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DRAFT SAMPLING AND ANALYSIS PLAN FOR REMEDIAL INVESTIGATION FEASIBILITY  
STUDY VOLUME 1 OF 3 NAS FORT WORTH TX  
6/1/1993  
LAW ENGINEERING AND ENVIRONMENTAL

149000



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

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**CARSWELL AIR FORCE BASE  
RI/FS Sampling and Analysis Plan**

**Volume I - Text**

**June 1993**

**Prepared for:**

**7th Support Group  
7 Civil Engineering Squadron  
Environmental Management Flight  
Carswell Air Force Base, Texas 76127-5000  
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**Contractor: Law Environmental, Inc.  
Kennesaw, Georgia 30144**



June 25, 1993

Air Force Center for Environmental Excellence  
AFCEE/ESB  
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Brooks Air Force Base, TX 78235-5328

Attention: Chris Hobbins (Team Chief)

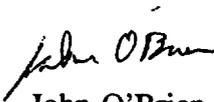
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Draft Sample and Analysis Plan  
Contract No. F33615-90-D-4008  
Delivery Order No. 0011  
Law Project No. 11-3517-0111

Dear Mr. Hobbins:

Law Environmental, Inc., Government Services Division is pleased to submit the enclosed eight (8) copies of the Draft Sample and Analysis Plan to the Air Force Center for Environmental Excellence (AFCEE) for review and comment.

If you have questions or comments, please contact us at (404) 499-6800.

Sincerely,

  
John O'Brien  
Project Manager

  
Winifred H. Curley, Ph.D.  
Principal

11-3517-0111.03

**INSTALLATION RESTORATION PROGRAM (IRP)  
REMEDIAL INVESTIGATION / FEASIBILITY STUDY**

**SAMPLING AND ANALYSIS PLAN**

Carswell Air Force Base, Fort Worth, Texas

Law Environmental, Inc.  
Kennesaw, Georgia 30144

June 1993

Draft



PREPARED FOR

7TH SUPPORT GROUP  
7TH CIVIL ENGINEERING SQUADRON  
ENVIRONMENTAL MANAGEMENT FLIGHT  
CARSWELL AIR FORCE BASE, TEXAS 76127

UNITED STATES AIR FORCE  
HUMAN SYSTEMS DIVISION (AFSC)  
AIR FORCE CENTER FOR ENVIRONMENTAL  
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BROOKS AIR FORCE BASE, TEXAS 78235-5328

INSTALLATION RESTORATION PROGRAM (IRP)  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY  
DRAFT SAMPLING AND ANALYSIS PLAN  
FOR  
CARSWELL AFB  
FORT WORTH, TEXAS 76127-5000

JUNE 1993

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CONTRACTOR CONTRACT NO. F33615-90-D-4008

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Base Closure Restoration Division (AFCEE/ESB)  
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Human Systems Center (HSC/PKV)  
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Brooks Air Force Base, Texas 78235-5328

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**SAMPLING AND ANALYSIS PLAN (SAP)  
DISCLAIMER NOTICE**

This Sampling and Analysis Plan has been prepared for the United States Air Force by Law Environmental, Inc. for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this plan and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this plan premature or inaccurate. Acceptance of this sampling and analysis work plan in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

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Cameron Station  
Alexandria, VA 22304-6145

Non-government agencies may purchase copies of this document from:

National Technical Information Service (NTIS)  
5285 Port Royal Road  
Springfield, VA 22161

**PURPOSE OF DOCUMENT**

This Sampling and Analysis Plan (SAP) is for use for the Remedial Investigation/Feasibility Study (RI/FS) activities at Carswell Air Force Base (Carswell AFB). Procedures outlined in this plan are designed to describe the collection of geologic data, hydrologic data, environmental samples, laboratory analysis of those samples for potential contaminants, evaluation of the analytical results and field measurements, with respect to quality control data and the interpretation and analysis of QA/QC reviewed data. The plan will be effective after final approval.

The success of Carswell AFB's Installation Restoration Program depends on team effort and total dedication from parties involved. Therefore, efforts will be focused on achieving and maintaining compliance with this Sampling and Analysis Plan and pertinent regulations.

The point of contact for this investigation is as follows:

Mr. Chris Hobbins  
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**SAMPLING AND ANALYSIS PLAN (SAP)  
PREFACE**

Law Environmental, Inc. (Law) was contracted by the U.S. Air Force Center for Environmental Excellence (AFCEE) to perform a Remedial Investigation/Feasibility Study (RI/FS) at two sites at Carswell AFB, Texas. The two sites to be investigated include: Unnamed Stream (SD-13) and POL Tank Farm (ST-14). The primary objectives of this field investigation are to: 1) investigate the extent of soil and ground water contamination at each site; 2) assess the overall environmental status of the sites; and 3) evaluate the appropriate remedial action for contaminated sites. These objectives will be achieved through the use of the following methods of investigation: geophysical and geochemical surveys; soil and ground water samples for field screening and laboratory analysis; and surface water and sediment samples for laboratory analysis.

The SAP outlines the field activities, collection, and laboratory analytical procedures required for the RI/FS at Carswell AFB.

The SAP is composed of two documents - the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP).

The QAPP consists of detailed information on defining and assuring that the Data Quality Objectives (DQOs) are achieved. DQOs are considered through various project tasks, including writing of plans, field work, and laboratory analysis. The QAPP delineates the procedures necessary to achieve DQO goals.

The FSP describes field tasks necessary for implementing the project objectives. Field tasks are described in detail to ensure that the DQOs are achieved during field activities.

Mr. John O'Brien is the Project Manager for the RI/FS. Members of the field investigation team will be selected prior to commencement of field activities.

The QAPP was prepared by Ms. Darice Kurtzer and reviewed by Mr. Jerry Preston and Dr. Winifred Curley. The FSP was prepared by Mr. Jim Beaver and Ms. Darice Kurtzer and reviewed by Ms. Queenie Mungin-Davis and Dr. Winifred Curley.

The support and assistance of Mr. Chris Hobbins (AFCEE) and personnel at Carswell AFB are greatly appreciated.

---

John F. O'Brien  
Project Manager

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LABORATORIES

## LIST OF ACRONYMS

AB	Ambient Condition Blank
ABB-ENV	ABB Environmental Services, Inc.
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
CA	Corrective Action
CCAS	Coast-to-Coast Analytical Services
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (PL-96-510) - SUPERFUND
CES	Civil Engineering Squadron
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
DC	Drill Cuttings
DOT	Department of Transportation
DQCR	Daily Quality Control Report
DQO	Data Quality Objectives
EB	Equipment Blank (Rinsate)
EMSL	Environmental Monitoring Systems Laboratory
FS	Feasibility Study
FSP	Field Sampling Plan
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Graphite Furnace Atomic Absorption
HNu	Photoionization Detector (trade name)
ID	Sample Identification
ICP	Inductively Coupled Plasma
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
ITIR	Informal Technical Information Report
Law	Law Environmental, Inc., Government Services Division
LENL	Law Environmental National Laboratories

**LIST OF ACRONYMS  
(Continued)**

LCS	Laboratory Control Standards
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MITRE	MITRE Corporation
MQL	Maximum Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MW	Monitoring Well
NCP	National Contingency Plan
NTU	Nephelometric Turbidity Unit
OSWER	Office of Solid Waste and Emergency Response
PA	Preliminary Assessment
PARCC	Precision Accuracy Representativeness Completeness Comparability
PE	Professional Engineer
POC	Point of Contact
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAMS	Quality Assurance Management Staff
QCCS	Quality Control Check Samples
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RLS	Registered Land Surveyors
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SB	Soil Boring
SC	Specific Conductance
SD	Surface Sediment

LIST OF ACRONYMS  
(Continued)

SI	Site Investigation
SOP	Standard Operating Procedures
SPT	Standard Penetration Test
SW	Surface Water
TB	Trip Blank
TC	Team Chief
TPM	Technical Project Manager
TWC	Texas Water Commission
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

## 1.0 QUALITY ASSURANCE PROJECT PLAN

### 1.1 INTRODUCTION

This Remedial Investigation/Feasibility Study (RI/FS) Quality Assurance Project Plan (QAPP) is provided in support of the United States Air Force (USAF) Installation Restoration Program (IRP) for 2 sites located at Carswell Air Force Base (Carswell AFB), Texas. This investigation will adhere to those procedures specified by the Air Force Center for Environmental Excellence (AFCEE) in the Handbook to Support the Installation Restoration Program (IRP) Statements of Work: Volume I - Remedial Investigation/Feasibility Studies (RI/FS) (AFCEE, 1991).

#### 1.1.1 The U.S. Air Force Installation Restoration Program

The objective of the Air Force IRP is to assess past hazardous waste disposal and spill sites at Air Force installations and to develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which present a threat to human health and welfare or the environment. This objective is achieved through a staged RI/FS process, ultimately from which are obtained conclusions and recommendations regarding remedial measures. This RI/FS is designed to determine the presence and lateral and vertical extent of contamination at the 2 investigative sites. Additional information regarding the Air Force IRP is discussed in Section 1.0 of the Work Plan.

#### 1.1.2 Purpose and Scope

The Sampling and Analysis Plan (SAP) describes those procedures necessary to perform a quality controlled sampling effort during

the execution of the project's scope of work. The activities addressed by the SAP include:

- Installation of monitoring wells;
- Soil borings;
- Acquisition of ground-water, surface and subsurface soil, surface water and sediment samples;
- Decontamination of equipment;
- Calibration of field instruments;
- Aquifer (slug) testing;
- Maintenance of laboratory and field QA/QC;
- Geophysical survey;
- Chemical analysis;
- Preventative maintenance;
- Data quality assessment;
- Corrective action;
- Quality control (QC) checks;
- Quality assurance (QA) audits and reports.

Specific quality control requirements are specified in Appendix A.

## 1.2 PROJECT DESCRIPTION

Carswell AFB is located in northeastern Texas, in Tarrant County, six miles west of downtown Fort Worth, as shown in Figure 1-1. This RI/FS for Carswell AFB will investigate the 2 sites listed below:

- Unnamed Stream (SD-13)
- POL Tank Farm (ST-14)

Detailed site maps are presented in Section 2.1. The RI/FS for each site is designed to evaluate the presence and extent of

contamination. The following sections present the project background, scope and objectives. Site figures are presented in Section 2.1.

### 1.2.1 Project Background

The 2 sites included under this RI/FS Investigation were identified as possibly contaminated sites through the efforts of the Installation Restoration Program Phase I Records Search Report (CH2M Hill, 1984). Information from that report is supplemented by information from the literature and from the general findings of studies conducted by the Radian Corporation (Radian, 1986, 1991).

1.2.1.1 POL Tank Farm Site (ST-14) - The POL Tank Farm is located in the east area of Carswell AFB, west of and adjacent to Knight's Lake Road and north of Hobby Shop Road (Figure 2-1). The Fuel Loading Area is east of Knight's Lake Road.

Three above-ground POL storage tanks currently are in place at this site and an additional three tanks have been removed from the site. Leaking underground POL lines are suspected to have released fuel products into the soil and ground water at and downgradient from the POL Tank Farm during the early 1960s. The leaking lines were reportedly located and replaced and no further fuel releases were documented after 1965. Previous studies (Radian, 1986, 1991) have found evidence of contamination by organic compounds, including ethylbenzene, benzene, chlorobenzene and total xylenes. Lead and chromium in excess of Maximum Containment Levels (MCLs) were also detected in the ground water at this site.

1.2.1.2 Unnamed Stream Site SD-13 - The Unnamed Stream and Abandoned Gas Station are located near the eastern boundary of the base, east of Rogner Drive and north of Farmer's Branch. This site

consists of two locations, the paved area around the Abandoned Gas Station and the intermittent stream flowing from an oil/water separator to Farmer's Branch (Figure 2-2).

The Abandoned Gas Station area may contain one or more USTs that may have leaked petroleum products. The Unnamed Stream flows from the oil/water separator that is the terminus of a french drain system installed in 1965 to recover fuel leaking from either the Abandoned Gas Station USTs or the POL Tank Farm. Previous studies (Radian, 1986, 1991) detected low levels of organic contamination in the ground water at this site. Surface water samples contaminated with lead and arsenic in excess of MCLs were collected from the Unnamed Stream downstream from the oil/water separator.

#### 1.2.2 Project Scope and Objectives

The following sections describe the site-specific scope and objectives. The objectives described below will be accomplished through the collection of geological data, hydrogeological data, and collection of environmental samples; the laboratory analysis of these samples for potential contaminants; the evaluation of the analytical results and field measurements with respect to quality control data; and the interpretation and analysis of valid data.

The data generated by this project must be of sufficient quality and quantity to meet the overall project objective, which is to improve site characterizations that would ultimately lead to remediation of the sites. The purpose of this RI/FS at Carswell AFB is to collect assessment data for ground water at POL Tank Farm and for soils, surface water, sediment, and ground water at the Unnamed Stream. The focus of this work will be to characterize the spatial distribution of contamination at each site and its potential for transport. The findings of this RI/FS will be used to complete a baseline risk assessment and feasibility study to define and evaluate remedial action alternatives.

Health and Safety data will be used to establish the level of protection needed for the work party and other site-related personnel. These data will be gathered by the use of geophysical instruments, organic vapor analyzers (HNU), Draeger tubes, tri-gas monitors, and explosimeters utilized during non-intrusive and intrusive activities.

Table 1-1 presents a combined list of the potential contaminants at both sites. In order to further evaluate the sites, samples of surface and subsurface soil, ground water, surface water, and sediment will be collected. The parameters of interest for each site for each of these matrices are presented in Table 1-2. The number of samples to be collected are presented in Section 2.1. The current scope of work does not plan for the collection and analysis of background soil, ground-water or surface water samples. Reference to these types of background samples have not been found in the AFCEE supplied documentation. Law Environmental is currently reviewing available documents located at Carswell AFB for information on background sample data that may have been collected from other sites. Lack of this background data may produce data gaps in the completion of the RI and FS phases of work. The following subsections describe the background scope and objectives for each site.

1.2.2.1 POL Tank Farm Site (ST-14) - Field tasks to be performed at the POL Tank Farm site include a geophysical survey and HydroPunch survey.

A. Geophysical Survey - A surface geophysical survey will be performed to help characterize the near surface conditions and to locate utilities and abandoned tanks and pipechases. A single type of geophysical survey (ground penetrating radar) will be performed at the POL Tank Farm site during the field work.

B. HydroPunch Survey - A HydroPunch survey will be conducted at the POL Tank Farm site as part of the remedial investigation effort. Twenty-two HydroPunch borings will be performed to provide supplemental geotechnical and analytical information in order to delineate the extent of contamination. Three HydroPunch borings will be held back to reserve for discretionary reasons once the survey is implemented (see Figure 2-3).

1.2.2.2 Unnamed Stream (SD-13) - Field tasks to be performed at the Unnamed Stream include a geophysical survey, monitoring well installation, aquifer testing, soil sampling and surface water/sediment sampling.

A. Geophysical Survey - A surface geophysical survey will be performed at both sites to help characterize the near surface conditions and to locate utilities and abandoned tanks and pipechases. A single type of geophysical survey (ground penetrating radar) will be performed at the Unnamed Stream during the field work.

B. Monitoring Well Installation - Three shallow monitoring wells will be installed at this site to assess the presence of site constituents in subsurface soils and the surficial aquifer.

C. Aquifer Testing - In-situ hydraulic conductivity tests will be performed on the new monitoring wells a minimum of 24 hours after ground-water sampling. The tests will be conducted to determine formation permeability. The results of the tests will be used to estimate ground-water flow rates.

D. Soil Sampling - Two soil samples will be collected from each of three soil borings. Soil borings will be performed to allow installation of each monitoring well. The soil borings

will provide subsurface information for well design and site stratigraphy as well as assessment of the presence of site constituents in surface and subsurface soils.

- E. Surface Water/Sediment Sampling - Three surface water/sediment samples will be collected at this site to assess if site constituents are affecting surface waters and underlying sediments in the area.

### 1.2.3 Subcontractors

The subcontractors to be utilized for this RI/FS investigation along with their service to be performed are identified in Section 1.3.

## 1.3 PROJECT ORGANIZATION AND RESPONSIBILITIES

Project organization and responsibilities for the RI/FS for the 2 sites at Carswell AFB are discussed in the following sections.

### 1.3.1 Project Organization

Law Environmental, Inc., Government Services Division (Law) will manage the project and provide services related to field samples, geophysics, data analysis, site characterization, and reporting.

- ✓ A state licensed drilling company (preferably a Texas company) will be subcontracted to perform the drilling activities.

- Law Environmental National Laboratories - Pensacola (LENL-P) will be subcontracted as the primary laboratory to perform the chemical analysis of the soil and water samples.

- Transglobal Environmental Geochemistry, Texas/of Austin, ~~Texas~~ will be subcontracted to perform the ground-water reconnaissance technique at the POL Tank Farm area. They will also perform on site analysis of the ground water collected.
- An OSHA-certified and Texas state licensed local surveying company will be subcontracted to survey the soil borings, monitoring wells, and other sampling locations. In addition, the surveyor will prepare a site map.
- Ensite, Inc., will be subcontracted to handle the transport and disposal of drummed soil cuttings, decontamination fluids, and development and purge water generated during investigative activities.

The project organization is shown on Figure 1-2.

1.3.1.1 Law Environmental, Inc. - Law Environmental's Government Services Division will provide the project management, engineering and analysis, and sampling through its in-house resources. It is a branch of Law Environmental, Inc., which, in turn, is a wholly-owned subsidiary of Law Companies Group, Inc. Law Companies Group, Inc., is entirely employee owned.

1.3.1.2 Drilling Subcontractor - A drilling company licensed in the state of Texas will be responsible for drilling soil borings and installation of monitoring wells. The drilling engineer will follow direction from the Site Manager during field activities and from the Project Manager prior to and after field work.

1.3.1.3 Chemical Analysis Laboratories - The Law Environmental, Inc., National Laboratories facility in Pensacola, Florida (LENL-P), is the Law Environmental, Inc., chemical testing laboratory which was established in 1989. LENL-P will be the laboratory responsible for providing sample shipping containers, chain-of-custody documents, chemical analysis, reporting, and laboratory QA/QC. LENL-P will perform all analyses of soil, ground water, surface water and sediments and associated QC samples.

LENL-P will report directly to the Project Manager during the project. LENL-P has integrated Quality Assurance Control (QA/QC) procedures into their laboratory design and standard operating procedures. LENL-P is certified in several states. In order to perform analyses for AFCEE projects, LENL-P has undergone and complied fully with MITRE Corporation audits. LENL-P's key personnel and their positions and responsibilities are outlined in Appendix B1.

1.3.1.4 Ground-Water Screening - Transglobal Environmental Geochemistry, Texas (TEG), specializing in ground-water screening, will conduct the ground-water screening. They will perform the sampling and analysis of the ground water on site. TEG's system has been recognized and approved by the Texas Water Commission as a viable tool for studying ground water contaminated plumes.

1.3.1.5 Surveying Subcontractor - A local engineering and surveying firm, certified in the state of Texas, will be subcontracted to survey boring/sampling locations and elevations and prepare site maps. The firm will report directly to the Site Manager during their survey activities and to the Project Manager prior to and after field work. Their in-house Professional Engineer (PE)/Registered Land Surveyor (RLS) will perform the field

surveying and preparation of the final site map. These individuals will follow the AFCEE guidance documents, provided by Law, to prepare their draft and final site map. The Law Project Manager will review and approve the site maps prior to inclusion of the SI Report.

1.3.1.6 Ensite - Environmental Contractor - Ensite will be contracted to perform services related to handling, transport and disposal of investigative derived wastes generated during the field investigation. Ensite, located in Atlanta, Georgia, is a wholly-owned subsidiary of Law Environmental and is a licensed site remediation contractor.

### 1.3.2 Key Project Individuals

Key project participants for this project include the project principal, project manager, project chemist, project geologist/site manager, health and safety officer, laboratory manager, and field work parties. The following paragraphs provide a description of the proposed project assignments and responsibilities, a list of individuals expected to serve in each capacity, and a brief synopsis of the participants' related experience.

1.3.2.1 Project Principal - The Project Principal provides technical quality control, oversight and direction for all aspects of the site investigation and data evaluation. Dr. Winifred Curley will serve as the Project Principal. Dr. Curley, a Principal with Law Environmental, will serve as the senior reviewer of Law's reports of the Carswell AFB RI/FS sites. Dr. Curley has over 14 years experience in environmental project work, with the past seven focusing on site assessment projects under regulatory review.

1.3.2.2 Project Manager - The Project Manager is responsible for the overall management of the Carswell AFB RI/FS. He coordinates between office and field personnel, manages administrative requirements, and supervises schedules, technical approach, implementation, and report preparation. Mr. John O'Brien will serve as project manager. Mr. O'Brien has six years of professional experience in site and project management. He is presently managing projects under CERCLA and IRP guidance including Carswell AFB.

1.3.2.3 Site Manager - The Site Manager will coordinate and supervise the field investigation activities. The Site Manager may also serve as the Health and Safety Officer for the field operations, and will be responsible for the implementation of the Work Plans and Health and Safety Plans. The Site Manager's primary responsibility is the health and safety of the workers on site. Mr. John Monger will serve as the Site Manager for this project. Mr. Monger is an Engineer-in-Training in the state of Virginia. He has 2 years of experience in site investigations and assessments.

1.3.2.4 Project Chemist - The Project Chemist is responsible for preparing and implementing the field sampling, preservation, chain-of-custody, and shipping activities. She performs data evaluation on the chemical data. Ms. Darice Kurtzer will serve as the Project Chemist for this investigation. Ms. Kurtzer is a chemist with over 3 years of experience in environmental chemistry, Quality Assurance/Quality Control (QA/QC) and data evaluation.

1.3.2.5 Laboratory Project Manager - The Laboratory Project Manager is responsible for the handling and analysis of water and/or soil samples received by the laboratory. This person oversees sample travel through the lab, analytical procedures, quality control, reporting and sample disposal. Mr. James Tucci is

LENL's Chemical Laboratory Manager. His areas of expertise include environmental field studies, laboratory analyses and personnel management.

1.3.2.6 Work Party - The work party performs on-site tasks contained in this plan, including surveying, drilling, monitoring well installation, test pitting, and analytical sampling under the direction of the Site Manager.

1.3.2.7 Health and Safety Officer - The Health and Safety Officer oversees the Health and Safety Plan for Carswell AFB. He conducts personnel training, administers company hazard assessment and surveillance medical program, and coordinates with the Site Manager for site safety. He is available for consultation during the actual investigation. Dr. Jack Peng is Law Environmental's Environmental Health and Safety Officer. He is a Certified Industrial Hygienist with over 10 years experience in hazardous waste site investigations. Subcontractors working on the Carswell AFB sites under this project will receive a copy of the project Health and Safety Plan. The Law Environmental Site Manager or an assigned qualified Health and Safety Officer will review with subcontractor personnel the Health and Safety Plan prior to any field activities. Site personnel will be required to sign and date the master field logbook to ensure that they understand the safety regulations and procedures as outlined in the Health and Safety Plans.

1.3.2.8 Project Safety Officer - The Project Safety Officer is responsible for the project Site Safety and Health Plan requirements. Ms. Cindy Kahout will serve as the project Safety Officer for this investigation at Carswell AFB. Ms. Kahout is an Industrial Hygienist with nine years of experience in developing and auditing health and safety programs.

### 1.3.3 Project QA Responsibilities

Law Environmental, Inc. has established a strong internal QA program with an associated QA Manual, Engineering Procedures Manual, Equipment Calibration Procedures Manual, and specialty manuals for hazardous waste site investigations and software documentation. Law Environmental employees use these manuals as the basis for conducting all company work within the QA program.

Mr. Leonard Ledbetter, the President of Law Environmental, Inc., has overall responsibility for Law's Corporate QA. The Corporate QA Office is directed by Dr. James R. Wallace, who is responsible for daily management and auditing of Law Environmental's QA Program. The Law Environmental lines of QA responsibility and audit flow from Corporate QA (Mr. Ledbetter and Dr. Wallace) to the Project Principal (Dr. Winifred Curley). This line of QA is outside of the operational lines of authority for this project.

Our Quality Assurance Program is one of the most important factors contributing to client satisfaction and our continued success. The purpose of the program is to provide the client with confidence that services are performed correctly.

Our Principal Review System is an integral part of the Quality Assurance Program. Each project is assigned to a Principal Reviewer who is responsible for maintaining the required professional quality from beginning to completion of the project. Every proposal and report must be reviewed and signed by two people and at least one must be a Law Principal with credentials and experience relevant to the area of work.

In each office, the Chief Scientist or Engineer is responsible for operation of the Quality Assurance Program and for reviewing the performance of assigned Principals. The Chief Engineer conducts internal audits of projects and at least once each year a formal

corporate audit is conducted by Chief Engineers and Principals from other offices. In addition to these internal and corporate audits, the company participates in laboratory and peer review programs sponsored by organizations such as the National Bureau of Standards, U.S. Geological Survey, USEPA, AFCEE and the U.S. Army Corps of Engineers.

Law Companies encourages staff membership and participation in various relevant professional societies. We believe such involvement fosters individual professional growth and helps keep our staff up-to-date on current developments. Many Law Principals also serve on subcommittees or teach in sponsored workshops.

Law will control the quality of subcontractor furnished data and services by source evaluation and selection, evaluation of objective evidence of quality compliance to procurement documents furnished by the subcontractor, site and/or source inspections, audits, and/or examination of items or services upon delivery or completion. Prior to award of subcontract, potential suppliers of quality affecting items or services will be evaluated by Law personnel. The evaluation may be performed by any appropriate means, including but not limited to, surveys, inspections, audits, or surveillances, depending upon the complexity of the item or service being supplied. When the Project Principal determines it necessary, on-site audits of subcontractor facilities may be conducted under a quality assurance program. While the responsibility for quality remains with the subcontractor under his quality control program, Law will conduct certain quality assurance activities to determine the subcontractors compliance with their own quality program.

#### 1.4 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

Quality Assurance (QA) objectives for measurement data are expressed in terms of the parameters of precision, accuracy,

representativeness, completeness, and comparability (PARCC). QA objectives provide the mechanism for ongoing control and evaluation of measurement data quality throughout the project and will ultimately be used to define data quality for the various measurement parameters. The achievement of these QA objectives will be demonstrated through the collection and analysis of laboratory and field quality control (QC) samples. The number and type of QC samples to be collected and analyzed and the acceptance criteria to be utilized will be presented in subsequent sections.

#### 1.4.1 Definitions of QA Criteria

The following sections define the Precision Accuracy Representativeness Completeness Comparability (PARCC) parameters.

1.4.1.1 Precision - "Precision" refers to the reproducibility or degree of agreement among individual measurements of a single analyte. It is defined by the USEPA as "a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the prescribed similar conditions" (USEPA, 1980). Analytical precision for a single analyte may be expressed as the relative standard deviation of multiple measurements.

1.4.1.2 Accuracy - "Accuracy" refers to the degree of difference between measured or calculated values and the true value. It is defined by the USEPA as "the degree of agreement of a measurement (or an average of measurements of the same thing), X, with an accepted reference or true value, T, usually expressed as the difference between the two values,  $X - T$ , or the difference as a percentage of the reference or true value,  $100 (X-T)/T$ , and sometimes expressed as a ratio,  $X/T$ . Accuracy is a measure of the

bias in a system" (USEPA, 1980). Analytical accuracy may be expressed as the percent bias from the correct answer.

1.4.1.3 Representativeness - "Representativeness" indicates the degree to which a sample contains the characteristics of the whole from which it came. As defined by the USEPA, representativeness "expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition" (USEPA, 1980). Only qualitative goals for representativeness can be set.

1.4.1.4 Completeness - "Completeness" is a measure of the amount of data collected with respect to project requirements. It is defined by the USEPA as "a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions" (USEPA, 1980). Completeness refers to the project as a whole.

1.4.1.5 Comparability - "Comparability" is a measure of the consistency of the measurement process. It is defined by the USEPA as the parameter that "expresses the confidence with which one data set can be compared to another" (USEPA, 1980). Comparability is also only expressed in a qualitative manner. To ensure comparability, only established methods and protocols will be used to collect and analyze samples.

1.4.1.6 Analytical Levels - Different levels of quality are required for the analytical data depending upon the planned use of the data. The procedures and methods will vary depending on the level of analytical data required. The USEPA has defined five analytical levels (USEPA, 1987a); these levels are presented in Table 1-3.

#### 1.4.2 Goals

Different levels of quality of the data are required depending upon its planned use. The DQOs may become more stringent as the project progresses and the extent of the contamination is determined. Establishment of the DQO goals for this phase was done with the consideration that failure to meet these goals will result in qualification of the data and/or re-sampling.

Quantitative goals for precision, accuracy, and completeness can be established. Tables 1-4 and 1-5 present specific objectives for soil and sediment samples and ground-water and surface water samples, respectively. These goals can be achieved with Level II (field) and Level III (laboratory) data, as defined by the USEPA (USEPA, 1987a; USEPA, 1987b).

In establishing the goals for precision and accuracy for each parameter and matrix, the following were considered:

##### Precision

- precision of instrument calibration
- precision of duplicate spikes
- precision of field duplicates
- sampling and handling procedures

##### Accuracy

- proper instrument set-up
- accuracy and stability of the calibration
- recovery of spiked samples
- recovery of spiked blanks and/or control samples
- method contamination
- surrogate recoveries (if applicable)
- interferences
- field contamination
- sampling and handling procedures

The worst performer of all the QC processes for all analytes within each parameter was used to determine the first estimate of the overall goal for each parameter and matrix. In order to provide a realistic approach in case there are unanticipated matrix effects, this estimate of the goal was then relaxed slightly in order to set goals that are realistic and achievable. The overall goal is to allow the use of as much reliable data as possible during this investigation. Data for individual analytes for which any applicable QC result falls outside of the acceptance limits set by the method will be qualified.

Representativeness and comparability are qualitative goals. Representativeness will be dependent upon the careful selection of sampling locations. Comparability will be established by adhering to the use of standard, published sampling and analytical methods and reporting data in standard units.

#### 1.5 SAMPLING PROCEDURES

Sampling procedures consist of sample collection, transport and storage protocols. These protocols which pertain to the field activities are presented in detail in the Field Sampling Plan (FSP) and are only referenced here.

##### 1.5.1 Sampling Protocols

Sample collection, transport and storage guidance documents to be adhered to are listed below:

- Practical Guide for Ground-Water Sampling, EPA 600/2-85/104, September 1985 (USEPA, 1985).

- Test Methods for Evaluating Solid Wastes, Third Edition, EPA SW-846, November 1986 (USEPA, 1986).
- Handbook to Support the Installation Restoration Program (IRP) Statements of Work, May 1991 (AFCEE, 1991).

Detailed sampling protocols are presented in Section 2.0.

#### 1.5.2 Sample Handling

The sample containers, sample volume, method of preservation, shipping and handling procedures are presented in Section 2.2.2.

#### 1.6 SAMPLE CUSTODY

Sample custody procedures during the collection of samples in the field and sample receipt in the laboratory are discussed in the following subsections.

##### 1.6.1 Field Operations

Maintenance of sample custody in the field starts with the collection, preservation and labeling of the sample. Documentation of field sampling activities will be performed. Specific procedures for the maintenance and documentation of the custody of the samples is discussed in detail in Section 2.2.3.

##### 1.6.2 Laboratory Operations

Sample custody, handling, and identification in the laboratory is presented in Appendix B.

## 1.7 FIELD EQUIPMENT CALIBRATION PROCEDURES

Several instruments will be used in the field investigation. These instruments consist of a photoionization detector (HNU), pH meter, combination temperature and specific conductance meter, and a turbidimeter. Each field meter will be calibrated before use. The calibration will be documented in the field book. Details of calibration and maintenance are presented in Section 2.3 of the FSP.

## 1.8 ANALYTICAL PROCEDURES

The following sections identify the analytical methods to be utilized.

### 1.8.1 Identification of Methods

The analytical methods to be utilized are presented in Tables 1-6 (soil, sediment) and 1-7 (ground water, surface water).

### 1.8.2 Detection and Quantitation Limits

1.8.2.1 Terminology - Each analytical parameter concentration will be reported as a specific number or less than the Detection Limit (DL) for inorganic methods and less than the Quantitation Limit (QL) for organic methods. Contaminant concentrations in water samples will be reported in micrograms per liter ( $\mu\text{g}/\text{L}$ ) for organic parameters and in milligrams per liter ( $\text{mg}/\text{L}$ ) for inorganic parameters. Contaminant concentrations in soil samples will be reported in micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ) for organic parameters and in milligrams per kilogram ( $\text{mg}/\text{kg}$ ) for the inorganic parameters. The Method Detection Limit (MDL) for a particular

matrix is the minimum concentration of a substance that can be measured with 99 percent confidence that the value is above zero as per 40 CFR 136 Appendix B. The QL is the minimum concentration that can be measured with 95 percent accuracy.

1.8.2.2 Procedures - The following procedures are used to establish limits of detection and quantification.

Method Detection Limit (MDL) - Parameters for each of the MDLs are established using the required EPA procedure specified in 40 CFR Part 136 Appendix B or equivalent procedure promulgated by the USEPA. A data pool of at least seven standards analyzed at a concentration approximately 3X the anticipated MDL is generated. The MDL is estimated by employing the "t" distribution with a 99% confidence interval by the following equation:

$$\text{MDL} = (t) (S)$$

Where:

- (t) - is a factor for n-1 degrees of freedom at the 99% confidence factor
- (S) - is the standard deviation of the data pool

The Maximum Quantitation Limit (MQL) for each parameter are calculated as follows:

$$\text{MQL} = F * S$$

Where:

- S - is the standard deviation of the data used to determine MDL
- F - is a factor between 5 and 10 based on chromatographic behavior.

The matrix used for these studies is spiked reagent water processed through the appropriate analytical procedure.

1.8.2.3 Values - The reporting limits required for this project are presented in Tables 1-8 and 1-9 for soil and sediment and ground water and surface water. The laboratory established detection and quantitation limits are presented in Appendix B.

### 1.8.3 Method Calibration

The calibration procedures, preparation of calibration standards, and frequency of initial and continuing calibration checks are to be performed as per each method's requirements, as summarized in Appendix A.

## 1.9 DATA REDUCTION, VALIDATION, AND REPORTING

The following sections describe the reduction, validation, and reporting of data employed after samples are analyzed.

### 1.9.1 Data Management

Analytical data are collected and processed in accordance with the requirements of the laboratory's protocols. These requirements include sample documentation and data collection. Sample/data flow is outlined in Appendix B for each laboratory.

### 1.9.2 Data Reduction

Raw data are to be reduced as specified by each method to produce results in the following units:

	<u>SOLID</u>	<u>AQUEOUS</u>
Organic parameters	$\mu\text{g}/\text{kg}$	$\mu\text{g}/\text{L}$
Inorganic parameters	$\text{mg}/\text{kg}$	$\text{mg}/\text{L}$

Note that for the organic and inorganic parameters, solid and sediment results will be corrected for the percentage of solids in the sample ("dry weight").

### 1.9.3 Data Quality Assessment

The parameters of precision, accuracy, representativeness, completeness, and comparability (PARCC) are indicators of data quality (USEPA, 1987a). Establishing goals for these parameters serves to guide the choice of the analytical methodology. It also establishes a strategy for the evaluation of the data once they have been acquired to determine whether the goals of the project have been met. Upon their receipt from the laboratory, the chemical analysis data will be evaluated by experienced personnel against pre-determined criteria to determine whether their quality meets the requirements of the project. The laboratory quality control (QC) data and the field QC data will be evaluated to objectively ascertain the level of quality of the data. Any issues requiring clarification by the laboratory or the samplers will be identified and pursued at this point. The data quality level will then be compared to that required by the project. If problems are found, qualification of the affected data points will be recommended. Upon determination of the level of quality for each data point, interpretation of the data can then be performed. The following sections describe the data quality evaluation and data qualification processes.

1.9.3.1 Data Quality Evaluation - The objective of the evaluation of the quality of the chemical data is to determine if qualifications of the data are necessary. This evaluation will be based upon the evaluation of the laboratory QC data, the field QC data, and the project DQOs presented in Section 1.4. The first step will be to perform an evaluation of the laboratory QC data, a

process often termed "data validation." This will provide a rating of the quality of each data point produced by the laboratory. The second part will provide an overall rating of each data point based upon the field QC data. The final step in the evaluation will compare the quality of the data acquired to the project's DQOs to determine whether the data are useful. These three steps are described in the following sub-sections. Each step will be completely documented. The overall goal of the data quality evaluation is to determine whether the data can be used to satisfy the objectives of the project.

Evaluation of Laboratory QC Data - Laboratory QC data for an analytical parameter fall within one of eight categories for evaluation purposes. These categories are listed in Table 1-10 in the order in which they will be considered. All QC data provided will be evaluated against the criteria established by each method after modification as presented in this document to achieve the objectives of this project. Each review will be completely documented to indicate the criteria used and the results and recommendations of the evaluation. [For this investigation, calibration accuracy, precision, and stability will be assumed to be correct because these data will not be provided for evaluation.]

Evaluation of Field QC Data - Field QC data for an analytical parameter fall within one of eight categories for evaluation purposes. These categories are also listed in Table 1-10 in the order in which they will be considered. QC data provided will be evaluated to assure the objectives of this project are achieved. Each review will be completely documented to indicate the criteria used and the results and recommendations of the evaluation. [For this project, no data for blind QC samples, performance evaluation samples, or split samples will be available.]

Usability Determination - Once the laboratory and field QC data have been evaluated, the uncertainty associated with each data

point can be estimated. The estimated accuracy and precision of each data point can then be compared to the data quality objectives of the project to determine its usefulness for evaluating the site. Recommendations for the qualification of a data point can also be made when necessary.

Precision will be determined by evaluation of the RPDs for the laboratory and field duplicates. The laboratory and field blank data, MS/MSD and surrogate (if applicable) recoveries, and other applicable QC data will be used to determine the accuracy of the data. The evaluator will use their judgement based upon established principles and the guidelines described in this document in the assignment of qualifications to the data.

The completeness parameter will be evaluated after the determination of the usability of each data point; it will be expressed in quantitative terms and then compared to the project objectives to determine whether enough data were collected. Representativeness will be determined through an evaluation of sampling procedures and locations utilized and will be expressed in qualitative terms. Comparability will be determined by the evaluation of data quality and will also be expressed in qualitative terms.

1.9.3.2 Data Qualification - Each data point will essentially be graded as falling into one of the following categories:

- usable as reported;
- usable with qualifications; or
- unusable.

These categories correspond to the three established for the DQOs in Section 1.4. Data for which the laboratory and field QC data are all within acceptance limits will be assigned the grade "usable as reported." Data for which slight QC problems are indicated but

the QC data are still within the action limits will be assigned the grade "usable with qualifications." These data may still be used if the QC problems are not excessive. Data for which the corresponding QC data are outside the action limits will be assigned the grade "unusable" and will not be used. Each data point will receive a flag indicating its level of quality. The flags to be used are presented in Table 1-11.

#### 1.9.4 Data Reporting

Data reports will be included in the technical reports preparation. The data will be presented as tables or in the appendices of the report. Tables will include the following information:

- sampling dates
- extraction and analysis dates
- surrogate recovery (if applicable)
- MS/MSD results
- duplicate/replicate results
- rinsate results
- positive results
- field characterization data (pH, SC, temp)
- control limits (surrogates, MS/MSD, duplicates)

#### 1.10 INTERNAL QUALITY CONTROL CHECKS

The following sections describe the quality control checks employed in the field and laboratory.

##### 1.10.1 Field Quality Control

Quality control of field measurements will be utilized through the calibration of instruments. The control parameters, control limits, and corrective actions are outlined in Section 2.4.

### 1.10.2 Laboratory Quality Control

The minimum requirements of the laboratory quality control consist of an initial demonstration of laboratory capability and an ongoing analysis of quality control samples to evaluate and document data quality. The laboratory must maintain records to document the quality of the data generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of quality control samples indicate atypical method performance, a quality control check standard must be analyzed to confirm that the measurements were performed in an in-control mode of operation. Calibration stability will be assessed and documented utilizing the procedures and at the frequency specified in each method.

Before processing any samples, the analyst should demonstrate, through the analysis of a reagent water blank, that interferences from the analytical system, glassware, and reagents are under control. Each time a set of samples is extracted or there is a change in reagents, whichever is more frequent, a reagent water blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through the stages of the sample preparation and measurement steps.

If any analyte fails the acceptance criteria for recovery, a QC check standard for each analyte that failed must be prepared and analyzed. As part of the QC program for the laboratory, method accuracy for each matrix studied must be assessed and records must be maintained.

The types and numbers of laboratory quality control samples to be used are presented in Tables 1-12 through 1-16 by matrix and parameters. They are defined as follows:

Method blanks. Method blanks consist of organic-free or deionized water that is carried through the analytical scheme like a sample. They serve to measure contamination associated with laboratory storage, preparation, or instrumentation. For most analyses, a method blank is analyzed for each batch and at a frequency of 1 per 20 samples if more than 20 samples are run in a given batch. If the analyte of interest is above the reporting detection limit, corrective action should be taken except for common solvents such as methylene chloride, acetone, toluene, 2-butanone and phthalates.

Sample blanks. Sample blanks are used when characteristics like color or turbidity interfere with a determination. In a spectrophotometric method, for example, the natural absorbance of the sample is measured and subtracted from the absorbance of the developed sample. Sample blanks are run only as necessary.

Calibration blanks. Calibration blanks are prepared with standards to create a calibration curve. They differ from the other standards only by the absence of analyte and provide the "zero-point" for the curve.

Internal standards. Internal standards are measured amounts of certain compounds added after preparation or extraction of a sample. They are used in an internal standard calibration method to correct sample results suffering from capillary column injection losses, purging losses, or viscosity effects. Internal standard calibration is currently used for volatile organics, chlorinated pesticides and GC/MS extractables.

Surrogates. Surrogates are measured amounts of certain compounds added before preparation or extraction of a sample. The recovery of a surrogate is measured to determine systematic extraction problems. Surrogates are added to all samples analyzed for chlorinated pesticides, GC/MS extractables and volatiles, and GC volatiles.

Spikes. Spikes are aliquots of samples to which known amounts of analyte have been added. They are subjected to the sample preparation or extraction procedure and analyzed as samples. The stock solutions used for spiking are purchased or prepared independently of calibration standards.

The spike recovery measures the effects of interferences in the sample matrix, and reflects the accuracy of the determination. Spike recoveries are calculated as follows:

$$\begin{array}{l} \text{Check Standard} \\ \text{Method Standard} \\ \text{Check Sample} \end{array} \qquad \text{Percent Recovery} = \frac{\text{Observed}}{\text{Expected}} \times 100$$

$$\text{Matrix Spike} \qquad \text{Percent Recovery} = \frac{\text{SSR} - \text{SR}}{\text{SA}} \times 100$$

Where:

SSR = Spike Sample Result  
 SR = Sample Result  
 SA = Spike added from Spiking Mix

Spikes are prepared and analyzed for each batch and at a frequency of at least one per 20 samples if more than 20 samples are run in a given batch.

Spike recoveries are stored in the laboratory database and are retrievable for statistical analysis. Laboratory control limits are calculated for individual matrix types when 20 data points become available.

Duplicate or Duplicate Spikes. Duplicate spikes are additional spiked aliquots of samples subjected to the same preparation and analytical scheme as the original spike sample. The relative

percent difference (RPD) between duplicates or duplicate spikes measures the precision of a given analysis. RPDs are calculated as follows:

$$\%RPD = \frac{R1 - R2}{Rav} \times 100$$

or

$$\%RPD = \frac{S1 - S2}{Sav} \times 100$$

Where:

- R1 and R2 = duplicate determinations of the analyte in the sample
- S1 and S2 = the observed concentrations of analyte in the spike and its duplicate
- Rav = the average determination of the analyte concentration in the original sample
- Sav = the average of the observed analyte concentrations in the spike and its duplicate

Duplicates or duplicate spikes are prepared and analyzed for each batch, or at a frequency of at least one per 20 samples if more than 20 samples are run in a given batch.

RPDs are stored in the laboratory database and are retrievable for statistical analysis.

Laboratory Control Standards. Laboratory Control Standards (LCSs) and Quality Control Check Samples (QCCSs) are aliquots of organic-free or deionized water to which known amounts of analyte have been added. They are subjected to the sample preparation or extraction procedure and analyzed as samples. The stock solutions used for

LCSS are purchased or prepared independently of calibration standards. The LCS recovery tests the function of analytical methods and equipment. For inorganic and metals analyses, the percent recovery for LCSS is compared to method specific criteria, and the analytical system is considered to be in control when these analyte specific criteria are met. When a result of an organic method aqueous matrix spike and/or matrix spike duplicate indicates atypical method performance, a quality control check standard will be analyzed to confirm that the measurements were performed in an in-control mode of operation for that analyte.

The acceptance criteria for the LCS is a recovery range of 80-120%. The acceptance criteria for the QCCS is stated in each method.

LCSS are prepared and analyzed for each batch or at a frequency of one per 20 samples if more than 20 samples are run in a given batch. Laboratory control limits are calculated when 20 data points become available.

The LCS is used to monitor overall performance of all steps in analysis, including sample preparation. If the LCS results fall within 20% of the calibration curve, this verifies that instrument performance, calibration and sample preparation are satisfactory. When the LCS is used in conjunction with matrix spikes, matrix spike recovery evaluation can be better interpreted as either matrix interference, preparatory error or matrix spiking solution preparation may be incorrect.

### 1.10.3 Control Limits

Control limits for this project are method specific and laboratory established. Project wide control limits expressed as precision, accuracy, and completeness can be found in Section 1.4. Appendix

A presents the control limits for each analytical method including frequency, acceptance criteria, and corrective action.

#### 1.11 PERFORMANCE AND SYSTEM AUDITS

Law views quality assurance as the means by which the effectiveness and quality of its various participating departments are gauged as they carry on day-to-day operations under the QA/QC program. The major goals associated with the QA/QC program are listed below:

- QA reviews should help ensure compliance with mandated QC procedures;
- QA reviews provide a structured means of communicating problems between the technical and administrative portions of the company;
- QA procedures are designed to ensure operating regularity between the various branches of Law; and
- QA audits provide a mechanism by which our QC procedures are constantly being reviewed and updated in an orderly fashion.

##### 1.11.1 Systems Audits

Systems audits are qualitative evaluations of each component of field and laboratory QC measurement systems. A systems audit will be performed periodically and will consist of inspecting the following procedures:

- Sampling
- Sample custody
- Sample storage and preservation

- Sample preparation
- Analytical methodology
- Data management
- Preventative maintenance
- Personnel qualifications

Law will submit to on-site external systems audits by AFCEE or any other appropriate regulating agency.

#### 1.11.2 Performance Audits

A performance audit is a quantitative evaluation of a measurement system. The performance audit procedures and responsibilities of each laboratory are presented in Appendix B.

#### 1.12 PREVENTIVE MAINTENANCE

Equipment maintenance is the responsibility of the analyst and their Manager. Repairs and/or modifications are recorded in bound maintenance logbooks. Daily equipment checks include visual and/or manual inspections of cooling fans, pumps, indicator readings, detectors, gas supplies, and other method specific inspections. Service schedules are established for performing routine preventive maintenance on major equipment.

#### 1.13 FIELD AND LABORATORY PROCEDURES USED TO ASSESS DATA QUALITY INDICATORS

##### 1.13.1 Formulas

Formulas for the calculation of quality control parameters for the evaluation of the quality of laboratory analyses are presented in

the methods. Field duplicate precision will be calculated using the same formula as for laboratory precision.

### 1.13.2 Control Limits

Control limits for analytical methods are presented in Appendix A. Control limits are developed by the laboratory based on historical data. If historical data are not complete then control limits are set based on those established by the method.

### 1.13.3 Documentation

Completeness and comparability of data are insured by adherence to a standard data-set protocol and checklist of data required to be available on laboratory report sheets for each type of analysis conducted. Each parameter data book must contain all data and calculations associated with each independent determination. These include such things as sample weight(s), dilution factor(s), applicable determinative measurements such as titration values, spectrometer readings, injection quantities, and standard(s) identity and concentrations, as well as all calculations related to each final value reported. Each laboratory report sheet will be checked and initialed by a second competent scientist other than the person who did the analysis to insure completeness of data and correctness of all calculations in the report. For the occasional project involving very critical samples on which serious action is contemplated, the entire set of analyses on the same sample(s) will be independently audited by a special project quality assurance officer. For example, the analysis of drinking water samples from residential wells where compounds were found to exceed the MCL. Samples collected at Carswell AFB are not considered to be in this category. Work sheets, chromatograms, spectra, etc., associated with every analysis will be present in the parameter data book.

These will give instrument operation parameters and details of instrument set-up, such as columns used, mobile and stationary phases and concentrations, temperatures, detectors, spectrometer type, wavelengths, etc., as applicable for the type analysis. Work sheets will bear a unique laboratory number identifying that sample, relating the laboratory data sheets to the sample. Each sheet will be recorded with dates and times and bear the laboratory analyst's initials.

#### 1.14 CORRECTIVE ACTION

An effective QC program requires rapid and thorough correction of the QC problems. Rapid corrective action (CA) minimizes the possibility of questionable data on any project. The need for corrective action originates when an inadequacy is found in the method of analysis (e.g., inappropriate calibration) or a determinate error occurs (e.g., calibration error due to standards failure). Failures of the first kind are precluded by LENL and Regulator/Contractee audits which evaluate analytical SOPs. The analytical SOPs incorporate mechanisms to detect the existence of determinate errors and specify the procedures to correct them.

Depending on the nature of the CA, it is classified as one of two types, immediate and long-term. Immediate corrective actions are the correction of procedures or repair of instrumentation that is working improperly. Long-term corrective actions are the correction of systematic errors, such as the detector on a GC becoming dirty and losing sensitivity. Corrective actions associated with field activities are presented in Section 2.4.3.

##### 1.14.1 Response

Many times the source of a nonsystematic problem is obvious to the analyst and can be corrected immediately. Immediate corrective

action routinely made by field technicians or laboratory analysts should be documented as normal operating procedures in instrument log books or personal notebooks. The Supervisor and analyst should compile a list of commonly encountered problems and the appropriate routine corrective actions (in addition to manufacturer's troubleshooting guides). The Operations Manager and QA/QC Coordinator are responsible for approving all corrective actions. Appendix A lists the corrective actions necessary for each analytical method.

#### 1.14.2 Reestablishment of Control

Corrective action is not complete until the problem has been effectively and permanently solved. Follow-up action to ensure that the problem remains corrected is a vitally important step in the corrective action procedure. Routine corrective actions, such as recalibrating the instrument, are incorporated into the Standard Operating Procedures (SOPs). Major corrective actions, such as a systems failure, are handled in the following manner: Once a problem has been technically defined, the Operations Manager and the QA/QC Coordinator discuss the problem and jointly take the following steps:

1. Determine that specific corrective action is needed to eliminate the problem and assign responsibility for investigating, implementing, and documenting the situation;
2. Set a time schedule for determining the required action;
3. Assign responsibility and time schedule to implement the desired action;
4. Establish desired effectiveness of the corrective action and implement the correction; and

5. Verify that the corrective action has eliminated the problem and document.

#### 1.14.3 Documentation

To provide a complete record of QC activities, QC problems and corrective actions applied must be documented. Historical records assist laboratory management in identifying long-term corrective actions, such as personnel training, replacement of instrumentation, improvement of sampling procedures, etc. Corrective action documentation forms for laboratory operations are presented in Appendix B. Corrective action documentation associated with field activities are recorded on Daily Quality Control Forms. These forms are presented in Section 2.4.3.

#### 1.15 QUALITY ASSURANCE REPORTS

The management is informed of QA activities in three ways: (1) by immediate verbal notification of QA problems, (2) by interim QA reports, and (3) written QA reports. The following subsections discuss the reporting procedures to be followed and report contents.

##### 1.15.1 Reporting Procedure

An Analytical Data Informal Technical Information Report (ITIR) will be prepared and submitted by Law Environmental Government Services Division at the end of the sampling and analysis activities to the AFCEE TC. The data will also be submitted to the USAF TPM in a format compatible with the USAF's Installation Restoration Program Information Management System (IRPIMS) data base.

1.15.2 Report Content

The format of the Analytical Data ITIR will substantially follow the format specified by the USAF (AFCEE, 1991). The format of the IRPIMS deliverable will correspond exactly to the format specified by the USAF (AFCEE, 1991; AFCEE, 1993a; AFCEE, 1993b).

## 2.0 FIELD SAMPLING PLAN (FSP)

Field tasks to be conducted at the Carswell AFB RI/FS sites are explained in detail in the following text.

### 2.1 FIELD OPERATIONS

The field investigations at the Unnamed Stream (SD-13) and POL Tank Farm (ST-14) sites which are located in the east area of Carswell AFB (Figures 2-1 and 2-2) will include the following activities:

- Geophysical surveys
- HydroPunch survey
- Installation of new monitoring wells
- Aquifer testing
- Soil, sediment, ground-water sampling (2 rounds), and surface water sampling

The proposed HydroPunch locations for the POL Tank Farm (ST-14) are presented in Figure 2-3. The proposed monitoring well location for the Unnamed Stream (SD-13) is presented in Figure 2-4. The methods for conducting the field operations and activities are discussed in the following sections.

#### 2.1.1 Site Reconnaissance, Preparation and Restoration

The two sites under this RI/FS were visited on April 14th, 1993, by representatives of Law, AFCEE, and Carswell AFB. During the site visit, AFCEE representatives outlined the RI/FS field tasks at each site.

Prior to commencement of field operations, all sites will be inspected and new monitoring well locations will be staked. The sites will also be inspected for access routes.

Site preparation will include removal of obstructions (if needed) and utility clearances by base personnel. Specific information concerning field office space, decontamination area, and drum staging areas will be coordinated with base personnel.

Upon completion of field activities, each site will be restored to a condition that as closely as possible approximates the condition of the site prior to field activities.

### 2.1.2 Surface Geophysical Survey

A geophysical survey will be performed at both sites to help characterize the near surface conditions and to locate utilities and abandoned tanks and pipechases. A single type of geophysical survey (ground penetrating radar) will be performed at Carswell AFB during the field work.

2.1.2.1 Ground Penetrating Radar - GPR is a geophysical technique which can provide high resolution data on surficial geology. The technique is used in general to map shallow bedrock, soil and water table features, and locate underground pipes and tanks. At hazardous waste sites, ground penetrating radar is also used to locate trenches, lagoons, buried drums, contaminant plumes and other structural and contaminant-related features. The depth of penetration is dependent upon the types of soil and the electrical properties of the subsurface. In silts and clays the depth of penetration may be on the order of only a few feet, while in dry sands the depth of penetration may extend to tens of feet.

A high frequency signal (typically in the 100 to 1000 Mhz range) is transmitted into the subsurface through a transmitting antenna and the resulting signal is received by a second antenna. The received signal may include an air wave, a ground wave, and reflected signals from subsurface boundaries, all in superposition.

The particular frequency range at which the radar operates is determined by radio frequency electronics and the specific antennas used. Typically in geologic materials, the lower the frequency range of the radar the greater the penetration range, assuming the transmitter output power and receiver sensitivity are not varied. The ability to resolve variations in electrical properties which have small spatial extent increases as the frequency increases, assuming a constant center-frequency to system-bandwidth ratio. It is necessary, therefore, to use antennas having the optimum frequency range and bandwidth characteristics to see the desired electrical variations in the particular geologic medium.

A GEODAR-I, Model-2441, or equivalent unit, will be used at the Carswell sites. A typical radar unit consists of a timing control unit which synchronizes all timing for the transmitter, receiver, data recorder, and data display. The transmitter and receiver electronics are located in the respective antenna modules. They are connected to the control unit through cables. Only the timing signals, the audio frequency facsimile of the received signal, and the DC voltage are carried on this cable.

The receiver has a sampling head similar to a sampling oscilloscope. The sampling head uses the repetitive nature of the received signal to transform the radio frequency signal into audio frequency facsimile. The transmitter sends out pulses and the receiver samples the received pulse for a small interval of the pulse duration. After each transmitter pulse, the sample window is moved in time and this is repeated until a complete scan of the pulse is obtained. The rapid rate at which the data is collected presents a virtually continuous record. During the survey, the antennas can be moved continuously over the line of interest. The sampled audio frequency signal is sent to the control unit where it is amplified, filtered and then monitored on an oscilloscope. The signal is recorded on an electrostatic recorder.

The electrostatic recorder uses a variable gray scale to display the data. Each scan draws a line across the paper in the direction of increasing signal travel time with the intensity dependent upon the radar signal amplitude.

The received radar signals are filtered before recording using audio frequency analog filters located in the control unit. Analog filtering helps to remove some of the equipment-generated noise.

For a routine reconnaissance map of reflections in the ground, the antennas are mounted rigidly at a known separation and moved along the profile line. The resultant trace shows reflection travel time versus position along the profile. In the profile mode, the travel time is related to the reflector depth and signal propagation velocity.

### 2.1.3 HydroPunch Survey

A HydroPunch survey will be conducted at Carswell AFB as part of the remedial investigation effort. This survey will be conducted by Transglobal Environmental Geochemistry, Texas located in Austin, Texas.

2.1.3.1 HydroPunch Survey - A HydroPunch survey will be performed at the POL Tank Farm (ST-14). The POL Tank Farm is located in the east area of Carswell AFB, west of and adjacent to Knight's Lake Road and north of Hobby Shop Road (Figure 2-1). Twenty-two HydroPunch borings will be performed at the POL Tank Farm to provide supplemental geotechnical and analytical information in order to delineate the extent of contamination. Three HydroPunch borings will be held back to reserve for discretionary reasons once the survey is implemented.

The HydroPunch sampler chamber holds approximately 500 ml of

liquid. As the HydroPunch is pushed through the soil, the sample intake pipe is shielded in a watertight housing that prevents contaminated soil or ground water from entering the unit. When the desired sampling depth is reached, the HydroPunch is pulled up (6-12 inches) using the drill rods. The perforated intake pipe and screen attached to the penetration core are exposed to the water-bearing zone (Figure 2-5). The in-situ hydrostatic pressure allows the ground water to flow through the screen and into the sample chamber. Once the sample chamber is filled, the HydroPunch is pulled towards the surface. This upward pulling closes the two internal teflon check valves and retains the sample within the sample chamber. Upon retrieval, the drill rods are disconnected from the HydroPunch and the upper ball check valve is removed. A teflon valve is then placed on the stainless steel discharge port at the top of the sampler. The HydroPunch is inverted 90 degrees and the ground-water sample transferred to a sample container.

#### 2.1.4 Borehole Construction, Lithologic Sampling and Logging

A soil boring will be performed to allow installation of each monitoring well. The soil boring will provide subsurface information for well design and site stratigraphy. The soil boring will be observed by a qualified geologist or geotechnical engineer. The geologist/engineer will log the subsurface conditions encountered in the boring, and record the information on a soil boring log. An example of a soil boring log is shown in Figure 2-6. Any other additional information concerning the boring will also be recorded on the log. Soils will be classified using the Unified Soil Classification System (ASTM D 2488-69).

Hollow-stem augering will be the preferred technique for all soil borings. The augers will be of sufficient inside diameter to allow installation of the wells as described in subsequent report sections. It is anticipated that use of the hollow-stem augers will provide a sufficiently stable hole for soil sampling and

monitoring well installation. If drilling fluids are to be utilized, a sample of the fluids introduced to the borehole will be analyzed to evaluate potential constituents introduced into the monitoring well.

#### 2.1.5 Monitoring Well Construction and Installation

2.1.5.1 Construction - The monitoring wells will be installed to accomplish the following objectives: to collect representative ground-water samples; to prevent contamination of the aquifer by the drilling equipment; to prevent inter-aquifer contamination; and to prevent vertical seepage of surface water into the monitoring well water-intake zone. The equipment, procedures and personnel that will be used at the Carswell AFB to accomplish these objectives are discussed below.

The monitoring wells will be designed to intercept the upper portion of the water-table aquifer. The screen will be placed so that it intercepts the maximum upper fluctuation of the water table. Seasonal fluctuations in the water table will be taken into account in placing the screen for each well. The screen will extend a minimum of one foot and a maximum of three feet above the water level encountered during drilling.

The screen and riser pipe will be installed through the hollow stem auger. The pipe will be centered and suspended prior to placing the filter pack. Sand for the filter pack will be tremied into the annular space between the well casing and hollow stem augers using a tremie pipe. The hollow stem auger extensions will be withdrawn as the sand is placed into the well. The sand will be placed to a minimum of two feet above the top of the screen. If wells are installed so that the top of screen is at a depth of two feet or less, the sand pack will be installed to six inches above the

screen. The sand will be continuously tamped to prevent bridging. The depth of the sand pack and the amount of sand used will be continuously monitored. After the filter pack has been installed to a level of at least two feet above the top of the screen, the well will be surged for ten minutes using a surge block. Additional sand will be added to bring the level back up to two feet above the screen. The well will then be surged for an additional five minutes. More sand will be added if necessary to return the level of the sand to two feet above the screen. Following placement of the sand, three feet of bentonite pellets will be placed above the sand pack. The remainder of the open hole will be sealed with a cement-bentonite grout. The grout will be placed using a tremie pipe equipped with a side discharge. A Type II Well Completion Diagram is shown in Figure 2-7.

2.1.5.2 Materials and Installation - All monitoring well surface casing and riser pipe will consist of new, threaded, and flush joint, Schedule 40 polyvinylchloride (PVC). The pipe will conform to ASTM F-480-88A standards. The pipe will bear markings identifying the material as that which is specified. Each section will be joined by threaded flush-joint couplings to form water-tight seals. No organic solvents or glue will be used in joining the pipe.

All well screens will consist of new, commercially fabricated, threaded 10-foot, flush joint, 4-inch PVC, factory slotted; slot size .010. A threaded PVC plug or short sand sump section will be provided for the bottom of the well.

A sand pack will be installed in the annulus between the boring and the well screen. The sand filter pack will extend two feet above the top of the screen. The sand pack will consist of clean, inert, non-carbonate materials. A "20/30" sand, or its equivalent, will be used in the wells to be installed at the sites.

A three-foot thick bentonite seal will be placed in the annulus above the filter pack and will be allowed to hydrate to prevent intrusion of the grout into the filter sand. A cement grout will be placed in the annular space between the well casing and boring from the top of the bentonite seal to the ground surface. The cement mixture will consist of Portland cement (ASTM-C150), and water added in the proportion of no less than five to no more than seven gallons per 94-pound bag of cement. Additionally, three percent by weight of bentonite powder will be added to the mixture to help reduce shrinkage, if permitted by state regulations.

Upon completion of the well, a vented cap will be installed to prevent material from entering the well. The PVC riser will be surrounded by a larger diameter steel casing rising approximately 24 to 36 inches above ground level. The steel casing will be provided with a locking cap and lock. A three-foot square, four-inch thick concrete pad, sloped away from the well, will be constructed around the well casing at the final ground level elevation. Three steel posts, with three-inch diameters and five foot lengths, will be equally spaced around the well outside of the concrete pad. Monitoring wells will be identified on the outside of the casing.

All wells will be checked for plumbness after installation. A ten-foot length of pipe, one half-inch less in diameter than the I.D of the riser pipe, will be run through the entire length of the well. This pipe section will be steam cleaned prior to use at each location. If the pipe does not run freely through the full length of the well, the well will be replaced or repaired.

2.1.5.3 Well Development - The monitoring wells will be developed no sooner than 48 hours after grouting is completed. Development protocol will be as follows:

- a. Measure static water level. Water levels will be measured using an interface probe capable of detecting both petroleum product and water levels.
- b. Measure total well depth.
- c. Develop the well using a combination of surging, bailing and pumping. Begin by surging the well with a surge block for a period of not less than fifteen minutes. Then use either a bailer or a pump to evacuate the well. Continue pumping/bailing and periodically surging until:
  - 1) the suspended sediment content of the water is less than 0.75 mL/L as measured in an Imhoff Cone according to Method E160.5;
  - 2) the turbidity remains within a ten nephelometric turbidity unit (NTU) range for at least 30 minutes; and
  - 3) the temperature, pH and conductivity have stabilized. Stabilization criteria are as follows: temperature  $\pm 1$  degree C, pH  $\pm 0.2$  units, conductance  $\pm 5\%$ .
- d. All fluids introduced into the well will be removed during development. Therefore in addition to the above criteria at least three times the total quantity of fluids added during drilling will be removed during development.
- e. In the event that the well goes dry during development, the well will be considered developed after it has been bailed dry three times; enough time will be allowed each time for the well to fully recharge.
- f. Denote physical characteristics of water throughout well development (color, odor, turbidity, etc.).
- g. Record the total quantity of water removed.

- h. Measure static water level after at least 24 hours.
- i. Measure total well depth.
- j. After final development collect approximately one liter of water from the well in a clear glass jar. Label and photograph the water jar. The photo will be suitably backlit to show the clarity of the water.

Well development data will be recorded on Monitoring Well Development Sheet, Figure 2-8.

#### 2.1.6 Aquifer Tests (Slug Tests)

In-situ hydraulic conductivity tests will be performed on the new monitoring wells a minimum of 24 hours after ground-water sampling. Decontamination of downhole testing equipment will be performed in accordance with Section 2.1.9. The tests will be conducted to determine formation permeability. The results of the tests will be used to estimate ground-water flow rates.

The tests which will be performed are known as rising head tests. The rising head test involves removing a solid rod which was previously inserted into the water column in the well. The rising head test is performed once the water level has returned to static after the initial insertion of the rod. Removal of the rod causes an immediate lowering of water level. The water level recovery to static is recorded over time using an automatic data logger. Water level readings will be measured and recorded continuously until the recovery is 90 percent of the original static water level. The rate of recovery is controlled by formation characteristics.

The data results of the hydraulic conductivity test are then calculated. The following formula (Bouwer, 1989) is utilized to calculate hydraulic conductivity (K):

$$K \text{ (ft/sec)} = \frac{r_c^2 \ln (R_e/r_w)}{2 L_e} * \frac{1}{t} * \frac{\ln Y_0}{Y_t}$$

Where:	$r_c$ (ft)	=	well radius
	$R_e$ (ft)	=	effective radial distance over which the head difference is dissipated
	$r_w$ (ft)	=	radial distance between well center and undisturbed aquifer
	$L_e$ (ft)	=	height of saturated screen
	$Y_0$ (ft)	=	water level Y at time zero
	$Y_t$ (ft)	=	water level Y at time t
	t (sec)	=	time since $Y_0$

Analysis of the data will be performed utilizing a commercially-available computer program such as AQTESOLV®. Because we expect the screen will extend above the water table, only the rising head data will be used to calculate K.

#### 2.1.7 Test Pit Excavation

Test pit excavations will not be performed within the scope of this investigation.

#### 2.1.8 Surveying

Upon completion of the wells, a state of Texas certified surveying crew will locate by standard surveying methods each new monitoring well and sampling location. A vertical survey will be conducted to establish the elevation of each permanent monitoring well. Vertical control will be to the National Geodetic Vertical Datum. The horizontal grid coordination of each monitoring well to within 0.1 foot and the ground elevation to within 0.01 foot and the

elevation for each well within 0.01 foot will be recorded. The survey will be tied to the state plane system.

#### 2.1.9 Equipment Decontamination

The following decontamination procedures will apply to split spoons, hand augers, stainless-steel bowls and spoons, and ground-water bailers. The decontamination steps are as follows:

- 1) Hand wash with bristle brush and a solution of Alconox (or equivalent);
- 2) Rinse with copious quantities of potable water;
- 3) Rinse with deionized (Reagent Grade II) water;
- 4) Spray-rinse with pesticide grade methanol;
- 5) Spray-rinse with pesticide grade hexane;
- 6) Air dry.

The following procedure shall be used to decontaminate large pieces of equipment such as drill rigs, auger flights, and casing.

- 1) Wash the external surface of equipment or materials with high-pressure hot water and Alconox or equivalent, and scrub with brushes if necessary until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been rinsed from the equipment.
- 2) Rinse with potable water.
- 3) Air dry. The sampling equipment will be cleaned prior to each use in accordance with this procedure. All decontamination solutions will be stored on site until analyses have been completed.

### 2.1.10 Waste Handling

All drill cuttings and drilling fluid will be containerized in clean, Department of Transportation (DOT), 17 H drums. All drums of soil will be moved to a staging area designated by the base. All drums shall be adequately labeled prior to being moved to the staging area. Law will analyze a maximum of one composite sample from the drums for each area to be analyzed for TCLP. The analytical information will be used to prepare a manifest for ultimate shipment of the drums to a disposal facility. Law will be responsible for off-site disposal of any drums.

Development water will be drummed and moved to a staging area on base following the procedure outlined in the drill cutting disposal section above. Drummed development water will not be analyzed, but the results of water analysis after monitoring well sampling will be used to prepare a manifest for ultimate shipment of the drums to a disposal facility. Law will be responsible for off-site disposal of any drums.

A separate drum will be provided for additional wastes, such as gloves, tyvek, etc., generated in drilling and sampling operations.

### 2.1.11 Field Activity Summary

The field tasks and associated QC and field samples per site are presented in Table 2-1.

## 2.2 ENVIRONMENTAL SAMPLING

Field sampling activities include the collection of ground-water, surface water, sediment, and soil samples. The collection methods, including sample handling, sample custody, QC samples, and sample

analysis are presented in the following subsections. Table 2-2 provides a list of equipment required.

### 2.2.1 Procedures for Collection of Samples

This section presents the planned program for collection of samples for chemical analysis. The following sections present the site-specific sampling requirements, the planned sample collection procedures, and the procedures to be used to maintain sample integrity.

Prior to sampling, field instruments will be calibrated, files containing sample information will be processed and labels will be prepared. Sample bottles will be sorted for each sample location according to analyses. Conditions and sampling information will be recorded in the field sampling books and used to assess sampling procedures in relation to the sample data. The field team leader will brief the sampling team on safety, decontamination stations and any other sampling protocols necessary. Each sampling team member will wear the appropriate level of safety gear as specified for each site in the Health and Safety Plan.

2.2.1.1 Ground-Water Sampling - Ground-water samples will be collected from newly-installed wells. Ground-water samples will be obtained using cleaned and dedicated Teflon® bailers. Bailers will be decontaminated as outlined in Section 2.1.9. After the bailer has air-dried it will be wrapped in aluminum foil to prevent contamination. Polyethylene rope will be used to lower the bailer into the well. A Teflon® leader will precede the rope attached to the bailer to prevent the rope from entering the well during sampling.

Ground-water sampling will be conducted in a manner which minimizes interaction of the sample and the surface environment. The sampling protocol will be as follows:

- a. Floating Hydrocarbon Measurement - An electronic interface probe will be used to test for the presence of floating product in the newly-installed and existing wells. The probe will be lowered into the wellbore and if product is present, its thickness will be recorded. Its presence will be confirmed by withdrawing a sample. The probe will be decontaminated after each use by the protocol described in Section 2.1.9.
- b. Measure Water Level - An electronic water level indicator will be used to measure the static water level in the well prior to purging. The water level probe will be lowered into the wellbore and the water level will be recorded. The volume of water in the wellbore and filter pack will be calculated using the equation in subpart c.

Decontamination of the probe will be performed as per Section 2.1.9 to minimize the potential for cross-contamination between wells as the probe is being withdrawn from the well.

- c. Purge the well until the pH, specific conductance, and temperature have stabilized within  $\pm 0.2$  pH units,  $\pm 5$  percent, and  $\pm 1$  degree C, respectively. Remove a minimum of three fluid casing volumes, checking the above mentioned parameters after each casing volume is removed. If, after three fluid casing volumes have been removed, the parameters have not been stabilized, remove well casing volumes until the parameters stabilize or until six volumes have been purged. If the well is purged to dryness and does not recharge within a reasonable time to

permit three volumes to be removed, record the volume removed and sample as soon as sufficient recharge has occurred. The calculation for well volume is presented below:

CALCULATING WATER VOLUME

VOLUME OF WATER IN WELL

$$H_1 \pi 7.48 [(R_1^2 - R_2^2) \cdot \phi + R_2^2]$$

Volume of	Volume of
hole with	PVC with
filter pack	filter pack

- $H_1$  = height of water in well screen and filter pack in feet
- $\pi$  = 3.14159
- $R_1$  = radius of borehole in feet
- $R_2$  = radius of PVC in feet
- 7.48 = amount of water in 1 cubic ft.
- $\phi$  = porosity of filter pack

- d. Label Sample - Label the sample container as outlined in Section 2.2.2.
- e. Collect Sample - Ground-water sampling will be conducted by using dedicated bailers. The collection procedure is described below.

After purging the well and sufficient recharge has been allowed, samples for volatile organics should be collected using the first bailer volume. Lower the bailer slowly until it contacts the water surface, and

allow the bailer to sink to the desired depth and fill, with a minimum of surface disturbance. Slowly withdraw the bailer, taking care to prevent contact of the bailer line with the ground. Slowly discharge the contents into the appropriate sample containers. Repeat the process as necessary to fill each container to the required volume (see Section 2.2.2.1). Vials for volatile analysis will be completely filled, leaving no air space above the liquid portion (to minimize volatilization). Check that the Teflon on the Teflon®-lined silicone septum is toward the sample in the caps and secure the cap tightly. If semi-volatile compounds are to be sampled for, collect these samples next. Proceed to the collection of samples for the remaining analyses. Care will be taken for all pre-preserved bottles. If acids are present, the bottle will be opened downwind of and away from the body.

- f. Measure pH, Temperature and Specific Conductance - Follow procedure as outlined in Section 2.3.
- g. Custody, Handling and Shipping - Complete the procedures as outlined in Sections 2.2.2 and 2.2.3.
- h. Measure Water Level - After samples have been collected, the well cap should be replaced. Static water level will be measured again after sufficient recharge has been allowed (24 hours).

2.2.1.2 Soil Sampling - Soil samples will be collected from soil borings of the newly-installed monitoring wells. The following section discusses soil sampling and collection procedures. Included are discussions of soil sampling protocol and equipment.

Subsurface soil samples from borings will be collected using a 3-inch, stainless-steel, split-barrel sampler with California brass

ring inserts. Care has been taken to determine the best practical sampling procedure that will result in obtaining representative samples. The samples must maintain the integrity of the original medium through collection, transportation, and delivery to the analyst. The soil samples will be collected and containerized as described in the following paragraphs.

Subsurface soil samples from soil borings - The auger will encase an 18-inch long, stainless-steel split barrel sampler which will, in turn, encase three 6-inch California brass rings. Each boring will be advanced using hollow-stem augers. The sampling device will be placed on a sheet of aluminum foil upon retrieval from the auger. Each end of the sampling device will be opened by unscrewing the end caps. Samples from certain borings are to be collected at depths which exhibit the highest organic vapor readings. A portable organic vapor analyzer will be used to screen the individual boring samples. The sampling device will be opened and the end of each brass ring screened. After the boring samples have been screened for organic vapor, the brass rings will be sealed with a Teflon® patch and plastic cap, thus encasing the sample in the brass ring. The middle 6-inch brass ring sample will be sent to the laboratory for volatile organic compound analysis. Soil from the remaining two brass rings will be removed and placed into a stainless-steel mixing bowl. The sample will be thoroughly mixed with a stainless-steel spoon and placed into the appropriate pre-cleaned jars (see Section 2.2.2.1). All sampling equipment will be decontaminated as presented in Section 2.1.9.

2.2.1.3 Surface Water Sampling - Surface water samples will be collected with stainless-steel beakers in "high-flow" areas. Each beaker will be cleaned using the method described in Section 2.1.9 before sample collection. Collect samples from the downstream to the upstream locations. Slowly submerge the beaker into the water. When the beaker is full, slowly pour the contents down the side and

into the sample bottles. Completely fill volatile vials first, leaving no headspace. Fill sample containers for the remaining analyses. Surface water samples should be collected from downstream to upstream and should be collected before sediment samples collected at the same location.

2.2.1.4 Sediment Sampling - Sediment samples will be collected with stainless-steel hand augers. The sample will be obtained by driving the hand auger through the water and into the sediments. Rotate the auger as necessary to reach a sample depth of 6 inches, avoiding excess disturbance of surface sediment particles. Retrieve the auger by lifting upward and empty the contents of the auger bucket into a stainless-steel mixing bowl. Completely fill sample containers to be submitted for analysis with volatile parameters first, leaving no headspace. Once the volatile organic samples have been collected, mix the remaining sediment thoroughly and fill sample containers for the remaining analyses. Sediment samples should be collected from downstream to upstream and should be collected after surface water samples collected at the same location.

#### 2.2.2 Sample Handling

The following sections describe the proper way to containerize, label, identify, ship, and preserve samples.

2.2.2.1 Sample Containers, Amounts and Preservation - Samples will be placed in appropriate containers as required by AFCEE (AFCEE, 1991). The amounts to be collected and preservation procedures to be followed specified by AFCEE (AFCEE, 1991) will be followed. These requirements are specified in Tables 2-3 (soil, sediment) and 2-4 (ground water, surface water).

2.2.2.2 Sample Labels - Field sampling personnel must properly identify all samples taken in the field with an adhesive sample label attached to the sample container. The sample label must contain the site name, field identification number; the date, time, and location of sample collection; designation of the sample as a grab or composite; notation of the type of sample (e.g., ground-water, soil boring, etc.); identification of preservatives used; any remarks; and the initials of the sampler. The sample labels will be placed on the bottles so as not to obscure any QA/QC data, and sample information will be legibly printed with waterproof ink. Field identification must be sufficient to allow easy cross-reference with the site logbook. Clear tape will be placed over the label to prevent removal or damage.

2.2.2.3 Sample Identification - The following section describes how each sample will be identified and what this identification signifies. Note that all sample IDs shall be no more than 10 characters long to facilitate input into the IRPIMS database.

For field samples, the following sample ID scheme shall be followed:

<u>N</u>	<u>N</u>	<u>N</u>	<u>C</u>	<u>C</u>	<u>#</u>	<u>#</u>	<u>-</u>	<u>?</u>	<u>?</u>
1	2	3	4	5	6	7	8	9	10

The "NNN" portion of the sample ID shall consist of the unique IRPIMS site code for the site. The "CC" portion of the sample ID shall consist of a two character location code, as follows:

- MW - Monitoring well
- SW - Surface water
- SB - Soil boring in which no monitoring well was installed
- SD - Sediment
- SS - Surface soil
- DC - Drill cuttings

The "##" portion of the sample ID shall consist of a number that is unique for each site and matrix, starting with "01". Characters 9 and 10 are optional for water samples and shall signify the upper depth of sample collection for soil and sediment samples. If characters 9 and/or 10 of the sample ID are used, character 8 shall be a dash. If characters 9 and 10 are not used, character 8 shall also not be used. Note that field duplicate samples will be given a false sample ID and date and time of sampling to hide their true identity from the laboratory.

For field QC samples, the following sample ID scheme shall be followed:

C	C	#	-	D	D	M	M	Y	Y
1	2	3	4	5	6	7	8	9	10

The "CC" portion of the sample ID shall consist of the appropriate two letter IRPIMS code for the type of QC sample, as follows:

- AB - Ambient conditions blank
- EB - Equipment blank
- TB - Trip blank

Character 3 shall be a unique number for that QC sample type and for the day of collection, starting with "1". Character 4 shall be a dash. Characters 5 through 10 shall indicate the date of collection, where "DD" is the day, "MM" is the month (01=January, etc.), and "YY" is the last two digits of the year.

2.2.2.4 Handling and Shipping - The properly labeled and sealed sample containers will be placed in plastic "Ziploc" type bags and sealed. Bagged sample containers will be placed in the bottom of the cooler. Bagged sample containers will be arranged in the cooler so that they do not touch, and will be packed in double-

bagged ice and additional packing material to prevent breakage. Samples should be packed so as to maintain a temperature of 4°C during shipment.

Analytical Request forms, as shown on Figure 2-9, and chain-of-custody documents (see Section 2.2.3) will be sealed in air-tight plastic bags and taped to the inside of the cooler lid. The lid of the container will be taped shut and sealed with custody seals (see Section 2.2.3). Samples will be shipped directly to the laboratory by overnight courier on the day they are collected, if at all possible. The laboratory will be notified by phone of the sample shipment schedule. No samples will be held more than 24 hours on site, unless special arrangements are made with the laboratory.

### 2.2.3 Sample Custody

Documentation of sample custody from the time of collection will be maintained. Custody within the laboratory is described in Appendix B. Custody in the field is described in the following paragraphs.

Chain-of-Custody records will be prepared for each shipping container. The custody record will be fully completed, in triplicate, by the field technician designated as responsible for sample shipment to the laboratory. The information specified on the chain-of-custody record will contain the same level of detail found in the site logbook, with the exception that on-site measurement data will not be recorded. The custody record will include the following information: name of person(s) collecting the samples, date samples were collected, the sample identification code (ID), type of sampling conducted (composite/grab), and number and type of containers used. Figure 2-10 presents an example of a Chain-of-Custody record.

Transfer of sample custody shall be indicated by the signatures of the sampler(s) and the person receiving the samples on the chain-

of-custody record, with date and time noted. Prior to sealing the shipping container, the original and first copy of the chain-of-custody record shall be placed in a plastic bag that will be attached to the inside of the shipping container lid. The second copy remains with the sampler(s). If a courier service is to be used, the signature of the receiving person will be replaced by the shipper's airbill number. Receipt at the laboratory shall be indicated by signature of the laboratory's Sample Custodian, with the date and time recorded.

To allow a means of determining whether sample integrity was maintained, custody seals will be placed on the shipping containers. Custody seals will be pre-printed, adhesive-backed seals with security slots designed to break if disturbed. Sample shipping containers (coolers, cardboard boxes, etc., as appropriate) will be sealed in as many places as necessary to ensure security. Seals will be signed and dated before use. Upon receipt by the laboratory, the Sample Custodian will check and document whether the custody seals are intact.

#### 2.2.4 QC Samples

Quality control (QC) samples are collected and analyzed for the purpose of assessing the quality of the sampling effort and the analytical data. QC samples include duplicates and replicates of field samples, equipment blanks, trip blanks, and ambient condition blanks. The type, description, preparation and collection of field QC samples are discussed in the following section.

- QC Samples - Samples initiated and analyzed to identify and diagnose problems related to sampling analysis.
- Replicate - A single sample divided into two equal parts for analysis in order to provide precision data. Replicates are applicable to soil and sediment samples.

- Duplicate - Two samples collected independently at a sampling location during a single act of sampling in order to provide precision data. Duplicates are applicable to water samples.
- Equipment Blank - Samples consisting of reagent water collected from a final rinse of sampling equipment after the decontamination procedure has been performed. The purpose of rinsate blanks is to determine whether the sampling equipment is causing cross contamination of samples.
- Trip Blank - Containers of Type II reagent grade water that are kept with the field sample containers from the time they leave the laboratory until the time they are returned to the laboratory. The purpose of the trip blank is to determine whether samples are being contaminated during transit to and from the laboratory. Trip blanks pertain only to volatile organic analyses; therefore, the containers must contain no headspace. Only one trip blank is required per sampling day and shall satisfy trip blank requirements for all water matrices for that day if the volatile samples are shipped in the same cooler. However, if more than one cooler contains volatile samples, then a trip blank will be placed in each cooler containing volatile samples.
- Ambient Conditions Blank - Samples consisting of Type II reagent grade water that are prepared at the site. Ambient condition blanks are used to measure the influence of ambient volatile conditions at a particular set of sampling locations. Ambient condition blanks will not necessarily be collected every time volatile samples are collected. They will be collected when samples are collected downwind of possible volatile sources such as active runways or an adjacent highway.

### 2.2.5 Sample Analysis Summary

Tables summarizing the environmental samples and the proposed QC samples to be analyzed by parameter by site are as follows:

<u>Matrix</u>	<u>Table No.</u>
Subsurface Soil from borings	2-5
Ground Water - Monitoring Wells	2-6
Ground Water - Hydropunch Survey	2-7
Surface Water	2-8
Sediments	2-9

## 2.3 FIELD MEASUREMENTS

### 2.3.1 Parameters for Field Characterization of Samples

Certain measurements must be performed as soon as possible after sampling in order to get accurate results. These parameters include pH, temperature and specific conductivity. These parameters will be measured in the field when the samples are obtained during sampling. Other field parameters include safety measurements of air vapors and turbidity during well development.

### 2.3.2 Equipment Calibration

All equipment will be calibrated according to manufacturers instructions or a generally accepted practice. Calibration of all instruments will be recorded in the field book. The following subsections describe calibration procedures. Additional detail is provided in Appendix A.

- Measurement of pH will be done on site with a pH meter. The instrument will be field-calibrated with two buffer solutions at the beginning of each day's use. Accuracy of the measurement is maintained by selecting a standard buffer with a pH as close as possible to that of the sample (preferably within three pH units). The pH of the buffers used will be dependent upon the pH of the sample, but in each case will "bracket" the range of measurement. The stability of the calibration will be verified through the analysis of one standard periodically throughout the day as deemed necessary by the Site Manager, but at least once every five hours.
- Temperature and specific conductivity will be measured with a portable meter. Calibration of the instrument is periodically performed at the factory as part of Law's internal QA program. The instrument probe will be rinsed with reagent water between each use and the calibration of the specific conductivity probe checked at the beginning and end of each day's use, using reagent grade water and a potassium chloride (KCl) solution with known conductance.
- The hand held portable organic vapor analyzer with a photoionization detector (PID) used to screen the air vapors at the head of the augers and in the breathing zone will be calibrated daily with a 100 ppm level of isobutylene.
- Turbidity will be measured with a nephelometer (also known as a turbidimeter). The instrument will be calibrated with three standards of concentrations at 0.1, 0.2, and 0.5 NTUs at the beginning of each day's use. The stability of the calibration will be verified through the analysis of one standard periodically throughout the day as deemed necessary by the Site Manager, but at least once every five hours.

### 2.3.3 Equipment Maintenance

Equipment used in the field is located in a central store room. The equipment must be "signed in" upon return and "signed out" when removed for use in the field. All equipment must be returned decontaminated and any malfunctions reported to the project manager. The project manager will incorporate any actions necessary for the repair or replacement of the equipment. Equipment maintenance logs are kept on file. Battery powered instruments will have their power supplies checked daily. Rechargeable instruments will be recharged daily.

### 2.3.4 Decontamination of Field Instruments

Decontamination of field instruments will depend upon the instrument. The probes for the pH, temperature and specific conductivity meters will be rinsed with reagent grade water before and after each use and at the end of each day. The measurement vial for the turbidity meter will be rinsed out with deionized water before and after each use. No decontamination is required for the organic vapor analyzer.

## 2.4 FIELD QA/QC PROGRAM

### 2.4.1 Control Parameters

Control parameters of the field procedures consist of the same controls that govern analytical data. Control parameters consist of the following:

- Collection of field and QC samples
- Calibration of field equipment
- Decontamination of field equipment

- Development of wells
- Purging a minimum of 3 well volumes before sampling
- Record keeping

#### 2.4.2 Control Limits and Corrective Actions

Appendix A presents a summary of field quality control procedures and acceptance criteria for field measurements. Corrective action requirements are presented in Table 2-10.

#### 2.5 RECORD KEEPING

Pertinent information concerning all aspects of sampling and field measurements will be recorded in hard-bound field notebooks, and all chain-of-custody documents completed in order to completely reconstruct the activities. The bound field notebook will have pre-numbered pages, and entries will be made in indelible ink. Environmental conditions will also be characterized. Each sampling site will be characterized by the following criteria.

1. Location of work
2. Weather
3. Rainfall
4. Temperature - minimum and maximum
5. Wind direction
6. Ongoing activities that may influence or disrupt sampling efforts
7. Accessibility to the sampling locations, e.g., rough terrain, fallen trees, flooding, etc.

Each day the site manager will prepare a Daily Quality Control Report (DQCR) and send it to the AFCEE TPM. The DQCR will include weather information at the time of sampling, samples collected, field instruments and calibrations and will reflect any problems that occurred in the field. A DQCR is shown in Figure 2-11.

## 2.6 SITE MANAGEMENT

The AFCEE Team Chief (TC) for the Carswell AFB RI/FS is Mr. Chris Hobbins. Mr. Hobbins' address and phone number are:

AFCEE/ESB  
Bldg. 624W  
Brooks AFB, TX 78235-5000  
(210) 536-5261

The Carswell AFB Point of Contact (POC) in the IRP Civil Engineering Squadron (CES) is Captain Erin Manning. Her address and phone number are:

7 SPGT/DEV  
Bldg. 1215  
Carswell AFB, TX 76127-5000  
(817) 782-6250

Carswell AFB personnel (Civil Engineering) will assist in base cooperation for the following:

- Personnel identification and vehicle passes
- Utility clearances and permits
- Temporary field office
- A water supply for large quantities of potable water to be used in equipment cleaning, etc.
- Rights of easement and access to all Air Force and private property to perform all required field investigations.

All field personnel will adhere to the procedures as described in the work plans. The site manager will supervise all field

activities and constantly update Mr. Hobbins and Law's Project Manager, John O'Brien of the daily activities. Any major problems that occur during field activities will be brought to the attention of the TC for his input into the resolution of the problem. Emergency contacts for medical assistance are discussed in the Health and Safety Plan.

## REFERENCES

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- USEPA, 1986. Test Methods for Evaluating Solid Waste, Third Edition, SW-846, Solid Waste and Emergency Response, Washington, D.C., November 1986

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PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Specific Conductance 120.1 (field analysis) (EPA-600/4-79-020)	<u>INSTRUMENT QC:</u>			
	Calibration	Prior to trip	± 25 umhos/cm	1. Check system as per manufacturer's instructions. 2. Check standard. 3. Replace instrument.
	Calibration Stability	At beginning and end of day	± 25 umhos/cm	1. Check standard. 2. Check system as per manufacturer's instructions. 3. Replace instrument.
<u>SAMPLE QC:</u>				
	Duplicate	1 per day	± 50 units	1. Analyze 3rd aliquot of sample. 2. Flag Data.
	Rinsate	1 per day	≤ detection limit	Flag Data.

149037

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
"EPA-600/4-79-020" = Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA, March 1979, Revised March 1983  
"MHETL" = Maine Health and Environmental Testing Laboratory

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PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
pH 150.1 (field analysis) (EPA-600/4-79-020)	<u>INSTRUMENT QC:</u> Calibration	1 per day at two levels	± 0.1 units	1. Check system as per manufacturer's instructions. 2. Check standard. 3. Replace instrument.
	Calibration Stability	1 per hour at two levels	± 0.2 units	1. Check standard. 2. Check system. 3. Recalibrate.
	<u>SAMPLE QC:</u> Duplicate	1 per day	± 0.5 units	1. Analyze 3rd aliquot of sample. 2. Flag data.
	Rinsate	1 per day	≤ detection limit	Flag data.

140000

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
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PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Temperature 170.1 (field analysis) (EPA-600/4-79-020)	<u>INSTRUMENT QC:</u> Calibration	Prior to trip	± 2 °C	1. Check against precision thermometer certified by NIST. 2. Replace instrument.
	<u>SAMPLE QC:</u> Duplicate	1 per day	± 2 °C	1. Analyze 3rd aliquot of sample. 2. Flag data.

149009

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
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PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<u>Metals by GFAA and CVAA</u>	<u>FIELD QC:</u>			
Arsenic (GFAA: 7060)	Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
Lead (GFAA: 7421)				
Selenium (GFAA: 7740)				
Mercury (CVAA: 7470/7471) (SW-86)	Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>			
ICV/CCV		ICV - prior to analysis CCV - after every 10 samples and end of analytical batch	5 pt. calibration; Measured value within 10% of true value (20% for Hg)	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
ICB/CCB		ICB - after initial calibration verification CCB - after every 10 samples and end of analytical batch	Absolute value < MDL	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
Prep Blank		1 per batch of samples, minimum of 1 per 20 samples	Absolute value < MDL	Redigest and reanalyze all samples less than 10X the MDL.
MS/MSD		1 per batch of samples, minimum of 1 per 20 samples	See Appendix B	Perform post digest spike and qualify all associated data.

149000

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
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PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<b>Metals by ICP 6010 (SW-846)</b>				
	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
	Rinseate (c)	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Qualify data.
	<u>LABORATORY QC:</u>			
	Initial (ICV) and Continuing (CCV) Calibration Verification	ICV - prior to sample analysis CCV - after every 10 samples and end of analytical batch	4 pt. calibration; Measured value within 10% of true value	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
	Initial (ICB) and Continuing (CCB) Calibration Blank	ICB - after initial calibration verification CCB - after every 10 samples and end of analytical batch	Absolute value $\leq$ Method Detection Limit (MDL)	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
	Prep Blank	1 per batch of samples, minimum 1 per 20 samples	Absolute value $\leq$ Method Detection Limit (MDL)	Redigest and reanalyze all samples greater than the MDL but less than 10x the blank concentration.
	MS/MSD	1 per batch of samples, minimum 1 per 20 samples	See Appendix B	Perform a post-digestion spike and qualify data appropriately.
	Laboratory Control Sample (LCS)	1 per batch of samples, minimum 1 per 20 samples	80 - 120% recovery: waters 75 - 125% recovery: soil/seed.	Rerun. If still out of control, solve problem and reanalyze batch.
	Interference Check	Beginning and end of run or per 8 hour shift	80-120% recovery	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good ICS.

149001

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
"EPA-600/4-79-020" = Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA, March 1979, Revised March 1983  
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PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<b>Volatile Organic Compounds</b> by GC/MS 8240 (SW-846)	<u>FIELD QC:</u> Trip Blank	1 for each batch of samples shipped to laboratory	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
	Ambient Blank	Collected when samples are collected downwind of possible volatile sources.	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
	Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
	Rinse (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>			
	Sensitivity Check with BFB	Every 12 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
	Mass Calibration	Every 12 hours of operation	See Method SW846	Tune instrument; repeat.
	Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration; SPCs exceed 0.300; CCCs response factor deviates < 30% from average	Recalibrate instrument.
	Continuing Calibration	Every 12 hours of operation	SPCCs exceed 0.300 with the exception of bromoform which must exceed 0.250; CCCs response factor deviates < 25% from average of initial calibration	Rerun continuing calibration. If still out of control, recalibrate instrument.
	Method Blank	1 for every 20 samples, or every day	Less than reported detection limit	Qualify results < 10 times that found in the blank.
	Surrogate Recovery	Every sample	See Appendix B	Reanalyze sample; flag data.
	MS/MSD	1 for every 20 samples	See Appendix B	Reanalyze samples. If still out of control, qualify the data.

1490032

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
"EPA-600/4-79-020" = Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA, March 1979, Revised March 1983  
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PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Volatile Organic Compounds by GC 8020 (SW-846)	FIELD QC: Trip Blank	1 for each batch of samples shipped to laboratory	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
	Ambient Blank	Collected when samples are collected downwind of possible volatile sources.	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
	Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
	Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
<b>LABORATORY QC:</b>				
	Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration: RSD ≤ 20% of RFs or correlation coefficient ≥ 0.995 (use avg. RF is RFD ≤ 20%, otherwise use calibration curve)	Recalibrate instrument.
	Continuing Calibration	Every 12 hours of operation	Measured value within 15% of true value	Rerun continuing calibration. If still out of control, recalibrate instrument.
	Method Blank	1 for every 20 samples, or every day	Less than reporting detection limit	Qualify results < 10 times that found in the blank.
	Surrogate Recovery	Every sample	See Appendix B	Reanalyze sample; flag data.
	MS/MSD	1 for every 20 samples	See Appendix B	Reanalyze samples. If still out of control, qualify the data.

140033

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
"EPA-600/4-79-020" = Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA, March 1979, Revised March 1983  
"MHETL" = Maine Health and Environmental Testing Laboratory

**SUMMARY OF QUALITY CONTROL REQUIREMENTS AND ACCEPTANCE CRITERIA**  
**Remedial Investigation/Feasibility Study**  
**Carswell Air Force Base, Texas**

PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Extractable Organic Compounds by GC/MS 8270 (SW-846)	<u>FIELD QC:</u>			
	Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
	Rinsate (c)	1 for every 10 field samples collected	Less than reporting limit	Qualify data.
	<u>LABORATORY QC:</u>			
	Sensitivity Check with DFTPP	Every 12 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
	Mass Calibration	Every 12 hours of operation	See Method SW846	Tune instrument; repeat.
	Initial Calibration	Before analysis and when continuing calibration fails criteria	5 pt. calibration; SPCCs exceed 0.050; CCCs response factor deviates < 30% from average	Recalibrate instrument.
	Continuing Calibration	Every 12 hours of operation	SPCCs exceed 0.050; CCCs response factor deviates < 25% from average of initial calibration	Rerun continuing calibration; if still out of control, recalibrate instrument.
	Method Blank	1 for every 20 samples	Less than reporting detect limit	Reanalyze blank, then re-extract, qualify all results < 10 times that found in blank (for blanks contaminated with common laboratory chemicals) and qualify all results < 5 times that found in blank (for blanks contaminated with compounds not commonly found in the laboratory).
	Surrogate Recovery	Every sample	See Appendix B	Rerun sample. If still out of control, re-extract, reanalyze, qualify data.
	MS/MSD	1 for every 20 samples	See Appendix B	Rerun sample. If still out of control, qualify data.

149004

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
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**SUMMARY OF QUALITY CONTROL REQUIREMENTS AND ACCEPTANCE CRITERIA**  
**Remedial Investigation/Feasibility Study**  
**Carswell Air Force Base, Texas**

PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<b>SW846 8015M</b> Total Petroleum Hydrocarbons (TPH)	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	Water samples - RPD < 20% Soil samples - RPD < 30%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
	Rinseate	1 for every 10 field samples collected	Less than reporting detection limits	Qualify data.
	Trip Blank (applies to volatile fraction only)	1 for each batch of samples shipped to laboratory	Less than reported detection limit	Qualify data.
	<u>LABORATORY QC:</u> Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration %RSD must be < 20% for all analytes	Recalibrate instrument.
	Continuing Calibration	Daily	Response factor must be < 15% from average of initial calibration	Rerun continuing calibration; if still out of control, recalibrate instrument.
	Method Blank	Daily	Compounds must be below respective detection limits	Step 1: Reanalyze Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
	MS/MSD	1 per every 20 samples	See Table 1-32 for current control limits	Rerun samples. If still out of control, qualify data.
	LCS	1 per every 20 samples	Aqueous MS/MSD criterion apply	Rerun. If still out of control, solve problem and reanalyze batch.

149095

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
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**SUMMARY OF QUALITY CONTROL REQUIREMENTS AND ACCEPTANCE CRITERIA**  
**Remedial Investigation/Feasibility Study**  
**Carswell Air Force Base, Texas**

PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<b>SW 1311</b>				
<b>TCLP</b>				
	<u>FIELD QC:</u>			
	Duplicate	1 for every 10 field samples collected	% RPD must be ≤ 40%	Review label QC data to determine if they are in control. If not, qualify data. Use data to evaluate proper collection procedures were followed. If not, determine further corrective action.
	Rinsates	1 for every 10 field samples collected	Less than reported method detection limits	Qualify data.
	<u>LABORATORY QC:</u>			
	Blank	1 per batch of samples, minimum 1 per 20 samples	Value must be less than reported detection limit	Reanalyze all samples greater than MDL but less than 10x blank concentration.
	MS/MSD	1 per matrix type, minimum 1 per 20 samples	See Table 1-32 for current control limits	Retrun. If still out of control, reanalyze. Qualify data.

140096

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
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**SUMMARY OF QUALITY CONTROL REQUIREMENTS AND ACCEPTANCE CRITERIA**  
**Remedial Investigation/Feasibility Study**  
**Carswell Air Force Base, Texas**

PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<b>SW 9071/EPA 418.1</b> Petroleum Hydrocarbons	<u>FIELD QC:</u>			
	Equipment Blank	1 for every 10 field samples	Less than reporting detection limit	Review lab QC data to determine if there is a laboratory problem. If not, review field decontamination procedures to either validate or invalidate data. If invalid, determine further corrective action.
	Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
	<u>LABORATORY QC</u>			
	Calibration Curve	Each batch	0.995 correlation with a 3 point calibration	Rerun calibration standards.
	Method Blank	1 for every 20 samples or extraction batch	Less than reporting detection limit	Document and report to client.
	Spiked Sample	1 for every 20 samples	Within current control limits	Rerun spike, if still out of control, reanalyze spike.
	Duplicate Spike	1 for every 20 samples	Above 10x detection limit; see Table 13-1 for %RSD	Reprep duplicates and reanalyze.

149037

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
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**SUMMARY OF QUALITY CONTROL REQUIREMENTS AND ACCEPTANCE CRITERIA**  
**Remedial Investigation/Feasibility Study**  
**Carswell Air Force Base, Texas**

PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<b>SW846 8010</b> Halogenated Volatile Organics	<u>FIELD QC:</u>			
	Trip Blank	1 for each batch of samples shipped to laboratory	No more than 4 target compounds each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
	Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 30%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
	Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>			
	Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration; % RSD must be < 20% for all analytes	Recalibrate instrument.
	Continuing Calibration	Daily	Response factors must be < 15% from average of initial calibration	Rerun continuing calibration. If still out of control, recalibrate instrument.
	Method Blank	Daily	Compounds must be below respective detection limits	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
	Surrogate Spike	All blanks, standards, QC samples, field samples	See Appendix D for current control limits	Step 1: Reanalyze. Step 2: If recovery still outside control limits, qualify the data.
	MS/MSD	1 per every 20 samples	See Appendix D for current control limits	Rerun samples. If still out of control, qualify data.

1490008

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
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**SUMMARY OF QUALITY CONTROL REQUIREMENTS AND ACCEPTANCE CRITERIA**  
**Remedial Investigation/Feasibility Study**  
**Carswell Air Force Base, Texas**

PARAMETER/ METHOD (a)	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<b>SW9070</b> Oil and Grease	<u>FIELD QC:</u>			
	Duplicate	1 for every 10 field samples collected	% RPD $\leq$ 35%	Review lab QC data to determine if they are in control. If not, qualify data. Use data to evaluate proper collection procedures were followed. If not, determine further corrective action.
	Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>			
	Calibration of the instrument	According to the instrument service manual	All measures must be accurate.	Check balance maintenance, qualify data.
	Method Blank	1 per batch of 20 samples	Less than reported detection limits	Reanalyze all samples greater than MDL but less than 10 x blank concentration.
	Duplicates	1 per batch of 20 samples	RPD $\leq$ 20%	Qualify data.

140033

(a) References: "SW-846" = Test Methods for Evaluating Solid Waste, SW-846, USEPA, November 1986  
"EPA-600/4-79-020" = Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA, March 1979, Revised March 1983  
"MHETL" = Maine Health and Environmental Testing Laboratory

PROJECT REQUIRED REPORTING LIMITS - SOIL/SEDIMENT  
LAW ENVIRONMENTAL, INC. - NATIONAL LABORATORIES - PENSACOLA (LENL-P)  
March 1993

ANALYTICAL METHOD	COMPOUND	UNITS	REPORTING LIMIT		SPIKE CONCENTRATION	CONTROL LIMITS	
			MDL	MQL		RECOVERY %	RELATIVE % DIFFERENCE
8010 (SW846)	Aluminum	mg/kg		50	*	75 - 125 **	20
	Antimony	mg/kg		15	50	78 - 117	18
	Arsenic	mg/kg		30	200	75 - 123	19
	Barium	mg/kg		10	200	85 - 121	20
	Beryllium	mg/kg		1	5	80 - 116	20
	Cadmium	mg/kg		0.5	5	87 - 123	20
	Calcium	mg/kg		100	*	75 - 125 **	20
	Chromium	mg/kg		5	20	82 - 124	18
	Cobalt	mg/kg		5	50	88 - 124	17
	Copper	mg/kg		5	25	89 - 125	20
	Iron	mg/kg		5	*	75 - 125 **	20
	Lead	mg/kg		5	50	86 - 125	18
	Magnesium	mg/kg		100	*	75 - 125 **	20
	Manganese	mg/kg		2	50	88 - 124	20
	Molybdenum	mg/kg		10	50	75 - 125 **	20
	Nickel	mg/kg		15	50	85 - 125	19
	Potassium	mg/kg		100	*	75 - 125 **	20
	Selenium	mg/kg		50	200	78 - 124	20
	Silver	mg/kg		5	5	80 - 125	18
	Sodium	mg/kg		100	*	75 - 125 **	20
Thallium	mg/kg		7	200	78 - 121	20	
Vanadium	mg/kg		10	50	81 - 123	19	
Zinc	mg/kg		2	50	80 - 122	20	
8240 (SW846)	Acetone	mg/kg		0.01	0.05	D - 208	40
	Benzene	mg/kg		0.001	0.05	32 - 171	40
	Bromodichloromethane	mg/kg		0.001	0.05	18 - 198	40
	Bromoforn	mg/kg		0.005	0.05	30 - 186	40
	Bromomethane	mg/kg		0.001	0.05	9 - 213	40
	2-Butanone (MEK)	mg/kg		0.01	0.05	D - 213	40
	Carbon disulfide	mg/kg		0.005	0.05	D - 222	40
	Carbon tetrachloride	mg/kg		0.005	0.05	34 - 181	40
	Chlorobenzene	mg/kg		0.005	0.05	20 - 186	40
	Chloroethane	mg/kg		0.005	0.05	19 - 208	40
	2-Chloroethyl vinyl ether	mg/kg		0.01	0.05	D - 278	40
	Chloroform	mg/kg		0.005	0.05	27 - 152	40
	Chloromethane	mg/kg		0.001	0.05	18 - 201	40
	Dibromochloromethane	mg/kg		0.005	0.05	30 - 179	40
	1,1-Dichloroethane	mg/kg		0.005	0.05	37 - 182	40
	1,2-Dichloroethane	mg/kg		0.005	0.05	25 - 192	40
	1,1-Dichloroethene	mg/kg		0.005	0.05	7 - 229	40
	trans-1,2-Dichloroethene	mg/kg		0.005	0.05	51 - 143	40
	1,2-Dichloropropene	mg/kg		0.001	0.05	2 - 225	40
	cis-1,3-Dichloropropene	mg/kg		0.001	0.05	8 - 233	40
	trans-1,3-Dichloropropene	mg/kg		0.005	0.05	1 - 206	40
	Ethylbenzene	mg/kg		0.005	0.05	24 - 192	40
	2-Hexanone	mg/kg		0.005	0.05	D - 229	40
	Methylene chloride	mg/kg		0.005	0.05	D - 192	40
	4-Methyl-2-pentanone (MIBK)	mg/kg		0.01	0.05	D - 226	40
	Styrene	mg/kg		0.005	0.05	6 - 196	40
	1,1,2,2-Tetrachloroethane	mg/kg		0.005	0.05	24 - 179	40
	Tetrachloroethene	mg/kg		0.005	0.05	38 - 175	40
	Toluene	mg/kg		0.005	0.05	18 - 177	40
	1,1,1-Trichloroethane	mg/kg		0.005	0.05	31 - 174	40
1,1,2-Trichloroethane	mg/kg		0.005	0.05	29 - 171	40	
Trichloroethene	mg/kg		0.005	0.05	37 - 171	40	
Vinyl acetate	mg/kg		0.01	0.05	5 - 239	40	
Vinyl chloride	mg/kg		0.002	0.05	6 - 215	40	
Xylenes (total)	mg/kg		0.005	0.05	7 - 211	40	
1,2-Dichloroethane-d4 (surrogate)	mg/kg		NA	0.05	72 - 117	NA	
Toluene-d8 (surrogate)	mg/kg		NA	0.05	87 - 116	NA	
4-Bromofluorobenzene (surrogate)	mg/kg		NA	0.05	75 - 107	NA	
8020 (SW846)	Benzene	mg/kg		0.0005		23 - 171	40
	Toluene	mg/kg		0.0005		61 - 142	40
	Ethylbenzene	mg/kg		0.0005		15 - 178	40
	Xylenes	mg/kg		0.001		50 - 156	40
	Fluorobenzene (surrogate)	mg/kg		NA		NE	NA
4-Chlorotoluene (surrogate)	mg/kg		NA		NE	NA	

**REPORTING LIMITS AND QUALITY CONTROL LIMITS - WATER**  
**LAW ENVIRONMENTAL, INC. - NATIONAL LABORATORIES - PENSACOLA (LENL-P)**  
 March 1993

ANALYTICAL METHOD	COMPOUND	UNITS	REPORTING LIMIT		SPIKE CONCENTRATION	CONTROL LIMITS	
			MDL	MDL		RECOVERY %	RELATIVE % DIFFERENCE
6010 (SW846)	Aluminum	mg/L	0.5	0.5	2000	77-123	20
	Antimony	mg/L	0.1	0.5	500	78-121	15
	Arsenic	mg/L	0.1	0.3	2000	78-122	17
	Barium	mg/L	0.05	0.1	2000	75-124	20
	Beryllium	mg/L	0.001	0.01	50	78-124	18
	Cadmium	mg/L	0.005	0.005	50	80-122	18
	Calcium	mg/L	1	1	*	75-125**	20
	Chromium	mg/L	0.01	0.05	200	76-121	15
	Cobalt	mg/L	0.01	0.05	500	75-123	14
	Copper	mg/L	0.01	0.05	250	78-124	18
	Iron	mg/L	0.05	0.05	1000	81-121	20
	Lead	mg/L	0.05	0.2	500	77-122	17
	Magnesium	mg/L	0.5	1	*	75-125**	20
	Manganese	mg/L	0.005	0.02	500	78-125	17
	Molybdenum	mg/L	0.05	0.1	500	75-123	18
	Nickel	mg/L	0.05	0.15	500	75-123	18
	Potassium	mg/L	1	5	*	75-125**	20
	Selenium	mg/L	0.1	1	2000	76-124	17
	Silver	mg/L	0.05	0.05	50	75-123	17
	Sodium	mg/L	0.5	1	*	75-125**	20
	Thallium	mg/L	0.07	0.4	2000	75-123	17
Vanadium	mg/L	0.008	0.1	500	77-125	18	
Zinc	mg/L	0.008	0.02	500	78-125	18	
7060 (SW846)	Arsenic	mg/L	0.005	0.005	40	75-118	18
7421 (SW846)	Lead	mg/L	0.005	0.005	20	75-123	18
7740 (SW846)	Selenium	mg/L	0.005	0.005	10	79-125	18
7471 (SW846)	Mercury	mg/L	0.001	0.001	1	78-123	19
8270 (SW846) (acids)	Benzoic acid	µg/L	36	50	50	D-500	40
	4-Chloro-3-methylphenol	µg/L	0.8	10	50	25-144	40
	2-Chlorophenol	µg/L	1	10	50	23-128	40
	2,4-Dichlorophenol	µg/L	0.9	10	50	40-124	40
	2,4-Dimethylphenol	µg/L	1	10	50	38-126	40
	4,6-Dinitro-2-methylphenol	µg/L	0.6	50	50	D-166	40
	2,4-Dinitrophenol	µg/L	3.3	50	50	D-190	40
	2-Methylphenol	µg/L	0.8	10	50	22-147	40
	4-Methylphenol	µg/L	0.9	10	50	22-147	40
	2-Nitrophenol	µg/L	0.9	10	50	10-181	40
	4-Nitrophenol	µg/L	2	50	50	D-128	40
	Pentachlorophenol	µg/L	0.6	30	50	10-171	40
	Phenol	µg/L	0.8	10	50	11-83	40
	2,4,5-Trichlorophenol	µg/L	1	50	50	D-250	40
	2,4,6-Trichlorophenol	µg/L	0.7	10	50	41-142	40
	2-Fluorophenol (surrogate)	µg/L	NA	NA	100	25-99	NA
	Phenol-d6 (surrogate)	µg/L	NA	NA	100	17-93	NA
	2,4,6-Tribromophenol (surrogate)	µg/L	NA	NA	100	16-118	NA

**REPORTING LIMITS AND QUALITY CONTROL LIMITS - WATER**  
**LAW ENVIRONMENTAL, INC. - NATIONAL LABORATORIES - PENSACOLA (LENL-P)**  
 March 1993

ANALYTICAL METHOD	COMPOUND	UNITS	REPORTING LIMIT		SPIKE CONCENTRATION	CONTROL LIMITS	
			MDL	MDL		RECOVERY %	RELATIVE % DIFFERENCE
8270 (SW846) (base/neutral)	Acenaphthene	µg/L	0.4	10	50	56-135	40
	Acenaphthylene	µg/L	0.6	10	50	40-137	40
	Anthracene	µg/L	0.6	10	50	40-131	40
	Benzo(a)anthracene	µg/L	0.4	10	50	36-133	40
	Benzo(b)fluoranthene	µg/L	0.8	10	50	31-148	40
	Benzo(k)fluoranthene	µg/L	0.8	10	50	17-149	40
	Benzo(ghi)perylene	µg/L	0.6	10	50	8-187	40
	Benzo(a)pyrene	µg/L	0.3	10	50	18-148	40
	Benzyl alcohol	µg/L	1.7	10	50	D-250	40
	bis(2-Chloroethoxy)methane	µg/L	0.5	10	50	34-163	40
	bis(2-Chloroethyl)ether	µg/L	0.9	10	50	19-147	40
	bis(2-Chloroisopropyl)ether	µg/L	0.6	10	50	42-154	40
	bis(2-Ethylhexyl)phthalate	µg/L	1.3	10	50	15-149	40
	4-Bromophenyl phenyl ether	µg/L	0.6	10	50	55-116	40
	Butylbenzylphthalate	µg/L	0.5	10	50	52-124	40
	4-Chloroaniline	µg/L	4.8	10	50	D-250	40
	2-Chloronaphthalene	µg/L	0.4	10	50	63-112	40
	4-Chlorophenyl phenyl ether	µg/L	0.4	10	50	34-144	40
	Chrysene	µg/L	0.5	10	50	23-153	40
	Dibenzo(a,h)anthracene	µg/L	0.6	10	50	6-194	40
	Dibenzofuran	µg/L	0.4	10	50	D-250	40
	Di-n-butylphthalate	µg/L	1	10	50	16-116	40
	1,2-Dichlorobenzene	µg/L	0.7	10	50	34-125	40
	1,3-Dichlorobenzene	µg/L	0.6	10	50	5-160	40
	1,4-Dichlorobenzene	µg/L	0.7	10	50	21-112	40
	3,3'-Dichlorobenzidine	µg/L	2	20	50	14-213	40
	Diethylphthalate	µg/L	0.5	10	50	14-97	40
	Dimethylphthalate	µg/L	0.3	10	50	D-112	40
	2,4-Dinitrotoluene	µg/L	0.8	10	50	35-124	40
	2,6-Dinitrotoluene	µg/L	0.8	10	50	55-143	40
	Di-n-octylphthalate	µg/L	0.7	10	50	3-143	40
	Fluoranthene	µg/L	0.6	10	50	30-130	40
	Fluorene	µg/L	0.5	10	50	59-119	40
	Hexachlorobenzene	µg/L	0.5	10	50	6-144	40
	Hexachlorobutadiene	µg/L	0.7	10	50	24-111	40
	Hexachlorocyclopentadiene	µg/L	1.8	10	50	7-86	40
	Hexachloroethane	µg/L	0.9	10	50	41-100	40
	Indeno[1,2,3-cd]pyrene	µg/L	1.6	10	50	2-140	40
	Isophorone	µg/L	0.5	10	50	26-196	40
	2-Methylnaphthalene	µg/L	0.5	10	50	D-250	40
	Naphthalene	µg/L	0.5	10	50	32-123	40
	2-Nitroaniline	µg/L	0.7	50	50	D-250	40
	3-Nitroaniline	µg/L	1	50	50	D-500	40
	4-Nitroaniline	µg/L	4	50	50	D-500	40
	Nitrobenzene	µg/L	0.9	10	50	42-160	40
	n-Nitrosodiphenylamine	µg/L	1	10	50	13-143	40
	n-Nitrosodipropylamine	µg/L	1	10	50	9-171	40
Phenanthrene	µg/L	0.4	10	50	55-113	40	
Pyrene	µg/L	0.7	10	50	60-113	40	
1,2,4-Trichlorobenzene	µg/L	0.5	10	50	46-140	40	
Nitrobenzene-d5 (surrogate)	µg/L	NA	NA	50	39-104	NA	
2-Fluorobiphenyl (surrogate)	µg/L	NA	NA	50	46-110	NA	
Terphenyl-d14 (surrogate)	µg/L	NA	NA	50	38-137	NA	

REPORTING LIMITS AND QUALITY CONTROL LIMITS - WATER  
 LAW ENVIRONMENTAL, INC. - NATIONAL LABORATORIES - PENSACOLA (LENL-P)  
 March 1993

ANALYTICAL METHOD	COMPOUND	UNITS	REPORTING LIMIT		SPIKE CONCENTRATION	CONTROL LIMITS	
			MDL	MQL		RECOVERY	RELATIVE % DIFFERENCE
						%	%
8240 (SW846)	Acetone	µg/L	7.5	10	50	32-199	40
	Benzene	µg/L	0.4	5	50	46-147	40
	Bromodichloromethane	µg/L	0.3	5	50	49-150	40
	Bromoform	µg/L	0.2	5	50	66-163	40
	Bromomethane	µg/L	0.7	10	50	28-156	40
	2-Butanone (MEK)	µg/L	2.8	10	50	29-156	40
	Carbon disulfide	µg/L	0.7	5	50	21-184	40
	Carbon tetrachloride	µg/L	0.4	5	50	78-132	40
	Chlorobenzene	µg/L	0.2	5	50	49-152	40
	Chloroethane	µg/L	0.3	10	50	35-177	40
	2-Chloroethyl vinyl ether	µg/L	8	10	50	9-244	40
	Chloroform	µg/L	0.3	5	50	56-126	40
	Chloromethane	µg/L	0.6	10	50	32-162	40
	Dibromochloromethane	µg/L	0.3	5	50	60-143	40
	1,1-Dichloroethane	µg/L	0.3	5	50	68-139	40
	1,2-Dichloroethane	µg/L	0.4	5	50	29-153	40
	1,1-Dichloroethene	µg/L	0.3	5	50	32-192	40
	trans-1,2-Dichloroethene	µg/L	0.4	5	50	81-119	40
	1,2-Dichloropropane	µg/L	0.6	5	50	12-192	40
	cis-1,3-Dichloropropene	µg/L	0.6	5	50	19-194	40
	trans-1,3-Dichloropropene	µg/L	0.2	5	50	19-177	40
	Ethylbenzene	µg/L	0.2	5	50	47-155	40
	2-Hexanone	µg/L	2.1	10	50	17-191	40
	Methylene chloride	µg/L	4.5	5	50	8-173	40
	4-Methyl-2-pentanone (MIBK)	µg/L	7	10	50	19-186	40
	Styrene	µg/L	0.5	5	50	27-148	40
	1,1,2,2-Tetrachloroethane	µg/L	0.7	5	50	49-140	40
	Tetrachloroethene	µg/L	0.2	5	50	71-142	40
	Toluene	µg/L	0.3	5	50	60-144	40
	1,1,1-Trichloroethane	µg/L	0.4	5	50	56-150	40
	1,1,2-Trichloroethane	µg/L	0.7	5	50	61-140	40
	Trichloroethene	µg/L	0.2	5	50	77-139	40
	Vinyl acetate	µg/L	0.7	10	50	26-200	40
	Vinyl chloride	µg/L	0.6	10	50	26-188	40
Xylenes (total)	µg/L	0.7	5	150	14-181	40	
1,2-Dichloroethane-d4 (surrogate)	µg/L	NA	NA	50	77-113	NA	
Toluene-d8 (surrogate)	µg/L	NA	NA	50	90-110	NA	
4-Bromofluorobenzene (surrogate)	µg/L	NA	NA	50	87-114	NA	
8020 (SW846)	Benzene	µg/L	0.5	1	NE	38-155	40
	Toluene	µg/L	0.5	2	NE	76-125	40
	Ethylbenzene	µg/L	0.5	4	NE	32-159	40
	Xylenes	µg/L	1	2	NE	67-138	40
	Fluorobenzene (surrogate)	µg/L	NA	NA	NE	NE	NA
	4-Chlorotoluene (surrogate)	µg/L	NA	NA	NE	NE	NA

## APPENDIX A

## QUALITY CONTROL REQUIREMENTS

## FOR

## CHEMICAL ANALYSIS

<u>Method</u>	<u>Parameter</u>
120.1	Specific conductance (field analysis)
150.1	pH (field analysis)
170.1	Temperature (field analysis)
+	Metals by GFAA/CVAA
6010	Metals by ICP
8240	Volatile Organic compounds by GC/MS
8020	Volatile Organic Compounds by GC
8270	Extractable Organics by GC/MS
8010	Purgeable Halocarbons
8015	Petroleum Hydrocarbons
9070	Oil and grease
418.1	Total Recoverable Petroleum Hydrocarbons
1311	Toxicity Characteristic Leaching Procedure

+

Methods 7060, 7421, 7740, 7470/7471

**APPENDIX B**

**QUALITY ASSURANCE PROGRAMS**

**FOR**

**CHEMICAL ANALYSIS LABORATORIES**

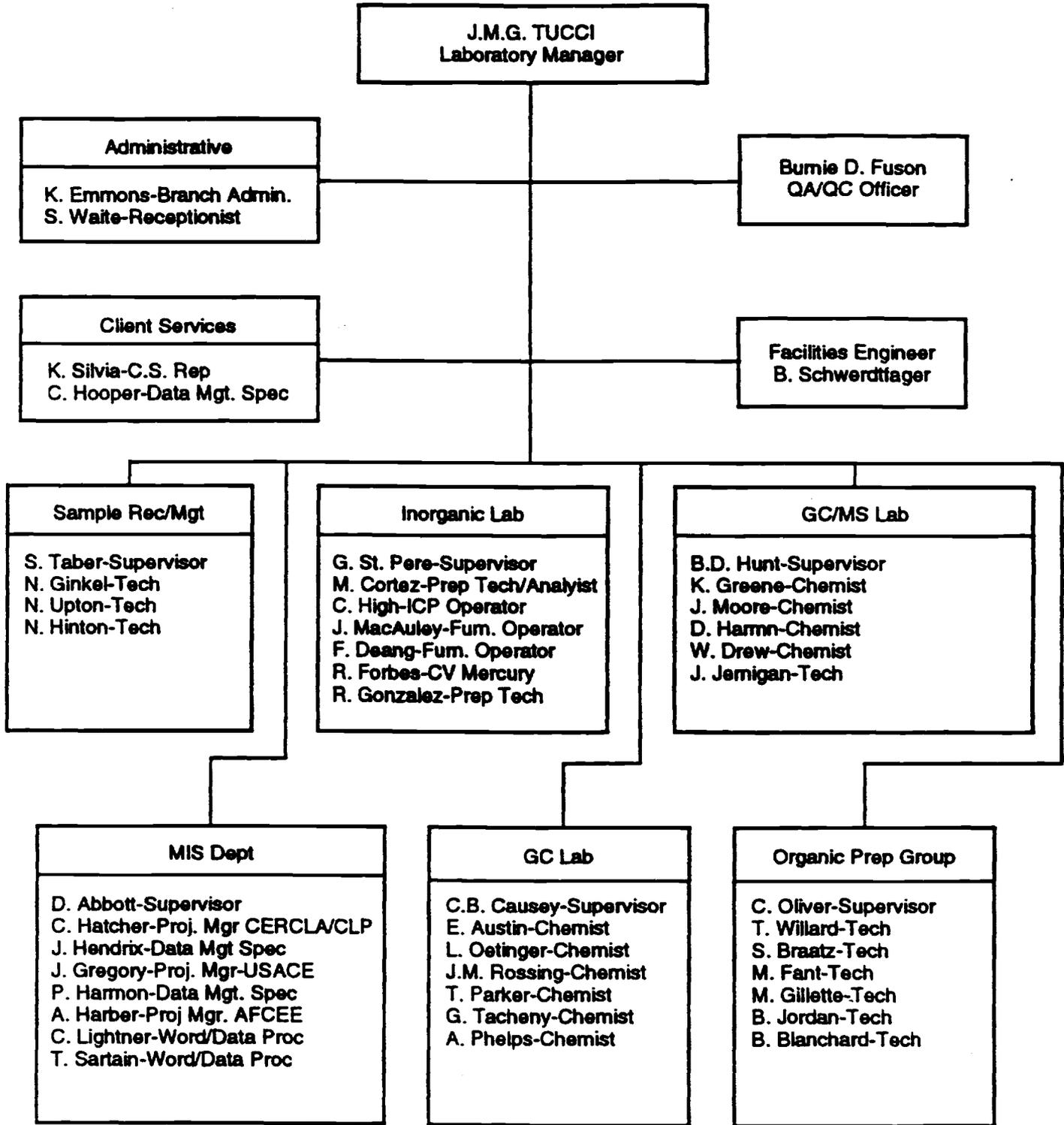
- B-1 Law Environmental, Inc. - National Laboratories Branch  
(LENL), Pensacola, Florida
  
- B-2 Transglobal Environmental Geochemistry, Texas

**APPENDIX B-1**

**QUALITY ASSURANCE PROGRAM**

**Law Environmental, Inc.  
National Laboratories Branch (LENL)  
Pensacola, Florida**

# LAW ENVIRONMENTAL, INC. NATIONAL LABORATORIES DIVISION PENSACOLA ORGANIZATION CHART



## LENL KEY PERSONNEL AND RESPONSIBILITIES

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<u>Position/Key Personnel</u>	<u>Responsibilities</u>
Laboratory Manager James M. G. Tucci	<ul style="list-style-type: none"><li>- Implement methodologies and procedures consistent with the generation of legally defensible data;</li><li>- Provide overall management and operation of the lab;</li><li>- Provide a safe working environment for employees;</li><li>- Provide resolutions to items requiring corrective actions;</li><li>- Provide training programs for employees;</li><li>- Interact with QA/QC Coordinator to resolve analytical, methodological and QA/QC problems;</li><li>- Obtain laboratory accreditations;</li><li>- Schedule work in a manner consistent with personnel and instrumentation;</li><li>- Implement procedures consistent with and building upon our philosophy of honesty, trust and ethics; and</li><li>- Implement actions required to establish our lab as a premier laboratory.</li></ul>

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## LENL KEY PERSONNEL AND RESPONSIBILITIES

143119

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<u>Position/Key Personnel</u>	<u>Responsibilities</u>
QA/QC Coordinator Burnie D. Fuson	<ul style="list-style-type: none"><li>- Implement the branch QA program;</li><li>- Develop the QA/QC manual;</li><li>- Establish and maintain safety standards and operating procedures;</li><li>- Coordinate and audit the technical review of deliverables;</li><li>- Issue recommendations and corrective actions required for any aspect of laboratory operations inconsistent with established policies and procedures;</li><li>- Monitor and identify out-of-control or potentially out-of-control situations to Operations Manager, Supervisors, and Branch Manager;</li><li>- Provide guidance for the chemistry QA/QC program development;</li><li>- Interact with external QA personnel concerning the lab's certifications and QA policies/procedures and coordinating QA compliance as required;</li><li>- Keep abreast of new techniques and programs for QA and safety and inform Branch Manager and Operations Manager;</li><li>- Coordinate the development of project QA plans as required;</li><li>- Provide historical QA reports for each method to the Branch Manager; and</li><li>- Perform QA/QC audits, provide blind check samples and monitor results.</li></ul>

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## LENL KEY PERSONNEL AND RESPONSIBILITIES

Position/Key PersonnelResponsibilities

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<b>Management Information Systems Department Damon Abbott</b>	<ul style="list-style-type: none"><li>- Establish and maintain the computer systems, the network, and the LIMS (Laboratory Information Management System);</li><li>- Provide data deliverables in U.S. EPA CLP format with hard copy and disc deliverable formats;</li><li>- Develop software necessary to meet other client's deliverable formats;</li><li>- Interpret U.S. EPA CLP Statements of Work - Organics and Inorganics for requirements and deliverables;</li><li>- Interface analytical instruments' data systems with our IBM Token Ring Network and develop software required at the interface;</li><li>- Train department personnel in various data entry software packages purchased or developed internally;</li><li>- Provide guidance and direction to other departments where required or requested or as determined by Branch Manager;</li><li>- Provide support to QA/QC Coordinator where necessary to automate, archive and generate QC trends from historical records; and</li><li>- Provide support and guidance for entire laboratory operation, from sample receiving through the generation of data deliverable packages, to streamline and increase productivity through computer automation.</li></ul>
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**LENL KEY PERSONNEL AND RESPONSIBILITIES**

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**Position/Key Personnel****Responsibilities**

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**Lab Supervision****C. Oliver (Organics)****B. D. Hunt (GC/MS)****Carl Causey (GC)****Gary St Pere (Inorganics)**

- Provide overall supervision of department/section operations;
  - Implement procedures consistent with the generation of legally defensible data;
  - Provide QC activities consistent with the branch QC procedures;
  - Provide additional QC activities, as needed, which are consistent with the Branch QA philosophies;
  - Provide final report review before releasing;
  - Provide work assignments to departmental personnel;
  - Provide analytical job training and cross-training within the department and between departments where applicable and warranted;
  - Provide corrective action for deficiencies;
  - Provide quarterly instrument detection limit (IDL) studies;
  - Maintain maintenance logs on all instruments;
  - Maintain all standards logs;
  - Provide leadership and management philosophies consistent with those of the Branch; and
  - Provide legally defensible data from each department.
-

## LENL KEY PERSONNEL AND RESPONSIBILITIES

Position/Key PersonnelResponsibilities

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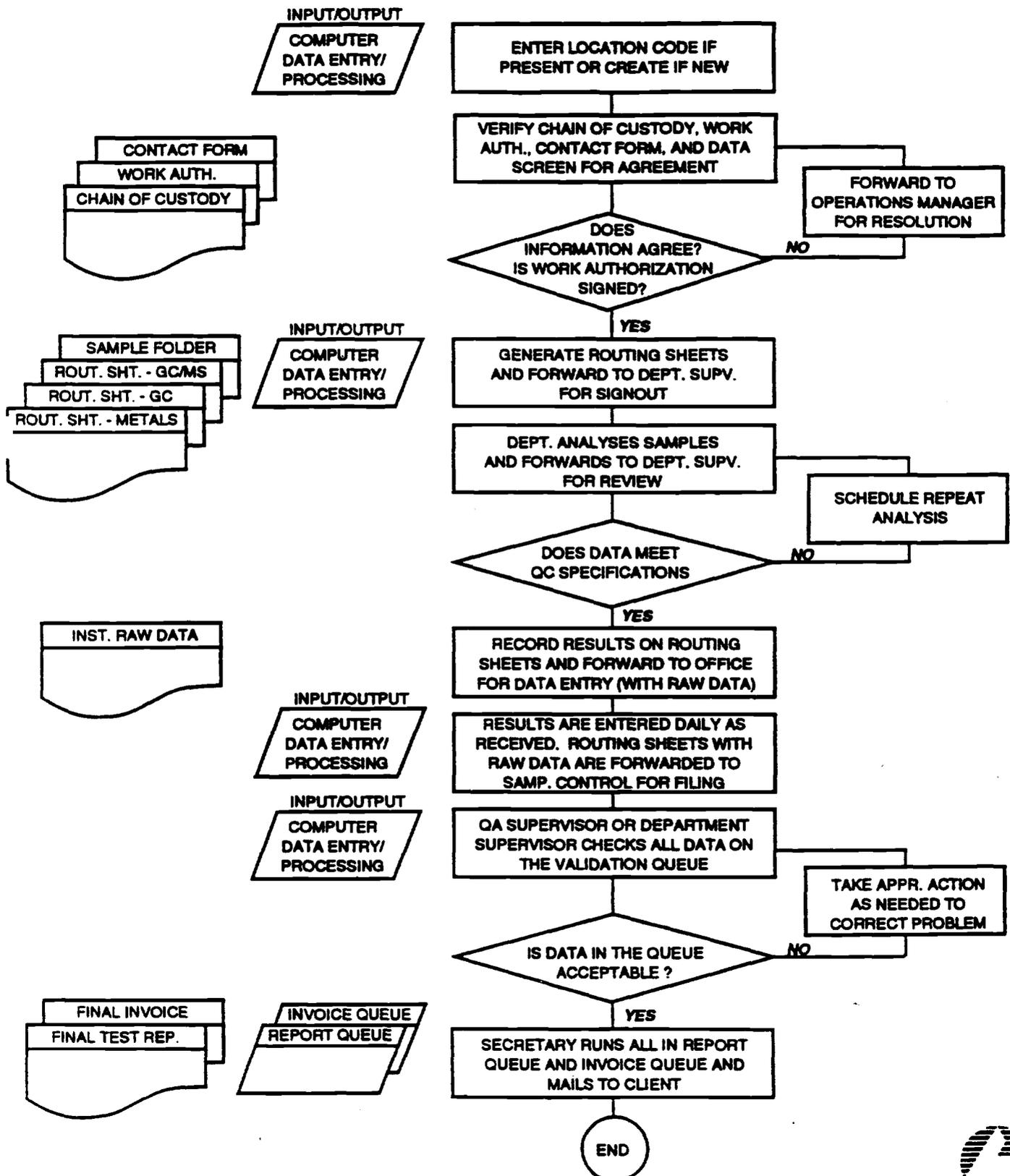
<b>Sample Receiving and Shipment Sharon Taber</b>	<ul style="list-style-type: none"><li>- Provide sample control via entry of all parameters to be analyzed per sample in LIMS when sample arrives;</li><li>- Provide chain-of-custody receipt of samples externally, and internal from our walk-in cooler to analysts and prep;</li><li>- Provide sample analysis report daily for all samples in-house;</li><li>- Provide prepared sample bottles in refrigerated shippers;</li><li>- Provide for sample disposal/return to sender; and</li><li>- Keep track of supplies, order when needed, bill clients for those used.</li></ul>
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## LENL SAMPLE FLOW AND DOCUMENTATION CHART

Sample Flow	Documentation
A. Incoming Samples	<ul style="list-style-type: none"> <li>- Chain of Custody</li> <li>- Request for Analysis</li> <li>- Work Authorization</li> </ul>
B. Log-In and Assignment	<ul style="list-style-type: none"> <li>- Master Logbook</li> <li>- Test Entry Form</li> </ul>
C. Sample Handling and QC (1) Organics Prep Lab	<ul style="list-style-type: none"> <li>- Extraction Record</li> <li>- Percent Moisture</li> <li>- Standards Prep Logs</li> <li>- QC Sample Logs</li> </ul>
(2) GC Lab	<ul style="list-style-type: none"> <li>- Chromatograms</li> <li>- Bench Sheets</li> <li>- Condition Reports</li> <li>- Linearity Checks</li> <li>- Surrogate Recovery Logs</li> <li>- Blank, Standard and Spike Results</li> <li>- Standards Logbook</li> </ul>
(3) GC/MS Lab	<ul style="list-style-type: none"> <li>- Instrument Maintenance Logs</li> <li>- Sample Logbook</li> <li>- Quantitation Reports</li> <li>- Chromatograms</li> <li>- Initial Calibration Forms</li> <li>- Continuing Calibration Checks</li> <li>- Surrogate Recovery Logs</li> <li>- Blank, Standard and Spike Results</li> <li>- Computer Streamer Tapes</li> <li>- Instrument Maintenance Logs</li> </ul>
(4) Metals Lab	<ul style="list-style-type: none"> <li>- Digestion Log</li> <li>- Bench Sheets</li> <li>- Blank, Standard and Spike Results</li> <li>- Percent Moisture</li> <li>- Standards Prep Logs</li> <li>- QC Sample Logs</li> </ul>
D. Reporting	<ul style="list-style-type: none"> <li>- Transmittal Letters</li> <li>- Test Data Reports</li> <li>- GC/MS Data Reports</li> </ul>
E. Sample Disposal	<ul style="list-style-type: none"> <li>- Internal Sample Disposal Forms.</li> </ul>

# LENL-PENSACOLA LABWORKS SAMPLE/DATA FLOW

## SAMPLE RECEIPT



NOTE: SPECIAL DELIVERABLES, IF REQUESTED ARE ALSO GENERATED AFTER VALIDATION STEP IS COMPLETED









# QA/QC CORRECTIVE ACTION REQUEST FORM

LENL-PENSACOLA, FL

CA # \_\_\_\_\_ Originator \_\_\_\_\_ DATE \_\_\_\_\_

**PROBLEM:**

SECTION: \_\_\_\_\_ DISCOVERER: \_\_\_\_\_ DATE: \_\_\_\_\_

DATA/DATES IMPACTED: \_\_\_\_\_

DESCRIPTION: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**REQUIRED ACTION:**

**DETERMINATION**

ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_ DUE DATE: \_\_\_\_\_

**IMPLEMENTATION**

ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_ DUE DATE: \_\_\_\_\_

ACTION: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**EFFECTIVENESS EVALUATION (S):**

ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_ DUE DATE: \_\_\_\_\_

ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_ DUE DATE: \_\_\_\_\_

CC: QA OFFICER \_\_\_\_\_

OPERATIONS MANAGER: \_\_\_\_\_

GROUP LEADER: \_\_\_\_\_

SECTION SUPERVISOR: \_\_\_\_\_







Law Environmental, Inc.

## INTEROFFICE MEMORANDUM

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TO: Chemistry Department  
FROM: Jerry S. Preston *JSP*  
DATE: September 28, 1992  
SUBJECT: Certifications held by LENL-P Laboratory

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Attached please find a listing of the certifications held by the LENL-Pensacola laboratory. This list will be useful during proposal and planning activities.

### CERTIFICATION BY STATE

<u>STATE</u>	<u>PARAMETERS</u>	<u>CERT. NO.</u>	<u>EXP. DATE</u>
Alabama	Drinking Water	40600	6/30/93
Florida	Drinking Water	HRS#81351	6/30/93
Florida	Environmental Water	HRS#E81234	6/30/93
Florida	Water	HRS#81351	6/30/93
Kansas	Drinking Water and/or Pollution Control Samples	E-184	7/31/93
Kansas	Solid or Hazardous Waste Samples	E-1161	7/31/93
Louisiana	Drinking Water	92-16	12/31/92
North Carolina	Wastewater	287	12/31/92
South Carolina	Wastewater	96008	Exp/Pending

<u>STATE</u>	<u>PARAMETERS</u>	<u>CERT. NO.</u>	<u>EXP. DATE</u>
Tennessee	BTX and TPH		7/01/93
Virginia	Water	00170	6/30/93
COE	Soil and Groundwater		2/20/94
USAF	Soil and Groundwater		9/25/93
U.S. Navy	Soil and Groundwater	Pending	
U.S. EPA	SAS Contracts	68-D9-0135	9/19/94

cc: Becky Pridgeon

/dsl

APPENDIX B-2

QUALITY ASSURANCE PROGRAM

Transglobal Environmental Geochemistry, (TEG)  
Austin, Texas



**TEG/TEXAS MOBILE LABORATORY  
STATEMENT OF QUALIFICATIONS**

**Transglobal Environmental Geochemistry, Texas**

10805 Metric Boulevard, Austin, TX 78758

(512) 835-9299

FAX (512) 835-9297

## CONTENTS

- I TEG/TEXAS MOBILE LABORATORY BACKGROUND & CAPABILITIES**
  - Mobile Lab Flyer**
  - Soil Vapor Flyer**
  - TEG Corporate Profile**
- II LIST OF TEG OFFICES**
- III EXAMPLES**
  - Chromatogram**
  - Data Sheet**
- IV RECENT PROJECT DESCRIPTIONS / REFERENCES**
- V LETTERS OF RECOMMENDATION**
- VI RESUMES OF LEAD PERSONNEL**
- VII CALIFORNIA DOHS CERTIFICATION**
- VIII TWC APPROVAL LETTER**
- IX INSURANCE DOCUMENTS**
- X MBE CERTIFICATES**
  - Texas Department of Transportation**
  - Texas Department of Commerce**
  - City of Houston**
  - City of Austin**
  - Metro**
  - City of San Antonio**
- XI SOP FOR SAMPLE DISPOSAL**

**FINAL PAGE**

**ADMINISTRATIVE RECORD**

**FINAL PAGE**

**FINAL PAGE**

**ADMINISTRATIVE RECORD**

**FINAL PAGE**