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FINAL

WORK PLAN

for Groundwater Monitoring at AFP 59

Prepared for:

Air Force Center for Environmental Excellence
and
Aeronautical Systems Center

Prepared by:

Earth Tech, Inc.
1420 King Street, Suite 600
Alexandria, Virginia 22314

Contract No. F41624-97-D-8018
Delivery Order No. 0003

October 1998

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PREFACE

This *Final Work Plan for Groundwater Monitoring at Air Force Plant 59* was prepared by Earth Tech to describe field and laboratory operations to be conducted as part of the 1998/1999 semiannual groundwater monitoring at Air Force Plant 59 (AFP 59), Johnson City, New York. Field work will follow guidelines set forth in the Air Force Center for Environmental Excellence (AFCEE) *Model Work Plan* (United States Air Force [USAF], 1996) and *Model Field Sampling Plan, Version 1.1* (USAF, 1997). All work will be completed under AFCEE Contract Number F41624-97-D-8018, Delivery Order 0003. The objectives are as follows:

1. To collect and analyze groundwater samples from select monitoring wells to further characterize the extent of volatile organic compounds (VOCs) in site groundwater, and

2. To further evaluate the direction of groundwater flow beneath AFP 59 in the shallow and deep zones of the aquifer.

The AFCEE Restoration Team Chief (RTC) is John McCown. The Air Force Aeronautical Systems Center Integrated Product Team Chief (IPTC) is George Walters. The Earth Tech Project Manager (PM) is David Parse.

Approved:

Brian J. Burgher
Vice President
Program Manager

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13. ABSTRACT *(Maximum 200 words)*

This document is the *Final Work Plan for Groundwater Monitoring at Air Force Plant 59 (AFP 59)*, Johnson City, New York. It summarizes the fieldwork that will be completed during the semiannual groundwater monitoring. The monitoring is being conducted to accomplish the following objectives: to collect and analyze groundwater samples from select monitoring wells to further characterize the extent of volatile organic compounds in site groundwater, and to further evaluate the direction of groundwater flow beneath AFP 59 in the shallow and deep zones of the aquifer.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAB#	Analytical Batch Number
A2LA	American Association of Laboratory Accreditation
AFCEE	Air Force Center for Environmental Excellence
AFP 59	Air Force Plant 59
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
ASCII	American Standard Code Information Exchange
ASTM	American Society for Testing and Materials
BFB	Bromofluorobenzene
°C	Degrees Celsius
CCC	Calibration Check Compound
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	Calibration Factor
CHSO	Corporate Health and Safety Officer
CL	Control Limit
COC	Chain-of-Custody
DCA	Dichloroethane
DCB	Dichlorobenzene
DCE	Dichloroethene
DOD	Department of Defense
DEQPPM	Defense Environmental Quality Policy Program Memorandum
DFTPP	Decafluorotriphenylphosphine
DQO	Data Quality Objective
EDB	Ethyl Dibromide
EICP	Extracted Ion Current Profile
ERPIMS	Environmental Restoration Program Information Management System
FSP	Field Sampling Plan
g	Gram
G	Glass
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

HCl	Hydrochloric Acid
HNO_3	Nitric Acid
HPLC	High Performance Liquid Chromatography
ICP	Inductively Coupled Plasma
ICS	Interference Check Sample
ID	Identification
IPTC	Integrated Product Team Chief
IRP	Installation Restoration Program
IS	Internal Standard
LCL	Lower Control Limit
LCS	Laboratory Control Sample
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
µg/ml	Micrograms per Milliliter
µL	Microliter
MDL	Method Detection Limit
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
mL	Milliliter
mm	Millimeter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
N/A	Not Applicable
NCP	National Contingency Plan
NIST	National Institute of Standards and Technology
NTU	Nephelometric Turbidity Unit
NYSDEC	New York State Department of Environmental Conservation
P	Polyethylene
PE	Performance Evaluation
PM	Project Manager
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
QAPP	Quality Assurance Project Plan

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

%R	Percent Recovery
RCA	Recommendations for Corrective Action
RCRA	Resource Conservation and Recovery Act
RF	Response Factor
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
RPD	Relative Percent Difference
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RTC	Restoration Team Chief
S	Soil
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard Operating Procedures
SOW	Statement of Work
SPCC	System Performance Check Compound
TCA	Trichloroethane
TCE	Trichloroethene
TIC	Tentatively Identified Compound
UCL	Upper Control Limit
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
W	Water

1.0 INTRODUCTION

Earth Tech has been contracted by the Air Force Center for Environmental Excellence (AFCEE) to perform two rounds of groundwater sampling (semiannual sampling) at Air Force Plant 59 (AFP 59), located in Johnson City, New York. Figure 1-1 shows the general location of AFP 59. Figure 1-2 shows the locations of buildings, monitoring wells, Installation Restoration Program (IRP) sites, and Areas of Concern (AOCs) at AFP 59. The groundwater monitoring is being conducted to accomplish the following objectives:

- To collect and analyze groundwater samples from select monitoring wells to further characterize the extent of volatile organic compounds (VOCs) in site groundwater, and
- To further evaluate the direction of groundwater flow beneath AFP 59 in the shallow and deep zones of the aquifer.

This *Final Work Plan for Groundwater Monitoring at AFP 59* (herein referred to as the Work Plan) contains the following three sections: Section 1 provides the objectives of the groundwater monitoring; Section 2 outlines the data quality objectives (DQOs), all field activities, the laboratory analyses to be completed during each groundwater sampling round, and the project organization; and Section 3 presents the Quality Assurance Project Plan (QAPP). Because groundwater sampling activities will follow protocols described in the *Final Sampling and Analysis Plan* (Earth Tech, 1994a) that was prepared for the remedial investigation (RI) conducted at AFP 59, a revised field sampling plan (FSP) is not being submitted. Additionally, because health and safety issues are the same as those described in the *Health and Safety Plan* (Earth Tech, 1994b) that was prepared for the RI conducted at AFP 59, a revised health and safety plan is not being submitted. However, because of updates in AFCEE sampling and analysis protocols since 1994, a revised QAPP is being submitted.

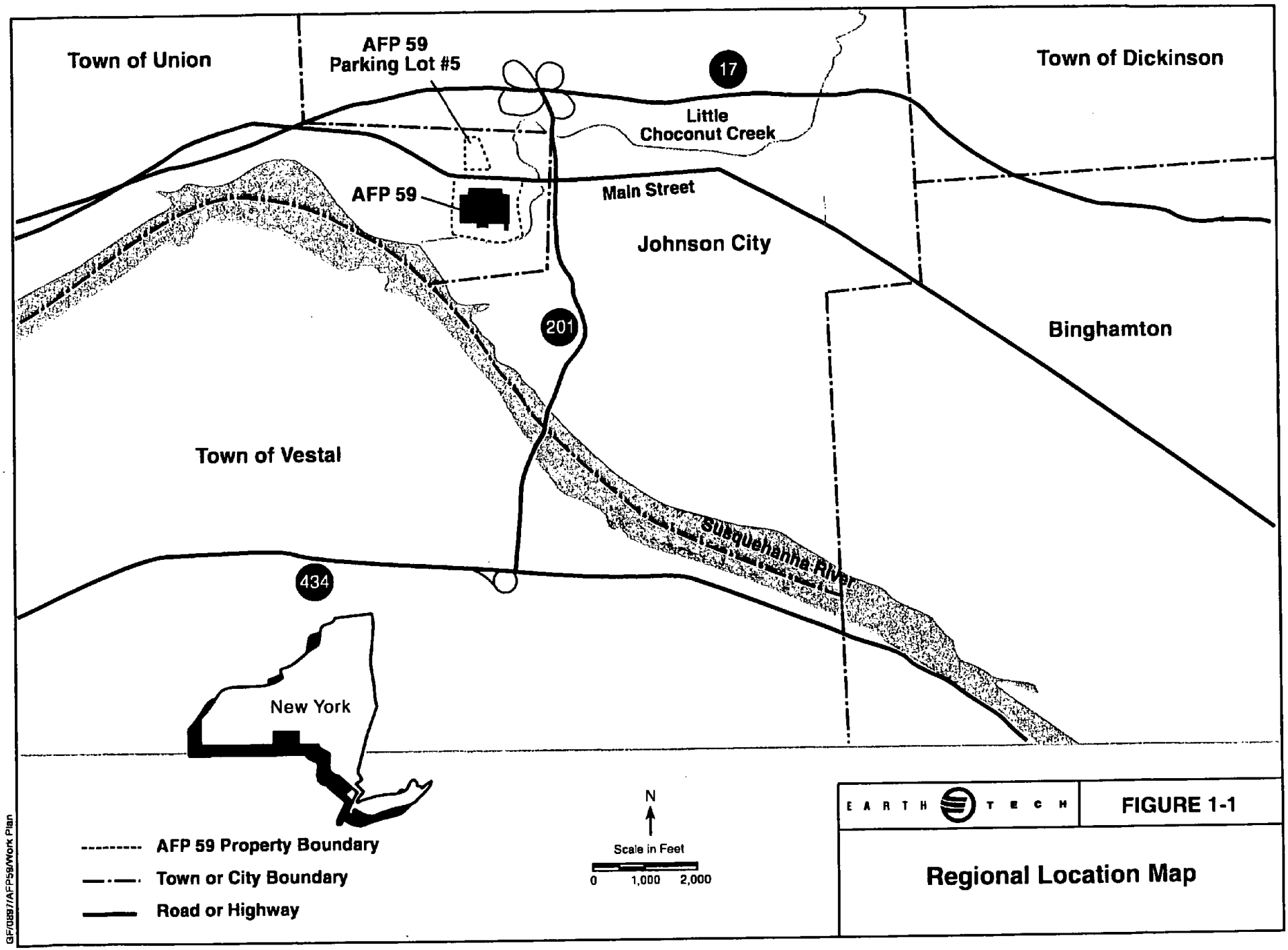
Town of Union
AFP 59
Parking Lot #5
17
Town of Dickinson
Little
Choconut Creek
AFP 59
Main Street
Johnson City
201
Binghamton
Town of Vestal
Susquehanna River
434
New York
AFP 59 Property Boundary
Town or City Boundary
Road or Highway
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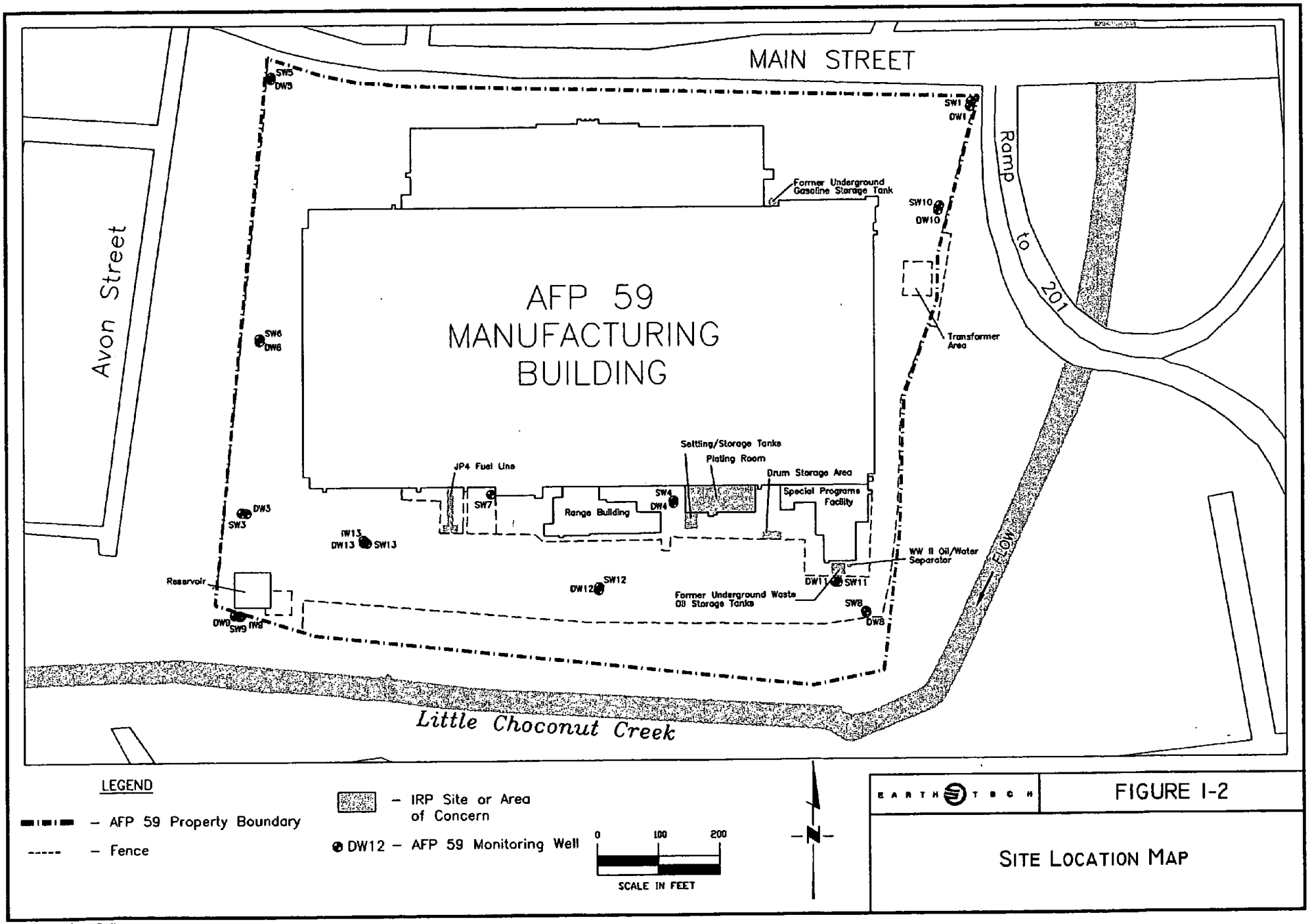
FIGURE 1-1
Regional Location Map
GF/0897/AFP59/Work Plan



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2.0 PROJECT ACTIVITIES

This section provides the DQOs for the project, summarizes the sample analyses and field activities, and outlines the project organization and responsibility.

2.1 Data Quality Objectives

Data must be of known quality to be beneficial to data users and decision makers. Primary data users on this project will be the United States Air Force (USAF) and its contractor, Earth Tech. The principal decision maker for this project in terms of adequacy of sampling and prescribing sampling requirements is the New York State Department of Environmental Conservation (NYSDEC).

The primary purpose of the groundwater monitoring is to provide two additional rounds of analytical data to further characterize the extent of VOCs in site groundwater (including both the shallow and deep zones of the aquifer). VOCs have been selected as the target parameters based on previous sample results.

Data categories are discussed below in Section 3.4.1 of the QAPP. The two general categories of data used by the AFCEE are defined as screening data and definitive data. Laboratory analyses will be performed to provide data reports equivalent to definitive data or Level IV, as described in the United States Environmental Protection Agency (USEPA) guidance document: *Data Quality Objectives for Remedial Response Activities (USEPA 540/G-87/1003).* This DQO level requires the use of USEPA analytical methods, reporting and deliverable requirements, and validation of the data.

Field analyses and measurements, such as the usage of water level indicators, air monitoring equipment, and pH, temperature, and conductivity meters, will adhere to AFCEE's definition of screening data or USEPA Analytical Levels I and II. Level I implies the use of portable instruments for field screening, while Level II implies the use of portable analytical instruments and calibration procedures for in-field measurements. The specific approaches that will be taken to achieve the required DQOs will be discussed in the remainder of this Work Plan.

2.2 Sample Analysis Summary

On the basis of conclusions presented in the *Final Remedial Investigation Report* (Earth Tech, 1996) and recommendations made by the NYSDEC, it was determined that VOCs represent the only chemicals of potential concern in groundwater at AFP 59. As a result, groundwater samples were collected in December 1995 and analyzed for VOCs by USEPA Method SW8260; the results of the December 1995 sampling are presented in the *Final Remedial Investigation Report Addendum* (Earth Tech, 1996). Because VOCs are the only chemicals of potential concern in

groundwater at AFP 59, groundwater samples to be collected during each groundwater sampling round will also be analyzed for VOCs by USEPA Method SW8260. Table 2.2-1 lists the total number of groundwater samples to be collected for each sample type (e.g., environmental sample, duplicate sample) during each sampling round. Figure 2.2-1 shows the locations of the on-site monitoring wells to be sampled during each groundwater sampling round, which are the same monitoring wells that were sampled during the December 1995 sampling event.

Table 2.2-1. Sample Analysis Summary

Method	Matrix	# Samples	# Equipment Blanks	# Ambient Blanks	# Trip Blanks	# Field Duplicates	Total # Samples
SW8260 Volatile Organics	Ground-water	10	0[1]	1	4	1	16

[1] No equipment blanks will be collected because disposable bailers will be used during groundwater sampling.

2.3 Field Activities

The primary field activity proposed is groundwater sampling of the monitoring wells shown in Figure 2.2-1. Based on the DQO process discussed in Section 2.1, specific sampling activities have been developed for the groundwater sampling rounds, as discussed below. A summary of the field activities is provided in Table 2.3-1.

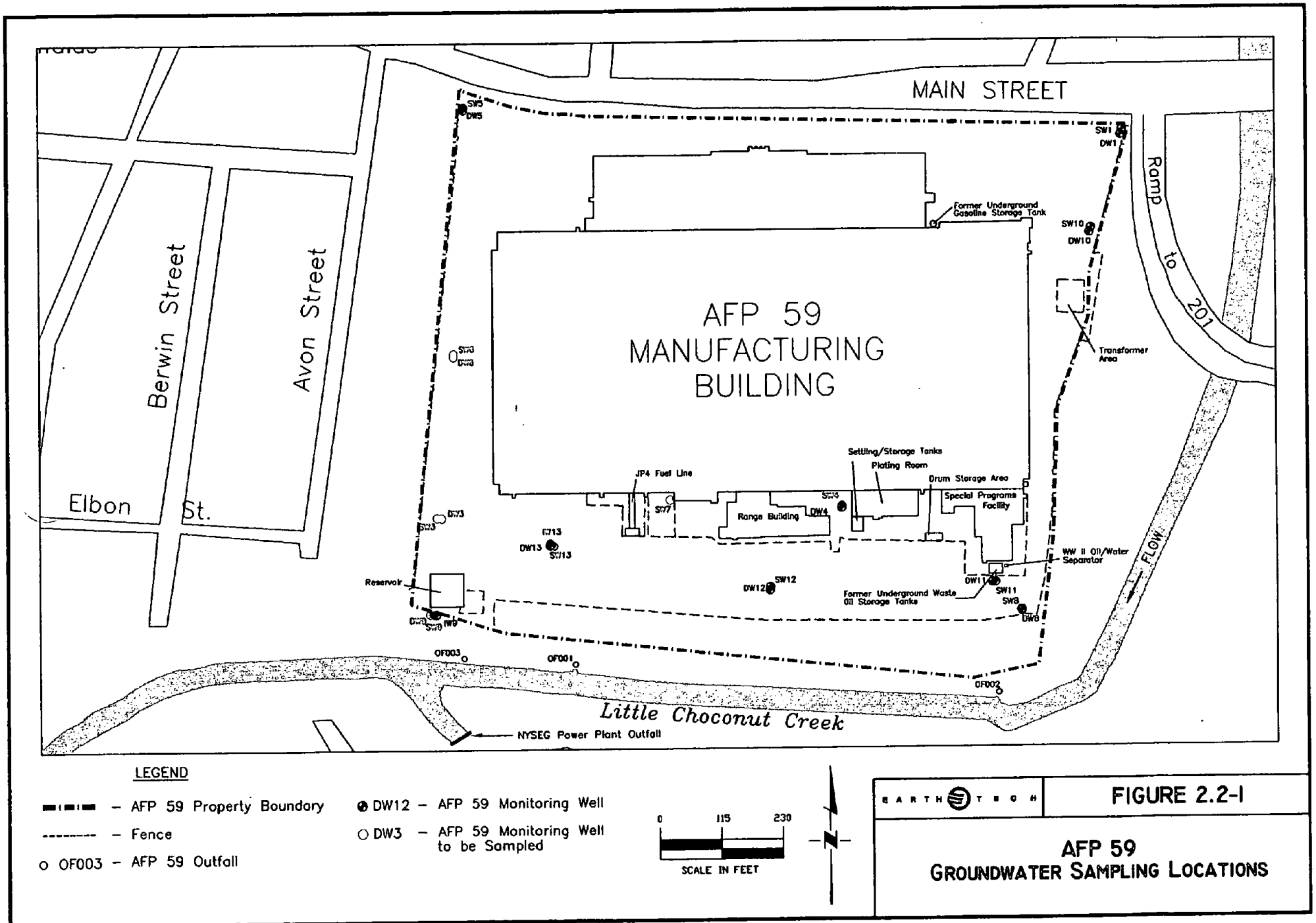
Table 2.3-1. Field Activities Summary

Activity
Measure the groundwater level in all on-site monitoring wells.
Collect groundwater samples from ten on-site monitoring wells.

Groundwater sampling methods will follow protocols presented in the *Final Sampling and Analysis Plan* (Earth Tech, 1994a) that was prepared for the RI conducted at AFP 59 and the USEPA document *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document* (USEPA, 1986). The objective of each groundwater sampling round is to provide an additional round of analytical data to further characterize the extent of VOCs in site groundwater (including both the shallow and deep zones of the aquifer).

Groundwater sampling procedures will include:

1. Measuring groundwater levels in all on-site monitoring wells;



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2. Purging select on-site groundwater monitoring wells prior to sampling;

3. Measuring field-derived parameters (including temperature, pH, and specific conductance) during monitoring well purging; and

4. Collecting groundwater samples from the purged monitoring wells.

Refer to the *Final Sampling and Analysis Plan* (Earth Tech, 1994a) for a detailed description of all sampling activities and protocols.

Water level measurements will be taken in all wells to determine the elevation of the water table or piezometric surface once within a single 24-hour period. Any conditions that may affect water levels will be recorded in the field log. Water-level measurements will be taken with an electric sounder and will be measured to the nearest 0.01-foot. All measuring equipment will be decontaminated according to the specifications in the *Final Sampling and Analysis Plan* (Earth Tech, 1994a).

Static water levels will be measured each time a well is sampled and before any equipment enters the well. If the casing cap is airtight, the equilibration of pressures will be allowed to stabilize after the cap is removed.

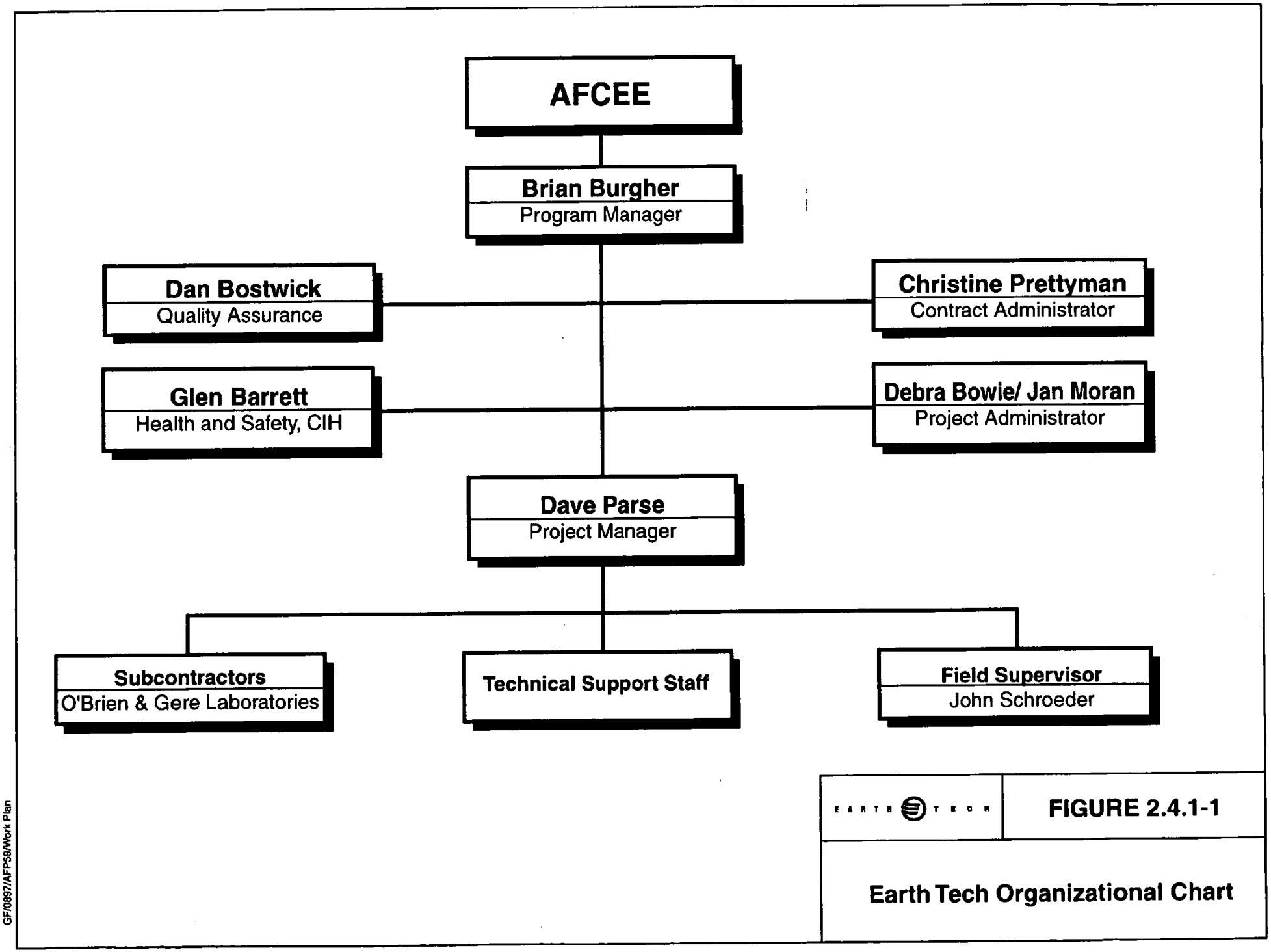
2.4 Project Organization and Responsibility

2.4.1 Earth Tech

Earth Tech will manage the groundwater sampling and all field services, including the sample collection, data analysis, and reporting. The project organization is shown in Figure 2.4.1-1. The following is a list of key Earth Tech personnel; brief descriptions of their roles are provided below. These Earth Tech personnel can be contacted at (703) 549-8728.

1.	Program Manager	Brian Burgher	703-549-8728
2.	Project Manager	Dave Parse	703-549-8728
3.	Corporate Health and Safety Officer	Glen Barrett	703-549-8728
4.	Project/Site Health and Safety Officer	Dave Parse	703-549-8728
5.	Project Quality Assurance Manager	Dan Bostwick	703-549-8728
6.	Contracts Administrator	Christine Prettyman	703-549-8728
7.	Cost Administrator	Debra Bowie/Jan Moran	703-549-8728

Program Manager. The Program Manager, Brian Burgher, is responsible for overall direction, coordination, technical consistency, and review of the entire contract. His responsibilities include:



EARTH TECH

FIGURE 2.4.1-1

Earth Tech Organizational Chart

GF/0897/AFP59/Work Plan

1. Final approval and review of work plans, all project deliverables, schedules, contract changes, and labor allocations for each task.

2. Approval of budgets and schedules, and changes in budgets or schedules.

3. Ensuring availability of key personnel assigned to the project for the duration of the contract.

4. Overseeing coordination among management, field teams, and support personnel to ensure consistency of performance.

5. Communicating, as necessary, with the AFCEE Restoration Team Chief (RTC) to evaluate the progress of the program and to facilitate the early resolution of any potential problem.

6. Frequent communication with the Project Manager to ensure that project objectives are being completed in a timely manner.

Project Manager. The Project Manager, Dave Parse, will be responsible for the effective day-to-day management of all operations. His responsibilities include:

1. Review and approval of project deliverables including the Work Plan and technical reports.

2. Review and approval of schedules, labor allocations, and sampling methods and Quality Assurance (QA) plans, including chemical analysis parameters.

3. Management of all funds for labor and materials procurement.

4. Oversight of project subcontractors and coordination of all requisitions.

5. Establishment and enforcement of work element milestones to ensure timely completion of project objectives.

6. Communicating developments in the project to the Program Manager.

7. Frequent communication with the AFCEE RTC with regard to day-to-day progress of the project.

8. Providing technical guidance to project staff.

9. Assisting in resolving nonconformance issues.

Corporate Health and Safety Officer. The Corporate Health and Safety Officer (CHSO), Glen Barrett, is responsible for implementing the Corporate Health and Safety Program, reviewing and approving all project-specific HSPs, ensuring that all personnel have successfully completed health and safety training as necessary, conducting on-site health and safety inspections, providing health and safety advice and assistance to project teams, and advising the Program Manager. THE CHSO HAS THE AUTHORITY TO IMMEDIATELY STOP ALL WORK AT THE SITE FOR HEALTH AND SAFETY REASONS.

Project/Site Health and Safety Officer. The Project/Site Health and Safety Officer, Dave Parse, is responsible for implementing the Corporate Health and Safety Program, reviewing and monitoring compliance with the site-specific HSP, implementing corrective measures for site-specific health and safety deficiencies, ensuring required training and medical monitoring of project personnel, conducting kick-off and daily safety meetings, and maintaining health and safety records (daily logs, meeting sign-in sheets, and accident reports). THE PROJECT/SITE HEALTH AND SAFETY OFFICER HAS THE AUTHORITY TO IMMEDIATELY STOP ALL WORK AT THE SITE FOR HEALTH AND SAFETY REASONS. Specific responsibilities include:

1. Ensuring that all personnel allowed access to the site (including regulatory agency personnel) are aware of all potential hazards and current activities at the site.

2. Ensuring that all personnel are aware of and follow the provisions of this plan, and are instructed in the safety practices established in this plan, including emergency procedures.

3. Capping and locking wells to prevent unauthorized access.

4. Ensuring that all heavy machinery and equipment are locked or chained each evening upon completion of daily activities.

5. Ensuring that all potentially contaminated materials, such as purge water, are contained prior to leaving the site each day.

Project Quality Assurance Manager. Dan Bostwick is designated as the Project QA Manager. He remains independent of the cost, scheduling, and other performance constraints that are the responsibility of the Program Manager and/or the Project Manager. The Project QA Manager's primary functions and responsibilities are to prepare, maintain, and verify compliance with the site-specific sampling and analysis plan (SAP); ensure that established laboratory and field procedures, as identified in the SAP, are being followed; ensure that quality control (QC) documentation is provided; and ensure that all QA problems are handled in an expeditious manner. He is responsible for project activity audits to verify conformance with QA objectives and for informing the Program Manager and the Project Manager of QA findings. The Project QA Manager will also be responsible for ensuring that all subcontractor activities are performed

in accordance with QA requirements through review of subcontractor documents, laboratory data, and periodic audits. Final data review is also the responsibility of the Project QA Manager. He has the authority and responsibility to identify problems, initiate or provide solutions, verify implementation of solutions, and order the stoppage of work, if necessary.

Contracts Administrator. The Contracts Administrator will be responsible for proper procurement and execution of subcontractor agreements.

2.4.2 Regulatory Agencies

The lead regulatory agency for the groundwater monitoring at AFP 59 is the NYSDEC.

2.4.3 Subcontractors

O'Brien & Gere Laboratories, Inc., will provide off-site, fixed-base laboratory analysis during the groundwater monitoring. The address and phone number of the laboratory subcontractor are provided below.

- O'Brien & Gere Laboratories, Inc.
  5000 Britton field Parkway
  P.O. Box 4842
  Syracuse, NY 13221
  (315) 437-0200

3.0 QUALITY ASSURANCE PROJECT PLAN

3.1 Introduction

The QAPP presents in specific terms the policies, organization, functions, and Quality Assurance/Quality Control (QA/QC) requirements designed to achieve the data quality goals described in the approved SAP for the project. This detailed QAPP, (1) has been prepared for use by contractors who perform environmental services to ensure the data are scientifically valid and defensible, and (2) establishes the analytical protocols and documentation requirements to ensure the data are collected, reviewed, and analyzed in a consistent manner. This QAPP and a site specific FSP constitute, by definition, an AFCEE SAP.

Because groundwater sampling activities will follow protocols defined in the *Final Sampling and Analysis Plan* (Earth Tech, 1994a) that was prepared for the RI conducted at AFP 59, a revised FSP is not being submitted. However, because of updates in AFCEE sampling and analysis protocols since 1994, a revised QAPP is being submitted.

The National Contingency Plan (NCP) specifies circumstances under which a QAPP 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 quality assurance project plan "which describes policy, organization, and functional activities and the data quality objectives and measures necessary to achieve adequate data for use in selecting the appropriate remedy." 40 CFR 300.430 (b)(8)(ii).

The USEPA QA policy requires a QAPP for every monitoring and measurement project mandated or supported by the USEPA through regulations, contracts, or other formalized means not currently covered by regulation. Guidelines followed in the preparation of this plan are set out in *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (USEPA, 1983a) and *USEPA Region IX QAPP: Guidance for Preparing QAPPs for Superfund Remedial Projects* (USEPA, 1989). Other documents that have been referenced for this plan include *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final* (USEPA, 1988); *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, Draft Final, EPA QA/R-5* (USEPA, 1993), *Compendium of Superfund Field Operations Methods* (USEPA, 1987a); *Data Quality Objectives Process for Superfund, Interim Final Guidance* (USEPA, 1993); *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA, 1994), *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA, 1994), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (USEPA SW-846, Third Edition, and its first, second, and third update), and the *Handbook for Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS)* (Handbook) (USAF, 1993).

This QAPP is required reading for all staff participating in the work effort. The QAPP shall be in the possession of the field teams and in the laboratories performing all analytical methods. All contractors and subcontractors shall be required to comply with the procedures documented in this QAPP in order to maintain comparability and representativeness of the data produced.

Controlled distribution of the QAPP shall be implemented by the prime contractor to ensure the current version is being used. A sequential numbering system shall be used to identify controlled copies of the QAPP. Controlled copies shall be provided to applicable Air Force managers, regulatory agencies, remedial project managers, project managers, and QA coordinators. Whenever Air Force revisions are made or addenda added to the QAPP, a document control system shall be put into place to assure (1) all parties holding a controlled copy of the QAPP 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 QAPP; 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.

This QAPP is based on AFCEE QAPP Version 3.0 (March, 1998); analytical parameter specifications not applicable to this project have been deleted. Additional project-specific information has been italicized.

3.2 Project Description

3.2.1 The 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 USEPA 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 USEPA 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 USEPA 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 USEPA'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 USEPA 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 USEPA 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.

3.2.2 Project Background

A project background description, including (1) the locations of sites at the base or facility, (2) a summary of the contamination history at each site and (3) the findings from previous investigations is provided in the Final Remedial Investigation Report (Earth Tech, 1996).

3.2.3 Project Scope and Objectives

A summary of the objectives and the proposed work for the site is included in Sections 1.0 and 2.0. A detailed description of all sampling activities and protocols is provided in the *Final Sampling and Analysis Plan* (Earth Tech, 1994a) that was prepared for the RI conducted at AFP 59.

3.3 Project Organization and Responsibility

The project organization and responsibility discussion including (1) a project organizational chart identifying task managers and individuals responsible for performance of the project, (2) a list of names of all key participants, including organization names and telephone numbers for project, field, and laboratory QA officers, (3) a description of the authority given to each key participant with an emphasis on the authority of the key individuals to initiate and approve corrective actions, and (4) the role of regulatory representatives shall be included in Section 2.4.

All contractors and subcontractors shall be identified and the scope of their performance in the project shall be clearly defined. Subcontractors proposed to provide backup services shall be identified.

3.4 Quality Program and 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 discussed in Section 2.1.

3.4.1 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 3.6).

Screening methods shall be confirmed, as required in Section 2.2, 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 3.7), such as approved EPA reference methods. The data can be generated in a mobile or off-site laboratory. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements (Sections 3.7 and 3.8). Definitive data are not restricted in their use unless quality problems require data qualification.

3.4.2 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 3.6 and 3.7.

3.4.2.1 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 3.4.2-1 as RPD. For replicate analyses, the relative standard deviation (RSD) is determined. The formula for the calculation of RSD is provided in Table 3.4.2-1.

3.4.2.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from

Table 3.4.2-1. Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Mean	$\overline{X}$	$\frac{\left(\sum_{i=1}^{n} x_i\right)}{n}$	Measure of central tendency	Used to determine average value of measurements
Standard Deviation	S	$\left(\frac{\Sigma(x_i-\overline{x})^2}{(n-1)}\right)^{1/2}$	Measure of relative scatter of the data	Used in calculating variation of measurements
Relative Standard Deviation	RSD	$(S/\overline{X}) \times 100$	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
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	$\frac{\left(\begin{array}{c}\text{value of}\\ \text{spiked}\\ \text{sample}\end{array} - \begin{array}{c}\text{value of}\\ \text{unspiked}\\ \text{sample}\end{array}\right)}{\text{Value of added spike}} \times 100$	Recovery of spiked compound in sample matrix	Used to assess matrix effects and total precision

x = Observation (concentration)
n = Number of observations

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 3.4.2-1 as percent recovery (%R) from pure and sample matrices.

3.4.2.3 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 Section 2.3.

3.4.2.4 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 3.8 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:

$$\%\ completeness = \left[\frac{Number\ of\ valid\ (i.e.,\ non-R\ flagged)\ results}{Number\ of\ possible\ results}\right] \times 100$$

3.4.2.5 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 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.

3.4.3 Method Detection Limits, AFCEE Reporting Limits, and Instrument Calibration Requirements

3.4.3.1 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 at least once per twelve month period. 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 3.8. Results less than or equal to the MDL shall be reported as the RL value on the hardcopy and flagged with a "U" (see Section 3.8).

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. Estimate the MDL using one of the following:

   a) the concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5, or

   b) the concentration equivalent of 3 times the standard deviation of replicate measurement of the analyte in reagent water, or

   c) 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. Prepare (i.e., extract, digest, etc.) and analyze seven samples of a matrix spike (ASTM Type II water for aqueous methods, Ottawa sand for soil methods, glass beads of 1 mm diameter or smaller for metals) 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:

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

where x_i = the ith measurement of the variable x and $\bar{x}$ = the average value of x

$$\overline{X} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

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)

6. If the spike level used in step 2 is more than 5 times the calculated MDL, repeat the process using a smaller spiking level.

Where multiple instruments are used, the MDL used for reporting purposes shall represent the least sensitive instrument.

3.4.3.2 Reporting Limits

The laboratories participating in this work effort shall compare the results of the MDL demonstrations to the reporting limits (RLs) for each method that is listed in Section 3.7. The MDL may not be more than one-half the corresponding RL. The laboratories shall also verify RLs by including a standard at or below the RL 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 RL, an "F" flag shall be applied to the results indicating the variability associated with the result (see Section 3.8). No results shall be reported below the MDL.

3.4.3.3 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 shall meet the acceptance criteria specified in Section 3.7. All results reported shall be within the calibration range. 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 3.7 for the method. This applies equally to multiresponse analytes (except as noted in Section 3.7). 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. Multipoint calibrations shall contain the minimum number of calibration points specified in the method with all points used for the calibration being contiguous. If more than the minimum number of standards is analyzed for the initial calibration, all of the standards analyzed shall be included in the initial calibration. The only exception to this rule is a standard that has been statistically determined as being an outlier can be dropped from the calibration, providing the requirement for the minimum number of standards is met. Acceptance criteria for the calibration check are presented in *Section 3.7.* 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. The continuing calibration verification cannot be used as the LCS.

3.4.4 Elements of Quality Control

QC elements relevant to screening data are presented in Section 3.6. 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) and analyzed sequentially. 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 3.7.

3.4.4.1 Laboratory Control Sample

The LCS is analyte-free water for aqueous analyses or Ottawa sand for soil analyses (except metals where glass beads of 1 mm diameter or smaller may be used) spiked with all analytes listed in the QC acceptance criteria table in Section 3.7 for the method. The LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. 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. The LCS cannot be used as the continuing calibration verification.

One LCS shall be included in every AFCEE analytical batch. If more than one LCS is analyzed in an AFCEE analytical batch, results from all LCSs analyzed shall be reported. A QC failure of an analyte in any of the LCSs shall require appropriate corrective action including qualification of the failed analyte in all of the samples as required.

The performance of the LCS is evaluated against the QC acceptance limits given in the tables in Section 3.7.

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 3.7 and 3.8, shall be applied to all affected results.

3.4.4.2 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 3.7 for the method. The spiking occurs prior to sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. 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 3.7. 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 3.7 and 3.8.

3.4.4.3 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 3.7 and 3.8, shall be applied to the sample results.

3.4.4.4 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 3.7 and 3.8, shall be applied to the sample results.

3.4.4.5 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 8000B.

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 3.7 and 3.8, shall be applied to the sample results.

3.4.4.6 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 equal to or greater than the RL 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 repreped 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 3.7 and 3.8, shall be applied to the sample results.

3.4.4.7 Ambient Blank

The ambient blank consists of ASTM Type II reagent grade water poured into a 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 Section 2.2. Ambient blanks shall be collected downwind of possible VOC sources.

3.4.4.8 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 Section 2.2. 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 3.8, shall be applied to all sample results from samples collected with the affected equipment.

3.4.4.9 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 3.8, 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.

3.4.4.10 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 Section 2.2.

3.4.5 Quality Control Procedures

3.4.5.1 Holding Time Compliance

All sample preparation and analysis shall be completed within the method-required holding times. The holding time for a sample begins at the time of sample collection. Some methods have more than one holding time requirement (e.g., methods SW8081A, SW8270C, 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 3.8.

3.4.5.2 Confirmation

Quantitative confirmation of results at or above the RL for samples analyzed by GC or HPLC shall be required, unless otherwise specified for the method in Section 3.7, 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 3.8.

3.4.5.3 Standard Materials

Standard materials, including second source materials, used in calibration and to prepare samples shall be traceable to National Institute Standards and Technology (NIST), USEPA, American Association of Laboratory Accreditation (A2LA) or other equivalent AFCEE approved source, if available. If an NIST, USEPA 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.

A second source standard is used to independently confirm initial calibration. A second source standard is a standard purchased from a different vendor than the vendor supplying the material used in the initial calibration standards. The second source material can be used for the continuing calibration standards or for the LCS (but shall be used for one of the two). Two different lot numbers from the same vendor do not constitute a second source.

3.4.5.4 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.

3.5 Sampling Procedures

3.5.1 Field Sampling

The field sampling procedures for collecting samples and sampling methods are summarized in Section 2.3 and provided in detail in the *Final Sampling and Analysis Plan* (Earth Tech, 1994a).

3.5.1.1 Sample Containers

Sample containers are purchased precleaned and treated according to USEPA specifications for the methods. Sampling containers that are reused are decontaminated between uses by the USEPA-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 (volatile organic analysis vials) will be used when glass containers are specified in the sampling protocol (except where noted).

3.5.1.2 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 3.5.1-1.

Table 3.5.1-1. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Analytical Methods	Container[a]	Preservation	Minimum Sample Volume or Weight	Maximum Holding Time
Hydrogen ion (pH) (W)	SW9040B	P, G	None required	Not Applicable	Analyze immediately
Conductance	SW9050A	P, G	None required	Not Applicable	Analyze immediately
Turbidity	E180.1	P, G	4°C	Not Applicable	48 hours
Volatile organics	SW8260B	G, Teflon-lined septum	4°C HCl to pH <2	2 x 40 mL	14 days (water and soil); 7 days if unpreserved by acid

a. Polyethylene (P); glass (G).

3.5.2 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 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 3.8):

- 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 the *Final Sampling and Analysis Plan* (Earth Tech, 1994a).

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. If the temperature of the samples upon receipt exceeds the temperature requirements, the exceedance shall be documented in laboratory records and discussed with AFCEE. The decision regarding the potentially affected samples 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 for the groundwater sampling are specified in Table 3.5.1-1. **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°C ± 2°C. Acceptance criteria for the temperatures of the freezers shall be less then 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 in accordance with 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.

3.6 Screening Analytical Methods

The analytical screening methods contained in this section are shown in Table 3.6-1. 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* (USEPA SW-846, Third Edition, and its first, second, and third update), *Methods for Chemical Analysis of Water and Waste* (USEPA 1979), *ASTM Annual Book of Standards* (1993), and from manufacturers' literature.

Table 3.6-1. Screening Analytical Methods

Method	Parameter
SW9040B	pH (water)
SW9050A	Conductance
E180.1	Turbidity

3.6.1 Analytical Screening Method Descriptions

Section 3.6.1 contains subsections for each analytical procedure. Each subsection contains the following information:

- A brief method description
- The RL (if applicable)

3.6.1.1 USEPA Method SW9040B (Water)-pH

pH measurements shall be performed for water samples using method SW9040B. Measurements are determined electrometrically using either a glass electrode in combination with a reference potential, or a combination electrode.

3.6.1.2 USEPA Method SW9050A–Conductance

Standard conductivity meters are used. Temperature is also reported.

3.6.1.3 USEPA 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.

3.6.2 Calibration and QC Procedures for Screening Methods

Table 3.6.2-1 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 are typically applied in the event that the method-required calibration and QC acceptance criteria are not met. However, because the limited amount of screening data that will be generated will only be used to determine when monitoring well purging is complete, the screening data will not be subjected to the typical data review, qualification, and validation process.

3.7 Definitive Data Analytical Methods and Procedures

Section 3.7.1 contains brief descriptions of preparation methods. Section 3.7.2 contains subsections for each analytical procedure. Each subsection contains the following information:

- A brief method description
- A table of RLs

Table 3.6.2-1. 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]
SW9050A	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
SW9040B	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
E180.1	Turbidity	Calibration with one formazin standard per instrument range used	Once per day at beginning of testing	± 5 units, 0–100 range ± 0.5 units, 0–0.2 range ± 0.2 units, 0–1 range	If calibration is not achieved, check meter; replace if necessary, recalibrate	R
		Field duplicate	10% of field samples	RPD ≤ 20%	Correct problem, repeat measurement	J
None	Organic vapor concentrations (FID and PID)	3 point calibration	Monthly	Correlation coefficient ≥0.995	Recalibrate; check instrument and replace if necessary	R
		Calibration verification and check	Daily at beginning and end of day	Response ± 20% of expected value	Correct problem, recalibrate	R

a. All corrective actions shall be documented, and the records shall be maintained by the prime contractor.
b. All screening results are typically 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". However, because the limited amount of screening data that will be generated will only be used to determine when monitoring well purging is complete, the screening data will not be subjected to the typical data review, qualification, and validation process.

- 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* (USEPA SW-846, Third Edition, and its first, second, and third update); *Handbook for the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS)* (Handbook), September 1993; and *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, USEPA, 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 3.4, and data validation guidelines are presented in Section 3.8.

3.7.1 Preparation Methods

Extraction and digestion procedures for liquid and solid matrices presented in this section are outlined in Table 3.7.1-1. The appropriate preparation method to be used (if applicable) for each analytical method is given in the RL tables.

Table 3.7.1-1. Extraction and Digestion Procedures

Method	Parameter
SW5030B	Purge and Trap Method

3.7.1.1 Method SW5030B-Purge and Trap Method

Method SW5030B 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.

3.7.2 Analytical Procedures

The analytical procedures presented in this section are outlined in Table 3.7.2-1.

Table 3.7.2-1. Analytical Procedures

Analytical Method	Parameter	Preparatory Methods
SW8260B	Volatile organics	SW5030B

A brief description and three tables for each method are included in the following subsections. The first table presents the RLs for each analyte in the method. The RLs are presented for the water matrix. 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 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.

3.7.2.1 Method SW8260B-Volatile Organics

Volatile (or purgeable) organics in water and soil samples are analyzed using method SW8260B. This method uses a capillary column GC/mass spectrometry technique. Volatile compounds are introduced into the GC by purge and trap (SW5030B). An inert gas is bubbled through the water samples to transfer the purgeable organic compounds from the liquid to vapor phase. 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 RLs (using a 25 mL purge) for this method are listed in Table 3.7.2-2.

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:

- mass 50 15 percent to 40 percent of mass 95
- mass 75 30 percent to 60 percent of mass 95

Table 3.7.2-2. RLs for Method SW8260B

Parameter/Method	Analyte	Water	
		RL	Unit
VOCs SW8260B	1,1,1,2-Tetrachloroethane	0.5	µg/L
	1,1,1-TCA	0.8	µg/L
	1,1,2,2-Tetrachloroethane	0.5	µg/L
	1,1,2-TCA	1.0	µg/L
	1,1-DCA	0.4	µg/L
	1,1-DCE	1.2	µg/L
	1,1-Dichloropropene	1.0	µg/L
	1,2,3-Trichlorobenzene	0.3	µg/L
	1,2,3-Trichloropropane	3.2	µg/L
	1,2,4-Trichlorobenzene	0.4	µg/L
	1,2,4-Trimethylbenzene	1.3	µg/L
	1,2-DCA	0.6	µg/L
	1,2-DCB	0.3	µg/L
	1,2-Dichloropropane	0.4	µg/L
	1,3,5-Trimethylbenzene	0.5	µg/L
	1,3-DCB	1.2	µg/L
	1,3-Dichloropropane	0.4	µg/L
	1,4-DCB	0.3	µg/L
	1-Chlorohexane	0.5	µg/L
	2,2-Dichloropropane	3.5	µg/L
	2-Chlorotoluene	0.4	µg/L
	4-Chlorotoluene	0.6	µg/L
	Benzene	0.4	µg/L
	Carbon tetrachloride	2.1	µg/L
	Chlorobenzene	0.4	µg/L
	Chloroethane	1.0	µg/L
	Chloroform	0.3	µg/L
	Chloromethane	1.3	µg/L
	Cis-1,2-DCE	1.2	µg/L
	Cis-1,3-Dichloropropene	1.0	µg/L
	Dichlorodifluoromethane	1.0	µg/L
	Ethylbenzene	0.6	µg/L
	Hexachlorobutadiene	1.1	µg/L
	Isopropylbenzene	0.5	µg/L
	Methylene chloride	2.0	µg/L
	n-Butylbenzene	1.1	µg/L
	n-Propylbenzene	0.4	µg/L
	Naphthalene	1.0	µg/L
	o-Xylene	1.1	µg/L
	p-Isopropyltoluene	1.2	µg/L
	m&p-Xylene	0.6	µg/L
	Sec-Butylbenzene	1.3	µg/L

Table 3.7.2-2. RLs for Method SW8260B (Continued)

Parameter/Method	Analyte	Water	
		RL	Unit
VOCs SW8260B (Continued)	Styrene	0.5	µg/L
	TCE	1.0	µg/L
	Tert-Butylbenzene	1.4	µg/L
	Tetrachloroethene	1.4	µg/L
	Toluene	1.1	µg/L
	Trans-1,2-DCE	0.6	µg/L
	Trans-1,3-Dichloropropene	1.0	µg/L
	Trichlorofluoromethane	0.8	µg/L
	Vinyl chloride	1.1	µg/L

- mass 95 base peak, 100 percent relative abundance
- mass 96 5 percent to 9 percent of mass 95
- mass 173 less than 2 percent of mass 174
- mass 174 greater than 50 percent of mass 95
- mass 175 5 percent to 9 percent of mass 174
- mass 176 greater than 95 percent, but less than 101 percent of mass 174
- mass 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 3.7.2-3 and 3.7.2-4.

3.8 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.

3.8.1 Data Review, Validation, and Reporting Requirements for Screening Data

Because the limited amount of screening data that will be generated will only be used to determine when monitoring well purging is complete, the screening data will not be subjected to the typical data review, validation, and reporting process. However, the calibration and QC procedures for screening methods (see Section 3.6.2) will be followed. The data will be reported on monitoring well purging and sampling forms.

3.8.2 Data Review, Validation, and Reporting Requirements for Definitive Data

The definition of data qualifiers are shown in Table 3.8.2-1.

MDLs and all positive results shall be reported to two significant figures; all nondetects shall be reported to the RL value on the hardcopy and flagged with a "U". RLs and MDLs are adjusted for dilution.

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 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 3.7.2. The calibration, QC requirements, corrective action requirements, and flagging criteria required for definitive data are shown in the tables in Section 3.7.2, and in summary Tables 3.8.2-2 and 3.8.2-3. The flagging criteria are

Table 3.7.2-3. QC Acceptance Criteria for Method SW8260B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Assoc. IS
SW8260B	1,1,1,2-Tetrachloroethane	72–125	≤ 20	2
	1,1,1-TCA	75–125	≤ 20	1
	1,1,2,2-Tetrachloroethane	74–125	≤ 20	3
	1,1,2-TCA	75–127	≤ 20	1
	1,1-DCA	72–125	≤ 20	1
	1,1-DCE	75–125	≤ 20	1
	1,1-Dichloropropene	75–125	≤ 20	1
	1,2,3-Trichlorobenzene	75–137	≤ 20	3
	1,2,3-Trichloropropane	75–125	≤ 20	3
	1,2,4-Trichlorobenzene	75–135	≤ 20	3
	1,2,4-Trimethylbenzene	75-125	≤ 20	3
	1,2-DCA	68–127	≤ 20	1
	1,2-DCB	75-125	≤ 20	3
	1,2-Dichloropropane	70–125	≤ 20	3
	1,3,5-Trimethylbenzene	72–112	≤ 20	3
	1,3-DCB	75-125	≤ 20	3
	1,3-Dichloropropane	75-125	≤ 20	2
	1,4-DCB	75-125	≤ 20	3
	1-Chlorohexane	75-125	≤ 20	2
	2,2-Dichloropropane	75-125	≤ 20	1
	2-Chlorotoluene	73–125	≤ 20	3
	4-Chlorotoluene	74–125	≤ 20	3
	Benzene	75–125	≤ 20	1
	Carbon Tetrachloride	62–125	≤ 20	1
	Chlorobenzene	75–125	≤ 20	2
	Chloroethane	65–125	≤ 20	1
	Chloroform	74–125	≤ 20	1
	Chloromethane	75-125	≤ 20	1
	Cis-1,2-DCE	75–125	≤ 20	1
	Cis-1,3-Dichloropropene	74–125	≤ 20	1
	Dichlorodifluoromethane	50-150	≤ 20	1
	Ethylbenzene	75-125	≤ 20	2
	Hexachlorobutadiene	75-125	≤ 20	3
	Isopropylbenzene	75-125	≤ 20	3
	m-Xylene	75-125	≤ 20	2
	Methylene chloride	75-125	≤ 20	1
	n-Butylbenzene	75-125	≤ 20	3
	n-Propylbenzene	75-125	≤ 20	3
	Naphthalene	75-125	≤ 20	3
	o-Xylene	75-125	≤ 20	2

Table 3.7.2-3. QC Acceptance Criteria for Method SW8260B (Continued)

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Assoc. IS
SW8260B (Continued)	p-Isopropyltoluene	75-125	≤ 20	3
	p-Xylene	75-125	≤ 20	2
	Sec-Butylbenzene	75-125	≤ 20	3
	Styrene	75-125	≤ 20	2
	TCE	71-125	≤ 20	1
	Tert-butylbenzene	75-125	≤ 20	3
	Tetrachloroethene	71-125	≤ 20	2
	Toluene	74-125	≤ 20	1
	Trans-1,2-DCE	75-125	≤ 20	1
	Trans-1,3-Dichloropropene	66-125	≤ 20	1
	Trichlorofluoromethane	67-125	≤ 20	1
	Vinyl Chloride	46-134	≤ 20	1
	Surrogates:			
	Dibromofluoromethane	75-125		
	Toluene-D8	75-125		
	4-Bromofluorobenzene	75-125		
	1,2-DCA-D4	62-139		
	Internal Standards:			
	Fluorobenzene			1
	Chlorobenzene-D5			2
	1,4-Dichlorobenzene-D			3

Table 3.7.2-4. Summary of Calibration and QC Procedures for Method SW8260B

Method	Applicable Parameter	QC Check	*Minimum* Frequency	Acceptance Criteria	Corrective Action[a]	Flagging Criteria[b]
SW8260B	Volatile Organics	Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	SPCCs average RF ≥ 0.30[c] and %RSD for RFs for CCCs ≤ 30% and one option below	Correct problem then repeat initial calibration	Apply R to all results for all samples associated with the calibration
				Option 1 linear- mean RSD for all analytes ≤15% with no individual analyte RSD >30%		Apply R to all results for specific analyte(s) for all samples associated with the calibration
				Option 2 linear – least squares regression r > 0.995		
				Option 3 non-linear – COD ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order)		
		Second-source calibration verification	Once per five-point initial calibration	All analytes within ±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 sample	Relative retention time (RRT) of the analyte within ± 0.06 RRT units of the RRT	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 and every 12 hours of analysis time	SPCCs average RF ≥ 0.30[c]; and CCCs ≤ 20% difference (when using RFs)or drift (when using least squares regression or non-linear calibration)	Correct problem then repeat initial calibration	Apply R to all results for all samples associated with the calibration verification
				All calibration analytes within ±20% of *expected* value		Apply R to all results for specific analyte(s) for all samples associated with the calibration verification

Table 3.7.2-4. Summary of Calibration and QC Procedures for Method SW8260B (Continued)

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]	Flagging Criteria[b]
SW8260B	Volatile Organics	Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 3.7.2-3	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
		ISs	Immediately after or during data acquisition for each sample	Retention time ±30 seconds from retention time of the mid-point std. in the ICAL. EICP area within -50% to +100% of ICAL mid-point std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Apply R to all results for analytes associated with the IS
		Method blank	One per analytical batch	No analytes detected ≥ RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
		LCS for all analytes	One LCS per analytical batch	QC acceptance criteria, Table 3.7.2-3	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch; if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
		MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table 3.7.2-3	none	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if; (1)%R for MS or MSD > UCL or(2)%R for MS or MSD < LCL or (3) MS/MSD RPD > CL

Table 3.7.2-4. Summary of Calibration and QC Procedures for Method SW8260B (Continued)

Method	Applicable Parameter	QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]	Flagging Criteria[b]
SW8260B	Volatile Organics	Check of mass spectral ion intensities using BFB	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description (section 3.7.2.1)	Retune instrument and verify	Apply R to all results for all samples associated with the tune
		Surrogate spike	Every sample, spiked sample, standard, and method blank	QC acceptance criteria, Table 3.7.2-3	Correct problem then reextract and analyze sample	For the samples; if the %R > UCL for a surrogate, apply J to all positive results if the %R < LCL for a surrogate, apply J to all positive results; apply R to all non-detect results If any surrogate recovery is <10%, apply R to all results
		MDL study	Once per 12 month period	Detection limits established shall be ≤ ½ the RLs in Table 3.7.2-2	None	Apply R to all results for the specific analyte(s) in all samples analyzed
		Results reported between MDL and RL	none	none	None	Apply F to all results between MDL and RL

a. All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory.
b. Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.
c. Except > 0.10 for bromoform, and > 0.10 for chloromethane and 1,1-dichloroethane

Table 3.8.2-1. 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 RL.
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)

Table 3.8.2-2. General Flagging Conventions

QC Requirement	Criteria	Flag	Flag Applied To
Holding Time	Time exceeded for extraction or analysis	R	All analytes in the sample
LCS	% R > UCL %R < LCL	J for the positive results J for the positive results, R for the nondetects	The specific analyte(s) in all samples in the associated AAB
Method Blank	Analyte(s) detected ≥ RL	B	The specific analyte(s) in all samples in the associated AAB
Equipment Blank	Analyte(s) detected ≥ RL	B	The specific analyte(s) in all samples with the same sampling date as the equipment blank
Field duplicates	Field duplicates > RLs AND RPD outside CL	J for the positive results R for the nondetects	The specific analyte(s) in all samples collected on the same sampling date
MS/MSD	MS or MSD % R > UCL OR MS or MSD % R < LCL OR MS/MSD RPD > CL	M for all results	The specific analyte(s) in all samples collected from the same site as the parent sample
Sample Preservation/ Collection	Preservation/collection requirements not met	R for all results	All analytes in the sample
Sample Storage	< 2°C or > 6°C	J for the positive results R for the nondetects	All analytes in the sample

UCL = upper control limit LCL = lower control limit CL = control limit

	Criteria	Flag*
Quantitation	≤ MDL	U
	> MDL < RL	F
	≥ RL	as needed

*Example 1: if the MDL is 0.04, the RL is 0.9 and the result is 0.03, the concentration reported on the result form would be 0.04 (the MDL) and the qualifier flag would be U.

Example 2: if the MDL is 0.04, the RL is 0.9 and the result is 0.07, the concentration reported on the result form would be 0.07 and the qualifier flag would be F.

Example 3: if the MDL is 0.04, the RL is 0.9 and the result is 1.2, the concentration reported on the result form would be 1.2 and the qualifier would be any flag needed because of a data quality problem (e.g., R, J, B, etc.).

Table 3.8.2-3. Flagging Conventions Specific to Organic Methods

QC Requirement	Criteria	Flag	Flag Applied To
Ambient Blank (VOC samples only)	Analyte(s) detected ≥ RL	B	The specific analyte(s) in all samples with the same matrix and sampling date
Trip Blank (VOC samples only)	Analyte(s) detected ≥ RL	B	The specific analyte(s) in all samples shipped in the same cooler as the blank
Initial Five Point Calibration (GC & HPLC methods)	Linearity criterion not met	R	The specific analyte(s) in all samples associated with the initial calibration
Initial Five Point Calibration *(GC/MS methods)*	SPCC or CCC criteria not met	R	All analytes in all samples associated with the initial calibration
	Linearity criterion not met	R	The specific analyte(s) in all samples associated with the initial calibration
Second Source Calibration Verification	CL exceeded	R	The specific analyte(s) in all samples associated with the second source calibration verification
Initial Daily Calibration Verification (GC & HPLC methods)	CL exceeded	R	The specific analyte(s) in all samples associated with the initial calibration verification
Calibration Verification (GC/MS methods)	SPCC or CCC criteria not met	R	All analytes in all samples associated with the calibration verification
	CL exceeded	R	The specific analyte(s) in all samples associated with the calibration verification
Calibration Verification (GC & HPLC methods)	CL exceeded	R	The specific analyte(s) in the sample associated with the continuing calibration verification
Retention time	Retention time of analyte outside of established retention time window	R	The specific analyte(s) in the sample
Surrogates	surrogate % R >UCL OR surrogate % R < LCL OR surrogate recovery < 10%	J for the positive results J for the positive results R for the nondetects R for all results	All analytes in the sample associated with the surrogate
Mass Spectrometer Tune	Ion abundance criteria not met	R for all results	All analytes in all samples associated with the tune

Table 3.8.2-3. Flagging Conventions Specific to Organic Methods (Continued)

QC Requirement	Criteria	Flag	Flag Applied To
Second Column/Second Detector Confirmation (GC & HPLC methods)	Not performed Agreement between results not within ±40%	R J	All analytes ≥RL All affected analytes
Internal Standard	Retention time not within ±30 seconds: EICP area not within -50% to +100% of last calibration verification	R	Apply R to all results for specific analytes associated with the IS
Lowest Calibration Standard	At or below RL in Initial Calibration	R	All results below the lowest calibration standard used
Tentatively Identified Compounds (TICs)		T	All TICs

UCL = upper control limit LCL = lower control limit CL = control limit

applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

Data qualifiers shall be added or, if applied by a software package, reviewed 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 3.8.2-1.

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 TICs numerical results will always be provided by hardcopy only on a separate report form from the target compound list form.

The laboratory QA section shall perform a 100 percent review of 10 percent of the completed data packages, and the laboratory project manager shall perform a sanity check review on all the completed data packages.

The prime contractor's project manager or project QA coordinator 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 3.8.2-2 and 3.8.2-3. Each matrix spike sample shall only be qualified by the laboratory, while the prime contractor shall apply the final qualifying flag for a matrix effect to all samples collected from the same site as the parent sample or all samples showing the same lithologic characteristics as the MS/MSD.

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 3.8.8.

3.8.3 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.

3.8.4 ERPIMS Electronic Data Reports

The prime contractor shall provide an electronic deliverable report in the Environmental Restoration Program Information Management System (ERPIMS) format as specified by the Statement of Work (SOW) for the project.

ERPIMS 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 ERPIMS 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 *ERPIMS Data Loading Handbook.*

3.8.5 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.

3.8.6 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.

3.8.7 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 contain 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), (3) method blank results, (4) IS results, (5) surrogate spiking records and results (as applicable), (6) spike and spike duplicate records and results, (7) laboratory records, (8) raw data, including instrument printouts, bench work sheets, and/or chromatograms with compound identification and quantitation reports, (9) corrective action reports, (10) other method and project required QC samples and results, and (11) laboratory-specific written SOPs for each analytical method and QA/QC function in place at the time of analysis of project samples.

3.8.8 Hardcopy Data Reports for Definitive Data

The hardcopy data reports shall conform to the formats identified in this section.

A definitive data organic report package shall consist of the following AFCEE forms: COC, O-1, O-2, O-3 or O-3A, O-4, O-5 or O-5A, O-6, O-7, O-8, O-9 and O-10 for each AAB with organic analyses performed.

Exceptions to these report forms are as follows: for GC/MS analyses, forms O-3A and O-5A shall be used and form O-11 shall be added to the organic report package.

3.9 Systems and Performance Audits, Performance Evaluation Programs, Magnetic Tape Audits, and Training

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. Audit guidance can be found in the *HQ AFCEE Technical Services Quality Assurance Program*, current version. 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 3.8.

3.9.1 Project Audits

3.9.1.1 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 from the laboratory 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.

INSTRUCTIONS FOR COMPLETING AFCEE REPORT FORMS

The following instructions shall be used in completing the AFCEE report forms for definitive data. The bold lettering identifies the fields on the AFCEE report form.

Use as many sheets as necessary. Sheets may be duplicated with only those sections necessary to be completed filled out (i.e., you do not have to duplicate previously reported information from one sheet to the next). Sequentially number the sheets at the bottom of the page if more than one sheet is necessary.

Reporting Dilutions: Justification for diluting samples shall be provided in the comments section on the appropriate form (O-2). If the result for any analyte is outside the calibration range (i.e., greater than the highest calibration standard), the sample shall be diluted appropriately and reanalyzed. Results from the undiluted and diluted sample shall be reported on the appropriate form (O-2). The results of the analysis of the diluted sample shall be reported with the dilution noted on the report form and the MDL and RL adjusted for the dilution.

ALL ORGANIC CHEM FORMS

AAB#: enter the unique AFCEE analytical batch number (see Section 3.4.4 of the QAPP for a definition of a batch)

Lab Name: enter the laboratory name (e.g., Garland Labs, Inc.)

Contract #: 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: enter any comments

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

FORM O-2

This form is completed for all environmental samples including the MS and MSD.

AAB#: enter the unique AFCEE analytical batch number (see Section 3.4.4 of the QAPP for a definition of a batch)

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

Initial Calibration ID: enter the unique identifying number given to the initial calibration event used in the determination of the sample results

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) dry weight

Analyte: enter all analyte names in the same order as listed in the tables in QAPP Section 3.7.

MDL: enter the laboratory derived method detection limit

RL: enter the project AFCEE reporting limit as stated in the QAPP or approved variance for each analyte

Concentration: enter the numeric result

Dilution: enter the dilution (if applicable) (e.g., 1:5)

Confirm: enter the numeric result from the confirmation column/detector

Qualifier: enter the qualifier flag as needed (see QAPP Section 3.7)

Surrogate: enter the name of the surrogate(s) used

Recovery: enter the per cent recovery of the surrogate

Control Limits: enter the control limits for the recovery of the surrogate (see QAPP Section 3.7)

Internal Std: (used for 8260B analysis) enter the name of the internal standard(s) used

FORM O-3 and 3A

AAB#: (optional) enter the unique AFCEE analytical batch number if this calibration pertains to all of the samples from one batch (see Section 3.4.4 of the QAPP for a definition of a batch)

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Date of Initial Calibration: enter the appropriate date in the format DD-MMM-YY (e.g., 3 Jun 96)

Initial Calibration ID: enter the unique identifying number given to the initial calibration event

Concentration Units: enter the appropriate units (i.e., μg/L or mg/kg)

Analyte: enter all analyte names in the same order as listed in the tables in QAPP Section 3.7. (On form 3A, some analyte names already appear on the form as provided, leave those analytes in that order.)

RF1, RF2, RF3, RF4, RF5, RF6, RF7: enter the response factor corresponding to the standard with the same number (RF6 and RF7 are used for nonlinear calibrations)

Std 1, Std 2, Std 3, Std 4, Std 5, Std 6, Std 7: enter the concentration of the standard (Std 6 and Std 7 are used for nonlinear calibrations)

%RSD: enter the per cent relative standard deviation of the response factors

Mean %RSD: enter the mean of the RSDs of all analytes for those analytes not using a least squares regression or non-linear calibration

r: (optional) if least squares regression is used for the calibration of an analyte, enter the correlation coefficient

COD: (optional) if a non-linear calibration is used for the calibration of an analyte, enter the coefficient of determination

Q: enter a "*" for any calibration that was not acceptable as per QAPP Section 3.7 and for any RFs not meeting minimum requirements for SPCCs and/or CCCs.

FORM O-4

AAB#: (optional) enter the unique AFCEE analytical batch number if this calibration event pertains to all the samples from one batch (see Section 3.4.4 of the QAPP for a definition of a batch)

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Initial Calibration ID: enter the unique identifying number given to the initial calibration event used in the determination of the second source calibration verification results

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)

Analyte: enter all analyte names in the same order as listed in the tables in QAPP Section 3.7.

Expected: enter the expected result (i.e., the concentration of the calibration material).

Found: enter the measured result.

%D: enter the per cent difference between the expected (i.e., the concentration of the second source calibration material) and measured result

Q: enter a "*" for any % D that was not acceptable as per QAPP Section 3.7

FORM O-5 and O-5A

AAB#: (optional) enter the unique AFCEE analytical batch number if these calibration events pertain to all the samples from one batch (see Section 3.4.4 of the QAPP for a definition of a batch)

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Initial Calibration ID: enter the unique identifying number given to the initial calibration event used in the determination of the continuing calibration verification results

ICV ID: enter the unique identification number for the ICV such that the ICV could be traced back to its source material (the same ID number will be found in the run sequence log, e.g., ICV960603-1)

CCV #1 ID: enter the unique identification number for the CCV run after the first 12 hours of operation 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 #2 ID: enter the unique identification number for the CCV run after the second 12 hours of operation 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)

Analyte: enter all analyte names in the same order as listed in the tables in QAPP Section 3.7. (On form O-5A, some analyte names already appear on the form as provided, leave those analytes in that order.)

RF: (form O-5A) enter the response factor for the SPCCs only

% D: enter the per cent difference for all analytes

% D or % drift: (form O-5) enter the per cent difference if using RFs or % drift if using CFs

Q: enter a "*" for any % drift that was not acceptable as per requirements in QAPP Section 3.7

FORM O-6

AAB#: enter the unique AFCEE analytical batch number for the method blank (see Section 3.4.4 of the QAPP for a definition of a batch)

Concentration Units: enter the appropriate units (i.e., μg/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)

Initial Calibration ID: enter the unique identifying number given to the initial calibration event used in the determination of the method blank results

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 3.7 of the QAPP)

Method Blank: enter a numeric result for the method blank

RL: enter the project AFCEE reporting limit as stated in this QAPP or approved variance for each analyte

Q: enter a "*" for any method blank analyte result that was not acceptable as per QAPP Section 3.7

Surrogate: enter the name of the surrogate(s) used

Recovery: enter the per cent recovery of the surrogate

FORM O-7

Control Limits: enter the control limits for the recovery of the surrogate (see QAPP Section 3.7)

Internal Std: (used for 8260B and 8270C analysis) enter the name of the internal standard(s) used

AAB#: enter the unique AFCEE analytical batch number (see Section 3.4.4 of the QAPP for a definition of a batch)

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)

Concentration Units: enter the appropriate units (i.e., µg/L or mg/kg)

Initial Calibration ID: enter the unique identifying number given to the initial calibration event used in the determination of the LCS results

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 3.7 of the QAPP)

Expected: enter the expected result (i.e., the concentration at which the analyte was spiked in the LCS)

Found: enter the measured result of the LCS sample

%R: enter the per cent recovery

Control Limits: enter the control limits required to be met (see QAPP Section 3.7)

Q: enter a "*" for any % R that was not acceptable as per QAPP Section 3.7

Surrogate: enter the name of the surrogate(s) used

Recovery: enter the per cent recovery of the surrogate

Internal Std: (used for 8260B and 8270C analysis) enter the name of the internal standard(s) u used

FORM O-8

Concentration Units: enter the appropriate units (i.e., µg/L or mg/kg)

Parent Field Sample ID: enter the field sample ID of the parent sample (the sample spiked for the MS and MSD)

% 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)

Initial Calibration ID: enter the unique identifying number given to the initial calibration event used in the determination of the MS/MSD results

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 3.7 of the QAPP)

Parent Sample Result: enter the result of the parent sample. If an analyte was not detected above the MDL, leave this column blank.

Spike Added: enter the amount of spike added to the parent sample

Spiked Sample Result: enter the numeric result of the MS

%R: enter the per cent recovery

Duplicate Spiked Sample Result: enter the result of the MSD

%RPD: enter the relative per cent difference between the spike (MS) and spike duplicate (MSD)

Control Limits %R: enter the control limits required to be met (see QAPP Section 3.7)

Control Limits %RPD: enter the control limits required to be met (see QAPP Section 3.7)

Q: enter the qualifier flag as needed (see QAPP Sections 3.7)

FORM O-9

AAB#: enter the unique AFCEE analytical batch number (see Section 3.4.4 of the QAPP for a definition of a batch)

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 (if applicable - see QAPP Section 3.5)

Time Held Ext.: enter the time in days elapsed between the date collected and the date extracted (if applicable)

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 3.5)

Time Held Anal.: enter the time in days elapsed between the date collected and the date analyzed

Q: enter a "*" for any holding time (Max. Holding Time E, or Max. Holding Time A, or Time Held Anal.) that was greater than the maximum holding time that was not acceptable as per QAPP Section 3.5

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)

FORM O-11

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Compound: enter BFB or DFTPP as appropriate

Injection Date/Time: enter the date (in the format DD-MMM-YY) and time (in 24 hour format) of the performance check

Initial Calibration ID: enter the unique identifying number given to the initial calibration event used in the determination of the MS/MSD results

Mass: enter the mass of the ion used for tuning (see QAPP Section 3.7)

Ion Abundance Criteria: enter the criteria for the specific mass (see QAPP Section 3.7)

% Relative Abundance: enter the per cent relative abundance as the result of the tune

Q: enter a "*" for any % relative abundance results that was not acceptable as per QAPP Section 3.7

MDL FORM

Matrix: enter the sample matrix (e.g., water, soil)

Analysis Date: enter the date (or inclusive dates if performed over a period of days) the MDL was performed in the format DD-MMM-YY (e.g., 6 Jun 96)

Instrument ID: enter the instrument identifier (e.g., the serial number or other identifying number/name)

Analyte: enter the name of the analyte (use the same name as used in the tables in Section 3.7 of the QAPP)

Amt. Spiked: enter the amount of spike added to the matrix

Replicate 1,2,3,4,5,6,7: enter the result of the replicate

Std. Dev.: enter the standard deviation of the seven replicates

MDL: enter the calculated MDL

CHAIN OF CUSTODY FORM

COC#: 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

Airbill#: 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., HNO_3) or "none"

Filtered/Unfilt.: enter "F" if the sample was filtered or "U" if the sample was not filtered

# of Containers: enter the number of containers (i.e., jars, bottles) 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., SW6010B)

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, upon opening, in degrees C

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

Time: enter the time in 24 hour format (e.g., 0900) when the samples were released/received

AFCEE
ORGANIC ANALYSES DATA PACKAGE

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Base/Command: _____ Prime Contractor: _____

Field Sample ID	Lab Sample ID

Comments:

_____

_____

_____

I certify this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: _____ Name: _____

Date: _____ Title: _____

AFCEE FORM O-1

AFCEE
ORGANIC ANALYSES DATA SHEET 2
RESULTS

Analytical Method: _____ Preparatory Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Field Sample ID: _____ Lab Sample ID: _____ Matrix: _____

% Solids: _____ Initial Calibration ID: _____

Date Received: _____ Date Extracted: _____ Date Analyzed: _____

Concentration Units (μg/L or mg/kg dry weight): _____

Analyte	MDL	RL	Concentration	Dilution	Qualifier

Surrogate	Recovery	Control Limits	Qualifier

Internal Std	Qualifier

Comments:

_____

_____

_____

_____

AFCEE FORM O-2 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 3A
INITIAL MULTIPOINT CALIBRATION-GC/MS ANALYSIS

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Instrument ID: _____ Date of Initial Calibration: _____

Initial Calibration ID: _____

Analyte	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	Ave. RF	% RSD	Q
Chloromethane *													
1,1-DCA *													
Bromoform *													
Chlorobenzene *													
1,1,2,2-TCA *													
1,1-DCE #													
Chloroform #													
1,2-DCP #													
Toluene #													
Ethylbenzene #													
Vinyl chloride #													

* SPCCs # CCCs

Comments:

_____

_____

_____

AFCEE FORM O-3A Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 3
INITIAL MULTIPOINT CALIBRATION

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Instrument ID: _____ Date of Initial Calibration: _____

Initial Calibration ID: _____

Analyte	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	Ave. RF	% RSD	Q

Comments:

_____

_____

_____

AFCEE FORM O-3 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 4
SECOND SOURCE CALIBRATION VERIFICATION

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Instrument ID: _____ Initial Calibration ID: _____

2nd Source ID: _____

Analyte	%D	Q

Comments:

_____

_____

_____

AFCEE FORM O-4 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 5A
CALIBRATION VERIFICATION-GC/MS ANALYSIS

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Instrument ID: _____ Initial Calibration ID: _____

CCV #1 ID: _____ CCV #2 ID: _____

	CCV #1		CCV #2		
Analyte	RF	% D	RF	% D	Q
Chloromethane *					
1,1-DCA *					
Bromoform *					
Chlorobenzene *					
1,1,2,2-TCA *					
1,1-DCE #					
Chloroform #					
1,2-DCP #					
Toluene #					
Ethylbenzene #					
Vinyl chloride #					

* SPCCs # CCCs

Comments:

_____

_____

_____

AFCEE FORM O-5A Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 5
CALIBRATION VERIFICATION

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Instrument ID: _____ Initial Calibration ID: _____

CCV #1 ID: _____ CCV #2 ID: _____

Analyte	%D	Q

Comments:

_____

_____

_____

AFCEE FORM O-5 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 6
BLANK

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Units: _____ Method Blank ID: _____

Initial Calibration ID: _____

Analyte	Method Blank	RL	Q

Comments:

_____

_____

_____

AFCEE FORM O-6 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 7
LABORATORY CONTROL SAMPLE

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

LCS ID: _____ Units: _____ Initial Calibration ID: _____

Analyte	Expected	Found	%R	Control Limits	Q

Comments:

_____

_____

_____

AFCEE FORM O-7 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 8
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLE RECOVERY

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Parent Field Sample ID: _____ Units: _____ % Solids: _____

MS ID: _____ MSD ID: _____ Initial Calibration ID: _____

Analyte	Parent Sample Result	Spike Added	Spiked Sample Result	%R	Duplicate Spiked Sample Result	%R	%RPD	Control Limits %R	Control Limits %RPD	Q

Comments:

_____

_____

_____

AFCEE FORM O-8 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 9
HOLDING TIMES

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Field Sample ID	Date Collected	Date Received	Date Extracted	Max. Holding Time E	Time Held Ext.	Date Analyzed	Max. Holding Time A	Time Held Anal.	Q

Comments:

_____

_____

_____

AFCEE FORM O-9 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 10
INSTRUMENT ANALYSIS SEQUENCE LOG

Analytical Method: _____

Lab Name: _____ Contract #: _____

Instrument ID #: _____

Field Sample ID/Std ID/ Blank ID/QC Sample ID	Date Analysis Started	Time Analysis Started	Date Analysis Completed	Time Analysis Completed

Comments:

_____

_____

_____

AFCEE FORM O-10 Page ___ of _____

AFCEE
ORGANIC ANALYSES DATA SHEET 11
INSTRUMENT PERFORMANCE CHECK
(BFB or DFTPP)

Analytical Method: _____ AAB #: _____

Lab Name: _____ Contract #: _____

Instrument ID: _____ Compound: _____ Injection Date/Time: _____

Initial Calibration ID: _____

Mass	Ion Abundance Criteria	% Relative Abundance	Q

AFCEE FORM O-11 Page ___ of _____

MDL STUDY REPORT FORM

Lab Name: ____________________ Analytical Method: ____________________ Matrix: ____________

Analysis Date: __________________ Instrument ID: _____________________

Analyte	Amt. Spiked	Replicate							Std. Dev.	MDL
		1	2	3	4	5	6	7		

MDL FORM Method ___________ Page ____ of ____

AFCEE
CHAIN OF CUSTODY RECORD

COC#: _____

Ship to:	Project Name:	Send Results to:
	Sampler Name:	
Carrier: Airbill #:	Sampler Signature:	

Field Sample ID	Date 19__	Time	Matrix	Pres	Filtered/ Unfilt.	# of Containers	MS/ MSD	Analyses Requested										Comments

Sample Condition Upon Receipt at Laboratory: Cooler temperature:

Special Instructions/Comments:

#1 Released by: (Sig)	Date:	#2 Released by: (Sig)	Date:	#3 Released by: (Sig)	Date:
Company Name:	Time	Company Name:	Time	Company Name:	Time
#1 Received by: (Sig)	Date	#2 Received by: (Sig)	Date	#3 Received by: (Sig)	Date
Company Name:	Time:	Company Name:	Time:	Company Name:	Time:

3.9.1.2 Technical Systems Audits

A technical systems audit is an on-site, 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 on-site 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 to the prime contractor. 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.

3.9.1.3 Project-Specific Performance Evaluation Audits

Performance audits quantitatively assess the data produced by a measurement system. A performance audit involves submitting project-specific PE samples for analysis for each analytical method used in the project. The prime contractor shall submit project specific PE samples once per groundwater sampling round. 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, (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 3.7. 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.

3.9.1.4 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, on-site audit results, or by other state/federal investigations.

3.9.1.5 Performance Evaluation Sample Programs

All laboratories shall participate in the USEPA 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.

3.9.2 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.

3.10 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.

3.10.1 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.

3.10.2 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).

3.10.3 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.

3.10.4 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 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.

3.11 Corrective Action

Corrective actions, if necessary, are to be completed once. If acceptance criteria were not met and a corrective action was not successful or corrective action was not performed, apply the appropriate flagging criteria. Requirements and procedures for documenting the need for corrective actions are described in this section.

3.11.1 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.

3.11.2 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.

3.12 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.

Appendix A References

Earth Tech, 1994a. *Installation Restoration Program - Final Sampling and Analysis Plan, Air Force Plant 59.*

Earth Tech, 1994b. *Installation Restoration Program – Final Health and Safety Plan, Air Force Plant 59.*

Earth Tech, 1996. *Installation Restoration Program - Final Remedial Investigation Report, Air Force Plant 59.*

United States Air Force (USAF), 1996. *Air Force Center for Environmental Excellence Model Work Plan.* July.

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United States Air Force (USAF), 1998. *Air Force Center for Environmental Excellence Quality Assurance Project Plan.* March.

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