. If the sampling device shall not be used immediately after being decontaminated, it shall be wrapped in oil-free aluminum foil, or placed it in a closed stainless steel, glass, or Teflon[®] container.

Reagent-Grade II Water, methanol, and hexane shall be purchased, stored, and dispensed only in glass, stainless steel, or Teflon[®] containers. These containers shall have Teflon[®] caps or cap liners. It is the contractor's responsibility to assure these materials remain free of contaminants. If any question of purity exists, new materials shall be used.

Prior to commencement of field activities, a decontamination area will be established at a suitable location coordinated with the Base POC. All sampling equipment will be decontaminated before and between each use. Drilling equipment will be decontaminated prior to drilling each boring or monitoring well, and prior to leaving the site. Monitoring well casing material that arrives on-site, sealed in factory supplied packaging, will not require decontamination prior to use in the well. All fluids generated during decontamination activities will be containerized in 55-gallon steel closed top drums. All drums will be properly labeled and staged in a central location designated by the Base POC for temporary storage pending removal and disposal.

5.13 WASTE HANDLING

Waste handling shall be dealt with on a site-by-site basis. Waste may be classified as noninvestigative waste or investigative waste

Noninvestigative waste, such as litter and household garbage, shall be collected on an as-needed basis to maintain each site in a clean and orderly manner. This waste shall be containerized and transported to the designated sanitary landfill or collection bin. Acceptable containers shall be sealed boxes or plastic garbage bags.

Investigation derived waste shall be properly containerized and temporarily stored at a designated central location, prior to transportation. Depending on the constituents of concern, fencing or other special marking may be required. The number of containers shall be estimated

on an as-needed basis. Acceptable containers shall be sealed, U.S. Department of Transportation (DOT)-approved steel 55-gallon drums or small dumping bins with lids. The containers shall be transported in such a manner to prevent spillage or particulate loss to the atmosphere. To facilitate handling, the containers shall be no more than half full when moved.

The investigative derived waste shall be segregated at the site according to matrix (solid or liquid) and as to how it was derived (drill cuttings, drilling fluid, decontamination fluids, and purged groundwater). Each container shall be properly labeled with site identification, sampling point, depth, matrix, constituents of concern, and other pertinent information for handling.

Waste generated during the field activities will be handled and disposed in accordance with applicable Federal, state, and local regulations. Disposable materials such as latex gloves, aluminum foil, paper towels, etc., shall be placed and sealed in plastic garbage bags for disposal with sanitary waste from the site. Soil cuttings will be placed in 55-gallon steel closed top drums. Development and purge waters evacuated from groundwater monitoring wells and all fluids generated during decontamination activities will be containerized in 55-gallon steel closed top drums. All drums will be properly labeled and staged in a central location designated by the Base POC for temporary storage pending removal and disposal.

5.14 HYDROGEOLOGICAL CONCEPTUAL MODEL

Site geological and hydrological conceptual models will be developed or existing models refined as necessary to meet project requirements and provide for risk-based evaluations

5.15 CORRECTIVE ACTION

Field performance and system audits will be performed as described in Section 7.5 of the FSP.

443 156B 201 800

Field Sampling Plan

Carswell AFB, TX

Risk-Based Assessment, Management, and Closure of SWMUs and AOCs

Contract #F41624-95-D-8003 / Delivery Order 0023

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6.0 ENVIRONMENTAL SAMPLING

6.1 SAMPLING PROCEDURES

The construction material of the sampling devices (e.g., plastic, PVC, metal) discussed below shall be appropriate for the contaminant of concern and shall not interfere with the chemical analyses being performed.

All purging and sampling equipment shall be decontaminated according to the specifications in Section 5.12 prior to any sampling activities and shall be protected from contamination until ready for use.

6.1.1 Ground-Water Sampling

6.1.1.1 Monitor Well Sampling

When numerous monitor wells are to be sampled in succession, those wells expected to have low levels of contamination or no contamination shall be sampled prior to those wells expected to have higher levels of contamination. This practice will help reduce the potential for cross contamination between wells. All sampling activities shall be recorded in the field log book. Additionally, all sampling data shall be recorded on a well sampling form. A well sampling form is shown in Section 8.0.

Before ground-water sampling begins, wells shall be inspected for signs of tampering or other damage. If tampering is suspected, (i.e., casing is damaged, lock or cap is missing) this shall be recorded in the field log book and on the well sampling form, and reported to the Field Operations Leader. Wells that are suspected to have been tampered with shall not be sampled until the Field Operations Leader has discussed the matter with the project manager.

Before the start of sampling activities, plastic sheeting shall be placed on the ground surrounding the well. The plastic sheeting shall be used to provide a clean working area around the well head, and prevent any soil contaminants from contacting sampling equipment. Remove water in the protective casing or in the vaults around the well casing prior to venting and purging. Every time a casing cap is removed to measure water level or collect a sample, the air in the breathing zone shall be checked with an organic vapor meter and the air in the well bore shall be checked with an explosimeter. Procedures in the Health and Safety Plan (HSP) shall be followed when high concentrations of organic vapors or explosive gases are detected. Air monitoring data shall be recorded on the well sampling form.

Purge pump intakes shall be equipped with a positive foot check valve to prevent purged water from flowing back into the well. Purging and sampling shall be performed in a manner that

minimizes aeration in the well bore and the agitation of sediments in the well and formation. Equipment shall not be allowed to free-fall into a well.

In addition to the information required in Section 8.0, the following information shall be recorded each time a well is purged and sampled. This information shall be encoded in Environmental Restoration Program Information Management System (ERPIMS) files when required. (1) depth to water before and after purging, (2) well bore volume calculation, (3) sounded total depth of the monitor well, (4) the condition of each well, including visual (mirror) survey, (5) the thickness of any nonaqueous layer and, (6) field parameters, such as pH, temperature, specific conductance, and turbidity.

6.1.1.1 Water Level Measurement

An interface probe shall be used if a nonconductive floating product layer is suspected in the well. The interface probe shall be used to determine the presence of floating product, if any, prior to measurement of the ground-water level. The ground-water level shall then be measured to the nearest 0.01 foot using an electric water level indicator. Water levels shall be measured from the notch located at the top of the well casing and recorded on the well sampling form. If well casings are not notched, measurements shall be taken from the north edge of the top of the well casing, and a notch shall be made using a decontaminated metal file.

Following water level measurement, the total depth of the well from the top of the casing shall be determined using a weighted tape or electric sounder and recorded on the well sampling form. The water level depth shall then be subtracted from the total depth of the well to determine the height of the water column present in the well casing. All water level and total depth measuring devices shall be routinely checked with a tape measure to ensure measurements are accurate.

6.1.1.2 Purging Prior to Sampling

Purging of monitor wells is performed to evacuate water that has been stagnant in the well and may not be representative of the aquifer. Purging shall be accomplished using a Teflon[®] bailer or a pump.

At least three well volumes shall be removed from the well before it is sampled. The well bore volume is defined as the volume of submerged casing and screen. One well volume can be calculated using the following equation (reference: Ohio EPA Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring Programs, June 1993):

$$V = H \times F$$

where V = one well volume

H = the difference between the depth of well and depth to water (ft)

F = factor for volume of one foot section of casing (gallons) from Table 6.1

Table 6.1 Volume of Water in One-Foot Section of Well Casing

Diameter of Casing (inches)	F Factor (gallons)
1.5	0.09
2	0.16
3	0.37
4	0.65
6	1.47

F can also be calculated from the formula:

$$F = \Pi (D/2)^2 \times 7.48 \text{ gal/ft}^3$$

where D = the inside diameter of the well casing (feet).

Wells with yields too low to produce three well volumes before the well goes dry shall be purged to dryness.

The temperature, pH, electrical conductivity (EC), and turbidity shall be measured and recorded on the well sampling form after removing each well volume during purging. Water removed from the well during purging shall be containerized. Detailed information concerning investigative derived wastes is presented in Section 5.13.

Micropurge is an acceptable procedure to use for AFCEE projects. Micropurge is a low flow-rate monitor well purging and sampling method that induces laminar (non turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing groundwater directly from the sampled aquifer, horizontally through the well screen, and into the sampling device. Low-flow pumping rates associated with the micropurge technique are in the approximate range of 0.2 to 2.0 liters/min. These low flow rates minimize disturbance in the screened aquifer, resulting in: (1) minimal production of artificial turbidity and oxidation; (2) minimal mixing of chemically distinct zones; (3) minimal loss of volatile organic compounds; and (4) collection of representative samples while minimizing purge volume.

6.1.1.1.3 Sample Collection

Samples shall not be taken within 24 hours of monitor well development. Except as noted below, at least three well volumes shall be removed from the well before it is sampled.

The sample may be collected after three well volumes have been removed and the temperature, pH, EC and, turbidity have stabilized. Stabilization shall be defined as follows: temperature $\pm 1^{\circ}\text{C}$, pH ± 0.1 units, EC ± 5 percent, turbidity ± 10 NTU for at least 30 minutes and suspended sediment < 0.75 mL/L. If these parameters do not stabilize, the sample shall be collected after six well volumes have been removed, and the anomalous parameters shall be brought to the Field Operations Leader's attention. Field equipment shall be calibrated in accordance with (IAW) the AFCEE QAPP, Section 6.0 and in Section 7.2 of this FSP.

Samples shall be collected after the water level has recovered to 80 percent of its static level or 16 hours after completion of purging, whichever occurs first. If a monitor well is bailed or pumped dry before three well volumes can be obtained, the sample shall be collected when a sufficient volume of water has accumulated in the well.

Micropurge sampling shall use small positive-displacement pumps (e.g., bladder pumps). Samples to be analyzed for volatile or gaseous constituents shall not be withdrawn with pumps or at flows that degas the samples. Water-quality indicators shall be monitored during micropurge (turbidity, dissolved oxygen, specific conductance, temperature, etc.).

Before collecting ground-water samples, the sampler shall don clean, phthalate-free protective gloves. Samples to be analyzed for volatile organic compounds (VOCs) shall be collected first using a bottom-filling Teflon[®] or PVC bailer. Samples to be analyzed for volatile or gaseous constituents shall not be withdrawn with pumps that exert a vacuum on the sample (e.g., centrifugal and peristaltic). Disposable nylon rope shall be used to lower and retrieve the bailers. A new length of nylon rope shall be used for each well, and the rope shall be disposed of following the sampling activities. Each bailer shall be equipped with a dedicated stainless steel or Teflon[®] coated leader so that the nylon rope shall not contact the water in the well.

If DNAPL are suspected, a bailer shall be lowered to the bottom of the well before purging, retrieved, and observed for the presence of DNAPL. The preservative hydrochloric acid shall be added to the VOC sample bottle before introducing the sample water. The sample shall be collected from the bailer using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization. The sample vial shall be filled until a meniscus is visible and immediately sealed. When the bottle is capped, it shall be inverted and gently tapped to ensure no air bubbles are present in the vial. If, after the initial filling bubbles are present, the vials shall be discarded and the VOC sampling effort shall be repeated. Refilling of vials will result in loss

of preservatives. After the containers are sealed, sample degassing may cause bubbles to form. These bubbles shall be left in the container. These samples shall never be composited, homogenized, or filtered.

Following collection of VOC samples, remaining water samples shall be collected in the following order: SVOCs (semivolatile organic compounds), including polynuclear aromatic hydrocarbons (PAHs); metals; mercury; cyanide; total organic carbon; anions/cations; dissolved oxygen.

The pH of preserved samples shall be checked in the field by pouring a small amount of the water sample onto pH paper. The paper shall not touch the sample inside the container. Do not check the pH of acidified VOC samples. The preservation checks shall be documented in the chain-of-custody forms. One preserved VOC sample per day per sampling crew shall be checked with pH paper. The sole purpose of this sample is to check the pH of VOC samples, it shall not be submitted for analysis.

Water samples requiring filtering (i.e., those for metals analysis) shall be filtered through a 0.45 μm membrane filter immediately (within five minutes) after sampling and prior to preservation. Do not use vacuum filtration or any method that may aerate the samples. Exposure of samples to atmospheric oxygen shall be kept to a minimum. In-line filtration and use of disposable filter assemblies are preferred. Filters with larger pores may be used as pre-filters. If samples are filtered, the contractor shall prepare a blank by filtering Type II Reagent-Grade Water and submitting the blank for analysis for metals. This shall be done once per sampling round to assure that filtration does not bias sample results. Sample turbidity shall be recorded and reported.

Required sample containers, preservation methods, volumes and holding times are given in Section 6.2 and Table 6.2.2-1. Sampling equipment shall be decontaminated in accordance with Section 5.12 upon completion of sampling activities.

6.1.1.2 Direct Push Sampling

Direct push sampling involves advancing a sampling probe to the point below the water table from which the sample is desired. The probe can be advanced by direct hydraulic pressure or by using a slide or rotary hammer. When the probe is at the proper depth, sampling ports on the probe are opened, and the sample is collected using a bailer, by vacuum pressure or using the natural pressure of the formation. Samples collected for VOC analysis shall not be drawn by vacuum pressure. The advantage of this method is no drill cuttings are produced.

HydroPunch®, cone penetrometer (e.g., SCAPS) or Geoprobe® samples are generally collected for on-site or quick-turnaround analysis to determine if the boring should be converted

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to a monitor well or to fill data gaps. These samples are not directly comparable to monitor well samples, because they are collected from disturbed conditions. HydroPunch® sampling is performed during drilling when the boring extends below the water table. With this method, a 2-inch diameter core is obtained by advancing a core sampler into the unconsolidated formation 3-5 feet below the water table using direct hydraulic pressure or a hydraulic hammer. The core is then retrieved, leaving a small borehole. The borehole is then completed as a temporary monitor well that can be sampled with a 1-inch diameter bailer or peristaltic pump, depending on depth. The temporary monitor well shall be sampled with a 1-inch diameter bailer.

6.1.2 Subsurface Soil Sampling

Soil samples shall be collected based on odors, discoloration, organic vapor meter readings and any other field screening method.

6.1.2.1 Split-Spoon Sampling

When soil samples are to be submitted for laboratory analysis, they shall be collected using stainless steel, continuous drive, California modified split-spoon samplers, or equivalent. These samplers are 24 inches in length and have an outside diameter (OD) of 3 inches to accommodate four 2-inch diameter brass/stainless steel rings, each of which is 6 inches in length.

Each time a split-spoon sample is taken, a standard penetration test shall be performed in accordance with ASTM D-1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." The sample is obtained by driving the sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. The sampler is first driven 6 inches to seat it in undisturbed soil; then the test is performed. The number of hammer blows for seating the spoon and making the test are then recorded for each 6 inches of penetration on the drill log (i.e., 5/7/8). The standard penetration test result (N) is obtained by adding the last two figures (i.e., 7+8=15 blows per foot). The sampler is then driven an additional 6 inches to fill the remainder of the split-spoon prior to retrieval.

As soon as the split-spoon is opened, the open ends of the brass/stainless steel rings shall be monitored for organic vapors using the PID or FID. Air monitor results shall be recorded on the boring log and in the field log book.

Samples for VOC analysis shall be collected as an entire brass/stainless steel ring sample. Brass/stainless steel rings selected for VOC analysis shall be completely filled, if possible, to minimize headspace. Rings with large gravel or debris shall not be used. Following monitoring for organic vapors, the brass/stainless steel rings shall be capped on both ends with Teflon® sheeting and plastic end caps to prevent volatilization. The brass/stainless steel rings shall then

be affixed with a completed sample label, placed in a zip lock plastic bag and placed in an iced cooler held at a temperature below 4°C.

Samples collected concurrently with VOC samples to be tested for other analytical parameters shall be collected by extruding the soil out of the brass/stainless steel rings immediately adjacent to (above and below) the VOC sample interval. Soil chemistry samples not being analyzed for VOCs shall be placed in *appropriate size*, laboratory cleaned, EPA-approved glass containers with Teflon® lined lids. This shall be done using clean stainless steel sampling tools. If soil from several brass/stainless steel rings must be composited to provide sufficient sample volume for a particular analysis, the sample shall be composited and homogenized in a stainless steel bowl using a stainless steel trowel or scoop. The sample shall then be transferred into the appropriate sample container, sealed, labeled, and place in an iced cooler held at a temperature below 4°C.

If initial screening results indicate the presence of organic vapors, a headspace analysis shall be conducted on remaining portions of the sample.

6.1.2.2 Sampling by Hand Auger

Hand augering may be used to collect soil samples from depths up to 10 feet bgs. Each hand auger boring shall be advanced by manually turning a hand auger, equipped with 3-inch diameter cylindrical stainless steel bits, until the auger head fills with cuttings. The hand auger is then pulled from the boring and the cuttings shall be deposited on plastic sheeting. The hand augering is continued until the sampling depth is achieved.

At the predetermined sampling depth, a manually powered hammer is used to drive a sampler. The sampler is driven into the bottom of the boring to a depth of 6 inches, or until refusal. The sampler is then retrieved and the recovery is determined by estimating the percentage of the sample in the brass/stainless steel sleeve. The sample lithology is then described and recorded on the boring log.

The brass/stainless steel sleeve shall be capped with Teflon® tape and end caps. The ends of the capped sleeve shall then also be wrapped with Teflon® tape. Care shall be taken not to touch the ends of the sleeves prior to capping. Custody seals shall be placed across the capped ends of the sleeve. Once the container has been filled, the appropriate information shall be recorded in the field logbook.

6.1.2.3 Direct Push Sampling

Direct push sampling involves advancing a sampling probe by direct hydraulic pressure or by using a slide or rotary hammer. *Soil* samples may be collected continuously or at specific depths.

The samples are collected in brass, stainless steel, or plastic sleeves. For VOC analysis, the brass/stainless steel sleeve shall be capped with Teflon® tape and end caps. The ends of the capped sleeve shall then also be wrapped with Teflon® tape. Care shall be taken not to touch the ends of the sleeves prior to capping. Custody seals shall be placed across the capped ends of the sleeve. For VOC analysis using plastic sleeves, the sample shall be transferred directly from the sleeve to the sample container to reduce loss of VOCs. For other analysis, samples shall be collected by extruding the soil out of the sleeves immediately adjacent to (above and below) the VOC sample interval. Once the containers have been filled, the appropriate information shall be recorded in the field logbook.

6.1.3 Surface Soil Sampling

Surface soil samples shall be collected from the land surface to six inches below the surface. The sample shall be homogenized and quartered before being containerized. If chemicals that are highly adsorbed to clay surfaces were released at the site, an additional sample shall be collected from the surface to the 1 inch depth.

Stainless steel scoops or trowels, glass jars with Teflon® lids or equivalent equipment compatible with the chemical analyses proposed shall be used to collect and store samples. Exclude above ground plant parts and debris from the sample.

In addition to records outlined in Section 8.0, record unusual surface conditions that may affect the chemical analyses, such as the following: (1) asphalt chunks that may have been shattered by mowers, thus spreading small fragments of asphalt over the sampling area, (2) distance to roadways, aircraft runways, or taxiways, (3) obvious, deposition of contaminated or clean soil at the site, (4) evidence of dumping or spillage of chemicals, (5) soil discoloration, and/or (6) unusual condition of growing plants, etc.

6.1.4 Surface Water Sampling

Collect samples so as not to cause cross-contamination. If collecting both water and sediment samples at a specific location, always obtain the water sample first. Measure and record pH, temperature, specific conductance, and dissolved oxygen (when required) at each surface water sampling point. Permanently mark the location where surface water or sediment samples are collected (e.g., flagged stake in stream bank). Record the location on a project map for each specific site or zone.

The sample collection sequence is as follows: (1) if sampling both water and sediment or just sediment, start at the most downstream point and proceed upstream, (2) if sampling water only and the sample can be taken without disturbing the river or stream bottom, obtain any background samples first, then the farthest downstream sample, and then move upstream toward

the source or discharge point, (3) if sampling water only and the stream or river bottom must be disturbed, start at the most downstream point and proceed upstream,

Samples shall be taken from the active portion of the stream on the side nearest the source of contamination or suspected plume. Water samples are collected using a Van Dorn Sampler or Kemmerer Sampler when grab samples are required, or using an autosampler (discrete or composite samples) with the inlet line located at the desired sampling depth. *Surface water samples may also be collected by direct filling of sample bottles.*

Surface water samples may also be obtained using a continuous automatic sampler. With a continuous sampler, an intake probe is secured at the sampling point and the sampler is pre-programmed to collect either individual or composite samples at designated times throughout the day.

The following records shall be maintained in addition to those in Section 8.0, (1) the width, depth, and flow rate of streams, (2) surface water conditions (e.g., floating oil or debris, gassing), (3) the location of any discharge pipes, sewers, or tributaries, and (4) instrument calibration.

6.1.5 Sediment Sampling

Sediment samples are collected from ponds, surface impoundments, and streambeds (both wet and dry). Sediment samples shall be collected using a PVC tube or dredge (Ponar, Peterson, or Ekman) when water is present. Each technique allows for the collection of discrete samples, with the option of compositing samples in either the field or the laboratory. Dry sediment samples may be collected by surface scraping, hand augering, or core sampling using a core sampler with stainless-steel sleeves. Methods for dry sediment sampling are the same as that for soil. Sediment samples may be collected near discharge points in areas where sediment has accumulated inside an edge of a bend, an area where a stream suddenly widens, etc. The order of sample collection shall be the same as that described for surface water samples.

6.2 SAMPLE HANDLING

6.2.1 Sample Containers

Sample containers are purchased precleaned and treated according to EPA specifications for the methods. Sampling containers that are reused are decontaminated between uses by the EPA-recommended procedures (i.e., EPA 540/R-93/051). Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

6.2.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on AFCEE samples are listed in Section 5.0 of the existing Basewide QAPP.

Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required routinely for AFCEE work are specified in Table 6.2.2-1. **Samples not preserved or analyzed in accordance with these requirements shall be resampled and analyzed, at no additional cost to AFCEE.**

6.2.3 Sample Identification

The site identification numbering system for this project is summarized as follows:

Each sample will be identified by a unique alphanumeric code according to the following convention:

- S19 = site number*
- T = the sample type*
- 02 = the sample location number*
- 10 = the sample depth in feet*
- A = sampling round*
- B = primary sample, duplicate, or QA/QC*

The three digit alphanumeric code for the site numbers is arranged according to the following convention:

- S = SWMU site*
- A = AOC site*
- 19 = SWMU or AOC number*

The sample type codes for this project include:

- S = soil sample*
- M = groundwater sample from monitoring well*
- T = groundwater sample from temporary well point*
- W = surface water sample*
- D = sediment*

The QA/QC characters include:

- A = Primary Sample*
- B = Primary Sample*

C = *QC Field Duplicate*
D = *Matrix Spike Duplicate*
E = *Equipment Blank*
F = *Ambient Blank*
R = *Trip Blank*
S = *Matrix Spike*

e.g.: S19T0210AB represents a primary groundwater sample obtained at a depth of 10 feet from temporary well location 02 at SWMU 19.

6.3 SAMPLE CUSTODY

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

The contractor shall maintain chain-of-custody records for all field and field QC samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view, after being in their possession, (3) it was in their possession and they locked it up or, (4) it is in a designated secure area.

All sample containers shall be sealed in a manner that shall prevent or detect tampering if it occurs. In no case shall tape be used to seal sample containers. Samples shall not be packaged with activated carbon unless prior approval is obtained from the AFCEE.

The following minimum information concerning the sample shall be documented on the AFCEE chain of custody (COC) form (as illustrated in Section 8):

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Designation of matrix spike/matrix spike duplicate (MS/MSD)
- Preservative used
- Analyses required
- Name of collector(s)
- Pertinent field data (pH, temperature, etc.)
- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

All samples shall be uniquely identified, labeled, and documented in the field at the time of collection IAW Section 6.2.3 of the FSP.

Samples collected in the field shall be transported to the laboratory or field testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. A temperature blank (a volatile organics compounds sampling vial filled with water) shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory.

6.4 FIELD QUALITY CONTROL SAMPLES

6.4.1 Ambient Blank

The ambient blank consists of ASTM Type II reagent grade water poured into a volatile organic compound (VOC) sample vial at the sampling site. It is handled like an environmental sample and transported to the laboratory for analysis. Ambient blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes.

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.) to the samples during sample collection. Ambient blanks shall be collected downwind of possible VOC sources. *One ambient blank will be collected at the beginning of the field investigation. Additional ambient blanks will be collected if site conditions warrant.*

6.4.2 Equipment Blank

An equipment blank is a sample of ASTM Type II reagent grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. *One equipment blank shall be taken by each sampling team on each day of sampling for each type of sampling equipment.* Equipment blanks shall be collected immediately after the equipment has been decontaminated. The blank shall be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

6.4.3 Trip Blank

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank shall accompany each cooler of samples sent to the laboratory for analysis of VOCs.

6.4.4 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest. *Field duplicates will be collected at a frequency of one per ten soil or sediment samples collected.*

6.4.5 Field Replicates

A field replicate sample, also called a split, is a single sample divided into two equal parts for analysis. The sample containers are assigned an identification number in the field such that they cannot be identified as replicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field replicate samples prior to the beginning of sample collection. Replicate sample results are used to assess precision. *The frequency of collection for field replicates shall be one per ten water samples collected.*

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7.0 FIELD MEASUREMENTS

7.1 PARAMETERS

7.1.1 Field Parameters for Soils

During soil sample collection activities including hand augering, hollow-stem auger drilling, direct push soil borings, and excavations, field screening of soil samples for volatile organic compounds will be utilized to select samples for laboratory analysis. Field screening of soils for VOCs will be performed with an OVA or PID. Headspace readings around the top of boreholes and augers (within breathing zone) will be performed. Headspace readings and background readings will be recorded in boring logs and in the field logbook.

7.1.2 Field Parameters for Water Samples

Temperature, pH, EC, and turbidity will be measured during monitoring well development and purging with a Horiba portable water quality meter.

7.2 EQUIPMENT CALIBRATION AND QUALITY CONTROL

Field equipment will be maintained and calibrated to the standards in their respective operations manuals. Field equipment will be calibrated daily before the start of sampling activities. Calibration records will be maintained in the Calibration Log. The calibration record will include a unique instrument number, standards used, concentrations, and meter readings. Equipment failures will be repaired in the field if possible; if not, the instrument will be removed from use, and returned for repair or replacement.

7.3 EQUIPMENT MAINTENANCE AND DECONTAMINATION

Field equipment will be maintained to the standards in their respective operations manuals. Field equipment will be kept under controlled storage and will be decontaminated prior to return to storage; any malfunctions will be reported to the Field Manager. The Field Manager will initiate actions necessary for the repair or replacement of defective equipment. Power supplies of battery-powered instruments will be checked daily. Rechargeable instruments will be recharged daily. Equipment maintenance logs will be maintained for each field instrument.

Decontamination of field instruments will be instrument-specific and in keeping with the procedures in the respective operations manuals. Portions of field measurement equipment coming into contact with sampled media shall be decontaminated according to the specifications in Section 5.12 prior to any measurement activities and shall be protected from contamination until ready for use.

7.4 FIELD MONITORING MEASUREMENTS

7.4.1 Ground Water Level Measurements

Water-level measurements shall be taken in all wells and piezometers to determine the elevation of the water table or piezometric surface at least once within a single 24-hour period. These measurements shall be taken after all wells and piezometers have been installed and developed and their water levels have recovered completely. Any conditions (e.g., barometric pressure) that may affect water levels shall be recorded in the field log. The field log shall also include the previous water level measurement for each well (to determine if current water level is reasonable).

Water-level measurements shall be taken with electric sounders, air lines, pressure transducers, or water-level recorders (e.g., Stevens recorder). Devices that may alter sample composition shall not be used. Pressure gauges, manometers, or equivalent devices shall be used for flowing wells to measure the elevation of the piezometric surface. All measuring equipment shall be decontaminated according to the specifications in Section 7.3 and 5.12. Ground-water level shall be measured to the nearest 0.01 foot. (Two or more sequential measurements shall be taken at each location until two measurements agree to within + or - 0.01 foot.)

Static water levels shall be measured each time a well is sampled, and before any equipment enters the well. If the casing cap is airtight, allow time prior to measurement for equilibration of pressures after the cap is removed. Repeat measurements until water level is stabilized.

7.4.2 Floating Hydrocarbon Measurements

If encountered, the thickness of hydrocarbons floating in monitor wells shall be measured with an electronic interface probe. Hydrocarbon detection paste, or any other method that may affect water chemistry, shall not be used. When detected, the presence of floating hydrocarbons shall be confirmed by withdrawing a sample with a clear, bottom-fill Teflon® bailer.

7.5 FIELD PERFORMANCE AND SYSTEM AUDITS

Periodic in-field performance audits will be conducted by the appropriate technical QA officers for the particular discipline of field activities. Prior to the audit, the auditing QA officer will prepare a checklist to ensure completeness of the review and to document the results of the audit. Items to be examined may include, as appropriate, the implementation of approved work procedures; packaging, storage, and shipping of samples obtained; and documentation procedures.

The records of field operations will be reviewed to verify that field-related activities were performed in accordance with appropriate project procedures. Items reviewed may include (but are not limited to) daily field notebooks, chain-of-custody documentation, and applicable forms and logs. Audits of field activities will occur at least once during the field activities.

During an audit and upon its completion, the auditors will discuss the findings with the individuals audited and cite any corrective actions to be initiated.

Minor administrative findings that can be resolved to the satisfaction of the auditors during an audit are not required to be cited as items requiring corrective actions. Findings that are not resolved during the course of the audit and findings affecting the overall quality of the project, will be noted on the audit checklist and the results provided to the Project Manager, who will ensure that the corrective actions have been implemented

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8.0 RECORD KEEPING

The contractor shall maintain field records sufficient to recreate all sampling and measurement activities and to meet all ERPIMS data loading requirements. The requirements listed in this section apply to all measuring and sampling activities. Requirements specific to individual activities are listed in the section that addresses each activity. The information shall be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages. *These logbooks will be kept at the site during all field activities and will be assigned to each sample team. A field equipment logbook will be kept on site to document the use, maintenance, and calibration of field instruments.* These records shall be archived in an easily accessible form and made available to the Air Force upon request.

The following information shall be recorded for all field activities: (1) location, (2) date and time, (3) identity of people performing activity, and (4) weather conditions. For field measurements: (1) the numerical value and units of each measurement, and (2) the identity of and calibration results for each field instrument, shall also be recorded.

The following additional information shall be recorded for all sampling activities: (1) sample type and sampling method, (2) the identity of each sample and depth(s), where applicable, from which it was collected, (3) the amount of each sample, (4) sample description (e.g., color, odor, clarity), (5) identification of sampling devices, and (6) identification of conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged casing).

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HQ Air Force Center for Environmental Excellence

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BASE-WIDE QUALITY ASSURANCE PROJECT PLAN

Contract No.: F41624-94-D-8053-0039

Project No.: W/O 72435



Prepared for:
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NAS Fort Worth JRB
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August 1996

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Notice

The enclosed Draft *Base-wide Quality Assurance Project Plan* (August 1996) was prepared to define the quality assurance and quality control activities to be utilized for analytical data generation and assessment associated with remedial investigation/remedial design/remedial action and long-term operations/monitoring activities at Naval Air Station Fort Worth Joint Reserve Base (NAS Fort Worth JRB). It was prepared as a draft document dated August 19, 1996, and utilized by AFCEE as such for the implementation of related activities conducted at the base during 1997, including the basewide groundwater sampling and analysis program and RFI activities at several SWMUs/AOCs. Specific variances were addressed as necessary on an activity-specific basis, and are described in the individual technical reports for those activities. The Base-wide QAPP was prepared as a working document, and future updates are expected.

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13. ABSTRACT (Maximum 200 words) This document presents the Basewide Quality Assurance Project Plan (QAPP) for NAS Fort Worth JRB, Carswell Field. This QAPP comprises only one portion of the AFCEE Sampling and Analysis Plan (SAP); the other portion, the Field Sampling Plan (FSP) will be submitted under separate cover. This QAPP establishes the general analytical protocols and documentation required to ensure that data are collected, reviewed, and analyzed in a consistent manner. This QAPP was written for use by contractors and laboratories who perform environmental services at NAS Fort Worth JRB in support of AFCEE contracts to ensure scientifically valid and defensible data.					
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Acronyms

AA	atomic absorption
AFCEE	Air Force Center for Environmental Excellence
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, xylenes (total)
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
COC	chain of custody
COR	contracting officer representative
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DERA	Defense Environmental Restoration Account
DL	detection limit
DOD	Department of Defense
DQO	Data Quality Objective
DRMO	Defense Reutilization Marketing Office
EC	electrical conductivity
EDB	ethylene dibromide
EPA	U.S. Environmental Protection Agency
eV	electron volt
F	fluoride
FID	flame ionization detector
FLAA	flame atomic absorption
FPM	Field Project Manager
FSP	Field Sampling Plan
g	gammas
G	glass
GC	gas chromatography
GFAA	graphite furnace atomic absorption
HSP	Health and Safety Plan
H ₂ SO ₄	sulfuric acid
Handbook	<i>Handbook for the Installation Restoration Program (IRP) Remedial Investigation and Feasibility Studies (RI/FS)</i> , September 1993
HCl	hydrochloric acid
HNO ₃	nitric acid
LAW	in accordance with
ICP	Inductively-Coupled Plasma
ICPES	Inductively-Coupled Plasma Emission Spectroscopy
ICV	initial calibration verification
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System

Acronyms, Continued

JRB	Joint Reserve Base
LCS	laboratory control sample
LCS/D	laboratory control sample duplicate
LTM/LTO	long-term monitoring/long-term operation
MDL	method detection limit
mg/L	milligrams per liter
mL	milliliter
MQO	measurement quality objective
MS/MSD	matrix spike/matrix spike duplicate
NAS	Naval Air Station
Na ₂ S ₂ O ₃	sodium thiosulfate
NCP	National Contingency Plan
NIST	National Institute of Standards and Technology
NO ₂	nitrite
NO ₃	nitrate
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
OVM	organic vapor meter
P	polyethylene
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, comparability, completeness
PA/SI	Preliminary Assessment/Site Investigation
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
PE	performance evaluation
PID	photoionization detector
PM	project manager
PO ₄ ³⁻	phosphate
PPE	personal protective equipment
PQL	practical quantitation limit
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
RPM	remedial project manager
SAC	Strategic Air Command
SAP	Sampling and Analysis Plan

Acronyms, Continued

SARA	Superfund Amendments and Reauthorization Act
SO ₄ ²⁻	sulfate
SOP	standard operating procedures
SOW	statement of work
SP	spontaneous potential
SVOC	semi-volatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
TIC	tentatively-identified compound
TNRCC	Texas Natural Resource Conservation Commission
TPH	total petroleum hydrocarbons
UHP	ultra-high purity
UV	ultraviolet
VOC	volatile organic compound
WP	Work Plan

SECTION 1.0

Introduction

1.0 Introduction

This quality assurance project plan (QAPP) presents, in specific terms, the policies, organization, functions, and specific quality assurance (QA) and quality control (QC) activities associated with analytical data generation and assessment designed to achieve the data quality goals for NAS Fort Worth JRB remedial design/remedial action (RD/RA) and long-term operations/long-term monitoring (LTO/LTM) activities. Sampling and analysis protocols and other associated field activities (i.e., standard operating procedures [SOPs] and detailed instructions) will be presented in the site-specific field sampling plans (FSPs) and/or Sampling and Analysis Plans (SAPs) for each field effort. The United States Environmental Protection Agency (U.S. EPA) QA policy requires a written and approved QAPP for every monitoring and measurement project mandated or supported by the U.S. EPA through regulations, contracts, or other formalized means not currently covered by regulation. Guidelines followed in preparing this plan are set out in several EPA and U.S. Air Force guidance documents.

This QAPP supports the ongoing efforts of the Installation Restoration Program (IRP). The IRP was developed by the U.S. Department of Defense (DoD) in 1981 to investigate hazardous material disposal sites on DoD facilities. NAS Fort Worth JRB integrated the ongoing IRP with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1985 (SARA); the National Oil and Hazardous Substances Pollution Contingency Plan (NCP); pertinent provisions of the Resource Conservation and Recovery Act (RCRA) statutes; Executive Order 12580; the Defense Environmental Restoration Program (DERP); and all other applicable or relevant and appropriate federal and state laws and regulations.

1.1 QAPP Objectives

This QAPP provides a comprehensive framework for obtaining analytical data of known quality during RD/RA and LTO/LTM activities at NAS Fort Worth JRB. The framework provided is necessarily broad and encompassing, due to the wide variety of design, construction, operation, and monitoring activities to be undertaken. This QAPP does not apply to remedial investigation/feasibility study (RI/FS) activities.

The objective of this QAPP is to provide appropriate analytical data for each RD/RA and LTO/LTM task economically. Flexibility is necessary within the QAPP, as what is appropriate for a large task, such as basewide groundwater monitoring, may not be appropriate or economical for a small task, such as a one-time determination of some single design parameter for a groundwater extraction system. To facilitate remedial actions within the IRP, this QAPP must be flexible to accommodate many different remediation contractors and laboratories while providing for acceptable data quality. This QAPP therefore provides robust guidance relevant to a "typical" RD/RA or LTO/LTM task, while also providing for modification to this guidance through task-specific Work Plans, FSPs, or SAPs. Where modifications are proposed to this QAPP, they must be submitted, approved

by the regulatory agencies, and incorporated separately from any FSP or SAP prior to implementation.

This QAPP is required reading for all staff participating in RD/RA and LTO/LTM projects. It must be referenced in all task-specific plans written to support these projects, and if modifications to the guidance contained in this QAPP are proposed, specific justification for the modifications must be provided.

1.2 Administrative Procedures

Since this QAPP will cover multiple tasks and be used by multiple contractors, it is imperative that proper communication and documentation procedures be followed. The following discussion addresses procedures that will be followed by all contractors to ensure that appropriate communication and documentation procedures are completed at each step of the RD/RA and LTO/LTM tasks.

Document Control

This QAPP may be revised as necessary when guidelines and regulatory documents are changed, or when additional sampling or analysis methods may be required for RD/RA or LTO/LTM tasks. Revisions to the QAPP will be addressed as follows:

- For specific project-required versions, an amendment to this QAPP will be prepared for the project-specific FSP.
- For permanent changes to the QAPP that apply to basewide activities, revisions will be incorporated into this QAPP through an addendum upon agency consensus.

All contractors who might be affected by such revisions will be included in the review process. This intercontractor coordination will ensure continued comparability of data produced throughout.

Revisions to this QAPP (final version) will be tracked by specifying the revision number and date in the upper right-hand corner of every page, using the following Document Control Format:

Section:	(Number)
Revision:	(Number)
(Date)	
Page	(Number)

Internal revisions will be identified by the number after the decimal point. After internal revisions are complete and the document is ready for submission to the agencies for approval, the revision number will be changed to the next whole integer. For example, Revision 0.1 undergoes changes after internal review and is submitted for a second internal review as Revision 0.2. After internal acceptance, it is submitted to the agencies for approval as Revision 1.0.

Table 1.2-1 lists various stakeholders in the project that must be kept apprised of the future revisions and addenda to the QAPP. Initial assignments and future distribution of the

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approved revisions or addenda will be noted on the table to ensure that all QAPP holders receive the distributed materials.

TABLE 1.2-1
Points of Contact NAS Fort Worth JRB

Name	Affiliation	Address
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Stacy Gent	Department of the Navy	Environmental Department Code 110, Building 1215 NAS Fort Worth JRB Carswell Field, TX 76127
Geof Meyer	TNRCC	IHW Federal Facilities (MC-127) P. O. Box 13087 Austin, TX 78711
Tim Sewell	TNRCC, Region 4	1019 Duncanville Road Duncanville, TX 75116
Judith Black	EPA Region VI	1445 Ross Avenue, Suite 1200 Dallas, TX 75202
Carole Kroc	Booz-Allen & Hamilton	300 Convent Street, Suite 1250 San Antonio, TX 78205
Margaret O'Hare	CH2M HILL, Inc.	5339 Alpha Road Dallas, TX 75420

Communications

It is the responsibility of the contractor in charge of a task to ensure that appropriate documentation of internal communications takes place. Methods of documenting internal communications may include phone logs, e-mail, or memoranda.

Because multiple contractors will be working at NAS Fort Worth JRB, there may be interdependency among various tasks. Any issues that could potentially affect other tasks, and therefore, the work of other contractors, must be communicated to all contractors. The primary method of communication will be written, either through memoranda or confirmation notices. All phone conversations during which issues are resolved will be documented with either a memorandum or a confirmation notice.

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1.3 QAPP Organization

Section 2.0 of the QAPP provides a description of the site description and history. The program organization and responsibilities are summarized in Section 3.0. Data quality objectives and measurement quality objectives are discussed in Section 4.0. Sampling procedures are summarized in Section 5.0 and screening analytical methods are presented in Section 6.0. Section 7.0 discusses definitive analytical methods. Section 8.0 describes data reduction, verification, and reporting. System and performance audits are addressed in Section 9.0. Preventive maintenance activities are summarized in Section 10.0. Section 11.0 provides a description of the corrective actions. Quality assurance reports are described in Section 12.0.

The final version of the NAS Fort Worth JRB QAPP and any addenda will be followed for all DQOs, MQOs, and QC requirements for sampling and analytical activities related to site closure during RD/RA and LTM/LTO activities at NAS Fort Worth JRB.

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SECTION 2.0

Site Description and History

2.0 Site Description and History

As part of a continuation of environmental investigation work initiated at NAS Fort Worth JRB in 1983, the United States Air Force will be conducting RD/RA efforts and LTM/LTO of the actions taken. This QAPP describes a data quality processor to be used as part of the RD/RA and LTM/LTO programs being conducted at NAS Fort Worth JRB. The RD/RA efforts include detailed definition of the area for which remedial action is being taken and the evaluation of bench/pilot scale treatment technologies for remediation. Demonstration of compliance with action-specific applicable or relevant and appropriate requirements (ARARs), demonstration of progress toward remediation, and the LTM/LTO efforts provide data for maintaining regulatory compliance at NAS Fort Worth JRB.

Previous IRP investigations have included a preliminary assessment/site investigation (PA/SI) and RI/FS activities.

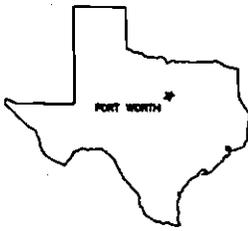
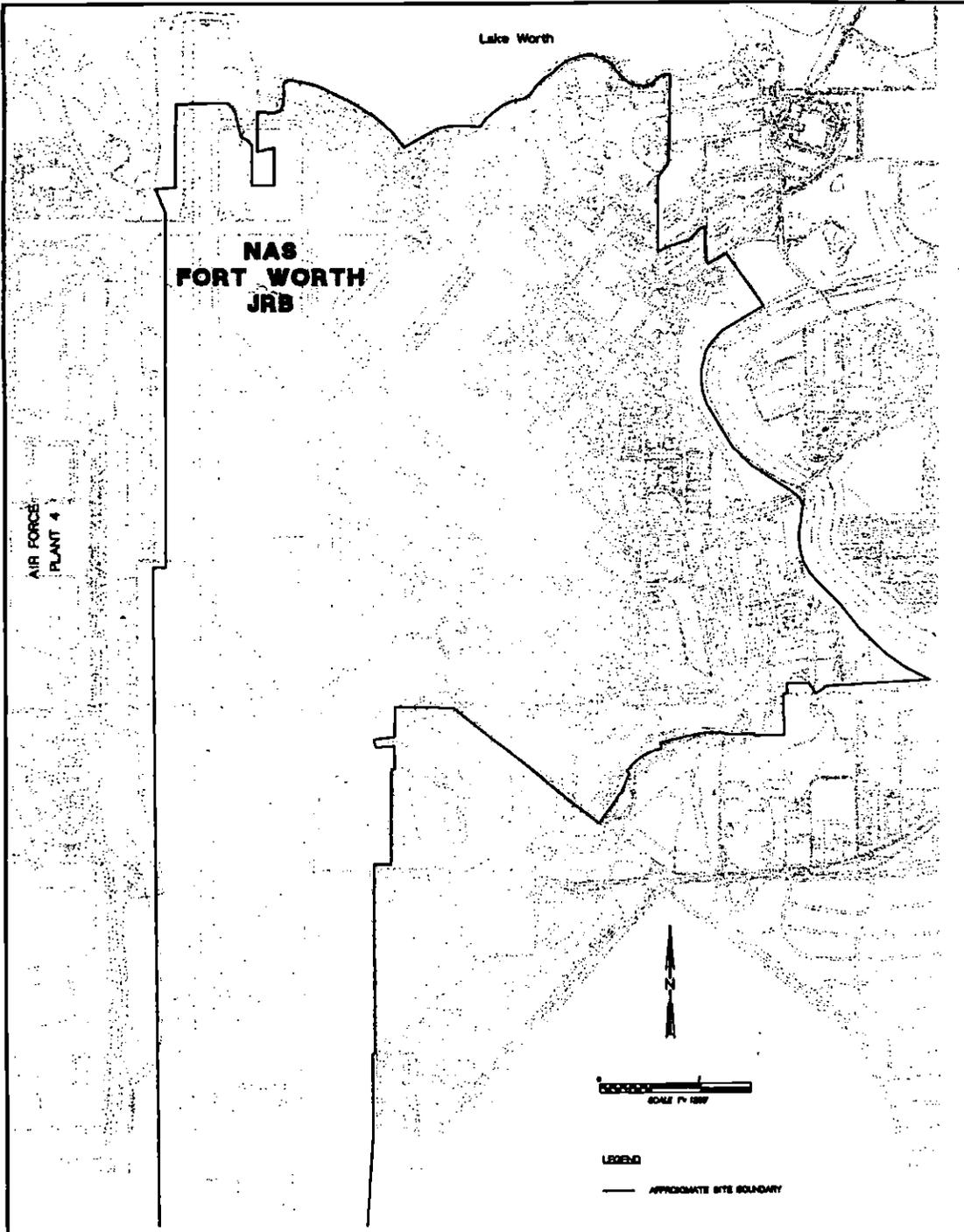
2.1 Site History

NAS Fort Worth JRB is located on 2,555 acres of land in Tarrant County, Texas, eight miles west of Fort Worth (Figure 2-1). It lies between the communities of White Settlement and River Oaks, within a bend of the West Fork of the Trinity River that flows along the northern part of the eastern boundary of the base. The river is dammed to form Lake Worth, a drinking water supply and recreation reservoir bordering NAS Fort Worth JRB to the north. To the west, NAS Fort Worth JRB is neighbored by Air Force (AF) Plant 4 and by the community of White Settlement. Lockheed Martin operates AF Plant 4 for the Air Force. It is an aircraft production plant that shares the runway and several facilities. The base is bordered on the east by the communities of River Oaks, Westworth Village, and other urban areas.

Two offsite facilities are part of the base: the ILS Marker Beacon and the Weapons Storage Area (WSA), both located west of the town of White Settlement.

Prior to 1941, the area that is now occupied by NAS Fort Worth JRB consisted of woods and pasture in an area called White Settlement. In August 1942, the base was opened as Tarrant Field Airdrome. The original mission was to train pilots to fly the new B-24 Liberator, which was being constructed across the runway by the Consolidated Aircraft Corporation.

Construction at the airfield continued into 1943, extending the runway and taxiways, and erecting hangars and additional facilities. In May 1943, the field was redesignated as Fort Worth Army Air Field. The training mission continued. In January 1945, the Fort Worth Army Air Field began to operate a transition school for the B-32 aircraft, which like the B-24, was manufactured across the runway. The 7th Bombardment Group was assigned to the Fort Worth Army Air Field in October 1946 with B-29 aircraft.



<p>NAS FORT WORTH JRB TEXAS</p>	
<p>SITE LOCATION MAP.</p>	
<p>Reviewed by P. VAN NOORT</p>	<p>Figure No. FIGURE 2-1</p>
<p>Draft by V. THIRUNAGARI</p>	<p>Project No. 135009.01.03</p>
<p>File Name P:/135009/FIGURES/QAP00001.DGN</p>	<p>Date 8/7/98</p>

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The facility was taken under the command of the Strategic Air Command (SAC) in 1946 and named Carswell Air Force Base in 1948. The SAC mission remained as Carswell AFB until 1992 when the Air Combat Command assumed control of the base. In October, 1994, the U.S. Navy assumed responsibility for the facility and the name was changed from Carswell AFB to NAS Fort Worth Joint Reserve Base (JRB). With the transfer of property at NAS Fort Worth JRB from the U.S. Air Force to the U.S. Navy many of the street names were changed. The principal activities on the base have been maintaining and servicing bombers, fuel tankers, and fighter jet aircraft. Many of the activities have been in conjunction with Air Force Plant 4 that has been successively operated by Consolidated Aircraft Corporation, Consolidated Vultec Corporation, General Dynamics Corporation, and most recently Lockheed Martin.

Servicing and maintenance of the engines and equipment of the multi-engined B-52 (eight engines) and the KC-135 (four engines) aircraft generated the majority of waste liquids at Carswell AFB.

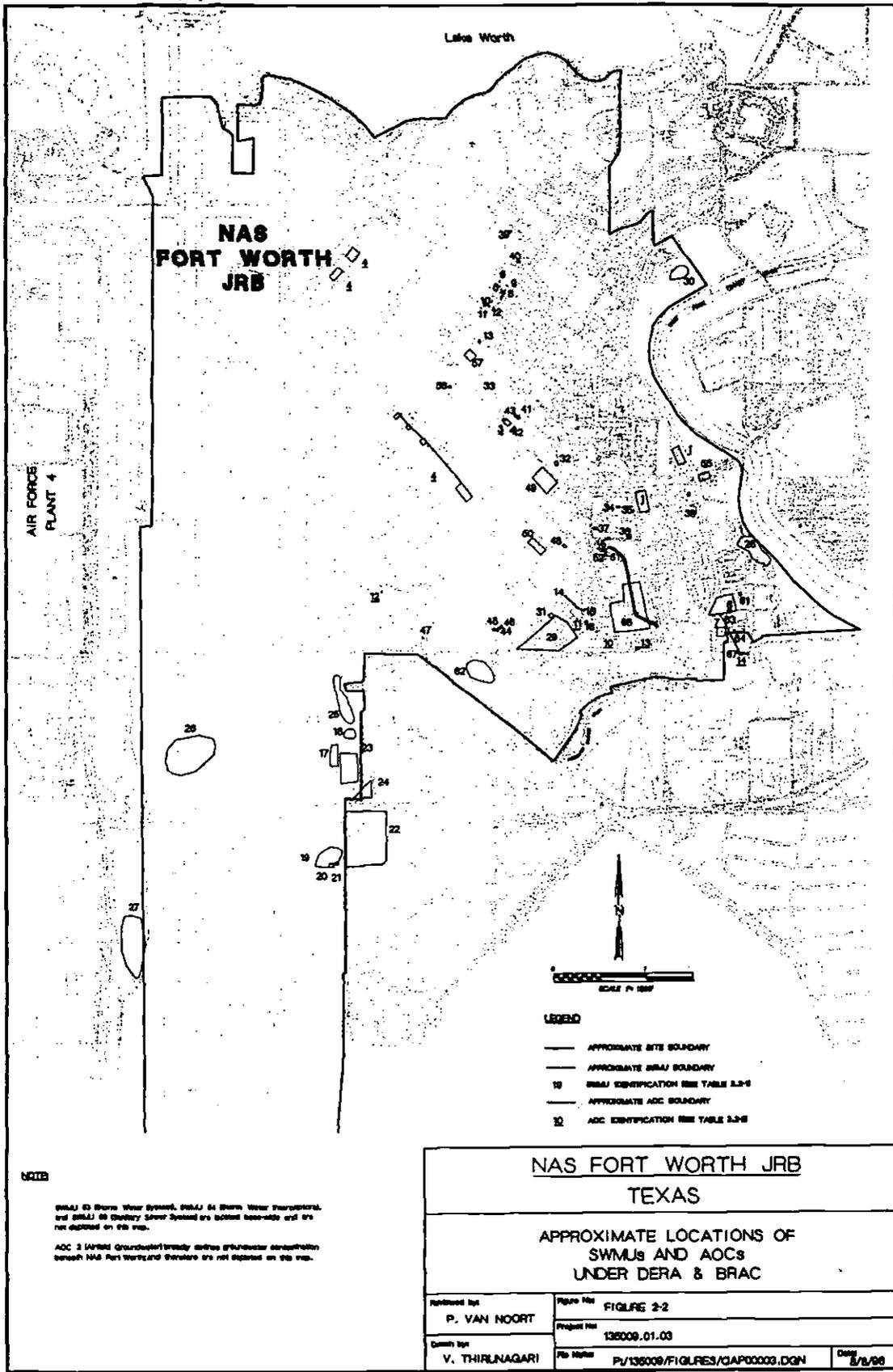
Under present operations, training to execute directed tactical fighter missions designed to destroy enemy forces, supplies, equipment, communications systems, and installations with conventional weapons is provided by the 301st Fighter Wing.

2.2 Summary of Waste Handled

Sixty-eight solid waste management units (SWMUs) and 17 areas of concern (AOC) have been identified at NAS Fort Worth JRB. A list of RCRA-regulated SWMUs is presented in Table 2.2-1; Table 2.2-2 lists the AOCs. The locations of these units and areas of concern (DERA sites only) are shown on Figure 2-2. Since 1942, most hazardous wastes generated through operations and activities at Carswell AFB have been disposed of in landfills, reused on base, or processed through the Defense Property Disposal Office (DPDO) for off-base recycling or disposal.

Most of the liquid waste generated by the industrial operations can be categorized as waste oils, recoverable fuels, and spent solvents and cleaners. Waste oils generally refer to lubricating fluids, such as crankcase oils and synthetic turbine oils. Hydraulic fluids have also been included in this category. Recoverable fuels refer to fuels drained from aircraft tanks and vehicles, such as JP-4 and MOGAS (unleaded gasoline). Spent solvents and cleaners refer to liquids used for degreasing and general cleaning of aircraft, aircraft systems, electronic components, and vehicles. This category includes PD-680 (petroleum naphtha product) and various chlorinated organic compounds, such as carbon tetrachloride, trichloroethylene (TCE), and 1,1,1-trichloroethane.

Specific types of solvents in use by the Air Force have changed over the years. In the 1950s, carbon tetrachloride was in common use. Its use was replaced by TCE about 1960. Since then, TCE and 1,1,1-trichloroethane have been commonly used; however, TCE usage has decreased in favor of 1,1,1-trichloroethane. Today, PD-680 Type II, 1,1,1-trichloroethane and, to a limited extent, TCE are in common use.



Waste paint solvents or thinners and strippers are generated by corrosion control activities. Typical thinners include isobutyl acetate, toluene, methyl ethyl ketone (MEK), isopropanol, naphtha, and xylene. Paint strippers generally contain such compounds as methylene chloride, toluene, ammonium hydroxide, and phenolics.

TABLE 2.2-1
Identification of Solid Waste Management Units at NAS Fort Worth JRB

SWMU No.	Description	OPR
1	Pathological Waste Incinerator	BRAC
2	Pathological Waste Storage Shed	BRAC
3	Metal Cans	BRAC
4	Facility Dumpsters	BRAC
5	Building 1627 Waste Accumulation Area	DERA
6	Building 1628 Wash Rack and Drain	DERA
7	Building 1628 Oil/Water Separator	DERA
8	Building 1628 Sludge Collection Tank	DERA
9	Building 1628 Work Station Waste Accumulation Area	DERA
10	Building 1617 Work Station Waste Accumulation Area	DERA
11	Building 1617 Waste Accumulation Area	DERA
12	Building 1619 Waste Accumulation Area	DERA
13	Building 1710 Visual Information Center Work Station Waste Accumulation Areas	DERA
14	Building 1060 Bead Blaster Collection Tray	DERA
15	Building 1060 Paint Booth Vault	DERA
16	Building 1060 Waste Accumulation Area	DERA
17	Landfill No. 7	DERA
18	Fire Training Area No. 1	BRAC
19	Fire Training Area No. 2	BRAC/DERA
20	Waste Fuel Storage Tank	BRAC/DERA
21	Waste Oil Tank	BRAC/DERA
22	Landfill No. 4	BRAC
23	Landfill No. 5	BRAC
24	Waste Burial Area	BRAC
25	Landfill No. 8	BRAC/DERA
26	Landfill No. 3	DERA

TABLE 2.2-1
Identification of Solid Waste Management Units at NAS Fort Worth JRB

SWMU No.	Description	OPR
27	Landfill No. 10	DERA
28	Landfill No. 1	DERA
29	Landfill No. 2	DERA
30	Landfill No. 9	DERA
31	Building 1050 Waste Accumulation Area	DERA
32	Building 1410 Waste Accumulation Area	DERA
33	Building 1420 Waste Accumulation Area	DERA
34	Building 1194 Waste Accumulation Area	DERA
35	Vehicle Refueling Shop (Building 1194) Oil/Water Separation System	DERA
36	Building 1191 Waste Accumulation Area	DERA
37	Vehicle Maintenance Shop (Building 1191) Oil/Water Separation System	DERA
38	Building 1269 PCB Transformers Building	DERA
39	Building 1641 Waste Accumulation Area	DERA
40	Building 1643 Oil/Water Separation System	DERA
41	Building 1414 Oil/Water Separation System, Field Maintenance Squadron Aerospace Ground Equipment	DERA
42	Building 1414 Waste Accumulation Area	DERA
43	Building 1414 NonDestructive Inspection (NDI) Waste Accumulation Point	DERA
44	Building 1027 Oil/Water Separation System at the Aircraft Washing Hangar	DERA
45	Building 1027 Waste Oil Tank Vault at the Aircraft Washing Hangar	DERA
46	Building 1027 Waste Accumulation Area	DERA
47	Building 1015 Jet Engine Test Cell Oil/Water Separator	DERA
48	Building 1048 Fuel Systems Shop Floor Drains	DERA
49	Aircraft Washing Area No. 1	DERA
50	Aircraft Washing Area No. 2	DERA
51	Building 1190 Central Waste Holding Area	DERA
52	Building 1190 Oil/Water Separation System	DERA
53	Storm Water Drainage System	DERA
54	Storm Water Interceptors	DERA
55	East Gate Oil/Water Separator	DERA

TABLE 2.2-1
Identification of Solid Waste Management Units at NAS Fort Worth JRB

SWMU No.	Description	OPR
56	Building 1405 Waste Accumulation Area	DERA
57	Buildings 1432/1434 Waste Accumulation Area	DERA
58	Pesticide Rinse Area	BRAC
59	Building 8503 Weapons Storage Area Waste Accumulation Area	BRAC
60	Building 8503 Radioactive Waste Burial Site	BRAC
61	Building 1320 Power Production Maintenance Facility Waste Accumulation Area	DERA
62	Landfill No. 6	DERA
63	Entomology Dry Well	DERA
64	French Underdrain System	BRAC/ DERA
65	Weapons Storage Area Disposal Site	BRAC
66	Sanitary Sewer System	BRAC/DERA
67	Building 1340 Oil/Water Separator	BRAC/DERA
68	POL Tank Farm	BRAC/DERA

TABLE 2.2-2
Identification of Areas of Concern at NAS Fort Worth JRB

AOC No.	Description	OPR
1	Former Base Service Station/ former Base Gas Station	BRAC/DERA
2	Airfield Groundwater	DERA
3	Waste Oil Dump	DERA
4	Fuel Hydrant System	DERA
5	Grounds Maintenance Yard	BRAC
6	RV Storage Area	DERA
7	Former Base Refueling Area	DERA
8	Aerospace Museum	BRAC
9	Golf Course Maintenance Yard	BRAC
10	O/W Separator	DERA
11	O/W Separator	DERA
12	O/W Separator	DERA
13	O/W Separator	DERA

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TABLE 2.2-2
Identification of Areas of Concern at NAS Fort Worth JRB

AOC No.	Description	OPR
14	Unnamed Stream	BRAC
15	Storage Shed	DERA
16	Family Camp	BRAC

SECTION 3.0

Program Organization and Responsibilities

3.0 Program Organization and Responsibilities

This base-wide QAPP for the IRP defines the program responsibilities for the signatory agencies. These agencies will work cooperatively to direct the NAS Fort Worth JRB IRP. This includes decisions related to priorities for site investigations and cleanup, as well as procedures and standards to be followed in accomplishing program activities and establishing project milestones and goals.

The efforts required to implement the IRP at NAS Fort Worth JRB are directed and funded by the Air Force. The Air Force is assisted in this effort by several contractors, subcontractors, and consultants. In this section, responsibilities are defined for each of the key personnel or functional areas of the agencies signing this QAPP.

3.1 Air Force, U.S. EPA, and TNRCC

Each of the agencies signing the QAPP have assigned a remedial project manager (RPM) to serve as the spokesperson for the following organizations in directing the course of RD/RA and LTO/LTM activities at NAS Fort Worth JRB:

- AFCEE/EDR
- EPA, Region VI
- TNRCC

3.2 Contractor Project Organization

A contractor's RD/RA or LTO/LTM project team generally will include technical professionals with experience in project management, quality assurance, analytical chemistry, field investigations, data management, and other technical and engineering disciplines. Contractors may use different organizational structures and titles for particular positions. An example of an organizational chart showing project management and associated tasks is presented in Figure 3-1. The following examples of personnel and associated responsibilities will generally be used, but the project team should be selected based on the effort. The assignment of tasks to specific roles or titles within a contractor's organization should be detailed within the scoping documents prepared for the specific sites or activities.

A project manager will be responsible for the contractual aspects of the project work and ensuring that appropriate staff are assigned to the project. In this role, a project manager will ensure that technical activities and reports receive appropriate planning and oversight to meet or exceed the quality and timeliness of data required by the project. A project manager will also have primary responsibility for decision-making and communication with the AFCEE COR.

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**Example Investigation at
Naval Air Station Fort Worth Joint Reserve Base
Carswell Field, Texas**

July 25, 1996

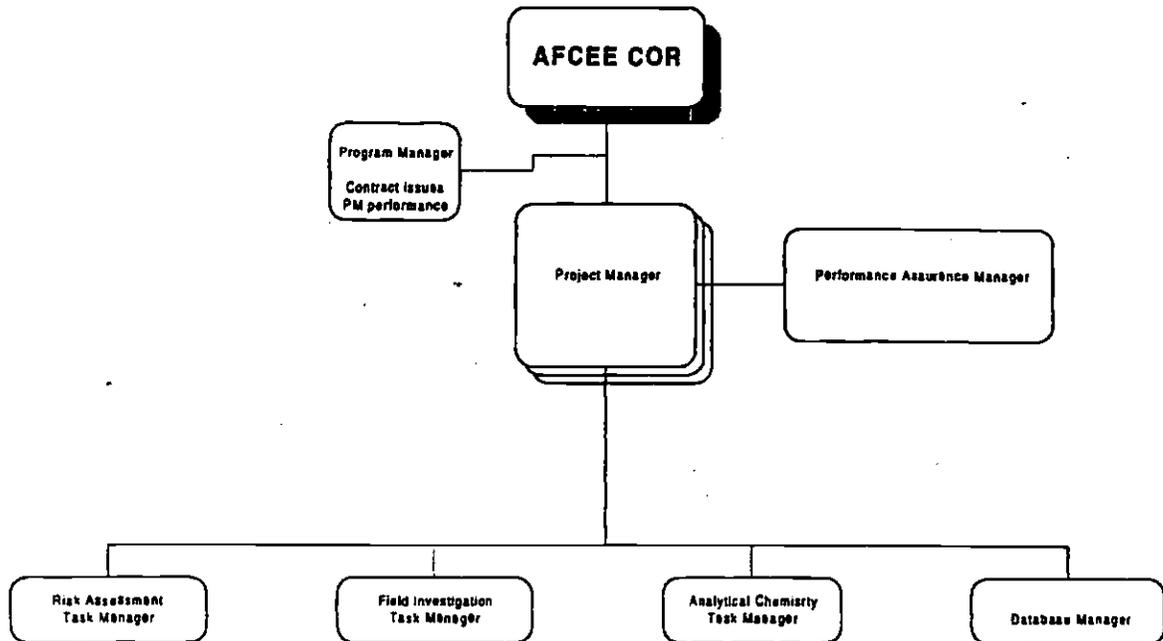


Figure 3-1 Example Organizational Chart

- A Program Manager, along with a project manager, will be responsible for the technical and financial management of a specific project and is the direct contact with the AFCEE COR.
- A Program Manager will ensure adequate field equipment and other resources will be allocated to fulfill the needs of the project.
- A Field Investigation Task Manager will be responsible for directing field work; ensuring the field staff has adequate training in both field sampling and measurement procedures and in health and safety procedures; reporting the status of field activity to project management and the Air Force; and directing subcontractors. A field coordinator will have overall responsibility for implementing the field sampling plan and communicating any difficulties encountered. A field coordinator will have the

authority to stop work if safety or data quality will be significantly affected by site operations.

- An Analytical Chemistry Task Manager will have overall responsibility for ensuring that the planning, implementation, and reporting for the analytical program fulfill the objectives for data use. Duties of this position include laboratory selection and management; QAPP development; data evaluation/validation implementation; audit performance; corrective action implementation; database information flow; and identification and communication of problems that affect data quality and project schedule to the NAS Fort Worth JRB Quality Assurance Officer.
- A Database Manager will be responsible for maintaining the project-specific database, reporting results in required formats to the Air Force and data users, and ensuring the integrity of the project-specific database. This position also will be responsible for establishing and testing that electronic formats are compatible with the project database.
- A Contractor Performance Assurance Manager will have overall responsibility to independently ensure that the planning, implementation, and reporting for RD/RA or LTO/LTM activities fulfill the objectives for data use. The Performance Assurance Manager will have reporting responsibility outside the project organization to ensure independence in decision-making and recommendation for corrective actions. The Performance Assurance Manager will be responsible for ensuring that needed corrective actions are implemented.
- A Health and Safety (H&S) Coordinator will be responsible for writing the H&S plan for each specific project.

The other primary project staff members include technical professionals with expertise in risk assessment, chemistry, geology, hydrology, treatability studies, and remedial engineering. These individuals will be responsible for internal communication and task planning to ensure that all data obtained will be used for the intended purpose, and to provide the direction and supervision needed to ensure that technically sound decisions will be made within their area of expertise.

3.3 Laboratories

The laboratories used for individual RD/RA investigations and LTO/LTM will be chosen by the contractor tasked with that investigation. All laboratories used will meet audit requirements and frequencies as described in Section 9.0

Notice to the Quality Assurance Project Plan (QAPP) Users and Reviewers: As described in the QAPP objectives (Section 1.1), this QAPP is designed to be flexible. An attempt is made to identify the most commonly used laboratory methods and associated QA/QC procedures, acceptance limits, and corrective actions. However, during the life of the project, there may be a need to perform specialized tests that may not be covered under the basic QAPP. Or there is a possibility that an analytical laboratory's internal procedures may be somewhat different from those specified in this QAPP. For these reasons, variances in the procedures and criteria may be necessary from time to time, depending on the

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objectives of the specific projects or the laboratory's procedures. Note that the data quality objectives for the specific projects still must be met; therefore, variances would, in no circumstance, produce data of a quality less than that desired. When the field investigations are defined and the FSP are prepared, the basic QAPP will be evaluated for adequacy for the proposed investigation. Any gaps and variances will be documented in an approved addendum to the QAPP.

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SECTION 4.0

Quality Program and Data Quality Objectives

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4.0 Quality Program and Data Quality Objectives

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Data Quality Objectives (DQOs) specify the data type, quality, quantity, and uses needed to make decisions and are the basis for designing data collection activities. The DQOs for the project are specified in the FSP.

4.1 Data Categories

The two general categories of data used by the AFCEE are defined as: (1) screening data and (2) definitive data.

Screening data are generated by rapid methods of analysis with less rigorous sample preparation, calibration and/or QC requirements than are necessary to produce definitive data. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Physical test methods, e.g., dissolved oxygen measurements, temperature and pH measurements, moisture content, turbidity, conductance, etc., have been designated by definition as screening methods (see Section 6).

Screening methods shall be confirmed, as required in the FSP, by analyses that generate definitive data. Confirmation samples shall be selected to include both detected and nondetected results from the screening method.

Definitive data are generated using rigorous analytical methods (see Section 7), such as approved EPA reference methods. The data can be generated in a mobile or offsite laboratory. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements (Sections 7 and 8). Definitive data are not restricted in their use unless quality problems require data qualification.

4.2 Precision, Accuracy, Representativeness, Completeness, and Comparability

The basis for assessing each of these elements of data quality is discussed in the following subsections. Precision and accuracy QC limits for each method and matrix are identified in Sections 6 and 7.

4.2.1 Precision

Precision measures the reproducibility of 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 the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. AFCEE uses the laboratory control sample (LCS) to determine the precision of the analytical method. If the recoveries of analytes in the LCS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, rather the comparison is between the sample and samples analyzed in previous batches. *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. Field duplicate samples and matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. The formula for the calculation of precision is provided in Table 4.2.1-1 as RPD. For replicate analyses, the relative standard deviation (RSD) is determined. The formula for the calculation of RSD is provided in Table 4.2.1-1.

4.2.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and system 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 comparing the percent recovery of analytes spiked into an LCS to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed. Analysis of performance evaluation (PE) samples shall also be used to provide additional information for assessing the accuracy of the analytical data being produced.

Both accuracy and precision are calculated for each AFCEE analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculation of accuracy is included in Table 4.2.1-1 as percent recovery (%R) from pure and sample matrices.

4.2.3 Representativeness

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, and sampling locations. Decisions regarding sample/well/ boring locations and numbers and the statistical sampling design are documented in the FSP.

4.2.4 Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage,

determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an "R" flag (see Section 8 for an explanation of flagging criteria). The requirement for completeness is 95 percent for aqueous samples and 90 percent for soil samples. For any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

The formula for calculation of completeness is presented below:

$$\% \text{ completeness} = \frac{\text{number of valid (i.e., nonR flagged) results}}{\text{number of possible results}}$$

4.2.5 Comparability

Comparability is the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Analysis of performance evaluation (PE) samples and reports from audits shall also be used to provide additional information for assessing the comparability of analytical data produced among subcontracting laboratories. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

TABLE 4.2.1-1
Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Mean	\bar{X}	$\frac{\left(\sum_{i=1}^n x_i \right)}{n}$	Measure of central tendency	Used to determine average value of measurements
Standard Deviation	S	$\left(\frac{\sum (x_i - \bar{X})^2}{(n-1)} \right)^{1/2}$	Measure of relative scatter of the data	Used in calculating variation of measurements
Relative Standard Deviation	RSD	$(S / \bar{X}) \times 100$	Relative standard deviation, adjusts for magnitude of observations	Used to assess precision for replicate results
Percent Difference	%D	$\frac{x_1 - x_2}{x_1} \times 100$	Measure of the difference of 2 observations	Used to assess accuracy

TABLE 4.2.1-1
Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Relative percent Difference	RPD	$\left(\frac{X_1 - X_2}{(X_1 + X_2)/2} \right) \times 100$	Measure of variability that adjusts for the magnitude of observations	Used to assess total and analytical precision of duplicate measurements
Percent Recovery	%R	$\left(\frac{X_{meas}}{X_{true}} \right) \times 100$	Recovery of spiked compound in pure matrix	Used to assess accuracy
Percent Recovery	%R	$\left(\frac{\text{value of spiked sample} - \text{value of unspiked sample}}{\text{Value of added spike}} \right) \times 100$	Recovery of spiked compound in sample matrix	Used to assess matrix effects and total precision

x = Observation (concentration)
n = Number of observations

4.3 Method Detection Limits, Practical Quantitation Limits, and Instrument Calibration Requirements

4.3.1 Method Detection Limits

The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The laboratory shall establish MDLs for each method, matrix, and analyte for each instrument the laboratory plans to use for the project. The laboratory shall revalidate these MDLs on an annual basis. The laboratory shall provide the MDL demonstrations to AFCEE at the beginning of the project (i.e., before project samples are analyzed) and upon request in the format specified in Section 8. Results less than the MDL shall be reported as the MDL value and flagged with a "U" (see Section 8).

Laboratories participating in this work effort shall demonstrate the MDLs for each instrument, including confirmatory columns, method of analysis, analyte, and matrix (i.e., water and soil) using the following instructions:

- (1) Obtain the concentration value that corresponds to:
 - a an instrument signal/noise ratio within the range of 2.5 to 5.0, or
 - b the region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).

- (2) Analyze seven replicates of a matrix spike (ASTM Type II water for aqueous methods, Ottawa sand for soil methods) containing the analyte of interest at a concentration three to five times the estimated MDL.
- (3) Determine the variance (S^2) for each analyte as follows:

$$S^2 = \frac{1}{n-1} \left[\sum_{i=1}^n (x_i - \bar{x})^2 \right]$$

where x_i = the i th measurement of the variable x and \bar{x} = the average value of x

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

- (4) Determine the standard deviation (s) for each analyte as follows:

$$s = (S^2)^{1/2}$$

- (5) Determine the MDL for each analyte as follows:

$$MDL = 3.14(s)$$

(note: 3.14 is the one-sided t-statistic at the 99 percent confidence level appropriate for determining the MDL using 7 samples)

4.3.2 Practical Quantitation Limits

The practical quantitation limit (PQL) is the lowest level that can be reasonably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The laboratories participating in this work effort shall compare the results of the MDL demonstrations to the PQLs for each method that is listed in Section 7. All MDLs shall be lower than the relevant PQLs. The laboratories shall also verify PQLs by including a standard at or below the PQL as the lowest point on the calibration curve. All results shall be reported at or above the MDL values, however, for those results falling between the MDL and the PQL, an "F" flag shall be applied to the results indicating the variability associated with the result (see Section 8.0).

4.3.3 Instrument Calibration

Analytical instruments shall be calibrated in accordance with the analytical methods. All analytes reported shall be present in the initial and continuing calibrations, and these calibrations must meet the acceptance criteria specified in Section 7. Records of standard preparation and instrument calibration shall be maintained. Records shall unambiguously trace the preparation of standards and their use in calibration and quantitation of sample results. Calibration standards shall be traceable to standard materials.

Instrument calibration shall be checked using all of the analytes listed in the QC acceptance criteria table in Section 7 for the method. This applies equally to multiresponse analytes. All calibration criteria shall satisfy SW-846 requirements at a minimum. The initial calibration shall be checked at the frequency specified in the method using materials prepared

independently of the calibration standards. Acceptance criteria for the calibration check are presented in Section 7. Analyte concentrations are determined with either calibration curves or response factors (RFs). For gas chromatography (GC) and gas chromatography/mass spectroscopy (GC/MS) methods, when using RFs to determine analyte concentrations, the average RF from the initial five point calibration shall be used. The continuing calibration shall not be used to update the RFs from the initial five point calibration.

4.4 Elements of Quality Control

QC elements relevant to screening data are presented in Section 6.0. This section presents QC requirements relevant to analysis of environmental samples that shall be followed during all analytical activities for fixed-base, mobile, and field laboratories producing definitive data. The purpose of this QC program is to produce data of known quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for ongoing control and evaluation of data quality measurements through the use of QC materials.

Laboratory QC samples (e.g., blanks and laboratory control samples) shall be included in the preparation batch with the field samples. An AFCEE analytical batch is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents. Matrix spikes and matrix spike duplicates count as environmental samples. The term AFCEE analytical batch also extends to cover samples that do not need separate extraction or digestion (e.g., volatile analyses by purge and trap). This AFCEE analytical batch is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) analyzed sequentially within a calibration period. The identity of each AFCEE analytical batch shall be unambiguously reported with the analyses so that a reviewer can identify the QC samples and the associated environmental samples. All references to the analytical batch in the following sections and tables in this QAPP refer to the AFCEE analytical batch.

The type of QC samples and the frequency of use of these samples are discussed below and in the method-specific subsections of Section 7.

4.4.1 Laboratory Control Sample

The laboratory control sample (LCS) is analyte-free water (for aqueous analyses) or Ottawa sand (for soil analyses) spiked with known concentrations of all analytes listed in the QC acceptance criteria table in Section 7 for the method. The LCS shall be carried through the complete sample preparation and analysis procedure.

The LCS is used to evaluate each AFCEE analytical batch and to determine if the method is in control.

One LCS shall be included in every AFCEE analytical batch.

The performance of the LCS is evaluated against the QC acceptance limits given in the tables in Section 7.

Whenever an analyte in an LCS is outside the acceptance limit, corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, all samples in the AFCEE analytical batch shall be reanalyzed for the out-of-control analyte(s). When an analyte in an LCS exceeds the upper or lower control limit and no corrective action is performed or the corrective action was ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to all affected results.

4.4.2 Matrix Spike/Matrix Spike Duplicate

A matrix spike (MS) and matrix spike duplicate (MSD) is an aliquot of sample spiked with known concentrations of all analytes listed in the QC acceptance criteria table in Section 7 for the method. The spiking occurs prior to sample preparation and analysis. Only AFCEE samples shall be used for spiking. The MS/MSD shall be designated on the chain-of-custody.

The MS/MSD is used to document the bias of a method due to sample matrix. AFCEE does not use MSs and MSDs to control the analytical process.

A minimum of one MS and one MSD sample shall be analyzed for every 20 AFCEE samples.

The performance of the MS and MSD is evaluated against the QC acceptance limits given in the tables in Section 7. If either the MS or the MSD is outside the QC acceptance limits, the analytes in all related samples shall be qualified according to the data flagging criteria in Sections 7 and 8.

4.4.3 Surrogates

Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples.

Surrogates are used to evaluate accuracy, method performance, and extraction efficiency.

Surrogates shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

Whenever a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been reestablished, reprep and reanalyze the sample. If corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to the sample results.

4.4.4 Internal Standards

Internal standards (ISs) are measured amounts of certain compounds added after preparation or extraction of a sample.

They are used in an IS calibration method to correct sample results affected by column injection losses, purging losses, or viscosity effects.

ISs shall be added to environmental samples, controls, and blanks, in accordance with the method requirements.

When the IS results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been reestablished, all samples analyzed while the system was malfunctioning shall be reanalyzed. If corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to the sample results.

4.4.5 Retention Time Windows

Retention time windows are used in GC and high performance liquid chromatography (HPLC) analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846 Method 8000A.

When the retention time is outside of the acceptance limits, corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, reanalyze all samples analyzed since the last acceptable retention time check. If corrective actions are not performed, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to the sample results.

4.4.6 Interference Check Sample

The interference check sample (ICS), used in inductively coupled plasma (ICP) analyses only, contains both interfering and analyte elements of known concentrations

The ICS is used to verify background and interelement correction factors.

The ICS is run at the beginning and end of each run sequence.

When the interference check sample results are outside of the acceptance limits stated in the method, corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, reanalyze the ICS. If the ICS result is acceptable, reanalyze all affected samples. If corrective action is not performed or the corrective action was ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to all affected results.

4.4.7 Method Blank

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank shall be carried through the complete sample preparation and analytical procedure.

The method blank is used to document contamination resulting from the analytical process.

A method blank shall be included in every AFCEE analytical batch.

The presence of analytes in a method blank at concentrations greater than the PQL indicates a need for corrective action. Corrective action shall be performed to eliminate the source of contamination prior to proceeding with analysis. After the source of contamination has been eliminated, all samples in the analytical batch shall be repped and reanalyzed. No

analytical data shall be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples and corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Sections 7 and 8, shall be applied to the sample results.

4.4.8 Ambient Blank

The ambient blank consists of ASTM Type II reagent grade water poured into a volatile organic compound (VOC) sample vial at the sampling site (in the same vicinity as the associated samples). It is handled like an environmental sample and transported to the laboratory for analysis. Ambient blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes.

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.) to the samples during sample collection.

The frequency of collection for ambient blanks is specified in the FSP. Ambient blanks shall be collected downwind of possible VOC sources.

4.4.9 Equipment Blank

An equipment blank is a sample of ASTM Type II reagent grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis.

Equipment blanks are used to assess the effectiveness of equipment decontamination procedures.

The frequency of collection for equipment blanks is specified in the FSP. Equipment blanks shall be collected immediately after the equipment has been decontaminated. The blank shall be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

When an analyte is detected in the equipment blank the appropriate validation flag, as described in Section 8, shall be applied to all sample results from samples collected.

4.4.10 Trip Blank

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes.

Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures.

When an analyte is detected in the trip blank the appropriate validation flag, as described in Section 8, shall be applied to all sample results from samples in the cooler with the affected trip blank.

One trip blank shall accompany each cooler of samples sent to the laboratory for analysis of VOCs.

4.4.11 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest.

The frequency of collection for field duplicates is specified in the FSP.

4.4.12 Field Replicates

A field replicate sample, also called a split, is a single sample divided into two equal parts for analysis. The sample containers are assigned an identification number in the field such that they cannot be identified as replicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field replicate samples prior to the beginning of sample collection.

Replicate sample results are used to assess precision.

The frequency of collection for field replicates is specified in the FSP.

4.5 Quality Control Procedures

4.5.1 Holding Time Compliance

All sample preparation and analysis shall be completed within the method-required holding times. The holding time begins at the time of sample collection. Some methods have more than one holding time requirement (e.g., methods SW8080A, SW8270B, etc.). The preparation holding time is calculated from the time of sample collection to the time of completion of the sample preparation process as described in the applicable method, prior to any necessary extract cleanup and/or volume reduction procedures. If no preparation (e.g., extraction) is required, the analysis holding time is calculated from the time of sample collection to the time of completion of all analytical runs, including dilutions, second-column confirmations, and any required reanalyses. In methods requiring sample preparation prior to analysis, the analysis holding time is calculated from the time of preparation completion to the time of completion of all analytical runs, including dilutions, second-column confirmations, and any required reanalyses.

If holding times are exceeded and the analyses are performed, the results shall be flagged according to the procedures as described in Section 8.

4.5.2 Confirmation

Quantitative confirmation of results at or above the PQL for samples analyzed by GC or HPLC shall be required and shall be completed within the method-required holding times. For GC methods, a second-column is used for confirmation. For HPLC methods, a second column or a different detector is used. The result of the first column/detector shall be the result reported. If holding times are exceeded and the analyses are performed, the results shall be flagged according to the procedures as described in Section 8.

4.5.3 Standard Materials

Standard materials used in calibration and to prepare samples shall be traceable to National Institute Standards and Technology (NIST), EPA, American Association of Laboratory Accreditation (A2LA) or other equivalent AFCEE approved source, if available. If an NIST, EPA or A2LA standard material is not available, the standard material proposed for use shall be included in an addendum to the SAP and approved before use. The standard materials shall be current, and the following expiration policy shall be followed: The expiration dates for ampulated solutions shall not exceed the manufacturer's expiration date or one year from the date of receipt, whichever comes first. Expiration dates for laboratory-prepared stock and diluted standards shall be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first. Expiration dates for pure chemicals shall be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions. Expired standard materials shall be either revalidated prior to use or discarded. Revalidation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory shall label standard and QC materials with expiration dates.

4.5.4 Supplies and Consumables

The laboratory shall inspect supplies and consumables prior to their use in analysis. The materials description in the methods of analysis shall be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents shall be monitored by analysis of LCSs. An inventory and storage system for these materials shall assure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

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SECTION 5.0

Sampling Procedures

5.0 Sampling Procedures

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5.1 Field Sampling

The field sampling procedures for collecting samples and sampling methods shall be included in the FSP.

5.1.1 Sample Containers

Sample containers are purchased precleaned and treated according to EPA specifications for the methods. Sampling containers that are reused are decontaminated between uses by the EPA-recommended procedures (i.e., EPA 540/R-93/051). Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

5.1.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on AFCEE samples are listed in Table 5.1.2-1. The required sample volumes, container types, and preservation requirements for analytical methods proposed for project work not listed in Table 5.1.2-1 shall be included in an addendum to the FSP and approved by AFCEE before use.

TABLE 5.1.2-1
 Requirements for Containers, Preservation Techniques,
 Sample Volumes, and Holding Times

Name	Analytical Methods	Container*	Preservation**	Minimum Sample Volume or Weight	Maximum Holding Time
Alkalinity	E310.1	P, G	4°C	50 mL	14 days
Common anions	SW9056	P, G	None required	50 mL	28 days for Br ⁻ , F ⁻ , Cl ⁻ , and SO ₄ ²⁻ ; 48 hours for NO ₂ ⁻ , NO ₃ ⁻ , and PO ₄ ³⁻
Cyanide, total and amenable to chlorination	SW9010A SW9012	P, G, T	4°C; NaOH to pH > 12. 0.6 g ascorbic acid	500 mL or 4 ounces	14 days (water and soil)
Filterable residue	E160.1	P, G	4°C	100 mL	7 days
Nonfilterable residue	E160.2	P, G	4°C	100 mL	7 days
Hydrogen ion (pH) (W, S)	SW9040/ SW9045	P, G	None required	N/A	Analyze immediately

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TABLE 5.1.2-1
Requirements for Containers, Preservation Techniques,
Sample Volumes, and Holding Times

Name	Analytical Methods	Container ^a	Preservation ^b	Minimum Sample Volume or Weight	Maximum Holding Time
Nitrogen, nitrate+nitrite	E353.1	P, G	4°C, H ₂ SO ₄ to pH < 2	500 mL	28 days
Conductance	SW9050	P, G	None required	N/A	Analyze immediately
Temperature	E170.1	P, G	None required	N/A	Analyze immediately
Dissolved oxygen	E360.1	G	None required	500 mL	Analyze immediately
Turbidity	E180.1	P, G	4°C	N/A	48 hours
Total organic carbon	SW9060	P, G, T	4°C, HCl or H ₂ SO ₄ to pH < 2	500 mL or 4 ounces	28 days (water and soil)
Chromium (VI)	SW7196	P, G, T	4°C	500 mL or 8 ounces	24 hours (water and soil) ^c
Mercury	SW7470 SW7471	P, G, T	HNO ₃ to pH < 2, 4°C	500 mL or 8 ounces	28 days (water and soil)
Metals (except chromium (VI) and mercury)	SW6010A SW6020 and SW-846 AA methods	P, G, T	HNO ₃ to pH < 2, 4°C	500 mL or 8 ounces	180 days (water and soil)
Total petroleum hydrocarbons (TPH)-volatile	SW8015 (modified)	G, Teflon-lined septum, T	4°C, HCl to pH < 2	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Total petroleum hydrocarbons (TPH)-extractable	SW8015 (modified)	G, amber, T	4°C	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Volatile aromatics	SW8020A	G, Teflon-lined septum, T	4°C, HCl to pH < 2, 0.008% Na ₂ S ₂ O ₅	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Halogenated volatiles	SW8021A	G, Teflon-lined septum, T	4°C, HCl to pH < 2, 0.008% Na ₂ S ₂ O ₅	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid

TABLE 5.1.2-1
Requirements for Containers, Preservation Techniques,
Sample Volumes, and Holding Times

Name	Analytical Methods	Container ^a	Preservation ^b	Minimum Sample Volume or Weight	Maximum Holding Time
Nitrosamines	SW8070	G, Teflon-lined cap, T	4°C	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Chlorinated herbicides	SW8150B SW8151	G, Teflon-lined cap, T	4°C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organochlorine pesticides and polychlorinated biphenyls (PCBs)	SW8080A, SW8081,	G, Teflon-lined cap, T	4°C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organophosphorus pesticides/ compounds	SW8140 SW8141A	G, Teflon-lined cap, T	4°C, pH 5-9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Semivolatile organics	SW8270B	G, Teflon-lined cap, T	4°C, 0.008% Na ₂ S ₂ O ₅	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Volatile organics	SW8240B, SW8010B, SW8260A	G, Teflon-lined septum, T	4°C, 0.008% Na ₂ S ₂ O ₅ (HCl to pH < 2 for volatile aromatics by SW8240 and SW8260) ^c	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days if unpreserved by acid
Polynuclear aromatic hydrocarbons (PAHs)	SW8310	G, Teflon-lined cap, T	4°C, store in dark, 0.008% Na ₂ S ₂ O ₅	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)

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TABLE 5.1.2-1
Requirements for Containers, Preservation Techniques,
Sample Volumes, and Holding Times

Name	Analytical Methods	Container ^a	Preservation ^b	Minimum Sample Volume or Weight	Maximum Holding Time
Dioxins and furans	SW8280	G, Teflon-lined cap, T	4°C, 0.008% Na ₂ S ₂ O ₃	1 liter or 8 ounces	30 days until extraction and 45 days after extraction (water and soil)
Ethylene dibromide (EDB)	SW8011	G, Teflon-lined cap, T	4°C, 0.008% Na ₂ S ₂ O ₃	2 x 40 mL	28 days (water)
Explosive residues	SW8330	P, G, T	Cool, 4°C	1 liter or 8 ounces	7 days to extraction (water); 14 days to extraction (soil); analyze within 40 days after extraction
TCLP	SW1311	G, Teflon-lined cap, T	Cool, 4°C	1 liter or 8 ounces	14 days to TCLP extraction and 14 days after extraction (volatiles); 14 days to TCLP extraction and 40 days after extraction (semivolatiles); 28 days to TCLP extraction and 28 days after extraction (mercury); 180 days to TCLP extraction and 180 days after extraction (metals)

^aPolyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T).

^bNo pH adjustment for soil.

^cPreservation with 0.008 percent Na₂S₂O₃ is only required when residual chlorine is present.

^dThe maximum recommended holding time for completion of extraction into water is 48 hours. The extract shall be analyzed within 24 hours of completion of extraction.

5.2 Sample Handling and Custody

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

The contractor shall maintain chain-of-custody records for all field and field Quality Control (QC) samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view, after being in their possession, (3) it was in their possession and they locked it up or, (4) it is in a designated secure area.

The following information concerning the sample shall be documented on the AFCEE chain of custody (COC) form (as illustrated in Section 8):

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Designation of MS/MSD
- Preservative used
- Analyses required
- Name of collector(s)
- Pertinent field data (pH, temperature, etc.)
- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

All samples shall be uniquely identified, labeled, and documented in the field at the time of collection in accordance with (LAW) the FSP.

Samples collected in the field shall be transported to the laboratory or field testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. A temperature blank (a volatile organics compounds sampling vial filled with tap water) shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory. When, in the judgment of the laboratory, the temperature of the samples upon receipt may have affected the stability of the analytes of interest, the problem shall be documented in laboratory records and discussed with AFCEE. The resolution of the problem shall also be documented.

Once the samples reach the laboratory, they shall be checked against information on the COC form for anomalies. The condition, temperature, and appropriate preservation of samples shall be checked and documented on the COC form. Checking an aliquot of the sample using pH paper is an acceptable procedure except for VOCs where an additional sample is required to check preservation. The occurrence of any anomalies in the received samples and their resolution shall be documented in laboratory records. All sample information shall then be entered into a tracking system, and unique analytical sample identifiers shall be assigned. A copy of this information shall be reviewed by the laboratory for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required routinely for AFCEE work are specified in Table 5.1.2-1. Samples not preserved or analyzed in accordance with these requirements shall be resampled and analyzed, at no additional cost to AFCEE. Subcontracted analyses shall be documented with the AFCEE COC form. Procedures ensuring internal laboratory COC shall also be implemented and documented by the laboratory. Specific instructions concerning the analysis specified for each sample

shall be communicated to the analysts. Analytical batches shall be created, and laboratory QC samples shall be introduced into each batch.

While in the laboratory, samples shall be stored in limited-access, temperature-controlled areas. Refrigerators, coolers and freezers shall be monitored for temperature seven days a week. Acceptance criteria for the temperatures of the refrigerators and coolers is $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Acceptance criteria for the temperatures of the freezers shall be less than 0°C . All of the cold storage areas shall be monitored by thermometers that have been calibrated with a NIST-traceable thermometer. As indicated by the findings of the calibration, correction factors shall be applied to each thermometer. Records that include acceptance criteria shall be maintained. Samples for volatile organics determination shall be stored separately from other samples, standards, and sample extracts. Samples shall be stored after analysis until disposed of IAW applicable local, state, and federal regulations. Disposal records shall be maintained by the laboratory.

Standard operating procedures (SOPs) describing sample control and custody shall be maintained by the laboratory.

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SECTION 6.0

Screening Analytical Methods

6.0 Screening Analytical Methods

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The analytical screening methods contained in this section are shown in Table 6.0-1. This section includes brief descriptions of the methods and QC required for screening procedures commonly used to conduct work efforts. The methods and QC procedures were taken from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (U.S. EPA SW-846, Third Edition, and its first and second update), *Methods for Chemical Analysis of Water and Waste* (U.S. EPA 1979), *ASTM Annual Book of Standards* (1993), and from manufacturers' literature.

TABLE 6.0-1
Screening Analytical Methods

Method	Parameter
SW9040	pH (water)
SW9045	pH (soil)
SW846 (3550)	Moisture
SW9050	Conductance
SW9060	Total organic carbon
E160.1	Filterable residue
E160.2	Nonfilterable residue
E170.1	Temperature
E180.1	Turbidity
E310.1	Alkalinity
E360.1	Dissolved oxygen
ASTM D422	Particle size
Organic Vapor (FID and PID)	Soil gas screening-halogenated, aromatic, and petroleum hydrocarbons
ASTM D1498	Oxidation-reduction potential
ASTM D3416	Methane
SW4020	PCBs by Immunoassay
SW4030	TPH by Immunoassay

6.1 Analytical Screening Method Descriptions

Section 6.1 contains subsections for each analytical procedure. Each subsection contains the following information:

- A brief method description
- The PQL (if applicable)

6.1.1 EPA Method SW9040 (Water)/SW9045 (Soil)-pH

pH measurements shall be performed for water samples using method SW9040. pH measurements of soil samples are performed using method SW9045. Measurements are determined electrometrically using either a glass electrode in combination with a reference potential, or a combination electrode.

6.1.2 SW-846 (Described in Method SW3550) –Percent Moisture

Percent moisture is determined for solid samples undergoing analysis for inorganic and organic analytes. The sample is weighed, dried, and then reweighed. Percent moisture is calculated as:

$$\frac{\text{Initial Weight} - \text{Dried Weight}}{\text{Initial Weight}} \times 100 = \% \text{ moisture}$$

The moisture content is used to calculate results for soil samples on a dry weight basis using the calculation presented below:

$$\frac{\text{Result of analysis on wet weight basis}}{100 - \% \text{ Moisture}} = \text{Result of analysis on a dry weight basis}$$

All soil or sediment results and detection limits shall be reported on a dry weight basis.

6.1.3 EPA Method SW9050–Conductance

Standard conductivity meters are used. Temperature is also reported.

6.1.4 EPA Method SW9060–Total Organic Carbon

Organic carbon is measured using a carbonaceous analyzer. This instrument converts the organic carbon in a sample to carbon dioxide by either catalytic combustion or wet chemical oxidation. The carbon dioxide formed is then either measured directly by an infrared detector or converted to methane and measured by a flame ionization detector. The amount of carbon dioxide or methane in a sample is directly proportional to the concentration of carbonaceous material in the sample.

Method	Analyte	Water	
		PQL	Unit
SW9060	Total organic carbon	1	mg/L

6.1.5 EPA Method 160.1–Filterable Residue

A well-mixed sample is filtered through a standard glass fiber filter. The filtrate is evaporated and dried to constant weight at 180 °C.

Method	Analyte	Water	
		PQL	Unit
E160.1	Total dissolved solids	10	mg/L

6.1.6 EPA Method 160.2–Nonfilterable Residue

A well-mixed sample is filtered through a glass fiber filter, and the residue retained on the filter is dried to constant weight at 103-105 °C.

Method	Analyte	Water	
		PQL	Unit
E160.2	Total suspended solids	5	mg/L

6.1.7 EPA Method 170.1—Temperature

Temperature measurements are made with a mercury-filled or dial type centigrade thermometer, or a thermistor.

6.1.8 EPA Method 180.1—Turbidity

This method is based on a comparison of the light scattered by the sample under defined conditions with the light intensity scattered by a standard reference suspension. The higher the intensity, the greater the turbidity. Turbidity measurements are made in a nephelometer and are reported in terms of nephelometric turbidity units (NTUs). The working range for the method is from 0–40 NTU. Higher levels of turbidity can be measured by diluting the sample with turbidity-free deionized water.

6.1.9 EPA Method 310.1—Alkalinity

In this method, an unaltered sample is titrated to an end point of pH 4.5 using hydrochloric or sulfuric acid.

Method	Analyte	Water	
		PQL	Unit
E360.1	Alkalinity ¹	10	mg/L

¹alkalinity measured as calcium carbonate equivalence

6.1.10 EPA Method 360.1—Dissolved Oxygen

An instrumental probe, usually dependent upon an electrochemical reaction, is used for determination of dissolved oxygen in water. Under steady-state conditions, the current or potential can be correlated with dissolved oxygen concentrations.

6.1.11 ASTM D422—Standard Method for Particle-Size Analysis of Soils

This method covers the quantitative determination of the distribution of particle sizes in soils. The distribution of particle sizes larger than 75 μ m (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 μ m is determined by a sedimentation process using a hydrometer.

6.1.12 Real-Time Portable Organic Vapor Analyzer

Two types of portable analyzers shall be used to perform real-time nonspecific analyses of hydrocarbon vapors. The instruments include an FID (e.g., Foxboro Century OVA) and a photoionization detector (PID) (e.g., HNu® Systems [HNu®] trace gas analyzer) organic vapor monitor. One or more of these instruments may be used at a specific site, depending on the contaminant species of interest. When used together, the instruments provide complementary information because they are sensitive to different types of hydrocarbon vapors.

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The portable analyzers shall be used as a screening tool to help determine the optimum locations for the collection of samples. Field data recorded on the COC forms give the laboratory analysts an indication of the approximate concentration of contaminants and aid in calculating dilution factors before analysis. Additionally, the real-time instruments are used to aid in selecting the proper level of personal protective equipment and monitoring air emissions during sampling activities. The comparability of results obtained from the PID and FID instruments can be considered only to be within the variability of this type of screening instrument. Comparability is greatest when the instruments are calibrated with the same standards and operated within similar concentration ranges.

The FID uses the principle of hydrogen flame ionization to detect and measure total hydrocarbon vapors. The FID has a dynamic operating range from 1 ppmv to 10 ppmv or 1 ppmv to 100,000 ppmv, depending on the instrument, and provides a nonspecific response to total hydrocarbons. If concentrations exceed the range of the instrument, a dilution probe shall be attached to the FID to allow elevated vapor concentrations to be measured. The instrument is highly sensitive to compounds such as methane, benzene, and acetone, but is less sensitive to alcohols and halogenated compounds.

During operation, a sample is drawn into the probe and transmitted to the detection chamber by an internal pumping system. Inside the chamber, the sample is exposed to a hydrogen flame that ionizes the organic vapors. As the organic vapors burn, the ions produced are collected on an electrode in the chamber, and a current proportional to the hydrocarbon concentration is generated. This current is measured and displayed on the meter.

The PID uses a photoionization detector to detect and measure total hydrocarbon vapors. The instrument has an operating range of 0-2,000 ppm. During operation, a gas sample is drawn into the probe and past an ultraviolet light source by an internal pumping system. Contaminants in the sample are ionized, producing an instrument response if their ionization potential is equal to or less than the ionizing energy supplied by the lamp. The radiation produces a free electron for each molecule of ionized contaminant, which generates a current directly proportional to the number of ions produced. This current is measured and displayed on the meter. The PID measures the *total* value for all species present with ionization potentials less than or equal to that of the lamp.

6.1.13 ASTM D1498—Oxidation-Reduction Potential

This method is designed to measure the oxidation-reduction potential (ORP) in water, which is defined as the electromotive force between a noble metal electrode and a reference electrode when immersed in a solution.

6.1.14 ASTM D3416—Methane in Soil Gas

An aliquot of the soil gas sample is introduced into a prechromatographic or stripper column which removes hydrocarbons other than methane and carbon monoxide. Methane and carbon monoxide are passed through a chromatographic column where they are separated. The methane is measured by a flame ionization detector (FID). Quantitation is performed by comparing the sample response to the response of a known concentration of methane.

6.1.15 Draft Method SW4020--Screening for Polychlorinated Biphenyls by Immunoassay

Soil samples are screened for total polychlorinated biphenyls (PCBs) using immunoassay test kits. A mini methanol extraction of the soil sample is performed, and the extract and an enzyme conjugate reagent are added to immobilized antibodies. The enzyme conjugate competes with the PCBs in the sample for binding to immobilized anti-PCB antibodies. The test is interpreted by comparing the response produced by the sample to the response produced by a standard.

6.1.16 Draft Method SW4030--Screening for Petroleum Hydrocarbons by Immunoassay

Soil samples are screened for levels of total petroleum hydrocarbons (TPH) using TPH test kits. A mini extraction of the soil sample is performed, and the extract and an enzyme conjugate reagent are added to immobilized antibodies. The enzyme conjugate competes with hydrocarbons for binding to immobilized anti-hydrocarbon antibodies. The test is interpreted by comparing the response produced by the sample to the response produced by a standard.

6.2 Calibration and QC Procedures for Screening Methods

All screening data shall be flagged with an "S" data qualifier to show the reported data are screening data (see Section 8). The other data qualifiers that shall be used with screening data are also shown in Table 6.2-1 and Section 8. Flagging criteria are applied (except for the "S" flag) when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

Table 6.2-1 presents the calibration and QC procedures for each method. These requirements as well as the corrective actions and data flagging criteria are included. In this table, the first two columns designate the method number and the class of analytes that may be determined by the method. The third column lists the method-required calibration and QC elements. The fourth column designates the minimum frequency for performing each calibration and QC element. The fifth column designates the acceptance criteria for each calibration and QC element. The sixth column designates the corrective action in the event that a calibration or QC element does not meet the acceptance criteria. The last column designates the data flagging criteria that must be applied in the event that the method-required calibration and QC acceptance criteria are not met.

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TABLE 6.2-1
Summary of Calibration and QC Procedures for Screening Methods

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Data Flagging Criteria*
SW-846'	Moisture	Duplicate sample	1 per 20 samples	% solid	Correct problem, repeat measurement. If still out, flag data	J
				RPD ≤ 15%		R
SW9045	pH (soil)	2-point calibration with pH buffers	1 per 10 samples analyzed	± 0.05 pH unit	Check with new buffers; if still out, repair meter; repeat calibration check	R
		pH 7 buffer	At each sample location	± 0.1 pH unit	Recalibrate	R
		Duplicate sample	10% of field samples	± 0.1 pH unit	Correct problem, repeat measurement. If still out, repeat calibration and reanalyze samples	J
SW9050	Conductance	Calibration with KCl standard	Once per day at beginning of testing	± 5%	If calibration is not achieved, check meter, standards, and probe; recalibrate	R
		Field duplicate	10% of field samples	± 5%	Correct problem, repeat measurement	J
SW9040	pH (water)	2-point calibration with pH buffers	Once per day	± 0.05 pH units for every buffer	If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary; repeat calibration	R
		pH 7 buffer	At each sample location	± 0.1 pH units	Correct problem, recalibrate	R
		Field duplicate	10% of field samples	± 0.1 pH units	Correct problem, repeat measurement	J
E170.1	Temperature	Field duplicate	10% of field samples	± 1.0°C	Correct problem, repeat measurement	J
E180.1	Turbidity	Calibration with one formazin standard per instrument	Once per day at beginning of testing	± 5 units, 0-100 range ± 0.5 units, 0-0.2 range ± 0.2 units,	If calibration is not achieved, check meter; replace if necessary, recalibrate	R

TABLE 6.2-1
Summary of Calibration and QC Procedures for Screening Methods

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Data Flagging Criteria ^b
		range used		0-1 range		
None	Organic vapor concentrations (FID and PID)	Field duplicate	10% of field samples	RPD \leq 20%	Correct problem, repeat measurement	J
		3 point calibration	Monthly	Correlation coefficient \geq 0.995	Recalibrate; check instrument and replace if necessary	R
		Calibration verification and check	Daily at beginning and end of day	Response \pm 20% of expected value	Correct problem, recalibrate	R
SW9060	Total organic carbon	Method blank	Daily or one per batch, whichever is more frequent	< PQL	Clean system; reanalyze blank. Repeat until analyte < PQL	B
		Field duplicate	10% of field samples	RPD < 20%	Repeat measurement	J
E160.1	Filterable residue	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
E160.2	Nonfilterable residue	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
ASTM D1498	Oxidation-reduction potential	Sensitivity verification	Daily	ORP should decrease when pH is increased	If ORP increases, correct the polarity of electrodes. If ORP still does not decrease, clean electrodes and Repeat procedure	R
		Calibration with one standard	Once per day	Two successive readings \pm 10 millivolts	Correct problem, recalibrate	R
		Field duplicate	10% of field samples	\pm 10 millivolts	Correct problem, repeat measurement	J
E310.1	Alkalinity	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
E360.1	Dissolved oxygen	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
SW4020	PCBs by immunoassay	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J

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TABLE 6.2-1
Summary of Calibration and QC Procedures for Screening Methods

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Data Flagging Criteria*
SW4030	Petroleum hydrocarbons by immunoassay	Field duplicate	10% of field samples	RPD < 20%	Correct problem, repeat measurement	J
ASTM D3416	Methane	Single point calibration	Daily, prior to sample analysis	Delineation from database average within $\pm 20\%$	Recalibrate	R
		Method blank	Daily or one per batch, whichever is more frequent	< PQL	Clean system; reanalyze blank and Repeat until all analytes < PQL	B
		Duplicate	1 per batch or 10%	RPD $\leq 20\%$	Analyze third aliquot: if still out, flag data	J

*All corrective actions shall be documented, and the records shall be maintained by the prime contractor.

*All screening results shall first be flagged with an "S" and also any other appropriate validation flags identified in the Data Flagging Criteria column of the table. For example "SJ", "SB", "SR".

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SECTION 7.0

Definitive Data Analytical Methods and Procedures

7.0 Definitive Data Analytical Methods and Procedures

Section 7.1 contains brief descriptions of preparation methods. Section 7.2 contains subsections for each analytical procedure. Each subsection contains the following information:

- A brief method description
- A table of PQLs
- A table of QC acceptance criteria
- A table of calibration procedures, QC procedures, and data validation guidelines

This information was obtained from the Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (U.S. EPA SW-846, Third Edition, and its first and second update); Handbook for the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS) (Handbook), September 1993; U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, D.C., Publication 9240.1-05-01, EPA-540/R-94-013, PB94-963502, February 1994; and U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, D.C., Publication 9240.1-05, EPA-540/R-94-012, PB94-963501, February 1994. Definitions of terms are given in Section 4.0, and data validation guidelines are presented in Section 8.0.

7.1 Preparation Methods

Extraction and digestion procedures for liquid and solid matrices presented in this section are outlined in Table 7.1-1. The appropriate preparation method to be used (if applicable) for each analytical method is given in the PQL tables.

TABLE 7.1-1
Extraction and Digestion Procedures

Method	Parameter
SW1311	Toxicity Characteristic Leaching Procedure
SW3005A	Acid Digestion of Water Samples for Metals Analysis
SW3020A	Acid Digestion of Aqueous Samples and Extracts for Metals Analysis
SW3050A	Acid Digestion for Solids, Sediments, and Sludges for Metals Analysis
SW3510B	Separatory Funnel Liquid-Liquid Extraction
SW3540B/SW3541	Soxhlet Extraction
SW3550A	Ultrasonic Extraction
SW5030A	Purge and Trap Method

7.1.1 Method SW1311-Toxicity Characteristic Leaching Procedure

Method SW1311 is used to prepare samples for determination of the concentration of organic (semivolatile and volatile) and inorganic constituents that are leachable from waste or other material.

QC is accomplished by preparing a toxicity characteristic leaching procedure (TCLP) blank at a rate of one blank for every 20 extractions conducted in the extraction vessel. Additional extract is prepared so one MS is performed for each waste type (samples of similar waste types shall be batched together). One MS must be analyzed in each AFCEE analytical batch. These QA measures are in accordance with the requirements of EPA method SW1311, Section 8.0.

7.1.2 Method SW3005A-Acid Digestion of Water Samples for Metals Analysis

This method is an acid digestion procedure used to prepare water samples for metals analysis. The digested samples are analyzed for total recoverable and dissolved metals determination by either flame atomic absorption (FLAA) or inductively coupled plasma (ICP).

For analysis of total recoverable metals, the entire sample is acidified at collection time.

For analysis of dissolved metals, upon collection the samples are filtered then acidified.

7.1.3 Method SW3020A- Acid Digestion of Aqueous Samples and Extracts for Metals Analysis

Method SW3020A prepares aqueous or waste samples for total metals determination by graphite furnace atomic absorption spectroscopy (GFAA). The samples are vigorously digested with acid and then diluted.

7.1.4 Method SW3050A-Acid Digestion for Solids, Sediments, and Sludges for Metals Analysis

Method SW3050A is applicable to the preparation of sediment, sludge, and soil samples for metals analysis by FLAA or GFAA or ICP.

A sample is digested then refluxed with acid. A separate aliquot of the sample is dried for a total solids and/or percent moisture determination.

7.1.5 Method SW3510B-Separatory Funnel Liquid-Liquid Extraction

Method SW3510B is designed to quantitatively extract nonvolatile and SVOCs from liquid samples using standard separatory funnel techniques. The sample and the extracting solvent must be immiscible in order to yield recovery of target compounds. Subsequent cleanup and detection methods are described in the organic analytical method used to analyze the extract.

7.1.6 Method SW3540B/SW3541-Soxhlet Extraction

Method SW3540B is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils and sludges. Method SW3541 is an automated Soxhlet extraction. The Soxhlet extraction process ensures intimate contact of the sample matrix with the extraction solvent.

7.1.7 Method SW3550A-Ultrasonic Extraction

Method SW3550A is a procedure for extracting nonvolatile and SVOCs from solids such as soils and sludges. The sonication process ensures intimate contact of the sample matrix with the extraction solvent.

7.1.8 Method SW5030A-Purge and Trap Method

Method SW5030A describes sample preparation and extraction for the analysis of VOCs. The method is applicable to nearly all types of samples, including aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, water, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments. The success of this method depends on the level of interferences in the sample. Results may vary due to the large variability and complexity of matrices of solid waste samples.

An inert gas is then bubbled through the a sample solution at ambient temperature to transfer the volatile components to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a GC column. For SW8020A, drying of the trap for under a helium flow is required. For methods SW8010B and SW8020A, the GC column is heated to elute the components that are detected by an appropriate detector.

7.2 Analytical Procedures

The analytical procedures presented in this section are outlined in Table 7.2-1.

A brief description and three tables for each method are included in the following subsections. The first table presents the PQLs for each analyte in the method. The PQLs are presented for both soil and water matrices. The second table presents the acceptance criteria for the accuracy of spiked analyte and surrogate recoveries. This table also presents the acceptance criteria for the precision of matrix, field, and laboratory duplicate recoveries. The third table presents the calibration and QC procedures for each method. Corrective actions and data flagging criteria are also included in this table.

In the third table, the first two columns designate the method number and the class of analytes that may be determined by the method. The third column lists the method-required calibration and QC elements. The fourth column designates the minimum frequency for performing each calibration and QC element. The fifth column designates the acceptance criteria for each calibration and QC element. The sixth column designates the corrective action in the event that a calibration or QC element does not meet the acceptance

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criteria. The last column designates the data flagging criteria that shall be applied in the event that the method-required calibration and QC acceptance criteria are not met.

TABLE 7.2-1
Analytical Procedures

SW Methods	Parameter
8010B	Halogenated volatiles (water and soil)
8011	Ethylene dibromide (EDB) (water)
8015 (modified)	TPH volatile and extractable (water and soil)
8020A	Aromatic volatile organics (water and soil)
8021A	Halogenated volatile organics (water and soil)
8070	Nitrosamines (water and soil)
8080A	Organochlorine pesticides and PCBs (water and soil)
8081	Organochlorine pesticides and PCBs (water and soil)
8140	Organophosphorus pesticides (water and soil)
8141A	Organophosphorus compounds (water and soil)
8150B	Chlorinated herbicides (water and soil)
8151	Chlorinated herbicides (water and soil)
8240B	Volatile organics (water and soil)
8260A	Volatile organics (water and soil)
8270B	Semivolatile organics (water and soil)
8280	Dioxins and furans (water and soil)
8310	Polynuclear aromatic hydrocarbons (PAHs) (water and soil)
8330	Explosive residues (water and soil)
6010A	Trace metals by ICP (water and soil)
6020	Trace metals by ICP-MS (water and soil)
7041	Antimony (water and soil)
7060A	Arsenic (water and soil)
7131A	Cadmium (water and soil)
7191	Chromium (water and soil)
7196	Hexavalent chromium
7421	Lead (water and soil)
7470A	Mercury (water)
7471A	Mercury (soil)
7740	Selenium (water and soil)
7841	Thallium (water and soil)
7911	Vanadium (water and soil)
9010A	Cyanide (water)
9012	Cyanide (water)
9056	Common anions

7.2.1 Method SW8010B-Halogenated Volatile Organics

Halogenated volatile organics in water and soil samples are analyzed using method SW8010B. This method is a purge and trap GC method using preparation method SW5030A. An inert gas is bubbled through a water matrix to transfer the volatile halocarbons from the liquid to the vapor phase. The volatile compounds are removed from the inert gas by passing the gas through a sorbent trap, which is then backflushed onto a GC column with an electrolytic conductivity detector to separate and quantify the compounds of interest. Soil samples are analyzed by direct purge and trap (for low-level samples) or by extraction of the sample. The PQL for the method SW8010B organic analytes are presented in Table 7.2.1-1.

This method provides for the use of a second GC column of a dissimilar polarity to resolve compounds of interest from interferences that may occur. When second-column analysis is performed, retention times for the analyte must match those established for each column. Otherwise, the chromatographic peaks are considered interferences, and the analyte is not considered to be present in the sample. Requirements for confirmation of analytes are described in Section 4.5.2. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.1-2 and 7.2.1-3.

Table 7.2.1-1
PQLs for Method SW8010B*

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Purgeable Halocarbons SW5030A/SW8010B (W, S)	1,1,1-TCA	1.0	µg/L	0.005	mg/kg
	1,1,2-TCA	1.0	µg/L	0.005	mg/kg
	1,1-DCA	1.0	µg/L	0.005	mg/kg
	1,1-DCE	1.0	µg/L	0.005	mg/kg
	1,2-DCB	2.0	µg/L	0.005	mg/kg
	1,3-DCB	3.0	µg/L	0.005	mg/kg
	1,4-DCB	2.0	µg/L	0.005	mg/kg
	Chlorobenzene	2.5	µg/L	0.005	mg/kg
	Chloroethane	5.0	µg/L	0.005	mg/kg
	Chloromethane	1.0	µg/L	0.005	mg/kg
	Cis-1,2-DCE	1.0	µg/L	0.005	mg/kg
	Methylene Chloride	2.0	µg/L	0.005	mg/kg
	TCE	1.0	µg/L	0.005	mg/kg
	Tetrachloroethylene	1.0	µg/L	0.005	mg/kg
	Trans-1,2-DCE	1.0	µg/L	0.005	mg/kg
Vinyl Chloride	2.0	µg/L	0.005	mg/kg	

*This list of compound was reduced to include those likely to be associated with site-specific conditions. If necessary, the list should be expanded to include other compounds depending on project-specific needs.

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TABLE 7.2.1-2
Acceptance Criteria for Method SW8010B*

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8010B	1,1,1-TCA	69-134	≤ 20	59-144	≤ 30
	1,1,2-TCA	61-130	≤ 20	51-140	≤ 30
	1,1-DCA	64-127	≤ 20	54-137	≤ 30
	1,1-DCE	53-147	≤ 20	43-157	≤ 30
	1,2-DCB	65-129	≤ 20	55-139	≤ 30
	1,3-DCB	63-137	≤ 20	53-147	≤ 30
	1,4-DCB	66-135	≤ 20	56-145	≤ 30
	Chlorobenzene	75-137	≤ 20	65-147	≤ 30
	Chloroethane	75-130	≤ 20	65-140	≤ 30
	Chloromethane	59-154	≤ 20	49-164	≤ 30
	Cis-1,2-DCE	75-125	≤ 20	65-130	≤ 30
	Methylene Chloride	42-176	≤ 20	32-166	≤ 30
	TCE	75-141	≤ 20	65-151	≤ 30
	Tetrachloroethylene	75-142	≤ 20	65-152	≤ 30
	Trans-1,2-DCE	78-130	≤ 20	65-140	≤ 30
	Vinyl Chloride	47-142	≤ 20	37-152	≤ 30
SW8010B	<i>Surrogates:</i>				
	Bromochloromethane	37-137		37-137	
	Bromofluorobenzene	27-137		27-137	
	Bromochlorobenzene	41-133		31-143	

*This list of compound was reduced to include those likely to be associated with site-specific conditions. If necessary, the list should be expanded to include other compounds depending on project-specific needs.

TABLE 7.2.1-3
 Summary of Calibration and QC Procedures for Method SW8010B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
SW8010B	Halogenated volatile organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for cfs or Rf's	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and verification	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.1-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem, then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.1-2	Correct problem then reprep and analyze the LCS and all samples in the affected APCBB analytical batch	Flagging conventions, Table 8.2-2

TABLE 7.2.1-3
Summary of Calibration and QC Procedures for Method SW8010B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria ^b
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.1-2	Correct problem then reextract and analyze sample	Flagging conventions, Table 8.2-2
	MS/MSD	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.1-2	none	Flagging conventions, Table 8.2-2
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.1-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
^bFlagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.2 Method SW8011-Ethylene Dibromide

Ethylene dibromide (EDB) in water is analyzed using method SW8011. The sample is extracted with hexane. The extract is injected into a GC with a linearized electron capture detector for separation and analysis. The PQL is presented in Table 7.2.2-1.

This method provides for the use of a second GC column of dissimilar phase to resolve compounds of interest from interferences that may occur. When second-column analysis is performed, retention times for the analyte must match those established for each column. Otherwise, the chromatographic peaks are considered interferences, and the analyte is not considered to be present in the sample. Requirements for confirmation of the analyte are described in Section 4.5.2. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.2-2 and 7.2.2-3.

TABLE 7.2.2-1
PQL for Method SW8011

Parameter/Method	Analyte	Water	
		PQL	Unit
SW8011	EDB	0.1	µg/L

TABLE 7.2.2-2
QC Acceptance Criteria for Method SW8011

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)
SW8011	EDB	85-115	≤ 15

TABLE 7.2.2-3
Summary of Calibration and QC Procedures for Method SW8011

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8011	EDB	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for cfs or Rf's	Correct problem then repeat initial calibration	Apply R to the result for EDB for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within ±15% of expected value	Correct problem then repeat initial calibration	Apply R to the result for EDB for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to the result for EDB in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within ±15% of expected value	Correct problem then repeat initial calibration	Apply R to the result for EDB for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±15% of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to the result for EDB in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.2-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to the EDB result for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.2-2	Correct problem then reprep and analyze the LCS and all samples in the affected APCEE analytical batch	Flagging conventions, Table 8.2-2

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TABLE 7.2.2-3
 Summary of Calibration and QC Procedures for Method SW8011

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.2-2	Correct problem then reextract and analyze sample	Flagging conventions, Table 8.2-2
	MS/MSD	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.2-2	none	Flagging conventions, Table 8.2-2
	Second-column confirmation	Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
	MDL study	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.1-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and PQL	Results reported between MDL and PQL	none	none	none	Apply P to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.3 Method SW8015 (Modified)-Volatile and Extractable Total Petroleum Hydrocarbons

Volatile petroleum hydrocarbon components, such as gasoline, jet fuel, and other low molecular weight petroleum products, are analyzed by the direct purge and trap technique described in method SW5030 followed by a modified approach to method SW8015. Extractable TPH components are analyzed by extraction method SW3520B or SW3550A followed by a modified method SW8015.

For volatile TPH, the sample is placed in the purge and trap sparge vessel and analysis is conducted using a GC equipped with an FID.

Extractable TPH components, such as kerosene, diesel, motor oil, and other high molecular weight extractable petroleum products, are analyzed by method SW3520B (continuous liquid/liquid extraction) for water-based matrices or by method SW3550A (sonication extraction) for soil/sludge matrices. The sample is extracted and analysis is accomplished on a GC equipped with a capillary or megabore column and a FID. PQLs for volatile TPH and extractable TPH are provided in Table 7.2.3-1.

Identification and quantitation of TPH components require more analytical judgment than other GC methods. The TPH chromatograms consist of groups of peaks that fall within a noted carbon retention time range (i.e., number of carbon atoms in the molecule). Standard fuel components are used to calibrate the instruments. The total petroleum hydrocarbons results are reported in mg/kg or mg/L based on quantitation of the total area count for the gasoline range organics (i.e., C6-C13) or the diesel range organics (i.e., C13-C28). The retention time window shall be set such that the window encompasses only the C6 through C28 range of organics. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.3-2 and 7.2.3-3.

TABLE 7.2.3-1
PQLs for Method SW8015 (Modified)

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Petroleum	Gasoline	0.1	mg/L	1.0	mg/kg
Hydrocarbons SW5030/SW8015 (Mod) SW3550A/SW8015 (Mod) SW3550A/SW8015 ² (Mod)	Diesel, Jet Fuel	1.0	mg/L	10.0	mg/kg

TABLE 7.2.3-2
QC Acceptance Criteria for Method SW8015 (Modified)

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8015 (Modified) GRO	TPH-Gasoline	67-136	≤ 30	57-146	≤ 50
	<i>Surrogate:</i> Chlorobenzene	74-138		64-148	
SW8015 (Modified) DRO	TPH-Diesel	61-143	≤ 30	51-153	≤ 50
	TPH-Jet Fuel	61-143	≤ 30	51-153	≤ 50
	<i>Surrogates:</i> Octacosane	26-152		25-162	
	Ortho-Terphenyl	57-132		47-142	

TABLE 7.2.3-3

QC Acceptance Criteria for Method SW8015 (Modified)

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW8015 (mod)	Volatile and Extractable Total Petroleum Hydrocarbons	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20%	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Initial calibration verification	Daily, before sample analysis	All concentration levels of GRO within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All concentration levels within $\pm 15\%$ of initial calibration	Correct problem then repeat initial calibration verification and reanalyze all successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.3-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No TPH detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.3-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.3-2	Correct problem then reextract and analyze sample	Flagging conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per	QC acceptance criteria, Table 7.2.3-2	none	Flagging conventions, Table 8.2-2

TABLE 7.2.3-3
 QC Acceptance Criteria for Method SW8015 (Modified)

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
			project samples per matrix			
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.3-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 †Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.4 Method SW8020A-Aromatic Volatile Organics

Aromatic volatile organics in water and soil samples are prepared using method SW5030 and analyzed using method SW8020A. This method (also known as the BTEX method since the compounds of interest include benzene, toluene, ethylbenzene, and xylene) is a purge and trap GC method. An inert gas is bubbled through a water matrix to transfer the volatile aromatic hydrocarbons from the liquid to the vapor phase. The aromatics are removed from the inert gas by passing the gas through a sorbent trap, which is then backflushed onto a GC column with a PID to separate and quantify the compounds of interest. Soil samples are first extracted. Low concentration contaminated soils may be prepared using method SW5030A. PQLs for method SW8020A are presented in Table 7.2.4-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.4-2 and 7.2.4-3.

Table 7.2.4-1
PQLs for Method SW8020A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Aromatic Volatile Organics	1,2-DCB	4.0	µg/L	0.004	mg/kg
SW5030A/SW8020A	1,3-DCB	4.0	µg/L	0.004	mg/kg
(W, S)	1,4-DCB	3.0	µg/L	0.003	mg/kg
	Benzene	2.0	µg/L	0.002	mg/kg
	Chlorobenzene	2.0	µg/L	0.002	mg/kg
	Ethylbenzene	2.0	µg/L	0.002	mg/kg
	Toluene	2.0	µg/L	0.002	mg/kg
	Xylenes, total	2.0	µg/L	0.002	mg/kg

Table 7.2.4-2
QC Acceptance Criteria for Method SW8020A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	
SW8020A	1,2-DCB	61-134	≤ 20	51-144	≤ 30	
	1,3-DCB	70-131	≤ 20	60-141	≤ 30	
	1,4-DCB	75-126	≤ 20	66-136	≤ 30	
	Benzene	75-125	≤ 20	66-135	≤ 30	
	Chlorobenzene	75-129	≤ 20	66-139	≤ 30	
	Ethylbenzene	71-129	≤ 20	61-139	≤ 30	
	Toluene	70-125	≤ 20	60-135	≤ 30	
	Xylenes, total	71-133	≤ 20	61-143	≤ 30	
	<i>Surrogates:</i>					
		Bromochlorobenzene	46-136		36-146	
	Bromofluorobenzene	48-138		38-148		
	Difluorobenzene	48-138		38-148		
	Fluorobenzene	44-165		34-175		
	1,1,1-Trifluorotoluene	44-165		34-175		

Table 7.2.4-3
 Summary of Calibration and QC Procedures for Method SW8020A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
SW8020A	Aromatic volatile organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for cfs or RPs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
	Second-source calibration verification	Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
	Retention time window calculated for each analyte	Retention time window calculated for each analyte	Each initial calibration and verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
	Initial calibration verification	Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
	Continuing calibration verification	Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.4-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
	Method blank	Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table B.2-2
	LCS for all analytes	LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.4-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging conventions, Table B.2-2

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Table 7.2.4-3
 Summary of Calibration and QC Procedures for Method SW8020A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.4-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.4-2	Correct problem then reextract and analyze sample	Flagging conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.4-2	none	Flagging conventions, Table 8.2-2
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.5 Method SW8021A-Halogenated Volatile Organics

Halogenated volatile organics in water and soil samples are analyzed using method SW8021A. This method is a purge and trap GC method using preparation method SW5030A. A temperature program is used in the GC to separate the compounds. Detection is achieved by a PID and an electrolytic conductivity detector (HECD) in series. The PQLs for the analytes are presented in Table 7.2.5-1. Requirements for confirmation of analytes are described in Section 4.5.2. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.5-2 and 7.2.5-3.

Table 7.2.5-1
PQLs for Method SW8021A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Halogenated Volatile Organics	1,1,1-TCA	0.30	µg/L	0.01	mg/kg
	1,1,2-TCA	0.30	µg/L	0.01	mg/kg
SW5030A/SW8021A (W, S)	1,1-DCA	0.70	µg/L	0.01	mg/kg
	1,1-DCE	0.70	µg/L	0.01	mg/kg
	1,2-DCA	0.30	µg/L	0.01	mg/kg
	1,2-DCB	0.50	µg/L	0.01	mg/kg
	1,3-DCB	0.20	µg/L	0.01	mg/kg
	1,4-DCB	0.10	µg/L	0.01	mg/kg
	Benzene	0.10	µg/L	0.01	mg/kg
	Bromodichloromethane	0.20	µg/L	0.01	mg/kg
	Bromoform	16.0	µg/L	0.01	mg/kg
	Bromomethane	11.00	µg/L	0.01	mg/kg
	Carbon Tetrachloride	0.10	µg/L	0.01	mg/kg
	Chlorobenzene	0.10	µg/L	0.01	mg/kg
	Chloroethane	1.00	µg/L	0.01	mg/kg
	Chloroform	0.20	µg/L	0.01	mg/kg
	Chloromethane	0.30	µg/L	0.01	mg/kg
	Cis-1,2-DCE	0.60	µg/L	0.01	mg/kg
	Cis-1,3-Dichloropropene	0.30	µg/L	0.01	mg/kg
	Dibromochloromethane	0.50	µg/L	0.01	mg/kg
	Dichlorodifluoromethane	0.50	µg/L	0.01	mg/kg
	EDB	8.00	µg/L	0.01	mg/kg
	Ethylbenzene	0.50	µg/L	0.01	mg/kg
	Methylene Chloride	0.20	µg/L	0.01	mg/kg
	TCE	0.20	µg/L	0.01	mg/kg
	Tetrachloroethylene	0.50	µg/L	0.01	mg/kg
	Toluene	0.10	µg/L	0.01	mg/kg
	Trans-1,2-DCE	0.60	µg/L	0.01	mg/kg
	Trans-1,3-Dichloropropene	1.00	µg/L	0.01	mg/kg
	Trichlorofluoromethane	0.30	µg/L	0.01	mg/kg
	Vinyl Chloride	0.40	µg/L	0.01	mg/kg
	Xylenes, Total	0.50	µg/L	0.01	mg/kg

Table 7.25-2
QC Acceptance Criteria for Method SW8021A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8021A	1,1,1-TCA	69-134	≤ 20	59-134	≤ 30
	1,1,2-TCA	61-130	≤ 20	51-130	≤ 30
	1,1-DCA	64-127	≤ 20	54-127	≤ 30
	1,1-DCE	53-147	≤ 20	43-147	≤ 30
	1,2-DCA	68-137	≤ 20	58-137	≤ 30
	1,2-DCB	61-134	≤ 20	51-134	≤ 30
	1,3-DCB	63-137	≤ 20	53-137	≤ 30
	1,4-DCB	66-135	≤ 20	56-135	≤ 30
	Benzene	75-125	≤ 20	65-125	≤ 30
	Chlorobenzene	75-129	≤ 20	65-129	≤ 30
	Chloroethane	75-130	≤ 20	65-130	≤ 30
	Chloromethane	59-154	≤ 20	49-154	≤ 30
	Cis-1,2-DCE	75-120	≤ 20	65-125	≤ 30
	Ethylbenzene	71-129	≤ 20	61-129	≤ 30
	Methylene Chloride	42-176	≤ 20	32-176	≤ 30
	TCE	75-141	≤ 20	65-141	≤ 30
	Tetrachloroethylene	75-142	≤ 20	65-142	≤ 30
	Toluene	70-125	≤ 20	60-125	≤ 30
	Trans-1,2-DCE	75-130	≤ 20	68-130	≤ 30
	Vinyl Chloride	47-142	≤ 20	37-142	≤ 30
Xylenes, Total	71-133	≤ 20	61-133	≤ 30	
SW8021A	<i>Surrogates:</i>				
	1,4-Dichlorobutane	35-135		35-135	
	Bromochlorobenzene	37-137		37-137	

Table 7.2.5-3
Summary of Calibration and QC Procedures for Method SW8021A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW8021A	Halogenated volatile organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for cis or Rf's	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.5-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table 8.2-2

Table 7.2.5-3
Summary of Calibration and QC Procedures for Method SW8021A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.5-2	Reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging conventions, Table 8.2-2
	Surrogate spike		Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.5-2	Correct problem then reextract and analyze sample	Flagging conventions, Table 8.2-2
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.5-2	none	Flagging conventions, Table 8.2-2
	Second-column confirmation		100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
	MDL study		Once per year	Detection limits established shall be < the PQLs in Table 7.2.5-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and PQL		none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

*Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.6 Method SW8070-Nitrosamines

Select nitrosamines in water and soil samples are analyzed using method SW8070. The sample is extracted and analyzed by gas chromatography. PQLs for method SW8070 are presented in Table 7.2.6-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.6-2 and 7.2.6-3.

TABLE 7.2.6-1
 PQLs for Method SW8070

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Nitrosamines/SW8070	N-Nitrosodi-n-propylamine	2.0	µg/L	4.0	mg/kg
	N-Nitrosodimethylamine	0.50	µg/L	1.0	mg/kg
	N-Nitrosodiphenylamine	3.0	µg/L	6.0	mg/kg

TABLE 7.2.6-2
 QC Acceptance Criteria for Method SW8070

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8070	N-Nitrosodi-n-propylamine	45-146	≤ 30	35-146	≤ 50
	N-Nitrosodimethylamine	25-125	≤ 30	25-135	≤ 50
	N-Nitrosodiphenylamine	25-139	≤ 30	25-149	≤ 50

Surrogates*:

*Use an analyte and its LCS limit from the method that is not expected to be present in the sample as the surrogate.

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TABLE 7.2.6-3
Summary of Calibration and QC Procedures for Method SW8070

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW8070	Nitrosamines	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for cfs or RFs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.6-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table 8.2-2

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TABLE 7.2.6-3
 Summary of Calibration and QC Procedures for Method SW8070

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria ^b
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.6-2	Reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.6-2	Correct problem then reextract and analyze sample	Flagging conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.6-2	none	Flagging conventions, Table 8.2-2
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.6-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply P to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
^bFlagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.7 Method SW8080A-Organochlorine Pesticides and Polychlorinated Biphenyls

Organochlorine pesticides and PCBs in water and soil samples are analyzed using method SW8080A. This analytical method involves extraction of water samples using a separatory funnel (method SW3510B). Extraction of solid samples is accomplished using ultrasonic extraction (method SW3550A) procedures. The pesticides and PCBs are separated and quantified by GC using electron capture detection. PQLs for this method are presented in Table 7.2.7-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.7-2 and 7.2.7-3.

TABLE 7.2.7-1
 PQLs for Method SW8080A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Organochlorine Pesticides and PCBs	Aldrin	0.04	µg/L	0.003	mg/kg
	α-BHC	0.03	µg/L	0.002	mg/kg
SW3510B/SW8080A (W)	β-BHC	0.06	µg/L	0.004	mg/kg
SW3550A/SW8080A (S)	δ-BHC	0.09	µg/L	0.006	mg/kg
	γ-BHC (Lindane)	0.04	µg/L	0.003	mg/kg
	Chlordane (technical)	0.14	µg/L	0.009	mg/kg
	4,4'-DDD	0.11	µg/L	0.007	mg/kg
	4,4'-DDE	0.04	µg/L	0.003	mg/kg
	4,4'-DDT	0.12	µg/L	0.008	mg/kg
	Dieldrin	0.02	µg/L	0.01	mg/kg
	Endosulfan I	0.14	µg/L	0.009	mg/kg
	Endosulfan II	0.04	µg/L	0.003	mg/kg
	Endosulfan Sulfate	0.66	µg/L	0.04	mg/kg
	Endrin	0.06	µg/L	0.004	mg/kg
	Endrin Aldehyde	0.23	µg/L	0.02	mg/kg
	Heptachlor	0.03	µg/L	0.002	mg/kg
	Heptachlor Epoxide	0.83	µg/L	0.06	mg/kg
	Methoxychlor	1.76	µg/L	0.1	mg/kg
	Toxaphene	2.4	µg/L	0.2	mg/kg
PCB-1016	1.0	µg/L	1.0	mg/kg	
PCB-1221	1.0	µg/L	1.0	mg/kg	
PCB-1232	1.0	µg/L	1.0	mg/kg	
PCB-1242	1.0	µg/L	1.0	mg/kg	
PCB-1248	1.0	µg/L	1.0	mg/kg	
PCB-1254	1.0	µg/L	1.0	mg/kg	
PCB-1260	1.0	µg/L	1.0	mg/kg	

TABLE 7.2.7-2
QC Acceptance Criteria for Method SW8080A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8080A	Aldrin	47-125	≤ 30	37-135	≤ 50
	α-BHC	75-125	≤ 30	65-135	≤ 50
	β-BHC	51-125	≤ 30	41-133	≤ 50
	δ-BHC	75-126	≤ 30	65-136	≤ 50
	γ-BHC (Lindane)	73-125	≤ 30	63-135	≤ 50
	Chlordane (technical)	45-125	≤ 30	35-135	≤ 50
	4,4'-DDD	48-136	≤ 30	38-146	≤ 50
	4,4'-DDE	45-139	≤ 30	35-149	≤ 50
	4,4'-DDT	34-143	≤ 30	25-153	≤ 50
	Dieldrin	42-132	≤ 30	32-142	≤ 50
	Endosulfan I	49-143	≤ 30	39-153	≤ 50
	Endosulfan II	75-159	≤ 30	65-169	≤ 50
	Endosulfan Sulfate	46-141	≤ 30	36-151	≤ 50
	Endrin	43-134	≤ 30	33-144	≤ 50
	Endrin Aldehyde	75-150	≤ 30	65-160	≤ 50
	Heptachlor	45-128	≤ 30	35-138	≤ 50
	Heptachlor Epoxide	53-134	≤ 30	43-144	≤ 50
	Methoxychlor	73-142	≤ 30	63-152	≤ 50
	Toxaphene	41-126	≤ 30	31-136	≤ 50
	PCB-1016	54-125	≤ 30	44-135	≤ 50
	PCB-1221	30-175	≤ 30	25-175	≤ 50
	PCB-1232	39-150	≤ 30	29-160	≤ 50
	PCB-1242	39-150	≤ 30	29-160	≤ 50
	PCB-1248	38-158	≤ 30	28-168	≤ 50
	PCB-1254	29-131	≤ 30	25-141	≤ 50
	PCB-1260	41-126	≤ 30	31-136	≤ 50
<i>Surrogates:</i>					
	DCBP	34-133		34-133	
	TCMX	45-120		45-120	

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TABLE 7.2.7-3
Summary of Calibration and QC Procedures for Method SW8080A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ¹	Flagging Criteria ²
SW8080A	Organo-chlorine pesticides and PCBs	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for cfs or Rf's	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within ±15% of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within ±15% of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±15% of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Breakdown check (Endrin and DDT)	Daily prior to analysis of samples	Degradation ≤20%	Repeat breakdown check	Apply J to all positive DDT, DDE, DDD, endrin, endrin ketone and endrin aldehyde results; apply R to the analytes listed above if minimum frequency is not met
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analysis	QC acceptance criteria, Table 7.2.7-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst

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TABLE 7.2.7-3
 Summary of Calibration and QC Procedures for Method SW8080A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem: reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table 8.2.2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.7-2	Reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging conventions, Table 8.2.2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.7-2	Correct problem then reextract and analyze sample	Flagging conventions, Table 8.2.2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.7-2	none	Flagging conventions, Table 8.2.2
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.7-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply P to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.8 Method SW8081-Organochlorine Pesticides and Polychlorinated Biphenyls

Organochlorine pesticides and PCBs in water and soil samples are analyzed using method SW8081. This analytical method involves extraction of water samples using a separator funnel (method SW3510B). Extraction of solid samples is accomplished with ultrasonic extraction (method SW3550A) procedures. The pesticides and PCBs are separated and quantified by GC using electron capture detection. PQLs for this method are presented in Table 7.2.8-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.8-2 and 7.2.8-3.

TABLE 7.2.8-1
 PQLs for Method SW8081

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Organochlorine Pesticides and PCBs	α-BHC	0.35	µg/L	0.019	mg/kg
	β-BHC	0.23	µg/L	0.033	mg/kg
SW3510B/SW8081 (W)	δ-BHC	0.24	µg/L	0.011	mg/kg
SW3550A/SW8081 (S)	γ-BHC (Lindane)	0.25	µg/L	0.020	mg/kg
	α-Chlordane	0.80	µg/L	0.015	mg/kg
	γ-Chlordane	0.37	µg/L	0.015	mg/kg
	4,4'-DDD	0.50	µg/L	0.042	mg/kg
	4,4'-DDE	0.58	µg/L	0.025	mg/kg
	4,4'-DDT	0.81	µg/L	0.036	mg/kg
	Aldrin	0.34	µg/L	0.022	mg/kg
	Dieldrin	0.44	µg/L	0.035	mg/kg
	Endosulfan I	0.30	µg/L	0.021	mg/kg
	Endosulfan II	0.40	µg/L	0.024	mg/kg
	Endosulfan Sulfate	0.35	µg/L	0.036	mg/kg
	Endrin	0.39	µg/L	0.036	mg/kg
	Endrin Aldehyde	0.50	µg/L	0.016	mg/kg
	Heptachlor	0.40	µg/L	0.020	mg/kg
	Heptachlor Epoxide	0.32	µg/L	0.021	mg/kg
	Methoxychlor	0.86	µg/L	0.057	mg/kg
	PCB-1016	1.00	µg/L	0.70	mg/kg
	PCB-1221	1.00	µg/L	0.70	mg/kg
	PCB-1232	1.00	µg/L	0.70	mg/kg
	PCB-1242	1.00	µg/L	0.70	mg/kg
	PCB-1248	1.00	µg/L	0.70	mg/kg
	PCB-1254	1.00	µg/L	0.70	mg/kg
	PCB-1260	1.00	µg/L	0.70	mg/kg
	Toxaphene	0.50	µg/L	0.57	mg/kg

TABLE 7.2.8-2
QC Acceptance Criteria for Method SW8081

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8081	α -BHC	75-125	≤ 30	65-135	≤ 50
	β -BHC	51-125	≤ 30	41-133	≤ 50
	δ -BHC	75-126	≤ 30	65-136	≤ 50
	γ -BHC (Lindane)	73-125	≤ 30	63-130	≤ 50
	α -Chlordane	41-125	≤ 30	31-135	≤ 50
	γ -Chlordane	41-125	≤ 30	31-133	≤ 50
	4,4-DDD	48-136	≤ 30	38-146	≤ 50
	4,4-DDE	45-139	≤ 30	35-149	≤ 50
	4,4-DDT	34-143	≤ 30	25-153	≤ 50
	Aldrin	47-125	≤ 30	37-126	≤ 50
	Dieldrin	42-132	≤ 30	32-142	≤ 50
	Endosulfan I	49-143	≤ 30	39-153	≤ 50
	Endosulfan II	75-159	≤ 30	65-169	≤ 50
	Endosulfan Sulfate	46-141	≤ 30	36-151	≤ 50
	Endrin	43-134	≤ 30	33-144	≤ 50
	Endrin Aldehyde	75-150	≤ 30	65-160	≤ 50
	Heptachlor	45-128	≤ 30	35-138	≤ 50
	Heptachlor Epoxide	53-134	≤ 30	43-144	≤ 50
	Methoxychlor	73-142	≤ 30	63-152	≤ 50
	PCB-1016	54-125	≤ 30	44-127	≤ 50
	PCB-1221	41-126	≤ 30	31-136	≤ 50
	PCB-1232	41-126	≤ 30	31-136	≤ 50
	PCB-1242	39-150	≤ 30	29-160	≤ 50
	PCB-1248	41-126	≤ 30	31-136	≤ 50
	PCB-1254	29-131	≤ 30	25-141	≤ 50
	PCB-1260	41-126	≤ 30	31-136	≤ 50
	Toxaphene	41-126	≤ 30	31-136	≤ 50
<i>Surrogates:</i>					
	DCBP	34-133		25-143	
	TCMX	45-125		35-135	

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TABLE 7.2.8.3
 Summary of Calibration and QC Procedures for Method SW8081

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
SW8081	Organo-chlorine pesticides and PCBs	Five-point initial calibration for all analytes Second-source calibration verification	Initial calibration prior to sample analysis Once per five-point initial calibration	%RSD < 20% for cfs or Rf's All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 20 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Breakdown check (Endrin and DDT)	Daily prior to analysis of samples	Degradation $\leq 15\%$	Repeat breakdown check	Apply J to all positive DDT, DDE, DDD, endrin, endrin ketone and endrin aldehyde results; apply R to the analytes listed above if minimum frequency is not met
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.8-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst

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TABLE 7.2.8.3
 Summary of Calibration and QC Procedures for Method SW8081

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.8-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.8-2	Correct problem then reextract and analyze sample	Flagging conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.8-2	none	Flagging conventions, Table 8.2-2
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.8-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

^aAll corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
^bFlagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.9 Method SW8140-Organophosphorus Pesticides

Method SW8140 is a GC method used to determine the concentrations of various organophosphorus pesticides. This analytical method involves extraction of water samples using a separatory funnel (method SW3510B). Extraction of solid samples is accomplished by ultrasonic extraction (method SW3550A) procedures. An aliquot of the extract is injected into a GC, and compounds in the GC effluent are detected with a flame photometric or nitrogen-phosphorus detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. PQLs for these pesticides are presented in Table 7.2.9-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.9-2 and 7.2.9-3.

TABLE 7.2.9-1
PQLs for Method SW8140

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Organophosphorus Pesticides	Azinphos Methyl	15.0	µg/L	1.0	mg/kg
SW3510B/SW8140 (W)	Bolstar	1.5	µg/L	0.1	mg/kg
SW3550A/SW8140 (S)	Chlorpyrifos	3.0	µg/L	0.2	mg/kg
	Coumaphos	15.0	µg/L	1.0	mg/kg
	Demeton-o	2.5	µg/L	0.2	mg/kg
	Demeton-s	2.5	µg/L	0.2	mg/kg
	Diazinon	6.0	µg/L	0.4	mg/kg
	Dichlorovos	10.0	µg/L	0.7	mg/kg
	Disulfoton	2.0	µg/L	0.1	mg/kg
	Ethoprop	2.5	µg/L	0.2	mg/kg
	Fensulfothion	15.0	µg/L	1.0	mg/kg
	Fenthion	1.0	µg/L	0.1	mg/kg
	Merphos	2.5	µg/L	0.2	mg/kg
	Mevinphos	3.0	µg/L	0.2	mg/kg
	Naled	1.0	µg/L	0.1	mg/kg
	Parathion Methyl	0.3	µg/L	0.02	mg/kg
	Phorate	1.5	µg/L	0.1	mg/kg
	Ronnel	3.0	µg/L	0.2	mg/kg
	Stirophos	50.0	µg/L	2.4	mg/kg
	Tokuthion	5.0	µg/L	0.4	mg/kg
	Trichloronate	1.5	µg/L	0.1	mg/kg

TABLE 7.2.9-2
QC Acceptance Criteria for Method SW8140

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8140	Azinphos Methyl	50-150	≤ 30	40-160	≤ 50
	Bolstar	46-125	≤ 30	36-135	≤ 50
	Chlorpyrifos	75-125	≤ 30	65-135	≤ 50
	Coumaphos	71-147	≤ 30	61-157	≤ 50
	Demeton-o	50-150	≤ 30	40-160	≤ 50
	Demeton-s	50-150	≤ 30	40-160	≤ 50
	Diazinon	47-149	≤ 30	37-159	≤ 50
	Dichlorovos	49-125	≤ 30	39-135	≤ 50
	Disulfoton	50-150	≤ 30	40-160	≤ 50
	Ethoprop	75-125	≤ 30	65-135	≤ 50
	Fensulfothion	43-145	≤ 30	33-155	≤ 50
	Fenthion	25-125	≤ 30	25-130	≤ 50
	Merphos	75-144	≤ 30	65-154	≤ 50
	Mevinphos	33-125	≤ 30	25-135	≤ 50
	Naled	54-125	≤ 30	44-135	≤ 50
	Parathion Methyl	45-130	≤ 30	35-140	≤ 50
	Phorate	50-150	≤ 30	40-160	≤ 50
	Ronnel	75-116	≤ 30	65-135	≤ 50
	Stirophos	48-125	≤ 30	38-135	≤ 50
	Tokuthion	44-125	≤ 30	34-135	≤ 50
Trichloronate	49-161	≤ 30	39-171	≤ 50	

Surrogates:

*Use an analyte and its LCS limit from the method that is not expected to be present in the sample as the surrogate.

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TABLE 7.2.9-3
 Summary of Calibration and QC Procedures for Method SW8140

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW8140	Organophosphorus pesticides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for cfs or Rf's	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.9-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.9-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-2

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TABLE 7.2.9-3
 Summary of Calibration and QC Procedures for Method SW8140

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.9-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.9-2	none	Flagging Conventions, Table 8.2-2
	Second-column confirmation		100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
	MDL study		Once per year	Detection limits established shall be < the POLs in Table 7.2.9-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and PQL		none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 †Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.10 Method SW8141A-Organophosphorus Pesticides

Method SW8141A is a GC method used to determine the concentrations of various organophosphorus pesticides. This analytical method involves extraction of water samples using a separatory funnel (method SW3510B). Extraction of solid samples is accomplished using one of the Soxhlet extraction (method SW3540B or SW3541) procedures. An aliquot of the extract is injected into a GC, and compounds in the GC effluent are detected with a flame photometric or nitrogen-phosphorus detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. PQLs for these pesticides are presented in Table 7.2.10-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.10-2 and 7.2.10-3.

TABLE 7.2.10-1
PQLs for Method SW8141A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Organophosphorus Pesticides	Azinphos Methyl	1.0	µg/L	0.05	mg/kg
	Bolstar	0.7	µg/L	0.04	mg/kg
SW3510B/SW8141A (W)	Chlorpyrifos	0.7	µg/L	0.05	mg/kg
SW3540A/SW8141A (S)	Coumaphos	2.0	µg/L	0.10	mg/kg
SW3541A/SW8141A (S)	Demeton-o	1.2	µg/L	0.06	mg/kg
	Demeton-s	1.2	µg/L	0.06	mg/kg
	Diazinon	2.0	µg/L	0.10	mg/kg
	Dichlorovos	8.0	µg/L	0.40	mg/kg
	Disulfoton	0.7	µg/L	0.04	mg/kg
	Ethoprop	2.0	µg/L	0.10	mg/kg
	Fensulfothion	0.8	µg/L	0.04	mg/kg
	Fenthion	0.8	µg/L	0.05	mg/kg
	Merphos	2.0	µg/L	0.10	mg/kg
	Mevinphos	5.0	µg/L	0.25	mg/kg
	Naled	5.0	µg/L	0.25	mg/kg
	Parathion Methyl	1.2	µg/L	0.06	mg/kg
	Phorate	0.4	µg/L	0.02	mg/kg
	Ronnel	0.7	µg/L	0.04	mg/kg
	Stirophos	8.0	µg/L	0.40	mg/kg
	Tokuthion	0.7	µg/L	0.06	mg/kg
	Trichloronate	8.0	µg/L	0.40	mg/kg

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TABLE 7.2-10-2
QC Acceptance Criteria for Method SW8141A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8141A	Azinphos Methyl	50-150	≤ 30	40-160	≤ 50
	Bolstar	46-125	≤ 30	36-135	≤ 50
	Chlorpyrifos	75-125	≤ 30	65-135	≤ 50
	Coumaphos	71-147	≤ 30	61-157	≤ 50
	Demeton-o	50-150	≤ 30	40-160	≤ 50
	Demeton-s	50-150	≤ 30	40-160	≤ 50
	Diazinon	47-149	≤ 30	37-159	≤ 50
	Dichlorovos	49-125	≤ 30	39-135	≤ 50
	Disulfoton	50-150	≤ 30	40-160	≤ 50
	Ethoprop	75-125	≤ 30	65-135	≤ 50
	Fensulfothion	43-145	≤ 30	33-155	≤ 50
	Fenthion	25-125	≤ 30	25-135	≤ 50
	Merphos	75-144	≤ 30	65-154	≤ 50
	Mevinphos	33-125	≤ 30	25-135	≤ 50
	Naled	54-125	≤ 30	44-135	≤ 50
	Parathion Methyl	45-130	≤ 30	35-140	≤ 50
	Phorate	50-150	≤ 30	40-160	≤ 50
	Ronnel	75-125	≤ 30	65-135	≤ 50
	Strophos	48-125	≤ 30	38-135	≤ 50
	Tokuthion	44-125	≤ 30	34-135	≤ 50
Trichloronate	49-161	≤ 30	39-171	≤ 50	
<i>Surrogates:</i>					
	Tributyl Phosphate	67-136	≤ 30	67-136	≤ 50
	Triphenyl Phosphate	65-134	≤ 30	65-134	≤ 50

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TABLE 7.2.10-3
 Summary of Calibration and QC Procedures for Method SW8141A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW8141A	Organophos-phorus pesticides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for cis or Rf's	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.10-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.10-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEB analytical batch	Flagging Conventions, Table 8.2-2

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TABLE 7.2.10-3
 Summary of Calibration and QC Procedures for Method SW8141A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.10-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
	MS/MSD	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.10-2	none	Flagging Conventions, Table 8.2-2
	Second-column confirmation	Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
	MDL study	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.10-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and PQL	Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.11 Method SW8150B-Chlorinated Herbicides

Method SW8150B is a GC method for determining selected chlorinated acid herbicides. The esters are hydrolyzed and extraneous organic material is removed by a solvent wash. After acidification, the acids are extracted with solvent and converted to esters. The esters are determined by GC employing an electron capture detector. The results are reported as the acid equivalents. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. PQLs for herbicides are presented in Table 7.2.11-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.11-2 and 7.2.11-3.

TABLE 7.2.11-1
PQLs for Method SW8150B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Chlorinated Phenoxy Acid Herbicides SW8150B (W, S)	2,4-D	12.0	µg/L	0.8	mg/kg
	2,4-DB	9.0	µg/L	0.6	mg/kg
	2,4,5-T	2.0	µg/L	0.1	mg/kg
	2,4,5-TP	1.7	µg/L	0.1	mg/kg
	Dalapon	60.0	µg/L	4.0	mg/kg
	Dicamba	2.7	µg/L	0.2	mg/kg
	Dichloroprop	6.5	µg/L	0.5	mg/kg
	Dinoseb	0.7	µg/L	0.05	mg/kg
	MCPA	2,500.0	µg/L	170.0	mg/kg
	MCPP	1,900.0	µg/L	130.0	mg/kg

TABLE 7.2.11-2
QC Acceptance Criteria for Method SW8150B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	
SW8150B	2,4-D	65-125	≤ 30	55-135	≤ 50	
	2,4-DB	65-125	≤ 30	55-135	≤ 50	
	2,4,5-T	71-125	≤ 30	61-135	≤ 50	
	2,4,5-TP	75-125	≤ 30	65-135	≤ 50	
	Dalapon	70-125	≤ 30	60-135	≤ 50	
	Dicamba	59-125	≤ 30	49-135	≤ 50	
	Dichloroprop	63-125	≤ 30	53-135	≤ 50	
	Dinoseb	72-125	≤ 30	62-135	≤ 50	
	MCPA	64-125	≤ 30	54-135	≤ 50	
	MCPP	75-125	≤ 30	65-135	≤ 50	
	<i>Surrogate:</i>					
		2,4-Dichlorophenylacetic acid	61-136	≤ 30	51-146	≤ 50

TABLE 7.2.11-3
Summary of Calibration and QC Procedures for Method SW8150B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW8150B	Chlorinated Herbicides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for d5 or Rf's	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and verification	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.11-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2

TABLE 7.2.11-3
 Summary of Calibration and QC Procedures for Method SW8150B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.11-2	Reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.11-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.11-2	none	Flagging Conventions, Table 8.2-2
		Second-column confirmation	100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.11-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

*Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.12 Method SW8151-Chlorinated Herbicides

Method SW8151 is a capillary GC method for determining selected chlorinated acid herbicides and related compounds. Samples are extracted then esterified. The esters are determined by GC employing an electron capture detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column. PQLs for herbicides are presented in Table 7.2.12-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.12-2 and 7.2.12-3.

TABLE 7.2.12-1
 PQLs for Method SW8151

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Chlorinated Phenoxy Acid Herbicides SW8151 (W, S)	2,4-D	20.0	µg/L	0.01	mg/kg
	2,4-DB	80.0	µg/L	10.0	mg/kg
	2,4,5-T	0.80	µg/L	0.5	mg/kg
	2,4,5-TP	0.75	µg/L	0.3	mg/kg
	Dalapon	13.0	µg/L	0.01	mg/kg
	Dicamba	0.81	µg/L	0.5	mg/kg
	Dichloroprop	2.6	µg/L	2.0	mg/kg
	Dinoseb	1.9	µg/L	2.7	mg/kg
	MCPA	0.56	µg/L	6.6	mg/kg
	MCPP	0.9	µg/L	4.3	mg/kg

TABLE 7.2.12-2
 QC Acceptance Criteria for Method SW8151

Method	Analyte	Accuracy	Precision	Accuracy	Precision	
		Water (% R)	Water (% RPD)	Soil (% R)	Soil (% RPD)	
SW8151	2,4-D	65-125	≤ 30	55-135	≤ 50	
	2,4-DB	65-125	≤ 30	55-135	≤ 50	
	2,4,5-T	71-125	≤ 30	61-135	≤ 50	
	2,4,5-TP	75-125	≤ 30	65-135	≤ 50	
	Dalapon	70-125	≤ 30	60-135	≤ 50	
	Dicamba	59-125	≤ 30	49-135	≤ 50	
	Dichloroprop	63-125	≤ 30	53-135	≤ 50	
	Dinoseb	72-125	≤ 30	62-135	≤ 50	
	MCPA	64-125	≤ 30	54-135	≤ 50	
	MCPP	75-125	≤ 30	65-135	≤ 50	
	<i>Surrogate:</i>					
		2,4-Dichlorophenylacetic acid	61-136	≤ 30	51-146	≤ 50

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TABLE 7.2.12-3
Summary of Calibration and QC Procedures for Method SW8151

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^a
SW8151	Chlorinated Herbicides	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	%RSD < 20% for dfs or Rf's	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.12-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2

TABLE 7.2.12-3
 Summary of Calibration and QC Procedures for Method SW8151

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.12-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-2
	Surrogate spike		Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.12-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.12-2	none	Flagging Conventions, Table 8.2-2
	Second-column confirmation		100% for all positive results	Same as for initial or primary column analysis	Same as for initial or primary column analysis	Apply R to the result for the specific analyte(s) in the sample
	MDL study		Once per year	Detection limits established shall be < the PQLs in Table 7.2.12-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and PQL		None	None	None	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 †Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.13 Method SW8240B-Volatile Organics

Volatile (or purgeable) organics in water and soil samples are analyzed using method SW8240B. This method uses a GC/mass spectrometry technique. Volatile compounds are introduced into the GC by purge and trap (SW5030A). An inert gas is bubbled through the water samples (or a soil-water slurry for soil samples) to transfer the purgeable organic compounds from the liquid to vapor phase. Soil samples with higher contaminant levels are extracted before purging. The vapor is then swept through a sorbent trap where the purgeable organics are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a capillary GC column where they are separated and then detected with a mass spectrometer. The analytes detected and PQLs for this method are listed in Table 7.2.13-1.

Calibration-The mass spectrometer is tuned daily to give an acceptable spectrum for bromofluorobenzene (BFB). The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- 50-15 percent to 40 percent of mass 95
- 75-30 percent to 60 percent of mass 95
- 95-base peak, 100 percent relative abundance
- 96-5 percent to 9 percent of mass 95
- 173-0 percent to less than 2 percent of mass 174
- 174-greater than 50 percent of mass 95
- 175-5 percent to 9 percent of mass 174
- 176-greater than 95 percent, but less than 101 percent of mass 174
- 177-5 percent to 9 percent of mass 176

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS that is added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.13-2 and 7.2.13-3.

TABLE 7.2.13-1
PQLs for Method SW8240B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
VOCs	1,1,1-TCA	5.0	µg/L	0.005	mg/kg
SW5030A/SW8240B	1,1,1,2-Tetrachloroethane	5.0	µg/L	0.005	mg/kg
(W, S)	1,1,2-TCA	5.0	µg/L	0.005	mg/kg
	1,1-DCA	5.0	µg/L	0.005	mg/kg
	1,1-DCE	5.0	µg/L	0.005	mg/kg
	1,2,3-Trichloropropane	5.0	µg/L	0.05	mg/kg
	1,2-DCA	5.0	µg/L	0.005	mg/kg
	1,2-Dichloropropane	5.0	µg/L	0.005	mg/kg
	2-Butanone	100.0	µg/L	0.1	mg/kg
	2-Chloroethyl Vinyl Ether	10.0	µg/L	0.01	mg/kg
	2-Hexanone	50.0	µg/L	0.05	mg/kg
	4-Methyl-2-Pentanone	50.0	µg/L	0.05	mg/kg
	Acetone	100.0	µg/L	0.1	mg/kg

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TABLE 7.2.13-1
PQLs for Method SW8240B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
	Benzene	5.0	µg/L	0.005	mg/kg
	Bromodichloromethane	5.0	µg/L	0.005	mg/kg
	Bromoform	5.0	µg/L	0.005	mg/kg
	Bromomethane	10.0	µg/L	0.01	mg/kg
	Carbon Disulfide	5.0	µg/L	0.005	mg/kg
	Carbon Tetrachloride	5.0	µg/L	0.005	mg/kg
	Chlorobenzene	5.0	µg/L	0.005	mg/kg
	Chloroethane	10.0	µg/L	0.01	mg/kg
	Chloroform	5.0	µg/L	0.005	mg/kg
	Chloromethane	10.0	µg/L	0.01	mg/kg
	Cis-1,2-DCE	5.0	µg/L	0.005	mg/kg
	Cis-1,3-Dichloropropene	5.0	µg/L	0.005	mg/kg
	Dibromochloromethane	5.0	µg/L	0.005	mg/kg
	Ethylbenzene	5.0	µg/L	0.005	mg/kg
	Methylene Chloride	5.0	µg/L	0.005	mg/kg
	Styrene	5.0	µg/L	0.005	mg/kg
	TCE	5.0	µg/L	0.005	mg/kg
	Tetrachloroethylene	5.0	µg/L	0.005	mg/kg
	Toluene	5.0	µg/L	0.005	mg/kg
	Trans-1,2-DCE	5.0	µg/L	0.005	mg/kg
	Trans-1,3-Dichloropropene	5.0	µg/L	0.005	mg/kg
	Vinyl Acetate	50.0	µg/L	0.05	mg/kg
	Vinyl Chloride	10.0	µg/L	0.01	mg/kg
	Xylenes (total all isomers)	5.0	µg/L	0.005	mg/kg

TABLE 7.2.13-2
QC Acceptance Criteria for Method SW8240B*

Method	Analyte	Accuracy	Precision	Accuracy	Precision	
		Water (% R)	Water (% RPD)	Soil (% R)	Soil (% RPD)	
SW8240B	1,1,1-TCA	68-135	≤ 20	58-145	≤ 30	
	1,1,2-TCA	70-141	≤ 20	60-151	≤ 30	
	1,1-DCA	62-141	≤ 20	52-151	≤ 30	
	1,1-DCE	54-128	≤ 20	44-138	≤ 30	
	1,2-DCA	68-135	≤ 20	58-145	≤ 30	
	Benzene	51-139	≤ 20	41-149	≤ 30	
	Chlorobenzene	59-140	≤ 20	49-150	≤ 30	
	Cis-1,2-DCE	70-131	≤ 20	60-141	≤ 30	
	Ethylbenzene	59-140	≤ 20	49-150	≤ 30	
	Methylene Chloride	55-126	≤ 20	45-136	≤ 30	
	TCE	67-137	≤ 20	57-147	≤ 30	
	Tetrachloroethylene	67-131	≤ 20	57-141	≤ 30	
	Toluene	61-137	≤ 20	51-147	≤ 30	
	Trans-1,2-DCE	61-138	≤ 20	51-148	≤ 30	
	Vinyl Chloride	31-125	≤ 20	25-135	≤ 30	
	Xylenes, Total	68-133	≤ 20	58-143	≤ 30	
	<i>Surrogates:</i>					
	Toluene-D8	88-110			88-110	

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TABLE 7.2.13-2
QC Acceptance Criteria for Method SW8240B*

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
	4-Bromofluorobenzene	86-115		86-115	
	1,2-DCA-D4	79-118		79-118	

*This list of compounds was reduced to include those likely to be associated with site-specific conditions. If necessary the list should be expanded to include other compounds depending on project-specific needs.

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TABLE 7.2.13-3
Summary of Calibration and QC Procedures for Method SW8240B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW8240B	Volatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF ≥ 0.30 ; and %RSD for all calibration analytes $\leq 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Calibration verification	Daily, before sample analysis, every 12 hours of analysis time, and at end of analysis sequence	SPCCs average RF ≥ 0.30 ; and CCCs $< 20\%$ drift; and all calibration analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check-sample	Once per analyst	QC acceptance criteria, Table 7.2.13-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 7.2.13)	Return instrument and verify	Apply R to all results for all samples associated with the tune

TABLE 7.2.13-3
Summary of Calibration and QC Procedures for Method SW8240B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		ISs	Immediately after or during data acquisition of calibration check standard	Retention time ±30 seconds; EICP area within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometry or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply J to all results for specific analytes for all samples associated with the IS
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.13-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.13-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.13-2	none	Flagging Conventions, Table 8.2-2
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.13-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
*Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
*Except > 0.10 for bromoform

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PAGE 7-53**7.2.14 Method SW8260A-Volatile Organics**

Volatile (or purgeable) organics in water and soil samples are analyzed using method SW8260A. This method uses a capillary column GC/mass spectrometry technique. Volatile compounds are introduced into the GC by purge and trap (SW5030A). An inert gas is bubbled through the water samples (or a soil-water slurry for soil samples) to transfer the purgeable organic compounds from the liquid to vapor phase. Soil samples with higher contaminant levels are extracted using methanol before purging. The vapor is then swept through a sorbent trap where the purgeable organics are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a capillary GC column where they are separated and then detected with a mass spectrometer. The analytes detected and PQLs for this method are listed in Table 7.2.14-1.

Calibration—The mass spectrometer is tuned daily to give an acceptable spectrum for BFB. The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- 50-15 percent to 40 percent of mass 95
- 75-30 percent to 60 percent of mass 95
- 95-base peak, 100 percent relative abundance
- 96-5 percent to 9 percent of mass 95
- 173-less than 2 percent of mass 174
- 174-greater than 50 percent of mass 95
- 175-5 percent to 9 percent of mass 174
- 176-greater than 95 percent, but less than 101 percent of mass 174
- 177-5 percent to 9 percent of mass 176

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.14-2 and 7.2.14-3.

TABLE 7.2.14-1
PQLs for Method SW8260A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
VOCs SW5030A/SW8260A (W, S)	1,1,1,2-Tetrachloroethane	0.5	µg/L	0.003	mg/kg
	1,1,1-TCA	0.8	µg/L	0.004	mg/kg
	1,1,2,2-Tetrachloroethane	0.4	µg/L	0.002	mg/kg
	1,1,2-TCA	1.0	µg/L	0.005	mg/kg
	1,1-DCA	0.4	µg/L	0.002	mg/kg
	1,1-DCE	1.2	µg/L	0.006	mg/kg
	1,1-Dichloropropene	1.0	µg/L	0.005	mg/kg
	1,2,3-Trichlorobenzene	0.3	µg/L	0.002	mg/kg
	1,2,3-Trichloropropane	3.2	µg/L	0.02	mg/kg
	1,2,4-Trichlorobenzene	0.4	µg/L	0.002	mg/kg
	1,2,4-Trimethylbenzene	1.3	µg/L	0.007	mg/kg
	1,2-DCA	0.6	µg/L	0.003	mg/kg

TABLE 7.2.14-1
PQLs for Method SW8260A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
	1,2-DCB	0.3	µg/L	0.002	mg/kg
	1,2-Dibromo-3-chloropropane	2.6	µg/L	0.01	mg/kg
	1,2-Dichloropropane	0.4	µg/L	0.002	mg/kg
	1,2-EDB	0.6	µg/L	0.003	mg/kg
	1,3,5-Trimethylbenzene	0.5	µg/L	0.003	mg/kg
	1,3-DCB	1.2	µg/L	0.006	mg/kg
	1,3-Dichloropropane	0.4	µg/L	0.002	mg/kg
	1,4-DCB	0.3	µg/L	0.002	mg/kg
	1-Chlorohexane	0.5	µg/L	0.003	mg/kg
	2,2-Dichloropropane	3.5	µg/L	0.02	mg/kg
	2-Chlorotoluene	0.4	µg/L	0.002	mg/kg
	4-Chlorotoluene	0.6	µg/L	0.003	mg/kg
	Benzene	0.4	µg/L	0.002	mg/kg
	Bromobenzene	0.3	µg/L	0.002	mg/kg
	Bromochloromethane	0.4	µg/L	0.002	mg/kg
	Bromodichloromethane	0.8	µg/L	0.004	mg/kg
	Bromoform	1.2	µg/L	0.006	mg/kg
	Bromomethane	1.1	µg/L	0.005	mg/kg
	Carbon tetrachloride	2.1	µg/L	0.01	mg/kg
	Chlorobenzene	0.4	µg/L	0.002	mg/kg
	Chloroethane	1.0	µg/L	0.005	mg/kg
	Chloroform	0.3	µg/L	0.002	mg/kg
	Chloromethane	1.3	µg/L	0.007	mg/kg
	Cis-1,2-DCE	1.2	µg/L	0.006	mg/kg
	Cis-1,3-Dichloropropene	1.0	µg/L	0.005	mg/kg
	Dibromochloromethane	0.5	µg/L	0.003	mg/kg
	Dibromomethane	2.4	µg/L	0.01	mg/kg
	Dichlorodifluoromethane	1.0	µg/L	0.005	mg/kg
	Ethylbenzene	0.6	µg/L	0.003	mg/kg
	Hexachlorobutadiene	1.1	µg/L	0.005	mg/kg
	Isopropylbenzene	0.5	µg/L	0.008	mg/kg
	m-Xylene	0.5	µg/L	0.003	mg/kg
	Methylene chloride	0.3	µg/L	0.002	mg/kg
	n-Butylbenzene	1.1	µg/L	0.005	mg/kg
	n-Propylbenzene	0.4	µg/L	0.002	mg/kg
	Naphthalene	0.4	µg/L	0.002	mg/kg
	o-Xylene	1.1	µg/L	0.005	mg/kg
	p-Isopropyltoluene	1.2	µg/L	0.006	mg/kg
	p-Xylene	1.3	µg/L	0.007	mg/kg
	Sec-Butylbenzene	1.3	µg/L	0.007	mg/kg
	Styrene	0.4	µg/L	0.002	mg/kg
	TCE	1.0	µg/L	0.01	mg/kg
	Tert-Butylbenzene	1.4	µg/L	0.007	mg/kg
	Tetrachloroethene	1.4	µg/L	0.007	mg/kg
	Toluene	1.1	µg/L	0.005	mg/kg
	Trans-1,2-DCE	0.6	µg/L	0.003	mg/kg
	Trans-1,3-Dichloropropene	1.0	µg/L	0.005	mg/kg
	Trichlorofluoromethane	0.8	µg/L	0.004	mg/kg
	Vinyl chloride	1.1	µg/L	0.009	mg/kg

7.2.14-2

QC Acceptance Criteria for Method SW8260A*

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	
SW8260A	1,1,1-TCA	75-125	≤ 20	65-135	≤ 30	
	1,1,2-TCA	75-127	≤ 20	65-135	≤ 30	
	1,1-DCA	72-125	≤ 20	62-135	≤ 30	
	1,1-DCE	75-125	≤ 20	65-135	≤ 30	
	1,2,3-Trichlorobenzene	75-137	≤ 20	65-147	≤ 30	
	1,2,4-Trichlorobenzene	75-135	≤ 20	65-145	≤ 30	
	1,2,4-Trimethyl Benzene	75-125	≤ 20	65-135	≤ 30	
	1,2-DCB	75-125	≤ 20	65-135	≤ 30	
	1,3,5-Trimethylbenzene	72-112	≤ 20	62-135	≤ 30	
	1,3-DCB	75-125	≤ 20	65-135	≤ 30	
	1,4-DCB	75-125	≤ 20	65-135	≤ 30	
	Benzene	75-125	≤ 20	65-135	≤ 30	
	Cis-1,2-DCE	75-125	≤ 20	65-135	≤ 30	
	Ethylbenzene	75-125	≤ 20	65-135	≤ 30	
	m-Xylene	75-125	≤ 20	65-135	≤ 30	
	Methylene chloride	75-125	≤ 20	65-135	≤ 30	
	o-Xylene	75-125	≤ 20	65-135	≤ 30	
	p-Xylene	75-125	≤ 20	65-135	≤ 30	
	TCE	71-125	≤ 20	61-135	≤ 30	
	Tetrachloroethene	71-125	≤ 20	61-135	≤ 30	
	Toluene	74-125	≤ 20	64-135	≤ 30	
	Trans-1,2-DCE	75-125	≤ 20	65-135	≤ 30	
	Vinyl Chloride	46-134	≤ 20	36-144	≤ 30	
	<i>Surrogates:</i>					
		Dibromofluoromethane	75-125		65-135	
		Toluene-D8	75-125		65-135	
		4-Bromofluorobenzene	75-125		65-135	
		1,2-DCA-D4	62-139		52-149	

*This list of compounds was reduced to include those likely to be associated with site-specific conditions. If necessary the list should be expanded to include other compounds depending on project-specific needs.

TABLE 7.2.14-3
Summary of Calibration and QC Procedures for Method SW8260A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW8260A	Volatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF ≥ 0.30 ; and %RSD for all calibration analytes $\leq 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Calibration verification	Daily, before sample analysis, every 12 hours of analysis time, and at end of analysis sequence	SPCCs average RF ≥ 0.30 ; and CCCs $< 20\%$ drift; and all calibration analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.14-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 7.2.14)	Retune instrument and verify	Apply R to all results for all samples associated with the tune
	ISs		Immediately after or during data acquisition of calibration check standard	Retention time ± 30 seconds; EICP area within -50% to $+100\%$ of last calibration verification (12 hours) for each	Inspect mass spectrometry or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply J to all results for specific analytes for all samples associated with the IS

TABLE 7.2.14-3
 Summary of Calibration and QC Procedures for Method SWB260A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.14-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEB analytical batch	Flagging Conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.14-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.14-2	none	Flagging Conventions, Table 8.2-2
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.14-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
 *Except > 0.10 for bromoform, and > 0.01 for chloromethane and 1,1-dichloroethane

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7.2.15 Method SW8270B-Semivolatile Organics

Semivolatile organics (also known as base/neutral and acid extractables) in water and soil samples are analyzed using method SW8270B. This technique determines quantitatively the concentration of a number of SVOCs. Aqueous samples are prepared using method SW3510B, solid samples are prepared by method SW3550A. Samples are extracted and both base/neutral and acid extracts are then concentrated through evaporation. Compounds of interest are separated and quantified using a capillary column GC/mass spectrometer. The PQLs are listed in Table 7.2.15-1.

The mass spectrometer is tuned every 12 hours to give an acceptable spectrum for decafluorotriphenylphosphine (DFTPP). The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- 51-30 percent to 60 percent of mass 198
- 68-less than 2 percent of mass 69
- 70-less than 2 percent of mass 69
- 127-40 percent to 60 percent of mass 198
- 197-less than 1 percent of mass 198
- 198-base peak, 100 percent relative abundance
- 199-5 percent to 9 percent of mass 198
- 275-10 percent to 30 percent of mass 198
- 365-greater than 1 percent of mass 198
- 441-present, but less than mass 443
- 442-greater than 40 percent of mass 198
- 443-17 percent to 23 percent of mass 442

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS that is added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.15-2 and 7.2.15-3.

TABLE 7.2.15-1
PQLs for Method SW8270B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Semivolatile organics	1,2,4-Trichlorobenzene	10.0	µg/L	0.7	mg/kg
Base/Neutral Extractables	1,2-DCB	10.0	µg/L	0.7	mg/kg
SW3510B/SW8270B (W)	1,3-DCB	10.0	µg/L	0.7	mg/kg
SW3550A/SW8270B (S)	1,4-DCB	10.0	µg/L	0.7	mg/kg
	2,4-DNT	10.0	µg/L	0.7	mg/kg
	2,6-DNT	10.0	µg/L	0.7	mg/kg
	2-Chloronaphthalene	10.0	µg/L	0.7	mg/kg
	2-Methylnaphthalene	10.0	µg/L	0.7	mg/kg
	2-Nitroaniline	50.0	µg/L	3.3	mg/kg
	3-Nitroaniline	50.0	µg/L	3.3	mg/kg
	3,3'-Dichlorobenzidine	20.0	µg/L	1.3	mg/kg
	4-Bromophenyl phenyl ether	10.0	µg/L	0.7	mg/kg
	4-Chloroaniline	20.0	µg/L	1.3	mg/kg

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TABLE 7.2.15-1
PQLs for Method SW8270B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
	4-Chlorophenyl phenyl ether	10.0	µg/L	0.7	mg/kg
	4-Nitroaniline	50.0	µg/L	3.3	mg/kg
	Acenaphthylene	10.0	µg/L	0.7	mg/kg
	Acenaphthene	10.0	µg/L	0.7	mg/kg
	Anthracene	10.0	µg/L	0.7	mg/kg
	Benz (a) anthracene	10.0	µg/L	0.7	mg/kg
	Benzo (a) pyrene	10.0	µg/L	0.7	mg/kg
	Benzo (b) fluoranthene	10.0	µg/L	0.7	mg/kg
	Benzo (g,h,i) perylene	10.0	µg/L	0.7	mg/kg
	Benzyl alcohol	20.0	µg/L	1.3	mg/kg
	Bis (2-chloroethoxy) methane	10.0	µg/L	0.7	mg/kg
	Bis (2-chlorethyl) ether	10.0	µg/L	0.7	mg/kg
	Bis (2-chloroisopropyl) ether	10.0	µg/L	0.7	mg/kg
	Bis (2-ethylhexyl) phthalate	10.0	µg/L	0.7	mg/kg
	Butyl benzylphthalate	10.0	µg/L	0.7	mg/kg
	Chrysene	10.0	µg/L	0.7	mg/kg
	Di-n-butylphthalate	10.0	µg/L	0.7	mg/kg
	Di-n-octylphthalate	10.0	µg/L	0.7	mg/kg
	Dibenz (a,h) anthracene	10.0	µg/L	0.7	mg/kg
	Dibenzofuran	10.0	µg/L	0.7	mg/kg
	Diethyl phthalate	10.0	µg/L	0.7	mg/kg
	Dimethyl phthalate	10.0	µg/L	0.7	mg/kg
	Fluoranthene	10.0	µg/L	0.7	mg/kg
	Fluorene	10.0	µg/L	0.7	mg/kg
	Hexachlorobenzene	10.0	µg/L	0.7	mg/kg
	Hexachlorobutadiene	10.0	µg/L	0.7	mg/kg
	Hexachlorocyclopentadiene	10.0	µg/L	0.7	mg/kg
	Hexachloroethane	10.0	µg/L	0.7	mg/kg
	Indeno (1,2,3-cd) pyrene	10.0	µg/L	0.7	mg/kg
	Isophorone	10.0	µg/L	0.7	mg/kg
	n-Nitrosodiphenylamine	10.0	µg/L	0.7	mg/kg
	n-Nitrosodi-n-propylamine	10.0	µg/L	0.7	mg/kg
	Naphthalene	10.0	µg/L	0.7	mg/kg
	Nitrobenzene	10.0	µg/L	0.7	mg/kg
	Phenanthrene	10.0	µg/L	0.7	mg/kg
	Pyrene	10.0	µg/L	0.7	mg/kg
	2,4,5-Trichlorophenol	50.0	µg/L	3.3	mg/kg
	2,4,6-Trichlorophenol	10.0	µg/L	0.3	mg/kg
	2,4-Dichlorophenol	10.0	µg/L	0.3	mg/kg
	2,4-Dimethylphenol	10.0	µg/L	0.3	mg/kg
	2,4-Dinitrophenol	50.0	µg/L	3.3	mg/kg
	2-Chlorophenol	10.0	µg/L	0.3	mg/kg
	2-Methylphenol	10.0	µg/L	0.3	mg/kg
	2-Nitrophenol	10.0	µg/L	0.3	mg/kg
	4,6-Dinitro-2-methylphenol	50.0	µg/L	3.3	mg/kg
	4-Chloro-3-methylphenol	20.0	µg/L	1.3	mg/kg
	4-Methylphenol	10.0	µg/L	0.3	mg/kg
	4-Nitrophenol	50.0	µg/L	1.6	mg/kg
	Benzoic acid	50.0	µg/L	1.6	mg/kg

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TABLE 7.2.15-1
PQLs for Method SW8270B

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
	Pentachlorophenol	50.0	µg/L	3.3	mg/kg
	Phenol	10.0	µg/L	0.3	mg/kg

7.2.15-2
QC Acceptance Criteria for Method SW8270B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	
SW8270B	Acenaphthylene	47-125	≤ 20	37-135	≤ 30	
	Acenaphthene	49-125	≤ 20	39-135	≤ 30	
	Anthracene	45-165	≤ 20	35-175	≤ 30	
	Benz (a) anthracene	51-133	≤ 20	41-143	≤ 30	
	Benzo (a) pyrene	41-125	≤ 20	31-135	≤ 30	
	Benzo (b) fluoranthene	37-125	≤ 20	27-135	≤ 30	
	Chrysene	55-133	≤ 20	45-143	≤ 30	
	Dibenz (a,h) Anthracene	50-125	≤ 20	40-135	≤ 30	
	Indeno (1,2,3-c,d) Pyrene	27-160	≤ 20	25-170	≤ 30	
	Naphthalene	50-125	≤ 20	40-135	≤ 30	
	Phenanthrene	54-125	≤ 20	44-135	≤ 30	
	Pyrene	47-136	≤ 20	37-146	≤ 30	
	<i>Surrogates:</i>					
		2,4,6-Tribromophenol	25-134		25-144	
	2-Fluorobiphenyl	43-125		34-135		
	2-Fluorophenol	25-125		25-135		
	Nitrobenzene-D5	32-125		25-135		
	Phenol-D5	25-125		25-135		
	Terphenyl-D14	42-126		32-136		

TABLE 7.2.15-3
Summary of Calibration and QC Procedures for Method SW8270B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
SW8270B	Semivolatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF ≥ 0.05 ; and %RSD for all calibration analytes $\leq 30\%$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Calibration verification	Daily, before sample analysis, every 12 hours of analysis time, and at end of analysis sequence	SPCCs average RF ≥ 0.05 ; and CCCs $< 20\%$ drift; analytes within $\pm 25\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.15-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 7.2.15)	Return instrument and verify	Apply R to all results for all samples associated with the tune
	ISs		Immediately after or during data acquisition of calibration check standard	Retention time ± 30 seconds; EICP area within -50% to $+100\%$ of last calibration verification (12 hours) for each	Inspect mass spectrometry or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply J to all results for specific analytes for all samples associated with the IS

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TABLE 7.2.15-3
 Summary of Calibration and QC Procedures for Method SW8270B

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
		Method blank	One per analytical batch	No analytes detected > IQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.15-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.15-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.15-2	none	Flagging Conventions, Table 8.2-2
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.15-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

^aAll corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

^bFlagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.16 Method SW8280-Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans

Method SW8280 is used to analyze for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in water, soil, and waste. This GC/MS method uses matrix-specific extraction, analyte-specific cleanup, and high-resolution capillary column GC/low resolution mass spectrometry techniques to separate and identify the analytes of interest. The sensitivity of the method is dependent on the level of matrix interference. Selected cleanup methods may be used to reduce or eliminate interferences. Target analytes include all congener classes, tetra- through octa-dioxins and furans. Achieved detection limits vary according to matrix and analyte. Because of the extreme toxicity of these compounds, the analyst must take appropriate precautions during preparation and analysis to prevent accidental exposure. PQLs are presented in Table 7.2.16-1.

A tetrachlorinated dibenzo-p-dioxin (TCDD) chromatographic test mixture is analyzed daily to verify that there is at least 25 percent valley resolution between 2,3,7,8 TCDD and 1,2,3,4 TCDD. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.16-2 and 7.2.16-3.

TABLE 7.2.16-1
PQLs for Method SW8280

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Dioxins and Furans SW8280 (W, S)	2,3,7,8-TCDD	4.4	ng/L	1.7	µg/kg
	2,3,7,8-TCDF	1.0	ng/L	1.1	µg/kg

TABLE 7.2.16-2
QC Acceptance Criteria for Method SW8280

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8280	2,3,7,8-TCDD	50-140	≤ 30	56-140	≤ 50
	2,3,7,8-TCDF	50-140	≤ 30	50-140	≤ 50
<i>Surrogates:</i>					
	C13-2,3,7,8-TCDF	40-125		30-135	
	C13-2,3,7,8-TCDD	40-125		30-135	

TABLE 7.2.16-3
Summary of Calibration and QC Procedures for Method SW8280

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action ^a	Flagging Criteria ^b
SW8280	Dioxins/ Furans	Check mass spectral ion intensity	Prior to each initial calibration	See footnote c	Retune instrument; verify	Apply R to all results associated with the tune
		Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD ≤15% for cis or Rf's	Correct problem then repeat initial calibration	Apply R to the result for the specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and verification	±3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to the result for the specific analyte(s) in the sample
		Column performance check	Prior to sample analysis, at the beginning of every 12-hour period, and at the end of the final run period	A ≤25% valley between 1,2,3,4-TCDD and 2,3,7,8-TCDD	Correct problem then repeat until criteria are met	Apply R to all tetra isomers if valley is > 5%
		Calibration verification (500 ng/mL standard)	As part of initial calibration and at the beginning of each 12-hour period	RF within 30% (RPD) of average initial multipoint RF; isotope ratios in agreement with footnote c	Correct problem then repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification	Apply R to the result for the specific analyte(s) for all samples associated with the calibration
		Sensitivity check (200 ng/mL standard)	As part of initial calibration and at the beginning of each 12-hour period	S/N for 2,3,7,8-TCDD standard ≥ 50:1	Correct problem then repeat initial calibration and reanalyze all samples analyzed since the last successful sensitivity check	Quality as estimated (J, UJ) for all analytes if S/N is ≤ 50:1
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.16-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to the specific analyte(s) result for all samples analyzed by the analyst

TABLE 7.2.16-3
 Summary of Calibration and QC Procedures for Method SW8280

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.16-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.16-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.16-2	none	Flagging Conventions, Table 8.2-2
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.1-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
SW8280	Dioxins/Furans	Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

PCDDs	Selected Ions (m/z)	Relative Intensity	PCDFs	Selected Ions (m/z)	Relative Intensity
Tetra	320/322	0.65-0.89	Tetra	304/306	0.65-0.89
Penta	358/356	0.55-0.75	Penta	342/340	0.55-0.75
Hexa	392/390	0.69-0.93	Hexa	376/374	0.69-0.93
Hepta	426/424	0.83-1.12	Hepta	410/408	0.83-1.12
Octa	458/460	0.75-1.01	Octa	442/444	0.75-1.01

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 †Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
 ‡The acceptance criteria for spectral ion intensities are given below:

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7.2.17 Method SW8310—Polynuclear Aromatic Hydrocarbons

Method SW8310 is used to determine the concentration of ppb levels of selected polynuclear aromatic hydrocarbons (PAHs) in groundwater and soils by HPLC. Aqueous samples are prepared using method SW3510B, solid samples are prepared by method SW3550A. Samples are analyzed by direct injection. Detection is by ultraviolet and fluorescent detectors. PQLs are listed in Table 7.2.17-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.17-2 and 7.2.17-3.

TABLE 7.2.17-1
PQLs for Method SW8310

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Polynuclear Aromatic Hydrocarbons SW3510B/SW8310 (W) SW3550A/SW8310 (S)	Acenaphthene	18.0	µg/L	1.2	mg/kg
	Acenaphthylene	23.0	µg/L	1.54	mg/kg
	Anthracene	6.6	µg/L	0.44	mg/kg
	Benzo (a) anthracene	0.13	µg/L	0.009	mg/kg
	Benzo (a) pyrene	0.23	µg/L	0.015	mg/kg
	Benzo (b) fluoranthene	0.18	µg/L	0.012	mg/kg
	Benzo (g,h,i) perylene	0.76	µg/L	0.05	mg/kg
	Benzo (k) fluoranthene	0.17	µg/L	0.011	mg/kg
	Chrysene	1.5	µg/L	0.1	mg/kg
	Dibenzo (a,h) anthracene	0.3	µg/L	0.02	mg/kg
	Fluoranthrene	2.1	µg/L	0.14	mg/kg
	Fluorene	2.1	µg/L	0.14	mg/kg
	Indeno (1,2,3-c,d) pyrene	0.43	µg/L	0.03	mg/kg
	Naphthalene	18.0	µg/L	1.2	mg/kg
	Phenanthrene	6.4	µg/L	0.42	mg/kg
	Pyrene	2.7	µg/L	0.18	mg/kg
	Acenaphthalene	49-125	≤ 30	39-135	≤ 50
	Acenaphthene	43-130	≤ 30	33-140	≤ 50
	Anthracene	54-125	≤ 30	44-135	≤ 50
	Benzo (a) Anthracene	39-135	≤ 30	29-145	≤ 50
Benzo (a) Pyrene	52-125	≤ 30	42-135	≤ 50	
Benzo (b) Fluoranthene	31-137	≤ 30	25-147	≤ 50	
Benzo (g,h,i) Perylene	53-125	≤ 30	43-135	≤ 50	
Benzo (k) Fluoranthene	60-129	≤ 30	50-139	≤ 50	
Chrysene	59-134	≤ 30	49-144	≤ 50	
Dibenzo (a,h) Anthracene	51-125	≤ 30	41-135	≤ 50	
Fluoranthene	42-125	≤ 30	32-135	≤ 50	
Fluorene	53-125	≤ 30	43-135	≤ 50	
Indeno (1,2,3-c,d) Pyrene	55-125	≤ 30	45-135	≤ 50	
Naphthalene	43-125	≤ 30	33-135	≤ 50	
Phenathrene	52-129	≤ 30	42-139	≤ 50	
Pyrene	55-125	≤ 30	45-135	≤ 50	
<i>Surrogates:</i>					
	Terphenyl-D14	25-157		22-167	

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TABLE 7.2.17-3
 Summary of Calibration and QC Procedures for Method SW8310

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
SW8310	PAHs	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD < 20% for cis or Rf	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and verification	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.17-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2

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TABLE 7.2.17-3
 Summary of Calibration and QC Procedures for Method SW8310

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.17-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEB analytical batch	Flagging Conventions, Table 8.2-2
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.17-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.17-2	none	Flagging Conventions, Table 8.2-2
		Confirmation [†]	100% for all positive results	Same as for initial or primary analysis	Same as for initial or primary analysis	Apply R to the result for the specific analyte(s) in the sample
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.17-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

†Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

‡Use a second column or different detector

7.2.18 Method SW8330—Explosive Residues

Method SW8330 provides HPLC conditions for the detection of ppb levels of certain explosive residues in a water, soil, and sediment matrix. Prior to using this method, appropriate sample preparation techniques must be used.

In the low-level, salting-out method with no evaporation, aqueous samples of low concentration are extracted by a salting-out extraction procedure. An aliquot of the extract is separated on a C-18 reverse-phase column, determined at 254 nm, and confirmed on a cyanide reverse-phase column.

In the high-level direct injection method, aqueous samples of higher concentration can be diluted, filtered, separated on a C-18 reverse-phase column, determined at 254 nm, and confirmed on a cyanide reverse-phase column.

Soil and sediment samples are extracted in an ultrasonic bath and filtered before chromatography.

PQLs are listed in Table 7.2.18-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.18-2 and 7.2.18-3.

TABLE 7.2.18-1
PQLs for Method SW8330

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Explosive Residues SW8330	1,3,5- TNB	7.3	µg/L	0.25	mg/kg
	1,3- DNB	4.0	µg/L	0.25	mg/kg
	2,4,6- TNT	6.9	µg/L	0.25	mg/kg
	2,4-DNT	5.7	µg/L	0.25	mg/kg
	2,6-DNT	9.4	µg/L	0.26	mg/kg
	HMX	13.0	µg/L	2.2	mg/kg
	m-Nitrotoluene	7.9	µg/L	0.25	mg/kg
	Methyl-2,4,6-trinitrophenylnitramine	44.0	µg/L	0.65	mg/kg
	Nitrobenzene	7.0	µg/L	0.26	mg/kg
	o-Nitrotoluene	12.0	µg/L	0.25	mg/kg
	p-Nitrotoluene	8.5	µg/L	0.25	mg/kg
	RDX	14.0	µg/L	1.0	mg/kg
	1,3,5-TNB	75-142	≤ 30	65-152	≤ 50
	1,3-DNB	75-125	≤ 30	65-135	≤ 50
	2,4,6-TNT	75-128	≤ 30	65-138	≤ 50
	2,4-DNT	75-125	≤ 30	65-135	≤ 50
	2,6-DNT	75-129	≤ 30	65-139	≤ 50
	HMX	74-137	≤ 30	64-147	≤ 50
	m-Nitrotoluene	60-134	≤ 30	50-144	≤ 50
Methyl-2,4,6-Trinitrophenylnitramine	44-142	≤ 30	34-152	≤ 50	
Nitrobenzene	29-134	≤ 30	25-144	≤ 50	

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TABLE 7.2.18-1
PQLs for Method SW8330

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
	o-Nitrotoluene	75-129	≤ 30	65-139	≤ 50
	p-Nitrotoluene	42-150	≤ 30	32-160	≤ 50
	RDX	75-132	≤ 30	65-142	≤ 50

Surrogates:

*Use an analyte and its LCS limit from the method that is not expected to be present in the sample as the surrogate.

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Table 7.2.18-3
 Summary of Calibration and QC Procedures for Method SW8330

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
SW8330	Explosives	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	RSD < 20% for cfs or RPs	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per five-point initial calibration	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and calibration verifications	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.18-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-2

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Table 7.2.18-3
Summary of Calibration and QC Procedures for Method SW8330

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.18-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-2
	Surrogate spike		Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 7.2.18-2	Correct problem then reextract and analyze sample	Flagging Conventions, Table 8.2-2
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.18-2	none	Flagging Conventions, Table 8.2-2
	Confirmation ¹		100% for all positive results	Same as for initial or primary analysis	Same as for initial or primary analysis	Apply R to the result for the specific analyte(s) in the sample
	MDL study		Once per year *	Detection limits established shall be < the PQLs in Table 7.2.18-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and PQL		none	none	none	Apply F to all results between MDL and PQL

* All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
¹Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
²Use a second column or different detector

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7.2.19 Method SW6010A-Trace Elements (Metals) by Inductively Coupled Plasma Emission Spectroscopy for Water and Soil

Samples are analyzed for trace elements or metals using method SW6010A for water and soils. Analysis for most metals requires digestion of the sample. This digestion is performed by method SW3005A for water or method SW3050A for soil. Following digestion, the trace elements are determined simultaneously or sequentially using (Inductively Coupled Plasma Emission Spectroscopy) ICPEs. The elements and corresponding PQLs for this method are listed in Table 7.2.19-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.19-2 and 7.2.19-3.

TABLE 7.2.19-1
PQLs for Method SW6010A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
ICP Screen for Metals	Aluminum	0.5	mg/L	50.0	mg/kg
SW3005A/SW6010A (W)	Antimony	0.4	mg/L	40.0	mg/kg
SW3050A/SW6010A (S)	Arsenic	0.6	mg/L	60.0	mg/kg
	Barium	0.02	mg/L	2.0	mg/kg
	Beryllium	0.003	mg/L	0.3	mg/kg
	Cadmium	0.04	mg/L	4.0	mg/kg
	Calcium	0.1	mg/L	10.0	mg/kg
	Chromium	0.07	mg/L	7.0	mg/kg
	Cobalt	0.07	mg/L	7.0	mg/kg
	Copper	0.06	mg/L	6.0	mg/kg
	Iron	0.07	mg/L	7.0	mg/kg
	Lead	0.5	mg/L	50.0	mg/kg
	Magnesium	0.3	mg/L	30.0	mg/kg
	Manganese	0.02	mg/L	2.0	mg/kg
	Molybdenum	0.08	mg/L	8.0	mg/kg
	Nickel	0.15	mg/L	15.0	mg/kg
	Potassium	5.0	mg/L	500.0	mg/kg
	Selenium	0.8	mg/L	80.0	mg/kg
	Silver	0.07	mg/L	7.0	mg/kg
	Sodium	0.3	mg/L	30.0	mg/kg
	Thallium	0.4	mg/L	40.0	mg/kg
	Vanadium	0.08	mg/L	8.0	mg/kg
	Zinc	0.02	mg/L	2.0	mg/kg

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TABLE 7.2.19-2
QC Acceptance Criteria for Method SW6010A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW6010A	Aluminum	80-120	≤ 15	80-120	≤ 25
	Antimony	80-120	≤ 15	80-120	≤ 25
	Arsenic	80-120	≤ 15	80-120	≤ 25
	Barium	80-120	≤ 15	80-120	≤ 25
	Beryllium	80-120	≤ 15	80-120	≤ 25
	Cadmium	80-120	≤ 15	80-120	≤ 25
	Calcium	80-120	≤ 15	80-120	≤ 25
	Chromium	80-120	≤ 15	80-120	≤ 25
	Cobalt	80-120	≤ 15	80-120	≤ 25
	Copper	80-120	≤ 15	80-120	≤ 25
	Iron	80-120	≤ 15	80-120	≤ 25
	Lead	80-120	≤ 15	80-120	≤ 25
	Magnesium	80-120	≤ 15	80-120	≤ 25
	Manganese	80-120	≤ 15	80-120	≤ 25
	Molybdenum	80-120	≤ 15	80-120	≤ 25
	Nickel	80-120	≤ 15	80-120	≤ 25
	Potassium	80-120	≤ 15	80-120	≤ 25
	Selenium	80-120	≤ 15	80-120	≤ 25
	Silver	80-120	≤ 15	80-120	≤ 25
	Sodium	80-120	≤ 15	80-120	≤ 25
Thallium	80-120	≤ 15	80-120	≤ 25	
Vanadium	80-120	≤ 15	80-120	≤ 25	
Zinc	80-120	≤ 15	80-120	≤ 25	

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7.2.19-3
 Summary of Calibration QC Procedures for Method SW6010A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
SW6010A	ICP Metals	Initial multipoint calibration (minimum 3 standards and a blank) Highest calibration standard	Daily initial calibration prior to sample analysis Before beginning a sample run	Correlation coefficient ≥ 0.995 for linear regression All analytes within $\pm 5\%$ of expected value	Correct problem then repeat initial calibration Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration blank	After every 10 samples and at end of the analysis sequence	No analytes detected > PQL	Correct problem then analyze calibration blank and previous 10 samples	Apply B to all results for specific analyte(s) in all samples associated with the blank
		Continuing calibration verification (Instrument Check Standard)	After every 10 samples and at the end of the analysis sequence	All analyte(s) within $\pm 10\%$ of expected value	Repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.19-2	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		Interference check solution (ICS)	At the beginning and end of an analytical run or twice during an 8 hour period, whichever is more frequent	Within $\pm 20\%$ of expected value	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples	Flagging Conventions, Table 8.2-3

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Summary of Calibration QC Procedures for Method SW6010A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.19-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-3
	Dilution test		Each new sample matrix	1:4 dilution must agree within $\pm 10\%$ of the original determination	Perform post digestion spike addition	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
	Post digestion spike addition		When dilution test fails	Recovery within 75-125% of expected results	Correct problem then reanalyze post digestion spike addition	Apply J to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post digestion spike addition Flagging Conventions, Table 8.2-3
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.19-2	none	
	MDL study		Once per year	Detection limits established shall be < the FQLs in Table 7.2.19-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and FQL		none	none	none	Apply F to all results between MDL and FQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
*Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.20 Method SW6020-Trace Elements (Metals) by Inductively Coupled Plasma Mass Spectroscopy for Water and Soil

Samples are analyzed for trace elements or metals using method SW6020 for water and soils. Analysis for total (i.e., acid leachable) metals requires digestion of the sample by method SW3005A for water or method SW3050A for soil. Following digestion, the trace elements are determined simultaneously or sequentially using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). The elements and PQLs for this method are listed in Table 7.2.20-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.20-2 and 7.2.20-3.

TABLE 7.2.20-1
PQLs for Method SW6020

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
ICP Screen for Metals	Aluminum	0.0004	mg/L	50.0	mg/kg
SW3005A/SW6020 (W)	Antimony	0.4	mg/L	40.0	mg/kg
SW3050A/SW6020 (S)	Arsenic	0.6	mg/L	60.0	mg/kg
	Barium	0.02	mg/L	2.0	mg/kg
	Beryllium	0.003	mg/L	0.3	mg/kg
	Cadmium	0.04	mg/L	4.0	mg/kg
	Chromium	0.07	mg/L	7.0	mg/kg
	Cobalt	0.07	mg/L	7.0	mg/kg
	Copper	0.06	mg/L	6.0	mg/kg
	Lead	0.5	mg/L	50.0	mg/kg
	Magnesium	0.3	mg/L	30.0	mg/kg
	Manganese	0.02	mg/L	2.0	mg/kg
	Nickel	0.15	mg/L	15.0	mg/kg
	Silver	0.07	mg/L	7.0	mg/kg
	Thallium	0.4	mg/L	40.0	mg/kg
	Zinc	0.02	mg/L	2.0	mg/kg

TABLE 7.2.20-2
QC Acceptance Criteria for Method SW6020

Method	Analyte	Accuracy	Precision	Accuracy	Precision
		Water (% R)	Water (% RPD)	Soil (% R)	Soil (% RPD)
SW6020	Aluminum	80-120	≤ 15	80-120	≤ 25
	Antimony	80-120	≤ 15	80-120	≤ 25
	Arsenic	80-120	≤ 15	80-120	≤ 25
	Barium	80-120	≤ 15	80-120	≤ 25
	Beryllium	80-120	≤ 15	80-120	≤ 25
	Cadmium	80-120	≤ 15	80-120	≤ 25
	Chromium	80-120	≤ 15	80-120	≤ 25
	Cobalt	80-120	≤ 15	80-120	≤ 25
	Copper	80-120	≤ 15	80-120	≤ 25
	Lead	80-120	≤ 15	80-120	≤ 25
	Manganese	80-120	≤ 15	80-120	≤ 25
	Nickel	80-120	≤ 15	80-120	≤ 25
	Silver	80-120	≤ 15	80-120	≤ 25

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TABLE 7.2.20-2
QC Acceptance Criteria for Method SW6020

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
	Thallium	80-120	≤ 15	80-120	≤ 25
	Zinc	80-120	≤ 15	80-120	≤ 25

TABLE 7.2.20-3
 Summary of Calibration and QC Procedures for Method SW6020

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
SW6020	ICP/MS Metals	MS tuning sample	Prior to initial calibration and calibration verification	RSD $\leq 5\%$ for all analytes	Retune instrument then reanalyze tuning solution	Apply R to all results for all analytes for all samples associated with the MS tuning
		Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Calibration blank	Before beginning a sample run, after every 10 samples and at the end of the analysis sequence	No analytes detected > PQL	Correct problem then analyze calibration blank and previous 10 samples	Flagging Conventions, Table 8.2-3
		Continuing calibration verification (Instrument Check Standard)	Before beginning a sample run, after every 10 samples and at the end of the analysis sequence	All analyte(s) within $\pm 10\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.20-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		Interference check solution (ICS)	At the beginning and end of an analytical run or twice during an 12 hour period, whichever is more frequent	Within $\pm 20\%$ of expected value	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all affected samples	Flagging Conventions, Table 8.2-3

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TABLE 7.2.20-3
 Summary of Calibration and QC Procedures for Method SW6020

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.20-2	Correct problem reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-3
	Dilution test		Each new sample matrix	1:4 dilution must agree within $\pm 10\%$ of the original determination	Perform post digestion spike addition	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
	Post digestion spike addition		When dilution test fails	Recovery within 75-125% of expected results	Dilute the sample; reanalyze post digestion spike addition	Apply J to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post digestion spike addition Flagging Conventions, Table 8.2-3
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.20-2	none	
	Internal Standards (ISs)		Every sample	IS intensity within 30-120% of intensity of the IS in the initial calibration	Perform corrective action as described in method SW6020	Apply R to all results for specific analyte(s) in all samples associated with the IS.
	MDL study		Every three months	Detection limits established shall be < the PQLs in Table 7.2.20-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and PQL		none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.21 Method SW7041—Graphite Furnace Atomic Absorption (Antimony)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3005A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the antimony. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.21-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.21-2 and 7.2.21-3.

TABLE 7.2.21-1
PQLs for Method 7041

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3050A/SW7041 (W)	Antimony	0.005	mg/L	0.5	mg/kg
SW3050A/SW7041 (S)					

TABLE 7.2.21-2
QC Acceptance Criteria for Method SW7041

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7041	Antimony	75-125	≤ 15	75-125	≤ 15

TABLE 7.2.21-3
 Summary of Calibration QC Procedures for Method SW7041

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
SW7041	Antimony	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Flagging Conventions, Table 8.2-3
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.21-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.21-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEB analytical batch	Flagging Conventions, Table 8.2-3
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$

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TABLE 7.2.21-3
 Summary of Calibration QC Procedures for Method SW7041

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria†
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.21-2	none	Flagging Conventions, Table 8.2-3
	MDL study		Once per year	Detection limits established shall be < the PQLs in Table 7.2.21-1	none	Apply R to all results for the specific analyte in all samples analyzed
	Results reported between MDL and PQL		none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.

†Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.22 Method SW7060A-Graphite Furnace Atomic Absorption (Arsenic)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using procedures described in the method or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the arsenic. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.22-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.22-2 and 7.2.22-3.

TABLE 7.2.22-1
PQLs for Method SW7060A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7060A (W)	Arsenic	0.005	mg/L	0.5	mg/kg
SW3050A/SW7060A (S)					

TABLE 7.2.22-2
QC Acceptance Criteria for Method SW7060A

Method	Analyte	Accuracy	Precision	Accuracy	Precision
		Water	Water	Soil	Soil
		(% R)	(% RPD)	(% R)	(% RPD)
SW7060A	Arsenic	74-120	≤ 15	74-120	≤ 15

TABLE 7.2.22-3
 Summary of Calibration and QC Procedures for Method SW7060A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW7060A	Arsenic	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Flagging Conventions, Table 8.2-3
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.22-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.22-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-3

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TABLE 7.2.22-3
 Summary of Calibration and QC Procedures for Method SW7060A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range Flagging Conventions, Table 6.2-3
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.22-2	none	
	MDL study		Once per year	Detection limits established shall be $<$ the PQLs in Table 7.2.22-1	none	Apply R to all results for the specific analyte in all samples analyzed
	Results reported between MDL and PQL		none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.23 Method SW7131A--Graphite Furnace Atomic Absorption (Cadmium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the Cadmium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.23-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.23-2 and 7.2.23-3.

TABLE 7.2.23-1
PQLs for Method SW7131A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7131A (W)	Cadmium	0.001	mg/L	0.1	mg/kg
SW3050A/SW7131A (S)					

TABLE 7.2.23-2
QC Acceptance Criteria for Method SW7131A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7131A	Cadmium	80-122	≤ 15	80-122	≤ 15

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TABLE 7.2.23-3
 Summary of Calibration and QC Procedures for Method SW7131A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW7131A	Cadmium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Flagging Conventions, Table 8.2-3
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.23-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.23-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEB analytical batch	Flagging Conventions, Table 8.2-3

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TABLE 7.2.23-3
 Summary of Calibration and QC Procedures for Method SW7131A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.23-2	none	Flagging Conventions, Table 8.2-3
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.23-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.24 Method SW7191—Graphite Furnace Atomic Absorption (Chromium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the chromium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.24-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.24-2 and 7.2.24-3.

TABLE 7.2.24-1
 PQLs for Method SW7191

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7191 (W)	Chromium	0.005	mg/L	0.5	mg/kg
SW3050A/SW7191 (S)					

TABLE 7.2.24-2
 QC Acceptance Criteria for Method SW7191

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7191	Chromium	80-121	≤ 15	80-121	≤ 15

TABLE 7.2.24-3
 Summary of Calibration and QC Procedures for Method SW7191

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
SW7191	Chromium	Initial multipoint calibration (minimum 3 standards and a blank) Second-source calibration check standard Calibration blank	Daily initial calibration prior to sample analysis Once per initial daily multipoint calibration Once per initial daily multipoint calibration	Correlation coefficient ≥ 0.995 for linear regression Analyte within $\pm 10\%$ of expected value No analyte detected > PQL	Correct problem then repeat initial calibration Correct problem then repeat initial calibration Correct problem then reanalyze calibration blank and all samples associated with blank	Apply R to all results for specific analyte for all samples associated with the calibration Apply R to all results for specific analyte for all samples associated with the calibration Flagging Conventions, Table 8.2-3
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.24-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.24-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-3
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$

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TABLE 7.2.24-3
 Summary of Calibration and QC Procedures for Method SW7191

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.24-2	none	Flagging Conventions, Table 8.2-3
	MDL study		Once per year	Detection limits established shall be < the PQLs in Table 7.2.24-1	none	Apply R to all results for the specific analyte in all samples analyzed
	Results reported between MDL and PQL		none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.25 Method SW7196-Hexavalent Chromium (Colorimetric)

Dissolved hexavalent chromium, in the absence of interfering amounts of substances such as molybdenum, vanadium, and mercury, may be determined colorimetrically. PQLs for this method are listed in Table 7.2.25-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.25-2 and 7.2.25-3.

TABLE 7.2.25-1
 PQLs for Method SW7196

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7196	Hexavalent Chromium	0.5	mg/L	1.0	mg/kg

TABLE 7.2.25-2
 QC Acceptance Criteria for Method SW7196

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7196	Hexavalent Chromium	86-117	≤ 15	86-117	≤ 25

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TABLE 7.2.25-3
Summary of Calibration and QC Procedures for Method SW7196A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
SW7196A	Hexavalent Chromium	Multipoint calibration curve (minimum three standards and a blank)	Initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to the specific analyte result for all samples associated with the calibration
		Second-source calibration verification	After each new stock standard preparation	Analytes within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to the specific analyte result for all samples associated with the calibration
		Continuing calibration verification	After every 15 samples and at the end of the analysis sequence	Chromium within $\pm 20\%$ of expected value	Correct problem then repeat initial calibration and reanalyze all samples since last successful calibration	Apply R to the specific analyte result in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.25-2	Recalculate results, locate and fix problem with system and then rerun demonstration	Apply R to the specific analyte result for all samples analyzed by the analyst
		Verification check to ensure lack of reducing condition and/or interference	Once for every sample matrix analyzed	5-pike recovery between 85-115%	If check indicates interference, dilute and reanalyze sample; persistent interference indicates the need to use and alternate method	Apply R to the specific analyte result for all samples analyzed since the last acceptable verification check
		MDL study	Once per year	Detection limits established shall be $<$ the PQLs in Table 7.2.1-1	none	Apply R to all specific analyte results for all samples analyzed
		Method blank	One per analytical batch	No analyte detected $>$ PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3

TABLE 7.2.25-3
 Summary of Calibration and QC Procedures for Method SW7196A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
	LCS		One LCS per analytical batch	QC acceptance criteria, Table 7.2.25-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEB analytical batch	Flagging Conventions, Table 8.2.3
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.25-2	none	Flagging Conventions, Table 8.2.3
	Results reported between MDL and PQL		none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.26 Method SW7421—Graphite Furnace Atomic Absorption (Lead)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the lead. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.26-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.26-2 and 7.2.26-3.

TABLE 7.2.26-1
PQLs for Method SW7421

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7421 (W)	Lead	0.005	mg/L	0.5	mg/kg
SW3050A/SW7421 (S)					

7.2.26-2
QC Acceptance Criteria for Method SW7421

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7421	Lead	74-124	≤ 15	74-124	≤ 25

TABLE 7.2.26-3
 Summary of Calibration and QC Procedures for Method SW7421

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
SW7421	Lead	Initial multipoint calibration (minimum 3 standards and a blank) Second-source calibration check standard	Daily initial calibration prior to sample analysis Once per initial daily multipoint calibration	Correlation coefficient ≥ 0.995 for linear regression Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Apply B to all results for the specific analyte in all samples associated with the blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.26-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.26-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-3
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$

TABLE 7.2.26-3
Summary of Calibration and QC Procedures for Method SW7421

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.26-2	none	Flagging Conventions, Table 8.2.3
	MDL study		Once per year	Detection limits established shall be < the PQLs in Table 7.2.26-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
*Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.27 Method SW7470A/SW7471A—Mercury Manual Cold-Vapor Technique

Water and soil samples are analyzed for mercury using methods SW7470A and SW7471A, respectively. This method is a cold-vapor, flameless atomic absorption (AA) technique based on the absorption of radiation by mercury vapor. Mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an AA spectrophotometer. Mercury concentration is measured as a function of absorbance. The PQLs for these methods are listed in Table 7.2.27-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.27-2 and 7.2.27-3.

TABLE 7.2.27-1
PQLs for Method SW7470A/SW7471A

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7470A (W)	Mercury	0.001	mg/L	0.1	mg/kg
SW7471A (S)					

TABLE 7.2.27-2
QC Acceptance Criteria for Methods SW7470A/SW7471A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7470A/SW7471A	Mercury	77-120	≤ 15	77-120	≤ 25

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TABLE 7.2.27-3
 Summary of Calibration and QC Procedures for Methods SW740A/SW7471A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW7470A SW7471A	Mercury	Initial multipoint calibration (minimum 5 standards and a blank) Second-source calibration check standard Calibration blank Continuing calibration verification Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample Method blank LCS for the analyte New matrix check: five-fold dilution test	Daily initial calibration prior to sample analysis Once per initial daily multipoint calibration Once per initial daily multipoint calibration After every 10 samples and at the end of the analysis sequence Once per analyst One per analytical batch One LCS per analytical batch Each new sample matrix	Correlation coefficient ≥ 0.995 for linear regression Analyte within $\pm 10\%$ of expected value No analyte detected > PQL The analyte within $\pm 20\%$ of expected value QC acceptance criteria, Table 7.2.27-2 No analytes detected > PQL QC acceptance criteria, Table 7.2.27-2 Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Correct problem then repeat initial calibration Correct problem then repeat initial calibration Correct problem then reanalyze calibration blank and all samples associated with blank Correct problem then repeat calibration and reanalyze all samples since last successful calibration Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank Correct problem then reprep and analyze the LCS and all samples in the affected APCBE analytical batch Perform recovery test	Apply R to all results for specific analyte for all samples associated with the calibration Apply R to all results for specific analyte for all samples associated with the calibration Flagging Conventions, Table 8.2.3 Apply R to all results for the specific analyte in all samples since the last acceptable calibration Apply R to all results for all samples analyzed by the analyst Flagging Conventions, Table 8.2.3 Flagging Conventions, Table 8.2.3 Apply J to all sample results if either of following exist: (1) New matrix check not run (2) RPD $\geq 10\%$

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TABLE 7.2.27-3
Summary of Calibration and QC Procedures for Methods SW740A/SW7471A

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range Flagging Conventions, Table 8.2.3
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.27-2	none	
	MDL study		Once per year	Detection limits established shall be < the PQLs in Table 7.2.27-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.28 Method SW7740-Graphite Furnace Atomic Absorption (Selenium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are prepared using procedures described in the method or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the Selenium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.28-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.28-2 and 7.2.28-3.

TABLE 7.2.28-1
PQLs for Method SW7740

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW7740 (W) SW3050A/SW7740 (S)	Selenium	0.005	mg/L	0.5	mg/kg

TABLE 7.2.28-2
QC Acceptance Criteria for Method SW7740

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7740	Selenium	73-122	≤ 15	73-122	≤ 25

TABLE 7.2.28-3
 Summary of Calibration and QC Procedures for Method SW7740

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
SW7740	Selenium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Flagging Conventions, Table 8.2.3
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.28-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2.3
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.28-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2.3
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$

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TABLE 7.2.28-3
Summary of Calibration and QC Procedures for Method SW7740

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.28-2	none	Flagging Conventions, Table 8.2.3
	MDL study		Once per year	Detection limits established shall be < the PQLs in Table 7.2.28-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply P to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.29 Method SW7841–Graphite Furnace Atomic Absorption (Thallium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the thallium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.29-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.29-2 and 7.2.29-3.

TABLE 7.2.29-1
 PQLs for Method SW7841

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7841 (W)	Thallium	0.001	mg/L	0.1	mg/kg
SW3050A/SW7841 (S)					

TABLE 7.2.29-2
 QC Acceptance Criteria for Method SW7841

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7841	Thallium	78-123	≤ 15	78-123	≤ 25

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TABLE 7.2.29-3
 Summary of Calibration and QC Procedures for Method SW7841

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW7841	Thallium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Flagging Conventions, Table 8.2-3
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.29-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.29-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEB analytical batch	Flagging Conventions, Table 8.2-3
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$

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TABLE 7.2.29-3
 Summary of Calibration and QC Procedures for Method SW7841

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
	MS/MSD		One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.29-2	none	Flagging Conventions, Table 8.2.3
	MDL study		Once per year	Detection limits established shall be < the PQLs in Table 7.2.29-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply P to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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7.2.30 Method SW7911-Graphite Furnace Atomic Absorption (Vanadium)

GFAA is used to measure low concentrations of metals in water and soil samples. The samples are extracted using method SW3020A or SW3050A, as appropriate. Discrete aliquots of sample extract are deposited in a graphite tube furnace in microliter amounts. The graphite tube is heated resistively by an electrical current. The sample solution is dried and charred to remove sample matrix components and then atomized at temperatures sufficient to vaporize the vanadium. Matrix modification is used to eliminate interference effects and may also enhance the vaporization efficiency and allow lower detection limits. PQLs for this analysis are listed in Table 7.2.30-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.30-2 and 7.2.30-3.

TABLE 7.2.30-1
PQLs for Method SW7911

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
SW3020A/SW7911 (W)	Vanadium	0.004	mg/L	0.4	mg/kg
SW3050A/SW7911 (S)					

TABLE 7.2.30-2
QC Acceptance Criteria for Method SW7911

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7911	Vanadium	78-123	≤ 15	78-123	≤ 25

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TABLE 7.2.30-3
 Summary of Calibration and QC Procedures for Method SW7911

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
SW7911	Vanadium	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte for all samples associated with the calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected > PQL	Correct problem then reanalyze calibration blank and all samples associated with blank	Flagging Conventions, Table 8.2-3
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within $\pm 20\%$ of expected value	Correct problem then repeat calibration and reanalyze all samples since last successful calibration	Apply R to all results for the specific analyte in all samples since the last acceptable calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table 7.2.30-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 7.2.30-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging Conventions, Table 8.2-3

TABLE 7.2.30-3
Summary of Calibration and QC Procedures for Method SW7911

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be $\pm 10\%$ of the undiluted sample result	Perform recovery test	Apply J to all sample results if either of following exist: (1) new matrix check not run (2) RPD $\geq 10\%$
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition	Apply J to all sample results (for same matrix) in which method of standard addition was not run when recovery outside of 85-115% range
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.30-2	none	Flagging Conventions, Table 8.2-3
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.30-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 †Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.31 Method SW9010A/SW9012-Total Cyanide and Cyanide Amenable to Chlorination

Water and waste samples are analyzed for total cyanide using method SW9010A or SW9012. These methods are equivalent in principle of analysis; SW9010A is a manual procedure, and SW9012 is an automated procedure.

Both methods are used to determine the concentration of inorganic cyanide in aqueous wastes and leachates. The methods detect inorganic cyanides that are present as either sample soluble salts or complex radicals. It is used to determine values for both total cyanide and cyanide amenable to chlorination. The cyanide is released by refluxing the sample with a strong acid and catalyst and distillation. Total cyanide in soils is determined after acidification of the soil and distillation. The cyanide ion in the absorbing solution is then determined by spectrophotometry for method SW9010A and by automated colorimetry for method SW9012. PQLs for cyanide are listed in Table 7.2.31-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.31-2 and 7.2.31-3.

TABLE 7.2.31-1
PQLs for Methods SW9010A/SW9012

		Water	
Parameter/Method	Analyte	PQL	Unit
SW9010A/SW9012	Total cyanide	0.02	mg/L

TABLE 7.2.31-2
QC Acceptance Criteria for Methods SW9010A/SW9012

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)
SW9010A	Total cyanide	79-114	≤ 20
SW9012			

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TABLE 7.2.31-3
Summary of Calibration and QC Procedures for Method SW9010A/SW9012

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria
SW9010A/ SW9012	Cyanide	Multipoint calibration curve (six standards and a calibration blank)	Initial daily calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to the result for cyanide for all samples associated with the calibration
		Distilled standards (one high and one low)	Once per multipoint calibration	Cyanide within $\pm 15\%$ of undistilled standard	Correct problem then repeat distilled standards	Apply R to all results for the specific analyte for all samples associated with the calibration
		Second-source calibration verification	Once per stock standard preparation	Cyanide within $\pm 15\%$ of expected value	Correct problem then repeat initial calibration	Apply R to the result for the specific analyte for all samples associated with the calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analytical batch	QC acceptance criteria, Table 7.2.22-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to the specific analyte result for all samples analyzed by the analyst
		Method blank	One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging Conventions, Table 8.2-3
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.22-2	Correct problem then reprep and analyze the LCS and all samples in the affected ARCEB analytical batch	Flagging Conventions, Table 8.2-3
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.22-2	none	Flagging Conventions, Table 8.2-3
		MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.22-1	none	Apply R to all results for the specific analyte in all samples analyzed
		Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 **Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

7.2.32 Method SW9056—Common Anions

This method addresses the sequential determination of the anions chloride, fluoride, bromide, nitrate, nitrite, phosphate, and sulfate in the collection solutions from the bomb combustion of solid waste samples, as well as water samples.

A small volume of combustate collection solution or other water sample is injected into an ion chromatograph to flush and fill a constant volume sample loop. The sample is then injected into a stream of eluent.

The sample is pumped through three different ion exchange columns and into a conductivity detector. The first two columns, a precolumn (guard column) and a separator column, are packed with a low-capacity, strongly basic anion exchanger. Ions are separated into discrete bands based on their affinity for the exchange sites of the resin. The last column is a suppressor column that reduces the anions in the sample to their corresponding acids. The separated anions in their acid form are measured using an electrical-conductivity cell. Anions are identified based on their retention times compared to known standards. Quantitation is accomplished by measuring the peak height or area and comparing it to a calibration curve generated from known standards.

PQLs are listed in Table 7.2.32-1. The calibration, QC, corrective action, and data flagging requirements are given in Tables 7.2.32-2 and 7.2.32-3.

TABLE 7.2.32-1
PQLs for Method SW9056

Parameter/Method	Analyte	Water		Soil	
		PQL	Unit	PQL	Unit
Common Anions SW9056	Bromide	0.1	mg/L	0.1	mg/kg
	Chloride	0.2	mg/L	0.2	mg/kg
	Fluoride	0.2	mg/L	0.2	mg/kg
	Nitrate	0.1	mg/L	0.1	mg/kg
	Nitrite	0.4	mg/L	0.1	mg/kg
	Phosphate	0.1	mg/L	0.1	mg/kg
	Sulfate	0.2	mg/L	0.2	mg/kg

TABLE 7.2.32-2
QC Acceptance Criteria for Method SW9056

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW9056	Bromide	86-112	≤ 20	86-112	≤ 30
	Chloride	91-111	≤ 20	91-111	≤ 30
	Fluoride	86-114	≤ 20	86-114	≤ 30
	Nitrate	90-110	≤ 20	90-110	≤ 30
	Nitrite	88-116	≤ 20	88-116	≤ 30
	Phosphate	87-110	≤ 20	87-110	≤ 30
	Sulfate	88-115	≤ 20	88-115	≤ 30

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TABLE 7.2.32-3
Summary of Calibration and QC Procedures for Method SW9056

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
SW9056	Common anions	Multipoint calibration for all analytes (minimum 3 standards and one calibration blank)	Initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Second-source calibration verification	Once per multipoint calibration	All analytes within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Retention time window calculated for each analyte	Each initial calibration and verification	± 3 times standard deviation for each analyte retention time from 72-hour study	Correct problem then reanalyze all samples analyzed since the last retention time check	Apply R to all results for the specific analyte(s) in the sample
		Initial calibration verification	Daily, before sample analysis or when eluent is changed	All analytes within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	Instrument response within $\pm 5\%$ of expected response	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	After every analytical batch	All analytes within $\pm 10\%$ of expected value	Correct problem then repeat initial calibration verification and reanalyze all samples since last successful calibration verification	Apply R to all results for the specific analyte(s) in all samples since the last acceptable calibration verification
		Method blank	Once per analyst batch	QC acceptance criteria, Table 7.2.32-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
			One per analytical batch	No analytes detected > PQL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Flagging conventions, Table 8.2-4

TABLE 7.2.32-3
 Summary of Calibration and QC Procedures for Method SW9056

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action*	Flagging Criteria*
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 7.2.32-2	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	Flagging conventions, Table 8.2-4
	MS/MSD	MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 7.2.32-2	none	Flagging conventions, Table 8.2-4
	MDL study	MDL study	Once per year	Detection limits established shall be < the PQLs in Table 7.2.32-1	none	Apply R to all results for the specific analyte(s) in all samples analyzed
	Results reported between MDL and PQL	Results reported between MDL and PQL	none	none	none	Apply F to all results between MDL and PQL

*All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
 *Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

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SECTION 8.0

Data Reduction, Review, Verification, Reporting, Validation, and Recordkeeping

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8.0 Data Reduction, Review, Verification, Reporting, Validation, and Recordkeeping

The data reduction, review, reporting, and validation procedures described in this section will ensure; (1) complete documentation is maintained, (2) transcription and data reduction errors are minimized, (3) the data are reviewed and documented, and (4) the reported results are qualified if necessary. Laboratory data reduction and verification procedures are required to ensure the overall objectives of analysis and reporting meet method and project specifications.

8.1 Data Review, Validation, and Reporting Requirements for Screening Data

The analysts shall perform a 100 percent review of the screening data. The screening data methods are identified in Table 6.0-1 of Section 6. All screening data shall be qualified with an S flag and shall be further qualified if critical calibration and QC requirements are not acceptable. The calibration, QC requirements, corrective action requirements, and flagging criteria required are shown in Table 6.2-1 in Section 6. The flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed. "S" designator flags shall be maintained in the final data qualification. When the data are reviewed and qualified, the analyst shall apply a final qualifier to any data that has been affected by multiple qualifiers. This final qualifier shall reflect the most severe qualifier that was applied to the data. The allowable final data qualifiers for screening data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are SR, SJ, SB, and SU. Therefore, the allowable final data qualifiers for screening data are SR, SJ, SB, SU, and S.

The definition of the data qualifiers are shown in Table 8.2-1. A summary of the flagging conventions of field screening methods is given in Table 6.2-1.

Screening data report packages shall be prepared for all field analyses as described in Section 8.8. The screening data shall be reported on the AFCEE screening data report forms (AFCEE Forms S-1 through S-3), as illustrated in Section 8.8. The prime contractor's project manager shall review the entire screening data report package with the field records. The prime contractor (1) shall determine if the data quality objectives have been met, and (2) shall calculate the data completeness for the project. These results shall be included in the data package deliverable.

8.2 Data Review, Validation, and Reporting Requirements for Definitive Data

In each laboratory analytical section, the analyst performing the tests shall review 100 percent of the definitive data. After the analyst's review has been completed, 100 percent of the data

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shall be reviewed independently by a senior analyst or by the supervisor of the respective analytical section using the same criteria.

The definitive data methods are identified in Section 7.2. The calibration, QC requirements, corrective action requirements, and flagging criteria required for definitive data are shown in the tables in Section 7.2, and in summary Tables 8.2-2, 8.2-3, and 8.2-4. The flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

Data qualifiers shall be added by the laboratory supervisor of the respective analytical section, after the first and second level of laboratory data reviews have been performed. Analytical batch comments shall be added to the first page of the definitive data report packages to explain any nonconformance or other issues. When data are qualified, the laboratory supervisor shall apply a final qualifier to any data that have been affected by multiple qualifiers. This final qualifier shall reflect the most severe qualifier that was applied to the data, i.e., all data will have only one data qualifying flag associate with it. The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are R, M, F, J, B, and U. The definitions of the data qualifiers are shown in Table 8.2-1.

The one exception to these data flagging criteria rules applies to the tentatively identified compounds (TICs) that are identified only in the GC/MS methods. These TIC numerical results will always be qualified with one and only one flag for any reason, and that is the "T" flag.

The laboratory QA section shall review 10 percent of the completed data packages, and the laboratory project manager shall perform a review on all the completed data packages.

The prime contractor's project manager shall review the entire definitive data report package, and with the field records, apply the final data qualifiers for the definitive data. The laboratory shall apply data qualifying flags to each environmental field QC sample, e.g., ambient blanks, equipment blanks, trip blanks, field duplicates, MS samples, and MSD samples. The prime contractor shall review the field QC samples and field logs, and shall then appropriately flag any of the associated samples identified with the field QC sample, as explained in Tables 8.2-2, 8.2-3, and 8.2-4. For example, each matrix spike sample would only be qualified by the laboratory, while the prime contractor would apply the final qualifying flag for a matrix effect to all samples collected from the same site as the parent sample.

The prime contractor (1) shall determine if the data quality objectives have been met, and (2) shall calculate the data completeness for the project. These results shall be included in the data package deliverable as described in Section 8.8.

TABLE 8.2-1
Data Qualifiers

Qualifier	Description
J	The analyte was positively identified, the quantitation is an estimation.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the MDL.
F	The analyte was positively identified but the associated numerical value is below the PQL.
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
B	The analyte was found in an associated blank, as well as in the sample.
M	A matrix effect was present.
S	To be applied to all field screening data.
T	Tentatively identified compound (using GC/MS)

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TABLE 8.2-2
 Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
 Criteria for Organic Methods

Quality Control Check	Evaluation	Flag	Samples Affected
Holding Time	Holding time exceeded for extraction or analysis	J- positive results	Sample
	Holding time exceeded by a factor of two	UJ nondetects	
	Sample not preserved	R nondetects	Sample
Sample Preservation SW8260, SW8015-P, SW8240		J-positive results	
		UJ nondetects	Sample
Sample Integrity SW8260, SW8015-P, 8240	Bubbles in VOA vial used for analysis	J- positive hits	Sample
Temperature blank	> 8°C	UJ nondetects	All samples in same cooler
Calibration Verification (ICV, CCV)	%R outside the acceptance range	J positive results (except PCBs and dioxins will not be flagged) UJ nondetects (except PCBs and dioxins will not be flagged) R	Out-of-compliance analytes in all associated samples in analysis batch
Laboratory Control Sample (LCS)	%R outside the acceptance range %R < LT	R	Out-of-compliance analytes in all associated samples in analysis batch
Method Blank	Multiply value by 5, common lab contaminants by 10	U flag reported results < calculated value	All samples in extraction batch and/or analytical batch, whichever is appropriate.
Equipment Blank	Convert to soil units, if applicable, multiply by 5	U flag reported results < calculated value	All samples, same site, matrix and date (w) or all samples, same site, matrix (soil)
Trip Blank	Convert to soil units, if applicable, multiply by	U flag reported results < calculated	All samples shipped in the same

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TABLE 8.2-2
 Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
 Criteria for Organic Methods

Quality Control Check	Evaluation	Flag	Samples Affected
	5	value	cooler
Matrix Spikes			
% Recoveries *	%R > UT'	J+ all positive results	Flag matrix spike analytes in parent sample only.
	%R < LT'	J- positive results	
	RPD > UT	UJ nondetects	Flag matrix spike analytes in parent sample only.
	RPD > LT	J positive results	Flag matrix spike analytes in parent sample only.
Unspiked reported analytes	Compound reported in only one sample	J positive result UJ nondetect	Flag matrix spike analytes in parent sample only.
Surrogates			
SW8260, SW8240, SW8270	If one or more surrogates: %R > UT and none < LT %R LT and all > 10%	J positive results * J positive results * UJ nondetects	Sample
	All recoveries < 10%	J- positive results * R nondetects	
SW8270 (evaluate acid and base/neutral surrogates separately)	If 2 or more surrogates: %R > UT and none < LT %R < LT and none < 10%	J+ positive results J- positive results	All associated analytes (acid or base/neutral) in sample

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TABLE 8.2-2
 Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
 Criteria for Organic Methods

Quality Control Check	Evaluation	Flag	Samples Affected
		UJ nondetects	
	All recoveries < 10%	J- positive results R nondetects	
GC Methods*, SW8290 and SW8310	%R > UT	J+ positive results*	All analytes in associated sample
	%R < LT and none < 10%	J- positive results ^b UJ nondetects	
	%R < 10%	J- positive results ^b R nondetects	All analytes in associated sample
Analytical duplicate	RPD > UT	J positive results	Analytical duplicate pair
Field duplicates	Reported in both samples, RPD > UT	FD positive results	Field duplicate pair
	Reported in one sample	FD positive/nondetect result	
Presence of PCB, chlordane, or toxaphene analytes	PCB, chlordane, or toxaphene peaks coelute with some single-analyte organochlorine pesticides on either column	R affected single-analyte organochlorine pesticide results	Sample
Tentatively identified compounds (TICs) in samples for GC/MS only	Reported	J reported results	All samples with TICS

*Common lab contaminants: methylene chloride, acetone, 2-butanone, toluene, and phthalates.

^bSpike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of 4 or more.

^cNumber of surrogates varies with GC Method; For Method SW8080, two or more surrogates must exceed the criteria for qualification of results.

^dCV/CCV: All analytes evaluated for GC-methods; only evaluate CCCs/SPCCs for GC/MS methods.

^eFor GC Methods SW8080, SW8141, and SW8150, the qualification of nondetects applies to primary column tolerances (either of the two GC columns may be designated as the primary column).

^fWhere one MS recovery meets acceptance criteria and the other MS of the pair does not, professional judgment may be used to determine if the parent sample should be qualified for matrix spike recoveries to other quality control results within the batch or sample site.

^gThis qualifier may not apply in cases where a surrogate coelutes with a nontarget analyte.

TABLE 8.2-2
 Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
 Criteria for Organic Methods

Quality Control Check	Evaluation	Flag	Samples Affected
<p>This qualifier may not apply in cases where low surrogate recoveries are due to sample dilution. Professional judgment must be used in determining the effect of the bubbles on data usability. Use SW-846, Update II, 9/85 for guidance.</p>			
CCV	= Continuing calibration verification.		
LT	= Lower tolerance.		
MB	= Method blank.	ICV	= Initial calibration verification.
UT	= Upper tolerance.	RPD	= Relative percent difference.
PQL	= Practical quantitation limit.	%R	= percent recovery.
		MDL	= Method detection limit.

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TABLE 8.2-3
Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
Criteria for Inorganic Metals Methods

Quality Control Check	Evaluation	Flag	Samples Affected
Holding Time	Holding time exceeded for digestion or analysis	J- positive results	Sample only
	Holding time exceeded by a factor of 2	R flag mercury, cyanide, and hexavalent chromium nondetects UJ nondetects for all other methods R nondetect results	
Sample Preservation	Sample preservation requirements not met (sample preservation may be adjusted at the laboratory with no flagging required)	J- positive results UJ nondetects for all methods except mercury and cyanide	Sample
Temperature Blank	> 8°C	R mercury and cyanide nondetects J mercury, cyanide, and hexavalent chromium positive results UJ mercury, cyanide, and hexavalent chromium nondetects	Samples in same cooler
Calibration standard check (SW6010 only)	Calibration above UT or below LT	R	Specific analyte in all associated samples in analysis batch
Calibration Verification: ICV, CCV	Calibration above UT or below LT	R	Specific analyte in all associated samples in analysis batch
Interference check sample	%R > UT	R positive results (%R > 135)	
	%R between 50-79	J+ positive results	All associated samples in analytical batch
Laboratory Control Sample	%R < 50	J+ positive results UJ nondetects	
	%R > UT or < LT	R positive R	Out-of-compliance analytes in all samples in digestion batch

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TABLE 8.2-3
 Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
 Criteria for Inorganic Metals Methods

Quality Control Check	Evaluation	Flag	Samples Affected
Blanks: MB, ICB, CCB, Leachate Blank	Multiply value by 5, convert to soil units if applicable	U flag reported results < calculated values	All samples in digestion batch (MB); All samples in analyte batch (ICB,CCB)
Equipment blank	Convert to soil units if applicable, multiply by 5	U flag reported results < calculated values	All samples, same field team, matrix and date (w) or all samples, same field team, matrix (soil)
Matrix Spikes*	%R > UT	J+ positive results	All samples from same site as parent sample
	30% > %R > LT	J- positive results	
	%R < 30%	UJ nondetects	
		J- positive results	
		R nondetects	
	RPD > UT	J positive results	
Laboratory Duplicates	One or both sample results < 5 times the PQL* and a difference of \pm PQL* for water (± 2 times PQL* soil) not met.	J positive results	All samples in digestion batch
	Concentration of reported analyte > 5 times PQL* in either sample and RPD > UT.	J positive results	
Serial Dilution	If concentration is > 25 times MDL for GFAA analyses (> 5 times the PQL for ICP analyses) and % difference > UT	J positive results	All samples from same site as parent sample if analytical spike not performed
Analytical Spikes	Spike results do not indicate performance of MSA	UJ nondetects	All samples in digestion batch if MSA not performed

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TABLE 8.2-3
 Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
 Criteria for Inorganic Metals Methods

Quality Control Check	Evaluation	Flag	Samples Affected
	%R < 40%	J+ positive	
	10 ≤ %R < 40%	UJ nondetects	
	%R < 10%	R nondetects	
MSA (GFAA only) for samples where analytical spike fails (only perform analytical spike as a result of out-of-specification serial dilution)	MSA not done	J positive results	Sample
MSA spike levels inappropriate		J positive results	
r < 0.995		J positive results	
Field Duplicates	Concentration of reported analytes are > 5 times PQL* in either sample and RPD > UT.	FD positive results	Field duplicate pair
	One or both sample results < 5 times the PQL* and a difference of ±2 times PQL* for water (±4 times for soil).	FD positive results	

*Spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of 4 or more.
 *The PQLs can be found in Section 7.0, Tables 7-19 through 7-30.

- CCB = Continuing calibration blank.
- ICB = Initial calibration blank.
- LT = Lower tolerance.
- MB = Method blank.
- UT = Upper tolerance.
- PQL = Practical quantitation limit.

- CCV = Continuing calibration verification.
- ICV = Initial calibration verification.
- MSA = Method of standard addition.
- RPD = Relative percent difference.
- %R = percent recovery.
- MDL = Method detection limit.

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TABLE 8.2-4
 Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
 Criteria for General Chemistry

Quality Control Check*	Evaluation	Flag	Samples Affected
Holding Time	Holding time exceeded for preparation or analysis	J- positive results UJ nondetects	Sample only
	Holding time exceeded by a factor of 2	R nondetect results	
Sample Preservation	Sample not preserved (preservation may be adjusted at the lab)	J- positive results R nondetects	Sample
Temperature Blank	> 8°C	J positive results UJ nondetects	All samples in same cooler
Calibration check (E901.1, SW9310, SW9045)	Calibration above UT or below LT	R	Out-of-compliance analytes in all associated samples in analytical batch
Calibration Verification: ICV, CCV	Calibration above UT or below LT	R	Out-of-compliance analytes in all associated samples in analytical batch
Laboratory Control Sample	%R > UT or < LT	R	Out-of-compliance analytes in all samples in preparation or analytical batch
Method Blank	Multiply value by 5, convert to soil units if applicable	U flag reported results < calculated values	All samples in preparation or analytical batch
Calibration Blank ICB, CCB	Multiply value by 5, convert to soil units if applicable	U flag results < calculated values	All associated samples in analytical batch
Equipment Blank	Convert to soil units if applicable, multiply by 5	U flag reported results < calculated values	All samples, same field team, matrix and date (w) or all samples, same field team, matrix (soil)
Matrix Spikes*	%R > UT	J+ positive results	All samples from same site
	%R < LT	J- positive results UJ nondetects	

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TABLE 8.2-4
 Flagging Conventions for NAS Fort Worth JRB—Minimum Data Evaluation
 Criteria for General Chemistry

Quality Control Check*	Evaluation	Flag	Samples Affected
Laboratory Duplicates	RPD > UT	J positive results	All samples in preparation or analytical batch
Field Duplicates	RPD > UT	J positive results	Field duplicate pair

*General chemistry methods include: E160, E300, E310, E325, E340, E350, E351, E353, E365, E375, E901.1, SW9045, SW9060 modified, SW9310, ASTM D422, acid volatile sulfides/simultaneously extracted metals, SW846 percent moisture, E130.1, E218.6, SW9066, PU-10, PU-11, G-02.
 *Where applicable—not all "Quality Control Checks" associated with every general chemistry method.
 *Spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of 4 or more.

CCV = Continuing calibration verification. %R = Percent recovery.
 ICV = Initial calibration verification. ICB = Initial calibration blank.
 LT = Lower tolerance. CCB = Continuing calibration blank.
 RPD = Relative percent difference. PQL = Practical quantitation limit.
 UT = Upper tolerance.

8.3 Quality Assurance Reports

The laboratory QA staff shall issue QA reports to the laboratory management, laboratory supervisors and task leaders. These reports shall describe the results of QC measurements, performance audits, and systems audits, and confirmation sample comparisons performed for each sampling and analysis task. Quality problems associated with performance of methods, completeness of data, comparability of data including field and confirmatory data, and data storage shall be documented with the corrective actions that have been taken to correct the deficiencies identified.

8.4 IRPIMS Electronic Data Reports

The prime contractor shall provide an electronic deliverable report in the Installation Restoration Program Information Management System (IRPIMS) format as specified by the SOW for the project.

IRPIMS is a data management system designed to accommodate all types of data collected for IRP projects. Specific codes and data forms have been developed to allow consistent and efficient input of information to the system. The database information shall be provided by the prime contractor via ASCII files in specified IRPIMS format on 3.5" floppy diskettes. The information transferred shall include all required technical data such as site information; well characteristics; and hydrogeologic, geologic, physical, and chemical analysis results. Electronic data reporting formats and requirements are given in the most current version of the *IRPIMS Data Loading Handbook*.

8.5 Archiving

Hardcopy and electronic data shall be archived in project files and on electronic archive tapes for the duration of the project or a minimum of five years, whichever is longer.

8.6 Project Data Flow and Transfer

The data flow from the laboratory and field to the project staff and data users shall be sufficiently documented to ensure the data are properly tracked, reviewed, and validated for use.

8.7 Recordkeeping

The laboratory shall maintain electronic and hardcopy records sufficient to recreate each analytical event conducted pursuant to the SOW. The minimum records the laboratory shall keep include the following: (1) COC forms, (2) initial and continuing calibration records including standards preparation traceable to the original material and lot number, (3) instrument tuning records (as applicable), (4) method blank results, (5) IS results, (6) surrogate spiking records and results (as applicable), (7) spike and spike duplicate records and results, (8) laboratory records, (9) raw data, including instrument printouts, bench work sheets, and/or

chromatograms with compound identification and quantitation reports, (10) corrective action reports, (11) other method and project required QC samples and results, and (12) laboratory-specific written SOPs for each analytical method and QA/QC function in place at the time of analysis of project samples.

8.8 Hardcopy Data Reports for Screening and Definitive Data

The hardcopy data reports shall conform to the formats identified in this section.

A screening data report package shall consist of the following AFCEE forms: S-1, S-2, and S-3.

A definitive data inorganic report package shall consist of the following AFCEE forms: I-1, I-2, I-3, I-4, I-5, I-6, I-7, I-8 and I-9.

A definitive data organic report package shall consist of the following AFCEE forms: O-1, O-2, O-3, O-4, O-5, O-6, O-7, O-8, O-9 and O-10.

Exceptions to these report forms are as follows: for mercury analysis, form I-3A will be substituted for form I-3 in the inorganic report package; for cyanide analysis, form I-3B will be substituted for form I-3 in the inorganic report package; for GC/MS analyses, form O-5A will be added to the organic report package.

Instructions for Completing AFCEE Report Forms**303192**

The following instructions shall be used in completing the AFCEE report forms for screening and definitive data. The bold lettering identifies the fields on the AFCEE report form.

All Inorganic and Organic Forms

Analytical Method: enter the method name (e.g., SW6010A, SW8270B)

AABNo. : enter the unique AFCEE analytical batch number (see Section 4.4 for a definition of a batch)

Lab Name: enter the laboratory name (e.g., Garland Labs, Inc.)

Contract No. : enter the Air Force contract number and delivery order number under which the analytical work is being performed (e.g., F21625-94-D-8005/0001)

Comments: any comments

Form I-1

Base/Command: enter the base name and the Air Force command (e.g., Banks AFB/SPACECOM)

Prime Contractor: enter the name of the prime contractor (e.g., RDS, Inc)

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Lab Sample ID: enter the unique identifying number given to the sample by the laboratory that corresponds to the Field Sample ID

Form I-2

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Lab Sample ID: enter the unique identifying number given to the sample by the laboratory that corresponds to the Field Sample ID

Matrix: enter the sample matrix (e.g., water, soil)

% Solids: enter the % solids

Dilution: enter the dilution (if applicable) (e.g., 1:5)

Date Received/Extracted/Analyzed: enter the appropriate dates in the format DD-MMM-YY (e.g., 3 Jun 96)

Concentration Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

MDL: enter the laboratory derived method detection limit

PQL: enter the project practical quantitation limit as stated in the QAPP or approved variance for each analyte

Concentration: enter the result

Qualifier: enter the qualifier flag (see QAPP Sections 7 and 8)

Form I-3

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

RF Blank, RF1, RF2, RF3: enter the response factor corresponding to the standard with the same number: RF Blank is the response factor for the blank

Std 1, Std2, Std3: enter the concentration of the standard

r: enter the correlation coefficient

Q: enter a "*" for all corresponding correlation coefficients that were not acceptable as per QAPP Section 7

Form I-3A (Mercury analyses only) and I-3B (cyanide analyses only)

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

RF Blank, RF1, RF2, RF3, RF4, RF5, RF6: enter the response factor corresponding to the standard with the same number: RF Blank is the response factor for the blank

Std 1, Std 2, Std 3, Std 4, Std 5, Std 6: enter the concentration of the standard

r: enter the correlation coefficient

Q: enter a "*" for all corresponding correlation coefficients that were not acceptable as per QAPP Section 7

Form I-4

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

Highest Std ID: enter the unique identifier for the highest standard such that the standard could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., HS960603)

2nd Source ID: enter the unique identifier for the 2nd source standard such that the standard could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., 2S960603)

CCV No. 1 ID: enter the unique identification number for the first CCV such that the CCV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCV960603-1)

CCV No. 2 ID: enter the unique identification number for the second CCV such that the CCV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCV960603-2)

Expected, Expected 1: enter the expected result (i.e., the concentration of the calibration material)

Found, Found 1, Found 2: enter the measured result

%D: enter the percent difference between the expected and found

Q: enter a "*" for all %Ds that were not acceptable as per QAPP Section 7

Form I-5

Units: enter the appropriate units (i.e., µg/L or mg/kg)

Calibration Blank ID: enter the identification number for the calibration blank (the same ID number will be found in the run sequence log, e.g., CB960603)

Method Blank ID: enter the identification number for the method blank (the same ID number will be found in the run sequence log, e.g., MB960603)

CCB No. 1 ID: enter the identification number for the first CCB (the same ID number will be found in the run sequence log, e.g., CCB960603-1)

CCB No. 2 ID: enter the identification number for the second CCB (the same ID number will be found in the run sequence log, e.g., CCB960603-2)

CCB No. 3 ID: enter the identification number for the third CCB (the same ID number will be found in the run sequence log, e.g., CCB960603-3)

Calibration Blank: enter the result for the calibration blank

Continuing Calibration Blank 1: enter the result for the continuing calibration blank 1

Continuing Calibration Blank 2: enter the result for the continuing calibration blank 2

Continuing Calibration Blank 3: enter the result for the continuing calibration blank 3

Method Blank: enter the result for the method blank

PQL: enter the project practical quantitation limit as stated in the QAPP or approved variance for each analyte

Q: enter a "*" for all calibration and method blank analytes that were not acceptable as per QAPP Section 7

Form I-6

LCS ID: enter the unique identification number for the laboratory control sample such that the LCS could be traced back to its source material (the same ID number will be found in the run sequence log e.g., LCS960603)

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

Expected: enter the expected result (i.e., the concentration of the calibration material)

Found: enter the measured result

%R: enter the percent difference between the expected and found

Control Limits: enter the control limits required to be met (see QAPP Section 7)

Q: enter a "*" for all %Rs that were not acceptable as per QAPP Section 7

Form I-7

Parent Field Sample ID: enter the field sample ID of the parent sample (the sample spiked for the MS and MSD)

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

% Solids: enter the % solids

MS ID: enter the unique identification number for the matrix spike such that the MS could be traced back to the source material used for spiking (the same ID number will be found in the run sequence log e.g., MS960603)

MSD ID: enter the unique identification number for the matrix spike duplicate such that the MSD could be traced back to the source material used for spiking (the same ID number will be found in the run sequence log e.g., MSD960603)

Parent Sample Result: enter the result of the parent sample

Spike Added: enter the amount of spike added to the parent sample

Spike Sample Result: enter the result of the MS

%R: enter the percent recovery

Duplicate Spike Sample Result: enter the result of the MSD

%RPD: enter the relative percent difference between the spike (MS) and spike duplicate (MSD)

Control Limits: enter the control limits required to be met (see QAPP Section 7)

Q: enter the qualifier flag as needed (see QAPP Sections 7 and 8)

Form I-8

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

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Date Collected: enter the date the sample was taken in the field in the format DD-MMM-YY (e.g., 6 Jun 96)

Date Received: enter the date the sample was received at the laboratory in the format DD-MMM-YY (e.g., 6 Jun 96)

Date Analyzed: enter the date the sample was analyzed by the laboratory in the format DD-MMM-YY (e.g., 6 Jun 96)

Max. Holding Time: enter the maximum allowable holding time in days (see QAPP Section 5)

Time Held: enter the time in days elapsed between the date collected and the date analyzed

Q: enter a "*" for all holding times that were greater than the maximum allowable holding time as per QAPP Section 5

Form I-9

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Field Sample ID/Std ID/Blank ID/QC Sample ID: enter the unique identifying number of each sample (environmental sample, standard, blank, LCS, MS, MSD, etc.) in the sequence they were analyzed

Date Analysis Started: enter the date the sample analysis was started in the format DD-MMM-YY (e.g., 6 Jun 96)

Time Analysis Started: enter the time the sample analysis was started in 24 hour format (e.g., 0900, 2130)

Date Analysis Completed: enter the date the sample analysis was completed in the format DD-MMM-YY (e.g., 6 Jun 96)

Time Analysis Completed: enter the time the sample analysis was completed in 24 hour format (e.g., 0900, 2130)

Form O-1

Base/Command: enter the base name and the Air Force command (e.g., Banks AFB/SPACECOM)

Prime Contractor: enter the name of the prime contractor (e.g., RDS, Inc)

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Lab Sample ID: enter the unique identifying number given to the sample by the laboratory that corresponds to the Field Sample ID

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Form 0-2

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Lab Sample ID: enter the unique identifying number given to the sample by the laboratory that corresponds to the Field Sample ID

Matrix: enter the sample matrix (e.g., water, soil)

% Solids: enter the % solids

Dilution: enter the dilution (if applicable) (e.g., 1:5)

Date Received/Extracted/Analyzed: enter the appropriate dates in the format DD-MMM-YY (e.g., 3 Jun 96)

Concentration Units: enter the appropriate units (i.e., µg/L or mg/kg)

MDL: enter the laboratory derived method detection limit

PQL: enter the project practical quantitation limit as stated in the QAPP or approved variance for each analyte

Concentration: enter the result

Qualifier: enter the qualifier flag as needed (see QAPP Sections 7)

Form 0-3

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Compound: enter BFB or DF TPP as appropriate

Injection Date/Time: enter the date (in the format DD-MMM-YY) and time (in 24 hour format) of the performance check

Mass: enter the mass of the ion used for tuning (see QAPP Section 7)

Ion Abundance Criteria: enter the criteria for the specific mass (see QAPP Section 7)

% Relative Abundance: enter the percent relative abundance as the result of the tune

Q: enter a "*" for all % relative abundance results that were not acceptable as per QAPP Section 7

Field Sample ID/Std ID/Blank ID/QC Sample ID: enter the unique identifying number of each sample (environmental sample, standard, blank, LCS, MS, MSD, etc.)

Date Analyzed: enter the date the sample was analyzed by the laboratory in the format DD-MMM-YY (e.g., 3 June 96)

Time Analyzed: enter the time the sample was analyzed by the laboratory in 24 hour format (e.g., 0900, 2130)

Form O-4

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

Calibration ID: enter the unique identifier for the specific calibration event

RF Blank, RF1, RF2, RF3, RF4, RF5: enter the response factor corresponding to the standard with the same number. RF Blank is the response factor for the blank

Std 1, Std 2, Std 3, Std 4, Std 5: enter the concentration of the standard

%RSD: enter the percent relative standard deviation

Q: enter a "*" for all % RSDs that were not acceptable as per QAPP Section 7

Form O-5

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

2nd Source ID: enter the unique identifier for the 2nd source standard such that the standard could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., 2S960603)

CCV No. 1 ID: enter the unique identification number for the first CCV such that the CCV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCV960603-1)

CCV No. 2 ID: enter the unique identification number for the second CCV such that the second CCV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCV960603-2)

Expected, Expected 1: enter the expected result (i.e., the concentration of the calibration material)

Found, Found 1, Found 2: enter the measured result

%D: enter the percent difference between the expected and found

Q: enter a "*" for all % Ds that were not acceptable as per QAPP Section 7

Form O-5A

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 June 96)

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SPCC No. 1 ID: enter the unique identification number for the SPCC associated with the initial multipoint calibration such that the SPCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., SPCC960603-1)

SPCC No. 2 ID: enter the unique identification number for the SPCC associated with the daily calibration such that the SPCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., SPCC960603-2)

SPCC No. 2 ID: enter the unique identification number for the SPCC run after 12 hours of operation such that the SPCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., SPCC960603-3)

CCC No. 2 ID: enter the unique identification number for the CCC associated with the daily calibration such that the CCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCC960603-2)

CCC No. 2 ID: enter the unique identification number for the CCC run after 12 hours of operation such that the CCC could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., CCC960603-3)

RF: enter the response factor

Min RF: enter the minimum acceptable response factor (see QAPP Section 7)

Expected: enter the expected result (i.e., the concentration of the calibration material)

Found: enter the measured result

%D: enter the percent difference between the expected and found

Q: enter a "*" for (1) any %Ds that were not acceptable or (2) any RFs not meeting minimum acceptable requirements as per QAPP Section 7

Form Q-6

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

Method Blank ID: enter the unique identification number for the method blank (the same ID number will be found in the run sequence log, e.g., MB960603)

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 7 of the QAPP)

Method Blank: enter the result for the method blank

PQL: enter the project practical quantitation limit as stated in this QAPP or approved variance for each analyte

Q: enter a "*" for all method blank analyte results that were not acceptable as per QAPP Section 7

Form O-7

LCS ID: enter the unique identification number for the laboratory control sample such that the LCS could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., LCS960603)

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 7 of the QAPP)

Expected: enter the expected result (i.e., the concentration of the calibration material)

Found: enter the measured result

%R: enter the percent recovery

Control Limits: enter the control limits required to be met (see QAPP Section 7)

Q: enter a "*" for all % Rs that were not acceptable as per QAPP Section 7

Form O-8

Parent Field Sample ID: enter the field sample ID of the parent sample (the sample spiked for the MS and MSD)

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

% Solids: enter the % solids

MS ID: enter the unique identification number for the matrix spike such that the MS could be traced back to the source material used for spiking (the same ID number will be found in the run sequence log, e.g., MS960603)

MSD ID: enter the identification number for the matrix spike duplicate such that the MSD could be traced back to the source material used for spiking (the same ID number will be found in the run sequence log, e.g., MSD960603)

Parent Sample Result: enter the result of the parent sample

Spike Added: enter the amount of spike added to the parent sample

Spike Sample Result: enter the result of the MS

%R: enter the percent recovery

Duplicate Spike Sample Result: enter the result of the MSD

%RPD: enter the relative percent difference between the spike (MS) and spike duplicate (MSD)

Control Limits: enter the control limits required to be met (see QAPP Section 7)

Q: enter the qualifier flag as needed (see QAPP Sections 7)

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Form O-9

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Date Collected: enter the date the sample was taken in the field in the format DD-MMM-YY (e.g., 3 Jun 96)

Date Received: enter the date the sample was received at the laboratory in the format DD-MMM-YY (e.g., 3 Jun 96)

Date Extracted: enter the date the sample was extracted by the laboratory in the format DD-MMM-YY (e.g., 3 Jun 96)

Max. Holding Time E: enter the maximum allowable holding time in days until the sample is extracted (see QAPP Section 5)

Time Held Ext.: enter the time in days elapsed between the date collected and the date extracted

Date Analyzed: enter the date the sample was analyzed by the laboratory in the format DD-MMM-YY (e.g., 3 Jun 96)

Max. Holding Time A: enter the maximum allowable holding time in days until the sample is analyzed (see QAPP Section 5)

Time Held Anal.: enter the time in days elapsed between the date collected and the date analyzed

Q: enter a "*" for all holding times (Max. Holding Time E, or Max. Holding Time A, or Time Held Anal.) that were greater than the maximum holding time that were not acceptable as per QAPP Section 5

Form O-10

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Field Sample ID/Std ID/Blank ID/QC Sample ID: enter the unique identifying number of each sample (environmental sample, standard, blank, LCS, MS, MSD, etc.) in the sequence they were analyzed

Date Analysis Started: enter the date the sample analysis was started in the format DD-MMM-YY (e.g., 3 Jun 96)

Time Analysis Started: enter the time the sample analysis was started in 24 hour format (e.g., 0900, 2130)

Date Analysis Completed: enter the date the sample analysis was completed in the format DD-MMM-YY (e.g., 3 Jun 96)

Time Analysis Completed: enter the time the sample analysis was completed in 24 hour format (e.g., 0900, 2130)

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Base/Command: enter the base name and the Air Force command (e.g., Banks AFB/
SPACECOM)

Prime Contractor: enter the name of the prime contractor (e.g., RDS, Inc)

Field Sample ID: enter the unique identifying number given to the field sample (includes MS,
MSD, field duplicate and field blanks)

Form S-2

Field Sample ID: enter the unique identifying number given to the field sample (includes MS,
MSD, field duplicate and field blanks)

Matrix: enter the sample matrix (e.g., water, soil)

Date Analyzed: enter the appropriate dates in the format DD-MMM-YY (e.g., 3 Jun 96)

Concentration Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

MDL: enter the laboratory derived method detection limit

PQL: enter the project practical quantitation limit as stated in the QAPP or approved variance
for each analyte

Concentration: enter the result

Qualifier: enter the qualifier needed (see QAPP Sections 7 and 8)

Form S-3

Units: enter the appropriate units (i.e., $\mu\text{g/L}$ or mg/kg)

Sample Result: enter the result of the sample

Duplicate Sample Result: enter the result of the duplicate sample

%D or %RPD: enter the percent or difference relative percent difference between the sample
and duplicate

Acceptance Criteria: enter the acceptance criteria required to be met (see QAPP Section 6)

Q: enter a "*" for all % Ds or % RPDs that were not acceptable as per QAPP Section 6

MDL Form

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 7 of
the QAPP)

Amt. Spiked: enter the amount of spike added to the parent sample

Replicate 1,2,3,4,5,6,7: enter the result of the replicate

Std. Dev.: enter the standard deviation of the seven replicates

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MDL: enter the calculated MDL

Chain-Of-Custody Form

COCNo. : enter a unique number for each chain-of-custody form

Ship to: enter the laboratory name and address

Carrier: enter the name of the transporter (e.g., FedEx) or handcarried

AirbillNo. : enter the airbill number or transporter tracking number (if applicable)

Project Name: enter the project name (e.g., Banks AFB RI/FS)

Sampler Name: enter the name of the person collecting the samples

Sampler Signature: signature of the person collecting the samples

Send Results to: enter the name and address of the prime contractor

Field Sample ID: enter the unique identifying number given to the field sample (includes MS, MSD, field duplicate and field blanks)

Date: enter the year and date the sample was collected in the format M/D (e.g., 6/3)

Time: enter the time the sample was collected in 24 hour format (e.g., 0900)

Matrix: enter the sample matrix (e.g., water, soil)

Pres: enter the preservative used (e.g., HNO₃) or "none"

Filtered/Unfilt.: enter "F" if the sample was filtered or "U" if the sample was not filtered

No. of Containers: enter the number of containers associated with the sample

MS/MSD: enter "X" if the sample is designated the MD/MSD

Analyses Requested: enter the method name of the analysis requested (e.g., SW6010A)

Comments: enter comments

Sample Condition Upon Receipt at Laboratory: enter any problems with the condition of any sample(s)

Cooler Temperature: enter the internal temperature of the cooler, in°C, upon opening

Special Instructions/Comments: enter any special instructions or comments

Released by: (SIG): enter the signature of the person releasing custody of the samples

Company Name: enter the company name employing the person releasing/ receiving custody

Received by: (SIG): enter the signature of the person receiving custody of the samples

Date: enter the date in the format M/D/YY (e.g., 6/3/96) when the samples were released/ received

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Time: enter the time in 24 hour format (e.g., 0900) when the samples were released/received

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MERCURY INITIAL MULTIPOINT CALIBRATION

Analytical Method: _____ AAB No. : _____
Lab Name: _____ Contract No. : _____
Instrument ID: _____ Date of Calibration: _____

Analyte	RF Blank	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	r	Q
Mercury													

r = correlation coefficient

Comments:

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INORGANIC ANALYSES DATA SHEET 3
CYANIDE INITIAL MULTIPOINT CALIBRATION

Analytical Method: _____ AAB No. : _____
Lab Name: _____ Contract No. : _____
Instrument ID: _____ Date of Calibration: _____

Analyte	RF Blank	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	Std 6	RF 6	r	Q
Cyanide															

r = correlation coefficient

Comments:

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SCREENING DATA PACKAGE

Analytical Method: _____ Contract No. : _____
Base/Command: _____ Prime Contractor: _____

Field Sample ID

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Comments:

Signature: _____ Name: _____
Date: _____ Title: _____

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SECTION 9.0

**Systems and Performance Audits,
Performance Evaluation Programs,
Magnetic Tape Audits, and Training**

9.0 Systems and Performance Audits, Performance Evaluation Programs, Magnetic Tape Audits, and Training

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Technical systems and performance audits shall be performed as independent assessments of sample collection and analysis procedures. Audit results will be used to evaluate the ability of an analytical contractor to: (1) produce data that fulfill the objectives established for the program, (2) comply with the QC criteria, and (3) identify any areas requiring corrective action. The systems audit is a qualitative review of the overall sampling or measurement system, while the performance audit is a quantitative assessment of a measurement system. Full data validation is also a quantitative check of the analytical process, where all documentation and calculations are evaluated and verified. Data validation is discussed in Section 8.

9.1 Project Audits

9.1.1 State/Federal Project Audits

Audits by various state and federal agencies are commonly conducted for the laboratories that will analyze project samples. Audit reports from these agencies shall be reviewed by the prime contractor to determine whether data produced by the analytical contractor shall fulfill the objectives of the program.

Audit findings shall be transmitted to the prime contractor and to AFCEE. The prime contractor shall review the audit findings and provide a written report to AFCEE. This report shall include the recommended corrective actions or procedures to correct the deficiencies identified during the state/federal audits(s). The audit results and discussion shall be incorporated into the QA report for each sampling effort.

9.1.2 Technical Systems Audits

A technical systems audit is an onsite, qualitative review of the sampling or analytical system to ensure that the activity is being performed in compliance with the SAP specifications. Sampling and field procedures, and the analytical laboratories shall be audited by the prime contractor at the beginning of the field work. In addition, a laboratory systems audit shall be performed by AFCEE if previous audit reports indicate that corrective actions are outstanding, a recent audit has not been conducted, or quality concerns have arisen based upon the use of that laboratory for other projects. The laboratory systems audit results will be used to review laboratory operation and ensure the technical procedures and documentation are in place and operating to provide data that fulfill the project objectives and to ensure outstanding corrective actions have been addressed.

Critical items for a laboratory or field systems audit include: (1) sample custody procedures, (2) calibration procedures and documentation, (3) completeness of data forms, notebooks, and other reporting requirements, (4) data review and validation procedures, (5) data storage, filing, and record keeping procedures, (6) QC procedures, tolerances, and documentation, (7) operating conditions of facilities and equipment, (8) documentation of training and maintenance activities, (9) systems and operations overview, and (10) security of laboratory automated systems.

Critical items for a sampling systems audit include: (1) calibration procedures and documentation for field equipment, (2) documentation in field logbooks and sampling data sheets, (3) organization and minimization of potential contamination sources while in the field, (4) proper sample collection, storage, and transportation procedures, and (5) compliance with established COC and transfer procedures.

After each onsite audit, a debriefing session will be held for all participants to discuss the preliminary audit results. The auditor will then complete the audit evaluation and submit an audit report including observations of the deficiencies and the necessary recommendations for corrective actions. Compliance with the specifications presented in the SAP will be noted and noncompliance or deviations shall be addressed in writing by the prime contractor to AFCEE with corrective actions and a time frame for implementation of the corrective actions. Follow-up audits will be performed prior to completion of the project to ensure corrective actions have been taken.

9.1.3 Project-Specific Performance Evaluation Audits

Performance audits quantitatively assess the data produced by a measurement system. A performance audit involves submitting project-specific performance evaluation (PE) samples for analysis for each analytical method used in the project. The prime contractor shall submit project-specific PE samples once per quarter per project. The project-specific PE samples are selected to reflect the expected range of concentrations for the sampling program. The performance audit answers questions about whether the measurement system is operating within control limits and whether the data produced meet the analytical QA specifications.

The project-specific PE samples are made to look as similar to field samples as possible and are submitted as part of a field sample shipment so that the laboratory is unable to distinguish between them and project samples. This approach ensures unbiased sample analysis and reporting by the laboratory.

The critical elements for review of PE results include: (1) correct identification and quantitation of the PE sample analytes, within project specifications, (2) accurate and complete reporting of the results, and (3) measurement system operation within established control limits for precision and accuracy.

The concentrations reported for the PE samples shall be compared to the known or expected concentrations spiked in the samples. The percent recovery shall be calculated and the results assessed according to the accuracy criteria for the LCS presented in Section 7. If the accuracy criteria are not met, the cause of the discrepancy shall be investigated and a second PE sample shall be submitted. The prime contractor shall notify the project staff, AFCEE, and agencies of the situation at the earliest possible time and the prime contractor

shall keep AFCEE up to date regarding corrective actions and subsequent PE sample results.

9.1.4 Magnetic Tape Audits

Magnetic tape audits involve the examination of the electronic media used in the analytical laboratory and by the prime contractor to collect, analyze, report, and store data. These audits are used to assess the authenticity of the data generated, and assess the implementation of good automated laboratory practices. AFCEE shall perform magnetic tape audits of the laboratories or of the prime contractors when warranted by project PE results, onsite audit results, or by other state/federal investigations.

9.1.5 Performance Evaluation Sample Programs

All laboratories shall participate in the U.S. EPA PE Water Supply and Water Pollution Studies programs or equivalent programs for state certifications. Satisfactory performance in these nonproject-specific PE programs also demonstrate proficiency in methods used to analyze AFCEE samples. The laboratory shall document the corrective actions to unacceptable PE results to demonstrate resolution of the problems.

9.2 Training

Training shall be provided to all project personnel to ensure compliance with the health and safety plan and technical competence in performing the work effort. Documentation of this training shall be maintained in the records of the contracted organizations.

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SECTION 10.0

Preventive Maintenance

10.0 Preventive Maintenance

A preventive maintenance program shall be in place to promote the timely and effective completion of a measurement effort. The preventive maintenance program is designed to minimize the downtime of crucial sampling and/or analytical equipment due to unexpected component failure. In implementing this program, efforts are focused in three primary areas: (1) establishment of maintenance responsibilities, (2) establishment of maintenance schedules for major and/or critical instrumentation and apparatus, and (3) establishment of an adequate inventory of critical spare parts and equipment.

10.1 Maintenance Responsibilities

Maintenance responsibilities for equipment and instruments are assumed by the respective facility managers. The managers then establish maintenance procedures and schedules for each major equipment item. This responsibility may be delegated to laboratory personnel, although the managers retain responsibility for ensuring adherence to the prescribed protocols.

10.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. Other maintenance activities are conducted as needed. Manufacturers' recommendations provide the primary basis for the established maintenance schedules, and manufacturers' service contracts provide primary maintenance for many major instruments (e.g., GC/mass spectrometry instruments, AA spectrometers, and analytical balances).

10.3 Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment downtime. The inventory includes those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner should failure occur.

Field sampling task leaders and the respective laboratory managers are responsible for maintaining an adequate inventory of spare parts. In addition to spare parts and supply inventories, the contractor shall maintain an in-house source of backup equipment and instrumentation.

10.4 Maintenance Records

Maintenance and repair of major field and laboratory equipment shall be recorded in field or laboratory logbooks. These records shall document the serial numbers of the equipment, the

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person performing the maintenance or repairs, the date of the repair, the procedures used during the repair, and proof of successful repair prior to the use of the equipment.

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SECTION 11.0

Corrective Action

11.0 Corrective Action

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Requirements and procedures for documenting the need for corrective actions are described in this section.

11.1 Corrective Action Report

Problems requiring corrective action in the laboratory are documented by the use of a corrective action report. The QA coordinator or any other laboratory member can initiate the corrective action request in the event QC results exceed acceptability limits, or upon identification of some other laboratory problem. Corrective actions can include reanalysis of the sample or samples affected, resampling and analysis, or a change in procedures, depending upon the severity of the problem.

11.2 Corrective Action System

A system for issuing, tracking, and documenting completion of formal Recommendations for Corrective Action (RCA) exists for addressing significant and systematic problems. Recommendations for corrective actions are issued only by a member of the QA group, or a designee in a specific QA role. Each RCA addresses a specific problem or deficiency, usually identified during QA audits of laboratory or project operations. An RCA requires a written response from the party to whom the RCA was issued. A summary of unresolved RCAs is included in the monthly QA report to management. The report lists all RCAs that have been issued, the manager responsible for the work area, and the current status of each RCA. An RCA requires verification by the QA group that the corrective action has been implemented before the RCA is considered to be resolved. In the event there is no response to an RCA within 30 days, or if the proposed corrective action is disputed, the recommendation and/or conflict is pursued to successively higher management levels until the issue is resolved.

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SECTION 12.0

Quality Assurance Reports to Management

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12.0 Quality Assurance Reports to Management

At a minimum, the QA coordinator shall prepare a summary report quarterly of the status of the project, of QA/QC problems, corrective actions taken, and unresolved RCAs with recommended solutions for management. The report shall also include results from all PE samples, audit findings, and periodic data quality assessments. This report shall be available for review by AFCEE auditors upon request.

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SECTION 13.0

References

13.0 References

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Methods for Chemical Analysis of Water and Waste, U.S. EPA, 1979.

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IRPIMS Data Loading Handbook, most current version.

Handbook for the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS), September, 1993.

U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, DC, Publication 9240.1-05-01, EPA-540/R-94-013, PB94-963502, February 1994.

U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, DC, Publication 9240.1-05, EPA-540/R-94-012, PB94-963501, February 1994.

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