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INSTALLATION RESTORATION RCRA FACILITY INVESTIGATION WORK PLAN NAS FORT WORTH TX
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# NAVAL AIR STATION
# FORT WORTH JRB
# CARSWELL FIELD
# TEXAS

## ADMINISTRATIVE RECORD
## COVER SHEET

**AR File Number** 185

11-3517-0111.09

# INSTALLATION RESTORATION PROGRAM (IRP)
# RCRA FACILITY INVESTIGATION

## WORK PLAN

Carswell Air Force Base, Fort Worth, Texas

February 1994

Revised Final

PREPARED FOR

AIR FORCE BASE CONVERSION AGENCY (AFBCA/OL-H)
CARSWELL AIR FORCE BASE, TEXAS 76127

UNITED STATES AIR FORCE
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BASE CLOSURE RESTORATION DIVISION (HQ AFCEE/ESB)
BROOKS AIR FORCE BASE, TEXAS 78235-5328

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES

185 02

February 23, 1994

Air Force Center for Environmental Excellence
HQ AFCEE/ESB
8001 Inner Circle Drive
Suite 2
Brooks Air Force Base, TX 78235-5328

Attention: Chris Hobbins (Team Chief)

Subject: Carswell Air Force Base
Final Work 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 (Law) is pleased to submit the enclosed 25 copies of the Revised Final Work Plan to the Air Force Center for Environmental Excellence (AFCEE) for approval.

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

Sincerely,

John F. O'Brien
Project Manager

E. Fred Sharpe, Jr., P.E.
Principal

3517-0111.09

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# REPORT DOCUMENTATION PAGE

*Form Approved*
*OMB No. 0704-0188*



| 1. AGENCY USE ONLY (*Leave blank*) | 2. REPORT DATE | 3. REPORT TYPE AND DATES COVERED |
|---|---|---|
| | FEBRUARY 1994 | REVISED FINAL |

**4. TITLE AND SUBTITLE**
INSTALLATION RESTORATION PROGRAM
FINAL RFI PROJECT WORK PLAN

**5. FUNDING NUMBERS**
CONTRACT NO.
F33615-90-D-4008/0011

**6. AUTHOR(S)**
LAW ENVIRONMENTAL, INC. (LAW)

**7. PERFORMANCE ORGANIZATION NAME(S) AND ADDRESS(ES)**
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**8. PERFORMING ORGANIZATION REPORT NUMBER**
(N/A)

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
ENVIRONMENTAL RESTORATION DIVISION (AFCEE/ESB)
BROOKS AFB, TEXAS 78235-5328

**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
(N/A)

**11. SUPPLEMENTARY NOTES**

**12a. DISTRIBUTION/AVAILABILITY STATEMENT**
APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

**12b. DISTRIBUTION CODE**

**13. ABSTRACT** (*Maximum 200 words*)

LAW ENVIRONMENTAL INC., (LAW), WILL, INITIALLY, CONDUCT A RCRA FACILITY INVESTIGATION AT TWO SITES AT CARSWELL AIR FORCE BASE, TEXAS, UNDER THE AIR FORCE INSTALLATION RESTORATION PROGRAM (IRP). THE PROJECT FOLLOWS THE REQUIREMENTS OF IRP, AND THE WORK DESCRIBED IN THIS WORK PLAN (WP) IS DESIGNED TO CHARACTERIZE ENVIRONMENTAL CONDITIONS AT THE TWO SITES AND TO ENSURE SUBSEQUENT REMEDIAL DESIGN AND REMEDIAL ACTION CONSISTENT WITH THE OBJECTIVES OF THE BASE REALIGNMENT AND CLOSURE (BRAC) PROGRAM. THE TWO SITES TO BE INVESTIGATED ARE THE UNNAMED STREAM (IRP SITE SD-13/SWMU64) AND THE POL TANK FARM (IRP SITE ST-14/SWMU68).

| 14. SUBJECT TERMS | 15. NUMBER OF PAGES |
|---|---|
| RCRA FACILITY INVESTIGATION | 125 |
| | 16. PRICE CODE |

| 17. SECURITY CLASSIFICATION OF REPORT | 18. SECURITY CLASSIFICATION OF THIS PAGE | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT |
|---|---|---|---|
| UNCLASSIFIED | UNCLASSIFIED | UNCLASSIFIED | UL |

# INSTALLATION RESTORATION PROGRAM (IRP)
# RCRA FACILITY INVESTIGATION
# FINAL WORK PLAN
# FOR
# CARSWELL AIR FORCE BASE
# FORT WORTH, TEXAS 76127-5000

FEBRUARY 1994

Prepared by:

Law Environmental, Inc.
114 TownPark Drive
Kennesaw, Georgia 30144

CONTRACTOR CONTRACT NO. F33615-90-D-4008 DELIVERY ORDER NO. 0011

United States Air Force
Air Force Center For Environmental Excellence
Base Closure Restoration Division (HQ AFCEE/ESB)
Brooks Air Force Base, Texas 78235-5328
Mr. Chris Hobbins (Team Chief)

**WORK PLAN**
**DISCLAIMER NOTICE**

185 05

This Work 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 Work 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 Work Plan, since subsequent facts may become known which may make this Work Plan premature or inaccurate. Acceptance of this Work Plan in performance of the contract under which it is prepared does not mean that the United States 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.

Copies of this Work Plan may be purchased from:

Government agencies and their contractors registered with Defense Technical Information Center (DTIC) should direct their requests for copies of this report to:

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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 Work Plan has been developed for the RCRA Facility Investigation (RFI) activities at Carsewll Air Force Base (Carswell AFB). Procedures outlined in this plan are designed to describe the work to be performed, explain the project objectives, and present the rationale for conducting specific project activities. The plan will be effective upon final approval by the Air Force Center For Environmental Excellence (AFCEE).

Every effort will be made to fully comply with this plan. The success of Carswell AFB's Installation Restoration Program depends on team effort and total dedication from the various parties involved. Therefore, efforts will be focused on achieving and maintaining compliance with this Work Plan and pertinent regulations.

The point of contact for this investigation is as follows:

Mr. Chris Hobbins
Team Chief (TC)
HQ AFCEE/ESB
8001 Inner Circle Drive
Suite 2
Brooks AFB, Texas 78235-5328
Phone: (210) 536-5261

## PREFACE



Law Environmental, Inc. (Law) was contracted by the U.S. Air Force Center For Environmental Excellence (AFCEE) to perform a RCRA Facility Investigation (RFI) at two sites on Carswell Air Force Base (Carswell AFB). The two sites to be investigated include: Unnamed Stream (IRP Site SD-13/SWMU No. 64) and POL Tank Farm (IRP Site ST-14/SWMU No. 68). The primary objective of this field investigation is to investigate the extent of soil and ground-water contamination at each site and assess the overall environmental status of the sites in order to support the recommendation of appropriate further actions. Project objectives will be achieved through the use of the following methods of investigation: geophysical and geochemical surveys; soil borings and hand auger borings; monitoring wells; soil and ground-water sampling for field screening and laboratory analyses; and surface water and sediment sampling for laboratory analysis. This Work Plan summarizes the approach developed for this RFI project.

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

This Final Work Plan was prepared by Mr. Jim Beaver and reviewed by Mr. John O'Brien and Mr. Fred Sharpe. The efforts of Mr. Chris Hobbins (Team Chief) from AFCEE and personnel at Carswell AFB are greatly appreciated.

John F. O'Brien
Project Manager

E. Fred Sharpe, Jr., P.E.
Principal

Louis S. Karably, P.E.
Program Manager

3517-0111.09

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## LIST OF ACRONYMS

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| | |
|---|---|
| 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 |
| F | Fahrenheit |
| 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 |

**LIST OF ACRONYMS**
**(Continued)**

| | |
|---|---|
| LENL | Law Environmental National Laboratories |
| LCS | Laboratory Control Standards |
| MCL | Maximum Contaminant Level |
| MDL | Method Detection Limit |
| MITRE | MITRE Corporation |
| MQL | Method Quantitation Limit |
| MQC | Method 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 |
| POTW | Publicly Owned Treatment Works |
| 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 |
| 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 |
| VOA | Volatile Organic Analysis |

# 1.0 INTRODUCTION



Law Environmental, Government Services Division (Law), Kennesaw, Georgia, has prepared this RCRA Facility Investigation (RFI) Work Plan in compliance with the United States Air Force (USAF) Installation Restoration Program (IRP). This Work Plan summarizes site characterization efforts performed at Carswell Air Force Base (Carswell AFB) as part of past IRP and non-IRP efforts relating to two problem sites/areas. The sites identified for continued investigation as part of the AFCEE Scope of Work for this project are the POL Tank Farm (IRP Site ST-14/SWMU No. 68) and the Unnamed Stream (IRP Site SD-13/SWMU No. 64). The overall intent of this investigation is to obtain additional data necessary to asses the contamination at each site and to identify criteria to be used to recommend if further investigation is warranted.

## 1.1 HISTORY OF PAST IRP WORK AT CARSWELL AFB

The IRP was developed as a four phase program:

- Phase I - Initial Assessment/Records Search
- Phase II - Confirmation and Quantification
- Phase III - Technology Base Development
- Phase IV - Operation/Remedial Actions

### 1.1.1 Previous Investigative Activities and Documentation

The Phase I Records Search study was conducted to identify past waste disposal activities at Carswell AFB which may have caused environmental contamination and the migration of contaminants off of the base ($CH_2M$ Hill, 1984). After ranking each site for potential adverse environmental effects, further investigation was recommended for eleven sites on the base and the Weapons Storage Area west of the base.

The twelve sites were investigated in the Phase II Stage 1 confirmation and quantification study (Radian, 1986). These sites include landfills, fire department training areas, industrial areas, and spills. The on-base sites were concentrated in two areas, the Flightline Area and the East Area (Figure 1-1). The Phase II Stage 1 investigation was intended to determine the effect of past waste disposal activities at Carswell AFB, including the magnitude and extent of contamination and its potential for further migration.

A Phase II Stage 2 Remedial Investigation was conducted to further detail the extent of existing contamination in the East Area (Radian, 1991a). This study focused on the hydrogeology and ground-water quality at Landfill 1, Unnamed Stream, POL Tank Farm, and the Base Service Station.

Data from Radian's 1991 Remedial Investigation were used in the selection of alternatives in a Feasibility Study conducted for twenty-two sites suspected of containing hazardous waste. Sites classed in Category II (requiring additional monitoring or work to assess the extent of current or future contamination) included the POL Tank Farm and the Unnamed Stream (Radian, 1991b).

A non-IRP investigation was conducted prior to construction at Building 1337-White House Communication, to determine if pesticide contamination posed an environmental concern (Maxim, 1991). No significant pesticide contamination was detected in the soil or ground water at that time, however, evidence of fuel-related contamination was detected in soil samples from two soil borings at this location.

In 1991, the U.S. Army Corps of Engineers prepared a work plan for a RCRA Facility Assessment of SWMU No. 64 (French Underdrain System) and SWMU No. 67 (Bldg. 1340 - Oil-Water Separator). The tasks proposed in this work plan were not implemented.

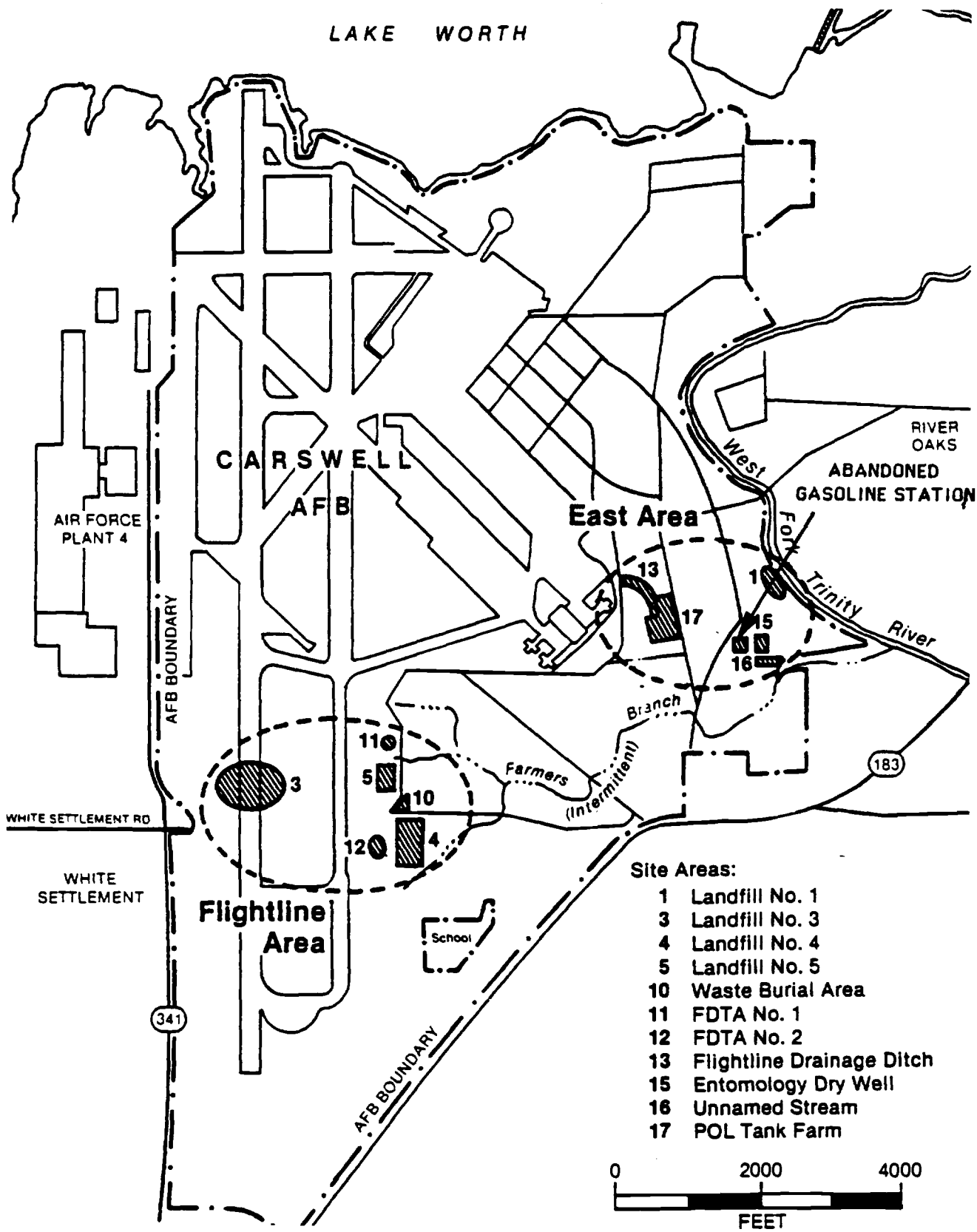
FIGURE 1-1

# LOCATION OF PHASE II, STAGE 1 SITES

185 18

(AFTER RADIAN, 1986)

CARSWELL AIR FORCE BASE, TEXAS



### 1.1.2 Existing Remedial Actions

A pilot test/treatability study has been recently completed by Engineering Science (ES, 1993) at the POL Tank Farm site to test the effectiveness of bioventing on the petroleum impacted soil. Results of this study will be incorporated into the RFI report.

## 1.2 DESCRIPTION OF CURRENT STUDY

This section describes project objectives, scoping documents, and the role of subcontractors.

### 1.2.1 Project Objectives

The objective of this study is to conduct an RFI at two sites to investigate the extent of soil and ground-water contamination at each site and assess the overall environmental status of each site in order to recommend if further investigation is warranted. This will involve the following site-specific approaches:

(1) Unnamed Stream

- Assess the types, quantities, and sources of contamination within the area of concern
- Assess the lateral and vertical extent of contamination

(2) POL Tank Farm

- Delineate the extent of ground-water contamination

1.2.2 Scoping Documents

Documents being prepared for this effort include:

- Work Plan
- Sampling and Analysis Plan (QAPP and FSP)
- Health and Safety Plan

1.2.2.1 Work Plan - Preparation of the Work Plan for the RFI effort has been based on findings and recommendations in part from past investigations and also from observations of potential environmental concerns at Carswell AFB. The Work Plan details recommendations and the decision rationale for conducting field investigations, determining applicable or relevant and appropriate requirements (ARARs), and Data Quality Objectives (DQOs). The format used for writing this Work Plan was provided in the Handbook to Support the Installation Restoration Program (IRP) Statements of Work for Remedial Investigation/Feasibility Studies (RI/FS), May 1991, and in accordance with guidance provided by the Carswell AFB RCRA Part B Permit issued on February 7, 1993.

1.2.2.2 Sampling and Analysis Plan - A Sampling and Analysis Plan (SAP) has also been developed as a companion document to the Work Plan. The SAP consists of two parts, the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP). The QAPP describes the policy, organization, functional activities, and quality assurance/quality control procedures which will be implemented in order to achieve the DQOs dictated by the intended use of the data. The FSP provides guidance for all field activities and defines, in detail, the sampling and data gathering methods to be used during the investigation.

1.2.2.3 Health and Safety Plan - A Health and Safety Plan (HSP) has been prepared to comply with the Occupational Safety and Health Administration (OSHA) health and safety regulations regarding the work effort detailed in the Work Plan. The HSP uses OSHA guidelines for designating the appropriate level of protection needed at the study sites.

### 1.2.3 Identity of Subcontractors and Their Roles

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

A state licensed drilling company will be subcontracted to perform the drilling activities. Law Environmental National Laboratories (LENL) has been subcontracted to perform the chemical analysis of the soil and water samples. A surveying company, certified in the state of Texas, will survey the soil boring and sampling locations and prepare a site map. In addition, Trans Global Environmental will perform a ground-water screening study at the POL Tank Farm in order to define the plume of contamination suspected to be located in association with that site. Details of project organization, personnel, and subcontractor responsibility are provided in the Quality Assurance Project Plan (QAPP).

# 2.0 SUMMARY OF EXISTING INFORMATION

The following discussion of the Carswell AFB environmental setting is derived primarily from the Installation Restoration Program Phase I Records Search Report ($CH_2M$ Hill, 1984). Information from that report is supplemented by information from the literature and from the general findings of studies conducted by the U.S. Army Corps of Engineers (1991) Radian Corporation (Radian, 1986; 1991a).

## 2.1 CARSWELL AFB ENVIRONMENTAL SETTING

Carswell AFB is located in northeastern Texas in Tarrant County, six miles west of downtown Fort Worth (Figure 2-1). The installation is bordered by Lake Worth to the north, the West Fork of the Trinity River and the community of Westworth to the east and southeast, the community of White Settlement to the south and southwest and Air Force Plant 4 to the west.

The following information applies to the area of the base in general. Specific variations from this for the two sites being studied are presented in Section 2.2.

### 2.1.1 Physiography

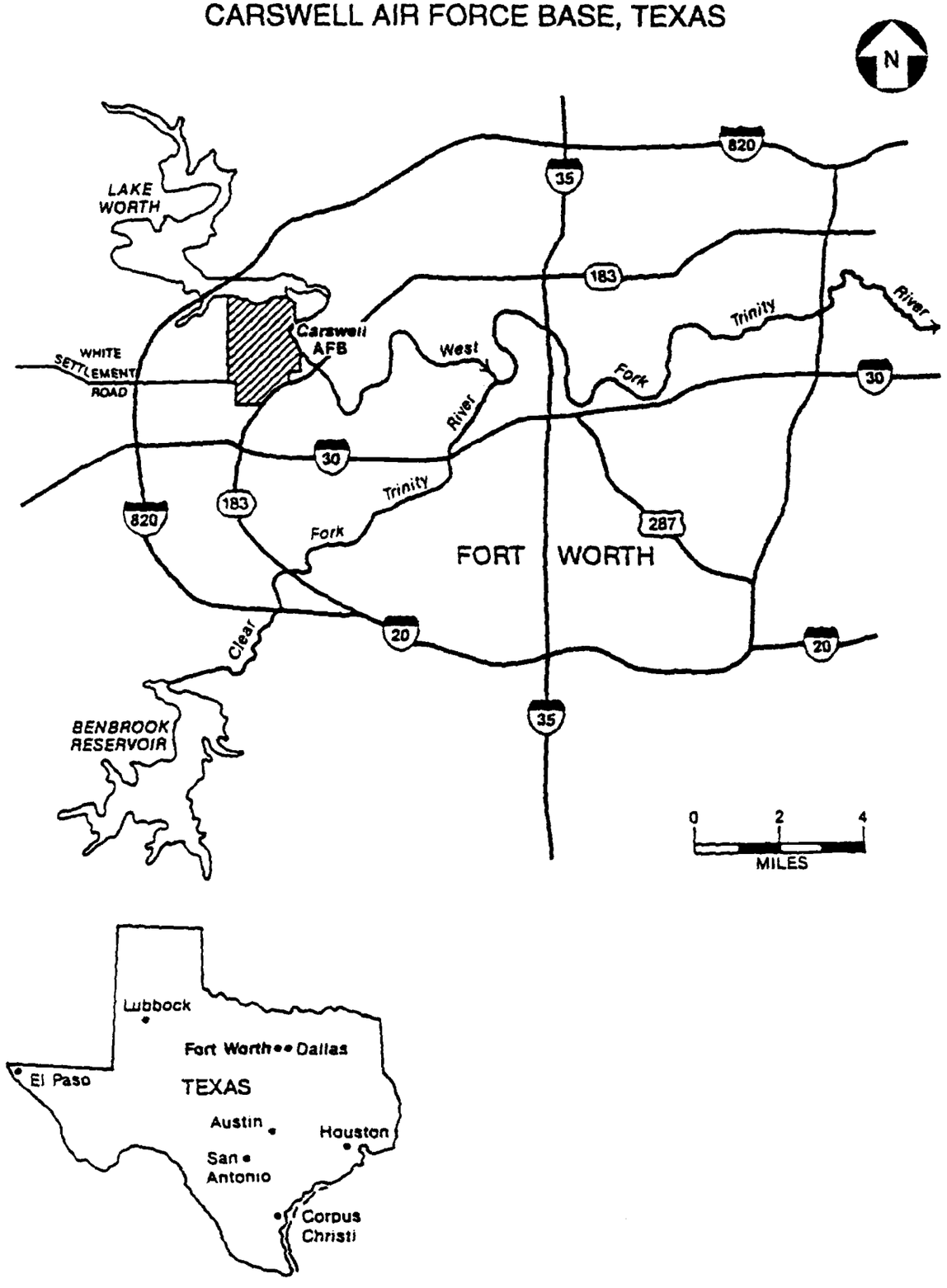
The majority of the Carswell AFB is located within the Grand Prairie section of the Central Lowlands Physiographic Province. This area is characterized by broad terraces sloping gently to the east, divided by westward-facing escarpments. The land is typically grass covered and treeless, except for isolated stands of upland timber. The northwestern portion of Carswell AFB is within the Western Cross Timbers Physiographic Province which is characterized by rolling topography and a heavy growth of post and black-jack oaks (U.S. Army Corps of Engineers, 1991).

FIGURE 2-1

# LOCATION MAP OF CARSWELL AFB 185 23

(AFTER RADIAN, 1986)

CARSWELL AIR FORCE BASE, TEXAS

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## 2.1.2 Geology

The following section summarizes the geological aspects of the study area which influence the environment at Carswell AFB.

2.1.2.1 Geomorphology - The topography of the installation is fairly flat except for areas near Farmer's Branch and the Trinity River. Land surface slopes gently northeast toward lake Worth and east toward the West Fork of the Trinity River. Elevations on the installation range from a high of approximately 690 feet above mean sea level (msl) at the southwest corner of the installation to a low of approximately 550 feet MSL at the east side of the installation. The elevation of Lake Worth usually approximates the elevation of the dam spillway, 594 feet MSL (U.S. Army Corps of Engineers, 1991).

The principal drainage for Carswell AFB is the West Fork of the Trinity River. Farmer's Branch drains the southern portion of the installation and discharges into the Trinity. A small portion of the north end of the base drains into Lake Worth (U.S. Army Corps of Engineers, 1991).

2.1.2.2 Stratigraphy - The geology of Carswell AFB can be characterized as a blanket of Quaternary clastic units overlying Cretaceous bedrock. From youngest to oldest, the geologic units of interest are as follows:

- Quaternary Alluvium
- Cretaceous Goodland Limestone
- Cretaceous Walnut Formation
- Cretaceous Paluxy Formation
- Cretaceous Glen Rose Formation
- Cretaceous Twin Mountains Formation

The areas where these units outcrop in the area of Carswell AFB are shown on Figure 2-2.

The majority of the installation is covered by alluvium deposited by the Trinity River. The alluvium is composed of gravel, sand, silt, and clay of variable thickness and lateral extent. The Goodland Limestone outcrops on the southern portion of the base, south of White Settlement road. The Goodland Formation is a chalky-white, fossiliferous limestone and marl. A small outcrop of the Walnut and Paluxy Formations occurs in the northwestern corner of the base along the shores of Lake Worth. The Walnut Formation is coquinoid limestone with variable quantities of clay and shale. The Paluxy Formation is primarily a fine to coarse-grained sand with minor quantities of clay, sandy clay, pyrite, lignite, and shale. Neither the Glen Rose Limestone, nor the Twin Mountains Formation outcrop at Carswell AFB (U.S. Army Corps of Engineers, 1991).

Carswell AFB is located on the relatively stable Texas shelf, west of the faulting associated with the Ouachita Structural Belt. No major faults or fracture zones have been mapped near the base. The regional dip of the rocks at Carswell AFB ranges from 35 and 40 feet per mile in an easterly to southeasterly direction. The stratigraphic and structural relationships of the shallow geologic units at Carswell AFB are illustrated in Figure 2-3. The geologic cross section extends from southwest to northeast across the southern portion of the installation (U.S. Army Corps of Engineers, 1991).

2.1.2.3 Soils - The USDA Soil Conservation Service has identified four soil associations at Carswell AFB. The soils are described in Table 2-1 and their occurrences on the installation are shown on Figure 2-4. The surficial soils of the installation are primarily nearly level to gently sloping clayey soils of the Sanger-Purves-

FIGURE 2-2

185 26

# GEOLOGIC MAP

(AFTER RADIAN, 1986)

CARSWELL AIR FORCE BASE, TEXAS

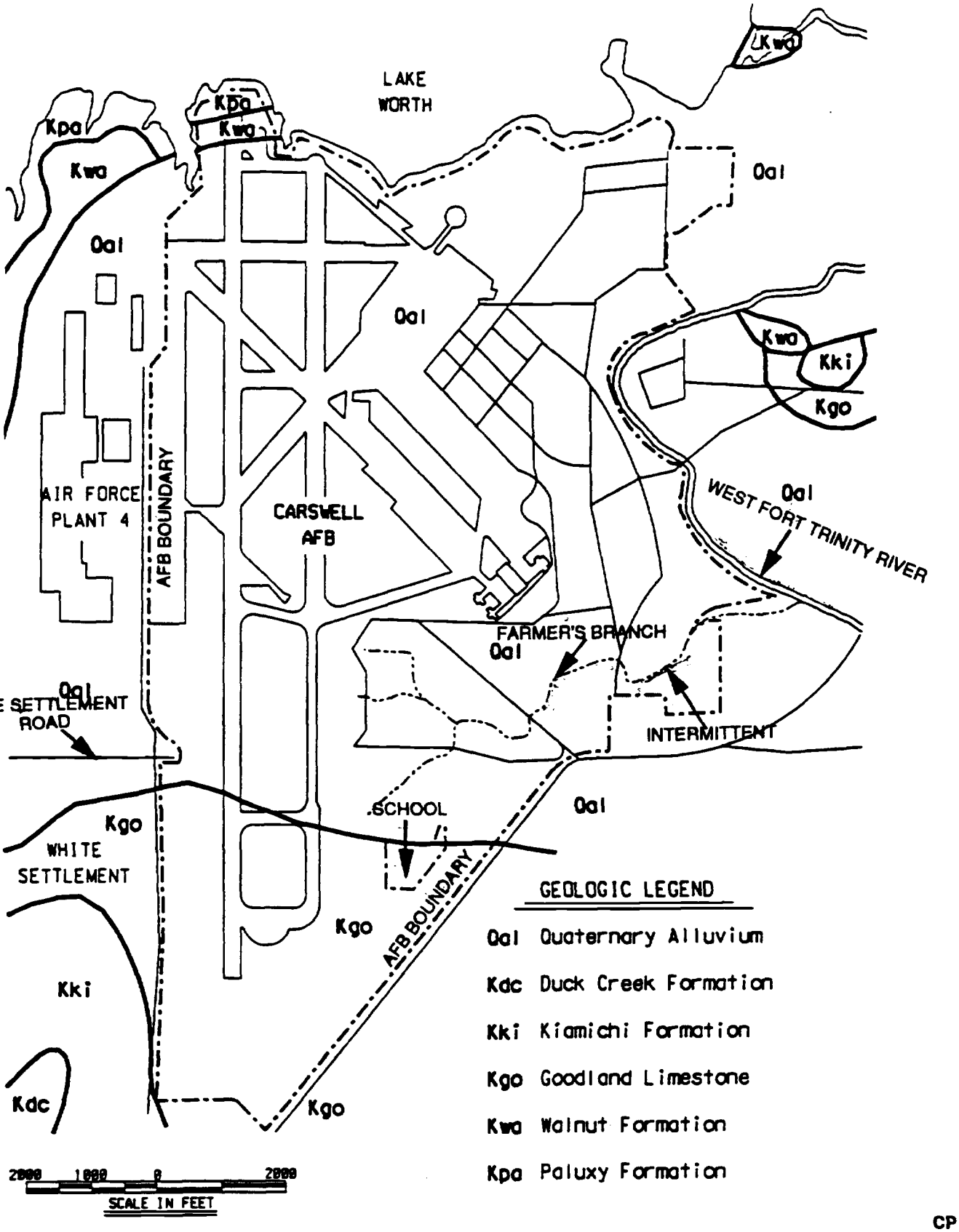


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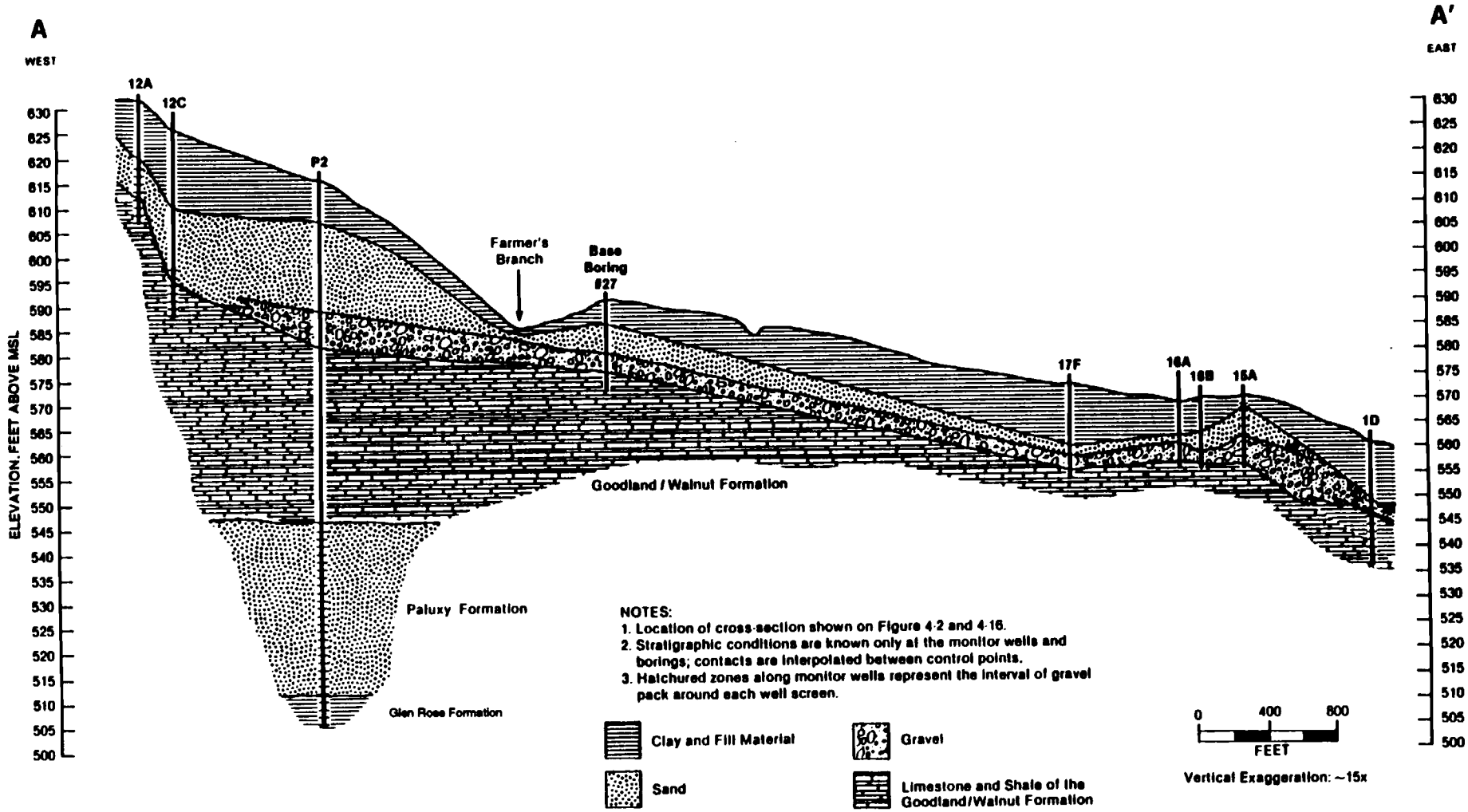
FIGURE 2-3

# NE-SW GEOLOGIC CROSS-SECTION

(AFTER RADIAN, 1986)

CARSWELL AIR FORCE BASE, TEXAS




NOTE: THE TWIN MOUNTAINS AQUIFER UNDERLIES THE GLEN ROSE AQUITARD

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**TABLE 2-1**

**SOIL CHARACTERISTICS**
**Carswell Air Force Base, Texas**

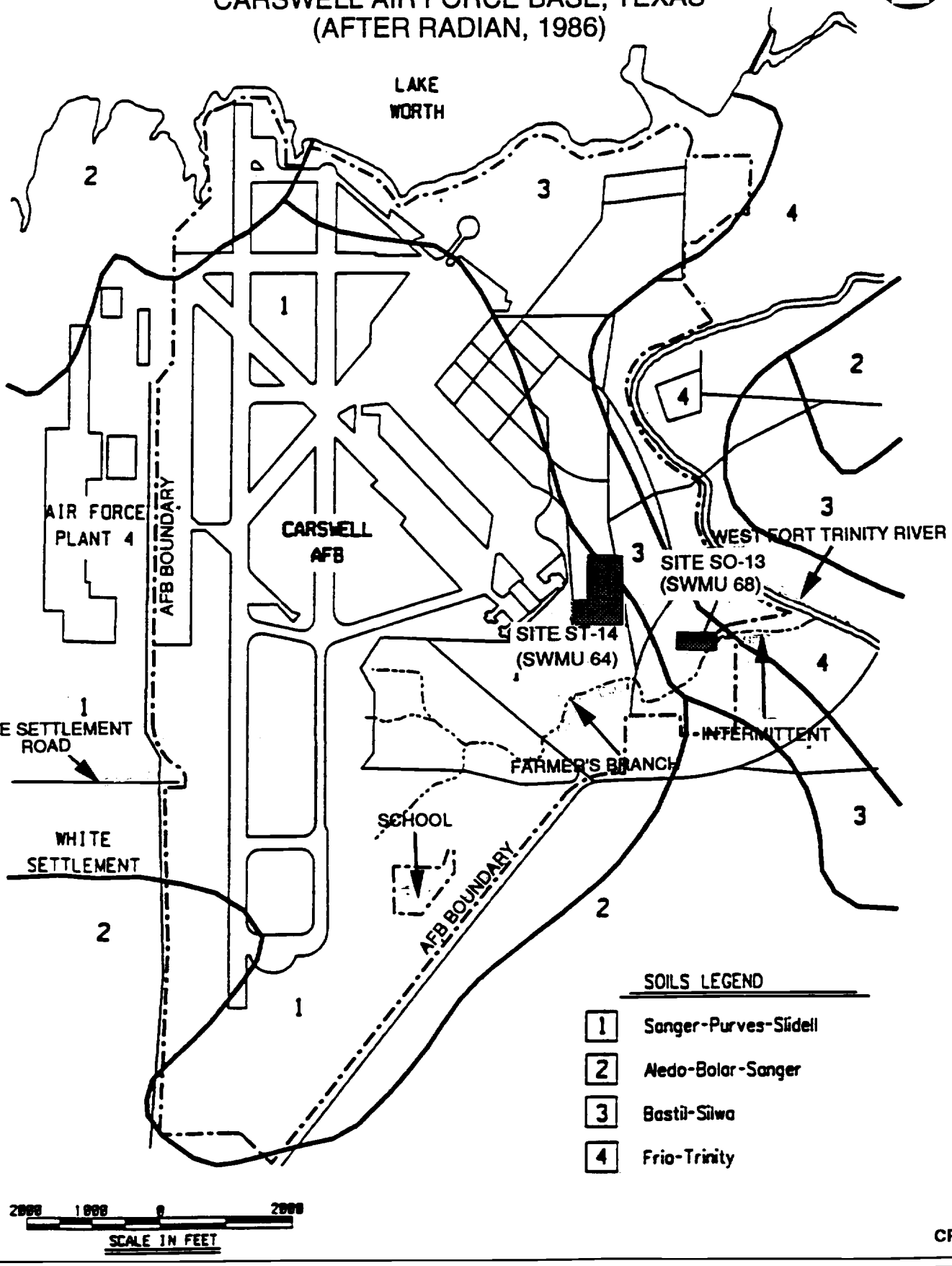
| ASSOCIATION | DESCRIPTION | TEXTURE | THICKNESS | PERMEABILITY |
|---|---|---|---|---|
| Sanger-Purves-Slidell | Clayey soils of nearly level to gently sloping uplands | Clay loam<br>Clay over bedrock<br>Silty clay | 8-80 inches | $<4.2 \times 10^{-5}$ to $3 \times 10^{-4}$ cm/sec |
| Aledo-Bolar-Sanger | Loamy and clayey soils of gently sloping to moderately steep uplands | Clay loam over bedrock<br>Clay loam | 8-70 inches | $<4.2 \times 10^{-5}$ to $9 \times 10^{-4}$ cm/sec |
| Frio-Trinity | Clayey soil on nearly level floodplains | Silty clay loam<br>Clay | 25-75 inches | $<4.2 \times 10^{-5}$ to $3 \times 10^{-4}$ cm/sec |
| Bastil-Silawa | Loamy soils on nearly level to sloping stream terraces | Sandy clay loam | 40-80 inches | $9 \times 10^{-4}$ to $3 \times 10^{-3}$ cm/sec |

Source: U.S. Dept. of Agriculture, Soil Conservation Service, 1981.

FIGURE 2-4

# SOILS ASSOCIATION MAP 185 29

CARSWELL AIR FORCE BASE, TEXAS
(AFTER RADIAN, 1986)



Slidell and Aledo-Bolar-Sanger Associations. Less widely distributed are the clayey soils of the Frio-Trinity Association and the loamy soils of the Bastil-Silawa Association occur on the floodplain and stream terraces of the West Fork of the Trinity River (U.S. Army Corps of Engineers, 1991).

### 2.1.3 Ground Water

Five hydrogeologic units have been identified at Carswell AFB. These units listed from most shallow to deepest are as follows:

- An upper perched-water zone occupying the alluvial terrace deposits of the Trinity River
- An aquitard consisting of predominantly unsaturated limestone of the Goodland and Walnut Formations
- The Paluxy sand
- An aquitard of relatively impermeable limestone in the Glen Rose Formation
- A major aquifer in the sandstone of the Twin Mountains Formation

Upper Zone - Perched ground water occurs as lenses within the coarse alluvial sand and gravel deposits along the Trinity River. These lenses are limited in lateral extent and are surrounded by low-permeability clays and silts. Ground water in the upper zone occurs at depths ranging from 7 to 13 feet. Annual ground-water table fluctuations are typically on the order of 5 feet (USGS, 1993). Recharge to the water-bearing deposits is from rainfall and infiltration in stream channels and drainage ditches. Water flow

in the alluvium is basically eastward, toward the West Fork of the Trinity River (U.S. Army Corps of Engineers, 1991) (Figure 2-5).

In parts of Tarrant County near the Trinity River, the upper zone is developed for irrigation and residential use. The community of River Oaks, immediately east of Carswell AFB, formerly utilized supply wells developed in alluvial deposits at a location near the Carswell AFB hospital. The wells were abandoned when Carswell AFB purchased the property for hospital construction. In general, ground water in the upper zone is not economical to develop due to the zone's limited distribution and susceptibility to surface/storm water pollution (U.S. Army Corps of Engineers, 1991).

Goodland/Walnut Aquitard - The perched water present in the alluvium is separated from the underlying aquifers by the low permeability limestone and shale of the Goodland Limestone and Walnut Formation. The aquitard consists of moist clay and shale layers interbedded with dry limestone beds. Though primarily dry, drillers in the area have reported small amounts of water in the Walnut Formation, suggesting that ground water may move through the Walnut along bedding planes. The thickness of the Goodland/Walnut aquitard is approximately 25 feet or greater beneath most of Carswell AFB. However, the top of the aquitard is an erosional surface and weathering may have locally reduced the thickness of the limestone. In a soil boring at Air Force Plant 4, immediately west of Carswell AFB, the Goodland Limestone had been completely eroded and only 3 feet of the Walnut Formation was present. It is also reported that the upper zone and Paluxy formation are in contact at the eastern boundary of plant 4, where both the Goodland and Walnut formations have been removed by erosion. In areas of similar erosion, water in the upper zone could come in contact with water in the Paluxy aquifer (U.S. Army Corps of Engineers, 1991).

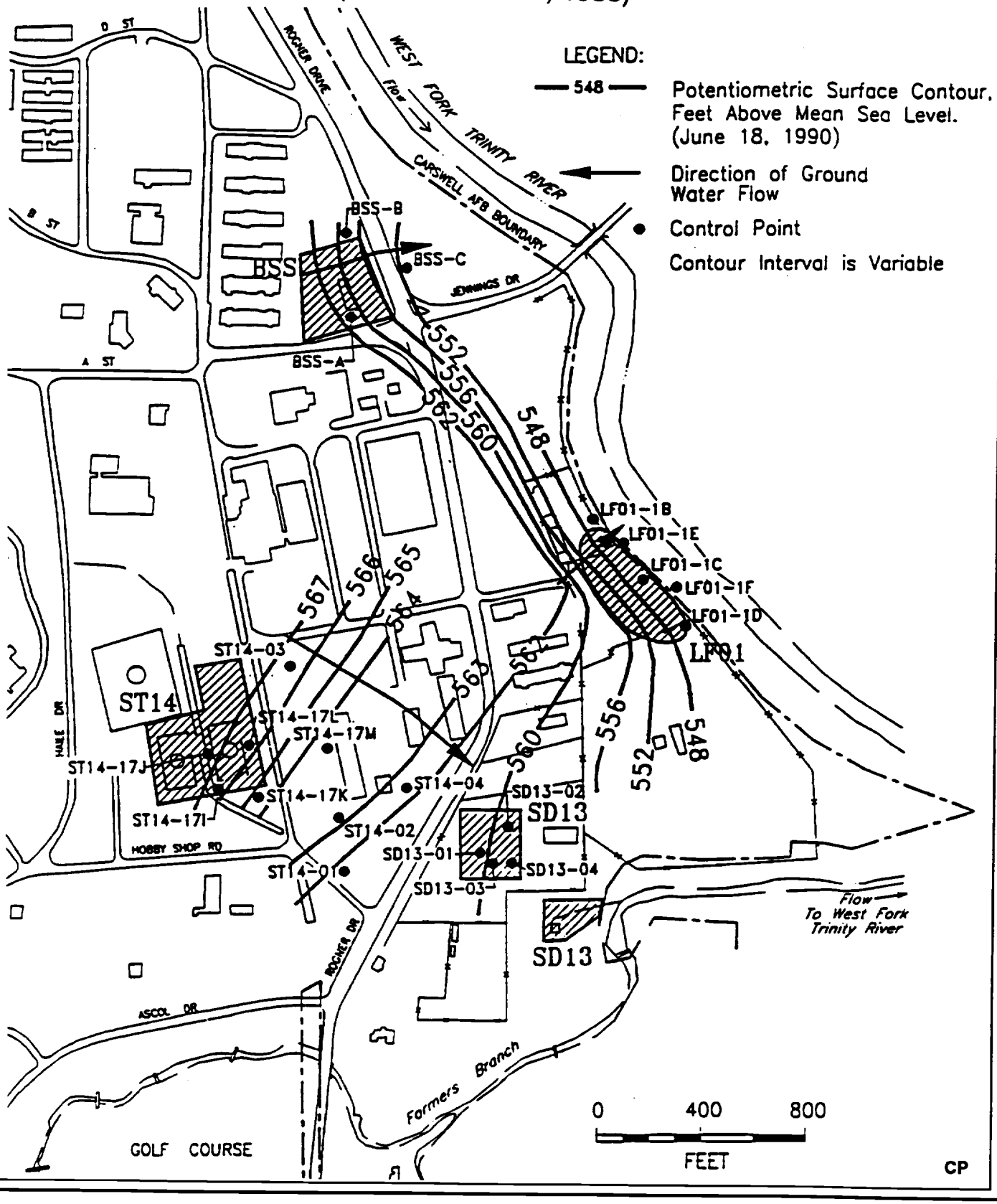
Paluxy Aquifer - The Paluxy aquifer is the shallowest bedrock aquifer beneath Carswell AFB. Water in the Paluxy normally occurs

FIGURE 2-5

# POTENTIOMETRIC SURFACE MAP OF THE UPPER ZONE EAST AREA,

## CARSWELL AIR FORCE BASE, TEXAS
## (AFTER RADIAN, 1986)

185 32



under confined conditions beneath the Goodland/Walnut aquitard except where the aquitard is absent due to erosion. Ground water is typically encountered at a depth of approximately 100 feet below land surface (450 ft. above mean sea level elevation) along the eastern portion of Carswell AFB (USGS, 1993). Extensive pumping in the Fort Worth area has lowered the Paluxy potentiometric surface below the top of the formation, resulting in unconfined conditions beneath the installation. The Paluxy Formation is divided into upper and lower sand members and the aquifer is likewise divided into upper and lower aquifers. The upper sand is fine-grained and shaley while the lower sand is coarser; therefore, most wells are completed in the lower section (U.S. Army Corps of Engineers, 1991).

The Paluxy aquifer is recharged along outcrops west of Carswell AFB. Paluxy outcroppings also occur north of the base in the bed of Lake Worth. The lake bed represents a significant recharge source for the aquifer and creates a localized potentiometric high. Regional ground-water flow within the Paluxy is eastward, parallel with regional dip. Ground-water flow at Carswell AFB is influenced by the Lake Worth potentiometric high and by a potentiometric low induced by ground-water withdrawals of the community of White Settlement. This produces a generally southeasterly flow direction (U.S. Army Corps of Engineers, 1991).

Transmissivities in the Paluxy aquifer range from 1,263 to 13,808 gallons per day per foot (gpd/ft) and average 3,700 gpd/ft. In Tarrant County, the Paluxy Formation ranges in thickness from 140 to 190 feet, averaging 160 feet. The actual water-bearing thickness in the Carswell AFB area probably approximates the formation thickness, but the aquifer is separated into two distinct water-bearing zones. In the vicinity of Carswell AFB, permeabilities range from 13 to 140 $gpd/ft^2$ (based on an approximate thickness for the aquifer of 100 ft.) Well yields from

the Paluxy aquifer range from 10 to 480 gallons per minute (gpm) averaging approximately 100 gpm (U.S. Army Corps of Engineers, 1991).

The Paluxy aquifer represents a significant source of potable ground water in the Fort Worth area. Communities adjacent to Carswell AFB, especially White Settlement, develop municipal water supplies from the Paluxy, as well as from the deeper Twin Mountains aquifer. As a result of extensive pumping, water levels in the Paluxy aquifer have declined significantly over the years. Water levels in the immediate Carswell AFB vicinity have not lowered to the same degree as in the Fort Worth area because the base does not produce water from the Paluxy (U.S. Army Corps of Engineers, 1991).

Glen Rose Aquitard - Below the Paluxy Aquifer are the fine-grained limestone, shale, marl, and sandstone beds of the Glen Rose Formation. The thickness of the formation varies from 250 to 450 feet. Although the sands in the Glen Rose Formation yield small supplies to wells in Fort Worth and western Tarrant County, the relatively impermeable limestone behaves as an aquitard, restricting water movement between the overlying Paluxy aquifer and the underlying Twin Mountains aquifer (U.S. Army Corps of Engineers, 1991).

Twin Mountains Aquifer - The Twin Mountains Formation is the oldest formation used for water supply in the Carswell AFB area. The formation consists of a basal conglomerate of chert and quartz, grading upward into coarse to fine grained sand interbedded with shale. The formation varies in thickness from 250 and 430 feet. The Twin Mountains aquifer is recharged along outcrops west of Carswell AFB. Water movement is eastward in the direction of regional dip. Like water in the Paluxy aquifer, the Twin Mountains aquifer occurs under unconfined conditions in the recharge area, becoming progressively more confined in the downdip direction (U.S. Army Corps of Engineers, 1991).

The Twin Mountains aquifer is the principal aquifer in Tarrant County and yields large water supplies for municipal (including human consumptive) and industrial purposes. In Tarrant County, transmissivities in the Twin Mountains aquifer range from 1,950 to 29,700 gpd/ft averaging 8,450 gpd/ft. Permeabilities range from 8 to 165 gpd/ft$^2$ averaging 68 gpd/ft$^2$ (U.S. Army Corps of Engineers, 1991).

Ground-water withdrawals from the Twin Mountains aquifer, primarily for municipal water supply, have resulted in declining water levels. Between 1955 and 1976, the potentiometric surface of the aquifer dropped approximately 250 feet. Water quality in the Twin Mountains aquifer is suitable for potable use throughout the Fort Worth area (U.S. Army Corps of Engineers, 1991).

### 2.1.4 Surface Water

Carswell AFB is located within the Trinity River Basin immediately south of Lake Worth, a man-made reservoir on the Trinity River. A portion of the installation is drained by Farmer's Branch which discharges into the West Fork of the Trinity River just south of the cantonment area. Farmer's Branch begins with the community of White Settlement and flows eastward. Immediately south of Air Force Plant 4, Farmer's Branch flows under the runway through two large culverts (U.S. Army Corps of Engineers, 1991).

Most of the installation's surface drainage is diverted through a series of storm drains and culverts. The water is in turn directed to oil/water separators and discharged to the West Fork downstream of Lake Worth. A small portion of the north end of the installation drains directly into Lake Worth.

## 2.1.5 Climatology/Air

Carswell AFB is located in north central Texas at approximately 33 degrees north latitude. The climate is humid subtropical with hot summers and dry winters. Tropical maritime air masses control the weather during much of the year; however, the passage of polar cold fronts and continental air masses create large variations in winter temperatures (U.S. Army Corps of Engineers, 1991).

The average annual temperature for Carswell AFB is 66 degrees fahrenheit (F) and monthly mean temperatures vary from 45 degrees F in January to 86 degrees F in July (Table 2-2). The average daily minimum temperature in January is 35 degrees F and the lowest recorded temperature is 2 degrees F. The average daily maximum temperature in July and August is 95 degrees F and the highest temperature recorded at the base was 111 degrees in the Month of June. On the average, freezing temperatures occur at Carswell AFB on 33 days per year (U.S. Army Corps of Engineers, 1991).

Mean annual precipitation recorded at Carswell AFB is 32 inches. The wettest month is May with a secondary maximum in September. The period from November to March is generally dry with a secondary minimum in August. Snowfall accounts for a small percentage of the total precipitation between November and March, with an average, measurable snowfall of two days per year. Lake evaporation at Carswell AFB is estimated to be approximately 57 inches per year. Evapotranspiration over land areas may be greater or less than lake evaporation depending on vegetative cover type and moisture availability. Average net precipitation is expected to be equal to the difference between average total precipitation and average lake evaporation or approximately minus 25 inches per year (U.S. Army Corps of Engineers, 1991).

Thunderstorm activity occurs at Carswell AFB an average of 45 days per year. The greatest number of these storms occurs between April

## TABLE 2-2

## METEOROLOGICAL DATA SUMMARY
### Carswell Air Force Base, Texas

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***TEMPERATURE (°F)*** | | | | | | | | | | | | | |
| Mean | 45 | 50 | 57 | 66 | 74 | 82 | 86 | 85 | 78 | 68 | 56 | 49 | 66 |
| Average Daily Maximum | 55 | 60 | 67 | 76 | 83 | 91 | 95 | 95 | 88 | 78 | 66 | 59 | 76 |
| Average Daily Minimum | 35 | 39 | 46 | 56 | 64 | 72 | 75 | 75 | 68 | 57 | 46 | 38 | 56 |
| Highest Recorded | 88 | 88 | 85 | 89 | 100 | 111 | 109 | 110 | 107 | 105 | 89 | 91 | 110 |
| Lowest Recorded | 2 | 6 | 11 | 31 | 42 | 55 | 61 | 60 | 46 | 33 | 17 | 11 | 2 |
| ***PRECIPITATION (inches)*** | | | | | | | | | | | | | |
| Mean | 1.7 | 1.9 | 2.1 | 3.9 | 4.2 | 3.1 | 2.5 | 2.1 | 3.6 | 3.1 | 1.8 | 1.9 | 31.9 |
| Maximum Monthly | 5.9 | 4.7 | 6.5 | 14.2 | 15.2 | 8.8 | 9.0 | 6.0 | 9.6 | 10.7 | 7.4 | 6.7 | 15.2 |
| Minimum Monthly | 0.1 | 0.1 | (a) | 0.8 | 0.8 | 0.1 | (a) | (a) | (a) | (a) | (a) | (a) | (a) |
| Maximum in 24 hours | 2.8 | 3.2 | 3.4 | 3.3 | 5.7 | 3.5 | 5.9 | 3.1 | 4.0 | 3.2 | 2.8 | 2.9 | 5.9 |
| Days with Thunderstorms | 1 | 2 | 3 | 6 | 8 | 6 | 5 | 5 | 4 | 3 | 1 | 1 | 45 |
| ***SNOWFALL (inches)*** | | | | | | | | | | | | | |
| Mean | 2 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (b) | (b) | 3 |
| Maximum Monthly | 8 | 12 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 8 |
| Maximum in 24 hours | 5 | 8 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 3 | 8 |
| ***RELATIVE HUMIDITY (%)*** | | | | | | | | | | | | | |
| Mean | 62 | 61 | 61 | 64 | 68 | 64 | 58 | 60 | 65 | 65 | 63 | 62 | 63 |
| ***SURFACE WINDS (knots)*** | | | | | | | | | | | | | |
| Mean | 8 | 8 | 9 | 9 | 7 | 8 | 6 | 5 | 6 | 6 | 8 | 8 | 7 |
| Maximum | 50 | 63 | 69 | 64 | 68 | 65 | 56 | 54 | 80 | 45 | 54 | 58 | 80 |
| Prevailing Direction | S | S | S | S | S | S | S | S | S | S | S | S | S |

Source: United States Air Force, Carswell AFB, Texas. Period of Record: 1946-1978.

(a) = Less than one tenth inch.
(b) = Less than 1 inch.

and June. Hail may fall on two to three days per year. The maximum precipitation recorded in a 24-hour period is 5.9 inches (U.S. Army Corps of Engineers, 1991).

Mean cloud cover averages 50 percent at Carswell AFB with clear weather occurring frequently during all months. Some fog is present on an average of 83 days per year. Wind speed averages 7 knots; however, a maximum of 80 knots has been recorded. Wind direction is predominately from the south during all months (U.S. Army Corps of Engineers, 1991).

### 2.1.6 Cultural Geography

2.1.6.1 Demographics - The total work force at Carswell AFB was approximately 6,100 persons, which includes about 1,000 civilian personnel (U.S. Army Corps of Engineers, 1991). Future demographics of Carswell AFB will be determined by the Final Base Realignment and Closure (BRAC) Policies.

The city of Fort Worth was estimated to have a population of 414,562 in 1984, with a population density of 1,617 people per square mile. The smaller suburbs of Forth Worth adjacent to Carswell AFB had 1980 population data as follows (U.S. Army Corps of Engineers, 1991):

- White Settlement - 13,508
- Westworth - 3,651
- River Oaks - 6,890

2.1.6.2 Land Use - The base is surrounded by residential, commercial, recreational, and industrial land. Residential land use is to the southwest, southeast and east of the installation. Commercial property is located to the south, while recreational

property (Lake Worth) is north of the installation. Air Force Plant 4 is the industrial facility directly west of Carswell AFB (U.S. Army Corps of Engineers, 1991).

## 2.2 SITE-SPECIFIC ENVIRONMENTAL SETTING

The following summaries of site-specific environmental data are based on the results of previous IRP investigations at Carswell AFB (Radian, 1986; 1991a).

### 2.2.1 POL Tank Farm Site (IRP Site ST-14/SWMU No. 68)

The POL Tank Farm (IRP Site ST-14/SWMU No. 68) 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 2-6). The Fuel Loading Area is east of Knight's Lake Road.

2.2.1.1 Contaminant Sources and Contamination - Three aboveground 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. A french drain system was installed in 1965 east of Rogner Drive between the Abandoned Service Station and the Entomology Area Building 1337 to intercept fuel released either from this site or the Abandoned Service Station. Previous studies (Radian, 1986, 1991a) have found evidence of contamination by organic compounds, including ethylbenzene, benzene, chlorobenzene and total xylenes (Figure 2-7). Lead and chromium in excess of MCLs were also detected in the ground water at this site.

FIGURE 2-6

# LOCATION OF EAST AREA SITES

## CARSWELL AIR FORCE BASE, TEXAS

185 40

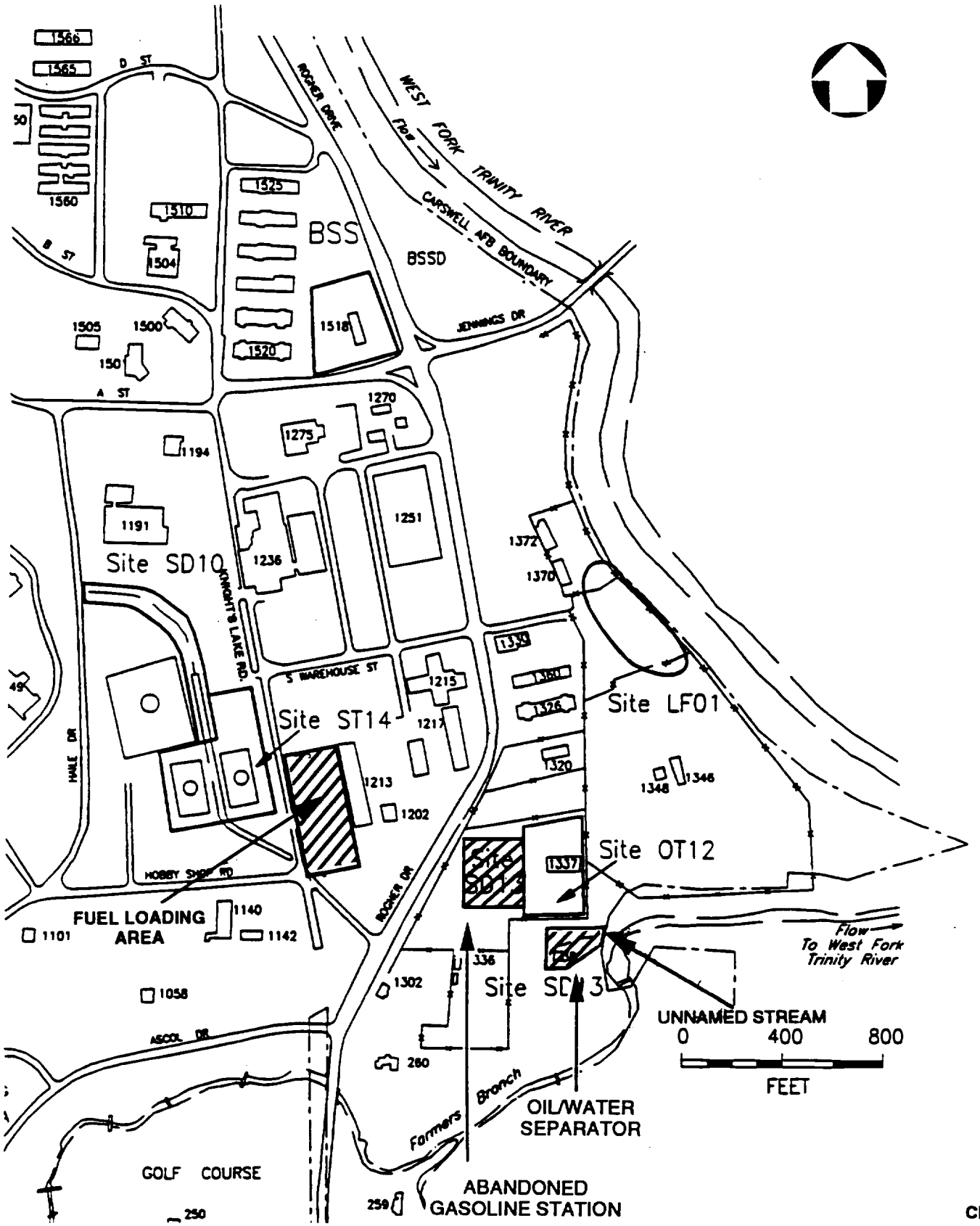
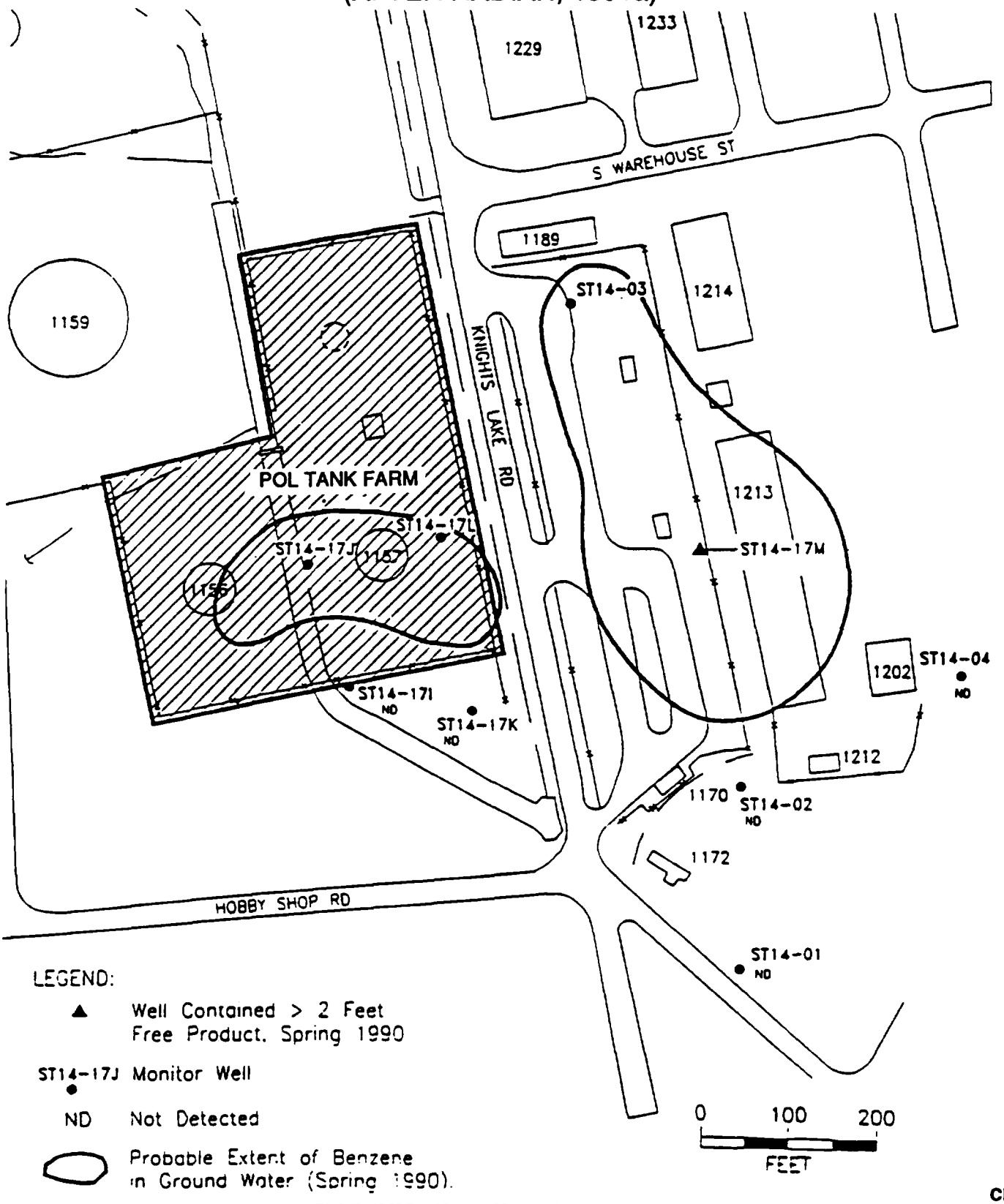


FIGURE 2-7

# PROBABLE EXTENT OF BENZENE CONTAMINATION (SPRING 1990), CARSWELL AIR FORCE BASE, TEXAS (AFTER RADIAN, 1991a)

185 41




CP

DATA COMPILED FROM STAGE 1 AND STAGE 2 RI REPORTS PREPARED BY RADIAN CORPORATION

2.2.1.2 Geology - Geomorphology - The POL Tank Farm is located in a relatively flat area in the eastern part of the base. Elevations range from approximately 580 feet MSL west of the site to 572 feet MSL to the east of the site. The ground surface slopes gently to the south southeast.

Stratigraphy - Previous investigations at the POL Tank Farm (Radian, 1986; Radian, 1991a) have revealed that 16 to more than 20 feet of Quaternary alluvium overlie the Cretaceous Goodland Limestone at this site (Figure 2-8; 2-9). Elevation data from wells and borings that were drilled to the top of the Goodland indicate that the contact of the Limestone with the Quaternary clastic units forms a gently sloping, uniform surface that dips to the southwest.

Quaternary alluvial strata in this area typically contain basal units of sand and gravel 5 to 10 feet thick that overlie the Goodland. The sand units are generally fine grained and vary in color from gray, tan to brown, to pink. The gravel clasts range from pea sized to over an inch in diameter.

Approximately 10 feet of gray to tan clay overlies the basal units. Limonite staining, pebbles and freshwater gastropod shells are frequently found in the clay unit. Hydrocarbon odor was observed emanating from the clay during drilling operations (Radian, 1991a).

Soil Properties

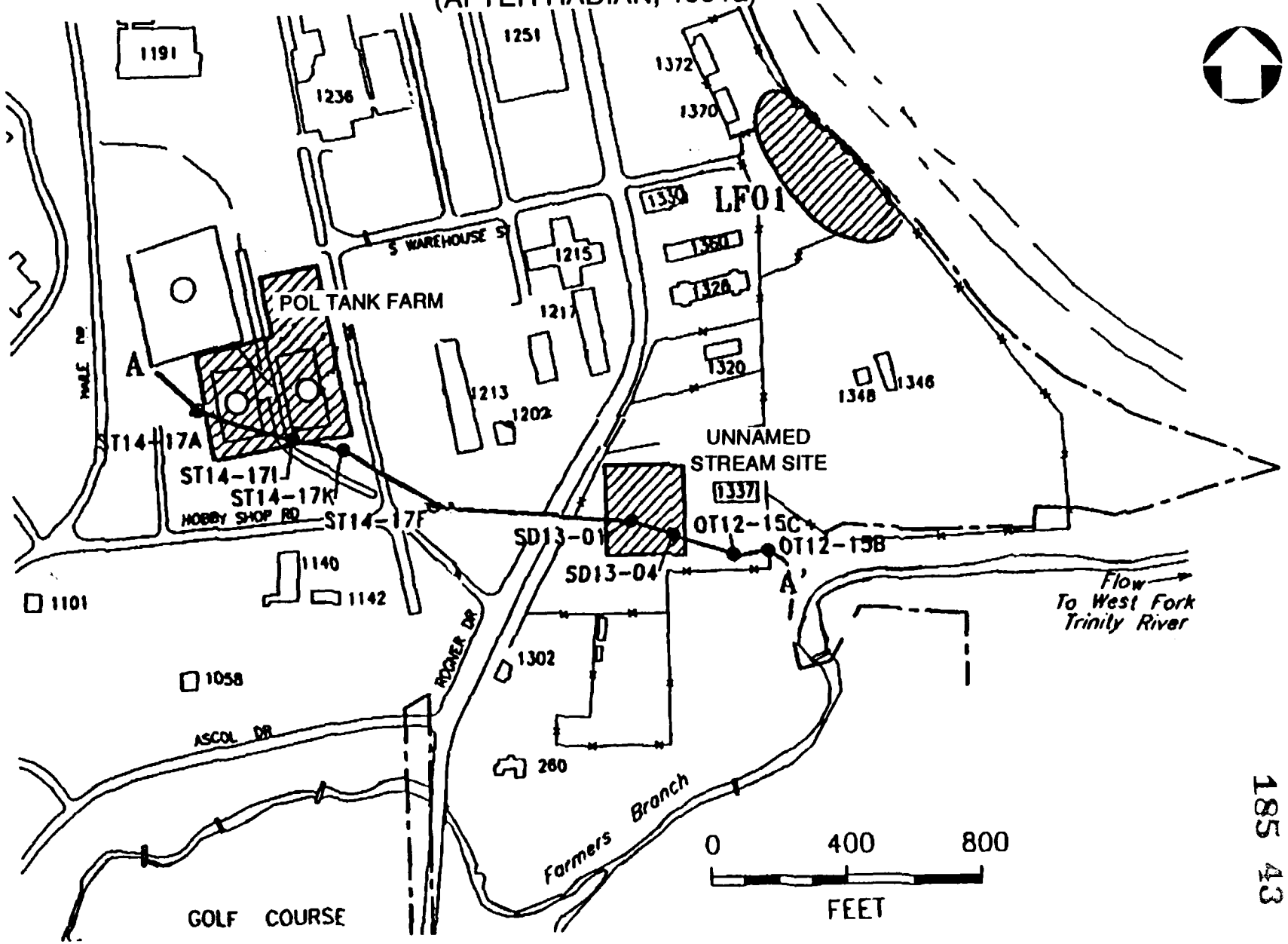
Soils at the POL Tank Farm are of the Sanger-Purves-Slidell Association. This association is characterized by clayey soils found on nearly level to gently sloping uplands. Textures include clay loam and silty clay. Thickness of the soil varies from 8 to 80 inches. Permeability values range from $< 4.2 \times 10^{-5}$ to $3 \times 10^{-4}$ cm/sec.

FIGURE 2-8

# POL TANK FARM AND UNNAMED STREAM CROSS-SECTION LOCATION MAP

CARSWELL AIR FORCE BASE, TEXAS

(AFTER RADIAN, 1991a)



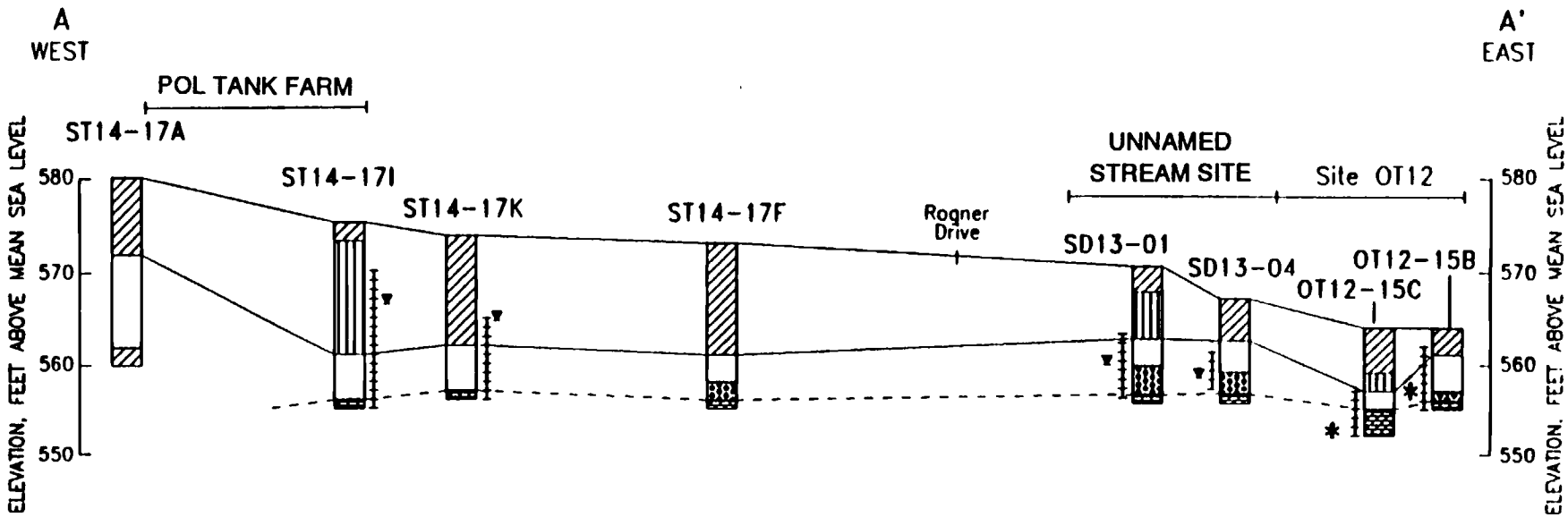

185 43

CP

FIGURE 2-9

# CROSS-SECTION A-A'

CARSWELL AFB, TEXAS
(AFTER RADIAN, 1991a)




## LEGEND:

- Clay and Fill Material
- Silt
- Sand
- Sand and Gravel
- Limestone and Shale
- Top of Bedrock
- Soil Contact
- Water Level, June/1990
- Screened Interval
- Water Level Not Taken

0 100 200 400
FEET
Vertical Exaggeration: 12.5x

185 44

*DATA COMPILED FROM STAGE 1 AND STAGE 2 RI REPORTS PREPARED BY RADIAN CORPORATION*

CP

Soil Geochemistry - Review of existing reports did not reveal site-specific data background or naturally occurring analytes in environmental media. Soil samples collected at this site during the Phase II stage 1 investigation (Radian, 1986) were analyzed only for oil and grease. No soil samples were submitted for chemical analysis in conjunction with the Phase II stage 2 study (Radian, 1991a).

2.2.1.3 Ground Water - The water bearing unit of concern at this site is the upper zone aquifer in the Quaternary alluvium overlying the Goodland formation. No wells have been drilled at this site into the Paluxy Aquifer under the Goodland Aquiclude. Depth to ground water at this site ranges from 8 to 16 feet. The upper zone aquifer is under unconfined conditions and water level is effected by precipitation recharge. Hydraulic conductivity values ranging from $2.5 \times 10^{-4}$ to $1.2 \times 10^{-2}$ cm/sec were calculated from slug tests performed by Radian on wells installed in the Carswell AFB "East Area" during previous investigations. The hydraulic gradient at the time of the June 1990 measurement was on average 0.007 feet/foot (Radian, 1991a). Ground-water velocities calculated from this gradient and an assumed porosity of 20% average about 0.3 ft/day to the southeast (Figure 2-10).

Ground-Water Quality - No data are available to assess background or naturally occurring levels of analytes for this site.

Ground-Water Use - The upper zone aquifer is not currently used as a water source. The only wells completed in the aquifer at this site are monitoring wells installed during prior IRP investigations.

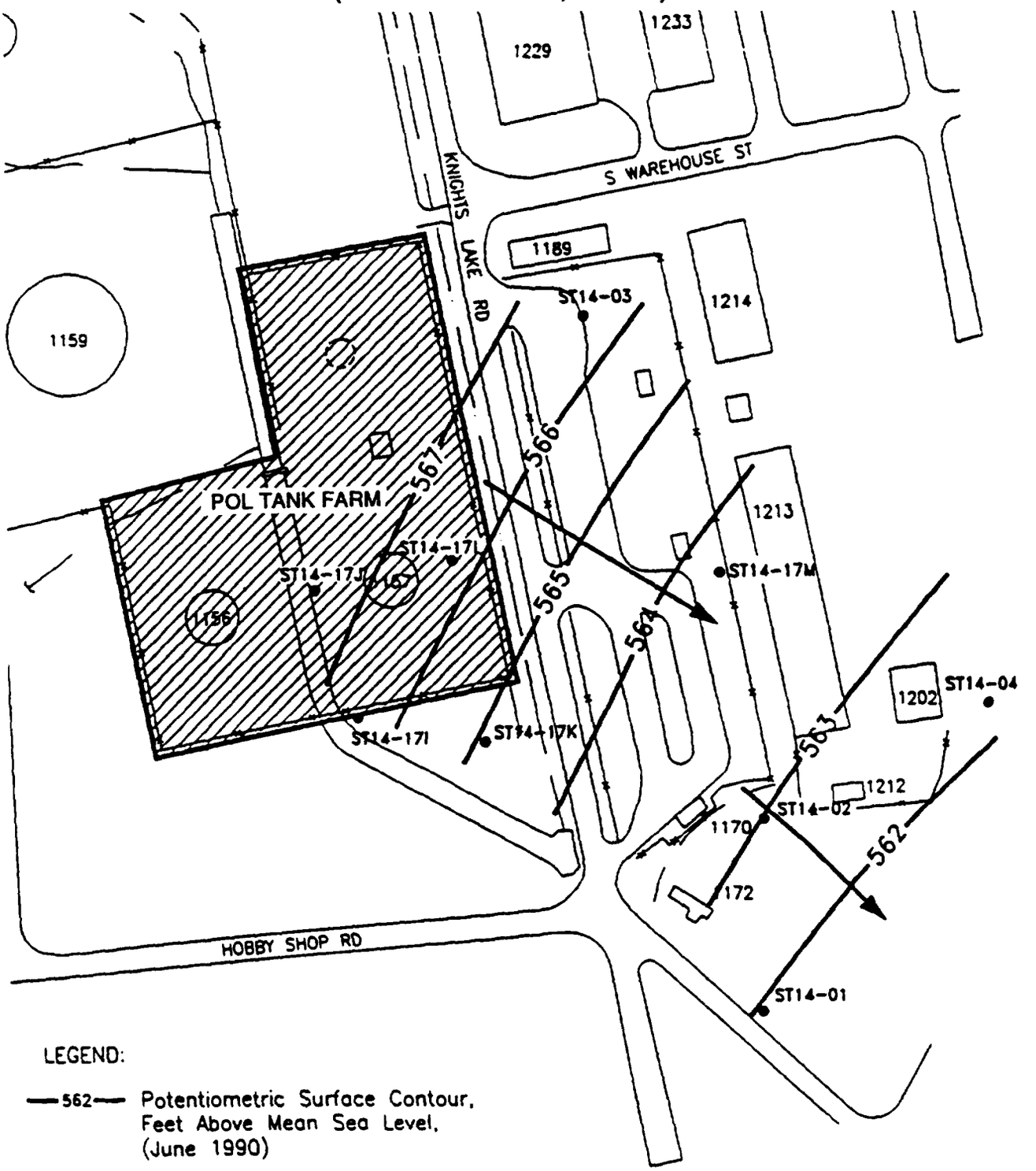
2.2.1.4 Surface Water - The only surface water present at the site is found in the concrete lined portion of the Flightline Drainage

FIGURE 2-10

# POTENTIOMETRIC SURFACE, POL TANK FARM (SPRING 1990)

CARSWELL AIR FORCE BASE, TEXAS
(AFTER RADIAN, 1991a)

185 46




LEGEND:

—562— Potentiometric Surface Contour, Feet Above Mean Sea Level, (June 1990)

• Control Point

← Direction of Ground-Water Flow

0 100 200
FEET

CP

*DATA COMPILED FROM STAGE 1 AND STAGE 2 RI REPORTS PREPARED BY RADIAN CORPORATION*

Ditch that bisects the site. Presence of water in this ditch depends on precipitation. Surface runoff at the site is to the south and east.

2.2.1.5 Air - The prevailing wind direction at the facility is south, and the mean annual wind speed is 7 knots. Meteorological data is presented in Table 2-2. No site-specific data is available on air quality at the facility.

2.2.1.6 Biology - Review of existing information identified this area of the base to be highly developed and paved. No known endangered species or sensitive communities were documented to be present at this site.

2.2.2 Unnamed Stream Site (IRP Site SD-13/SWMU No. 64)

The Unnamed Stream Site (IRP Site SD-13/SWMU No. 64) area is 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 Service Station and the intermittent stream flowing from an Oil/Water separator to Farmer's Branch (Figure 2-11). This stream is approximately 200 ft. long before it enters Farmers Branch (see Figure 2-12).

2.2.2.1 Contaminant Sources and Contamination - Although no documentation has been provided indicating fuel spills or releases, the Abandoned Service Station area could 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 Service Station UST(s) or the POL Tank Farm. Previous studies (Radian, 1986, 1991a) detected low levels of organic

FIGURE 2-11

# LOCATION OF EAST AREA SITES

CARSWELL AIR FORCE BASE, TEXAS

185 48

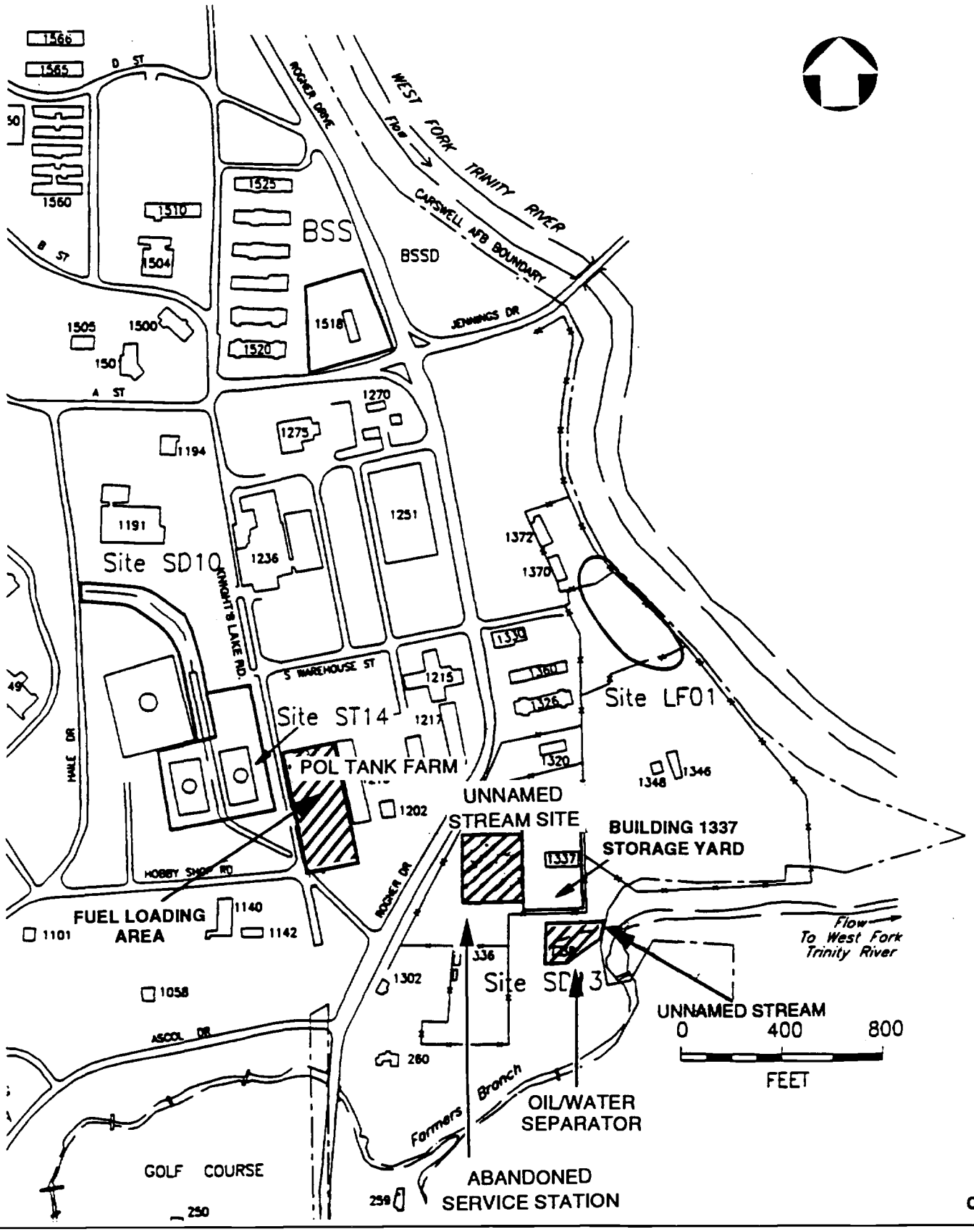


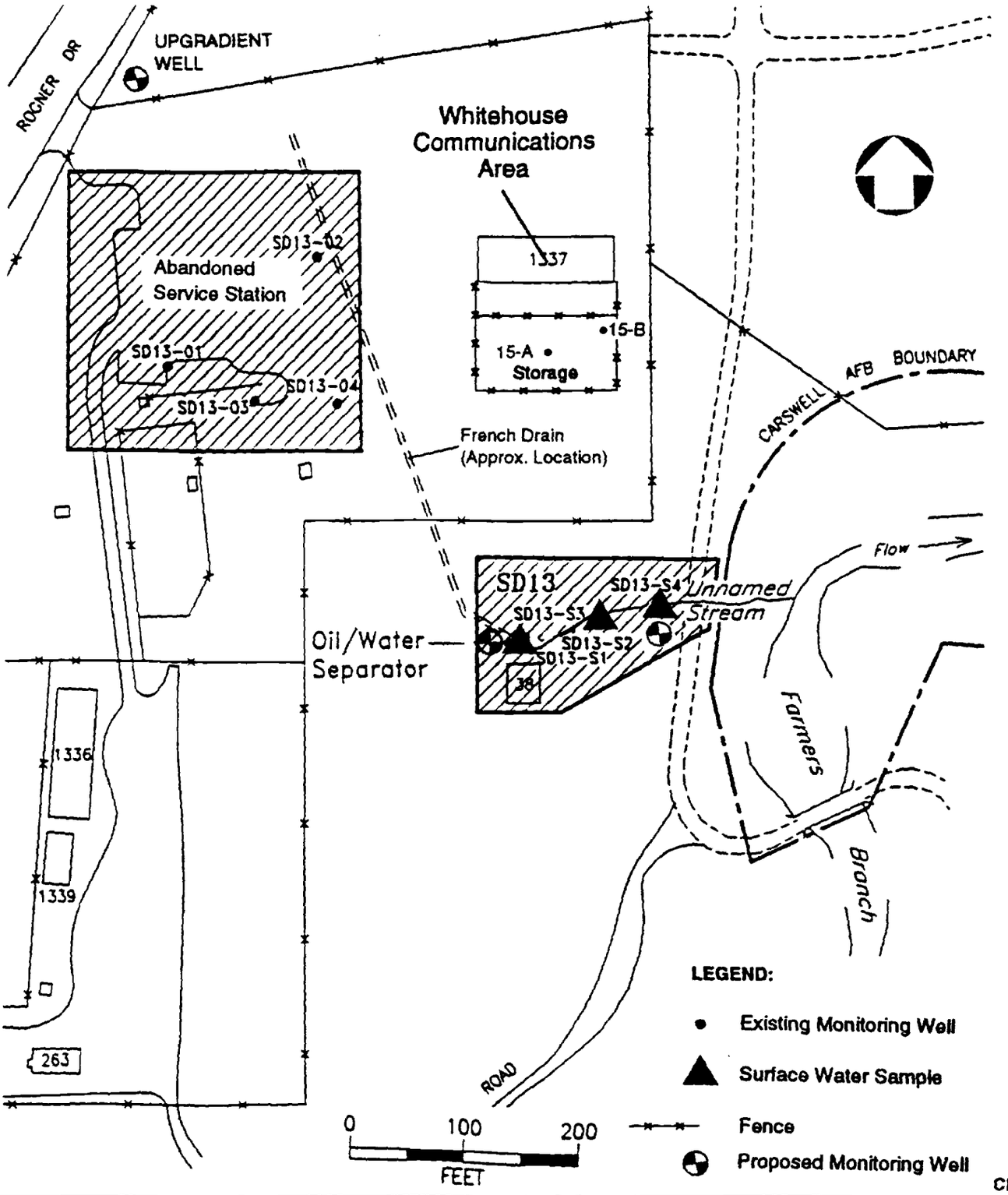
FIGURE 2-12

# LOCATION OF WELLS AND SURFACE WATER SAMPLING LOCATIONS AND APPROXIMATE LOCATIONS OF FRENCH DRAINS AND OIL/WATER SEPARATOR

185 49

(AFTER RADIAN, 1991a)

CARSWELL AIR FORCE BASE, TEXAS



contamination in the ground water at this site. Surface water samples with lead and arsenic in excess of MCLs were collected from the Unnamed Stream downstream from the oil/water separator (Figure 2-12).

2.2.2.2 Geology - Geomorphology - The Abandoned Service Station is located in a fairly flat area in the eastern part of the base. There is approximately 15 to 20 feet of topographic relief between the location of the Abandoned Service Station on the upper terrace deposits and the Unnamed Stream which is located on the lower floodplain of Farmer's Branch.

Stratigraphy - Previous investigations found 10 to 15 feet of Quaternary alluvium overlying the Goodland Formation in the vicinity of the Abandoned Service Station (Figure 2-8; 2-9). Elevation data from wells and borings that were drilled to the top of the Goodland indicate that the upper surface of the limestone dips slightly to the southwest towards Farmer's Branch. No subsurface data is available for the vicinity of the Unnamed Stream.

Quaternary alluvial strata in the area of the Abandoned Service Station contain from 2 to 5 feet of gravel in unconformable contact with the weathered surface of the Goodland formation. The gravel generally consists of subrounded chert and larger limestone clasts. Medium grained sand is usually a component of these units (Radian, 1991).

The gravel unit is overlain by 3 to 5 feet of fine to medium grained sand. Most of the sand in this area is green gray, fine to medium grained and contains minor amounts of clay. Some of the sand is orange to tan, coarser grained and lacking in fines. The uppermost sediments at this site are orange to orange brown clays

and silts ranging in thickness from 4 to 8 feet. Roots, calcareous nodules and oxidation staining are frequently observed in these fine grained clastic units.

Soil Properties - Soils at the Unnamed Stream site are of the Bastil - Silawa Association. This association is characterized by loamy soils on nearly level to sloping stream terraces. Soil texture is predominantly sandy clay loam. Soil thickness ranges from 40 to 80 inches. Permeability values range from $9 \times 10^{-4}$ to $3 \times 10^{-3}$ cm/sec (USDA, 1981).

Soil Geochemistry - Soil samples collected along the Unnamed Stream had high levels of oil and grease that increased with proximity to the oil/water separator (Radian, 1986).

2.2.2.3 Ground Water - The water bearing unit of concern at this site is the upper zone aquifer in the Quaternary alluvium overlying the Goodland Formation. No wells at this site have been drilled into the Paluxy Aquifer. Depth to ground water at this site ranges from 7 to 12 feet. No aquifer tests were performed to determine the hydraulic characteristics of the upper zone at this site. The hydraulic gradient at the time of June 1990 water level measurements was approximately 0.01 ft/ft. Based on the interpreted potentiometric surface, ground-water flow was determined to be to the north-northeast towards the french drain and the Trinity River, instead of to the southwest in the direction of dip at the top of the Goodland (Figure 2-13).

Ground-Water Quality - No data is available for background or naturally occurring analyte concentrations.

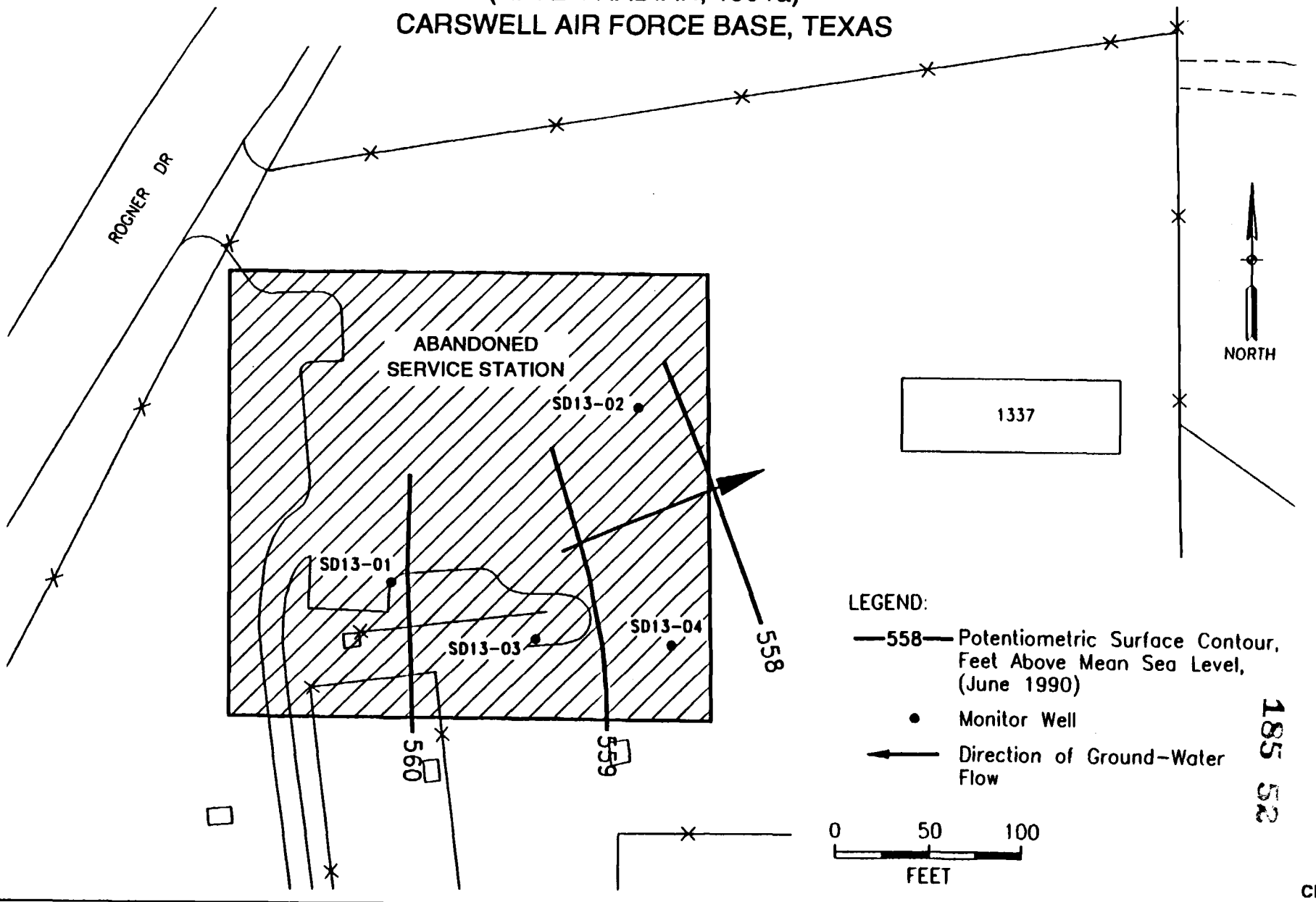
Ground-Water Use - The upper zone aquifer is not currently used as a water source in the vicinity of this site. The only wells completed in the upper zone in this area are monitoring wells.

FIGURE 2-13

# UPPER ZONE POTENTIOMETRIC SURFACE
# UNNAMED STREAM SITE

(AFTER RADIAN, 1991a)

CARSWELL AIR FORCE BASE, TEXAS



However, the upper aquifer has historically been utilized in portions of Tarrant County proximal to the Trinity River for agricultural and residential use. The aquifer has been used as a source of supply by the community of River Oaks, immediately east of Carswell AFB; however, three wells were abandoned when Carswell AFB purchased the property for construction. Development of the upper aquifer has been hampered by low productivity and high susceptibility to contamination (Corps of Engineers, 1991).

2.2.2.4 Surface Water - The Unnamed Stream is a intermittent stream that flows via the oil/water separator from the french drain system. Surface runoff at the Abandoned Service Station is to the south and east.

2.2.2.5 Air - No data is available on air quality at this site.

2.2.2.6 Biology - Based on review of available data, no endangered species or environmentally sensitive communities are known to exist at this site or the surrounding area. The area is highly developed which would discourage most nonhuman habitation.

## 2.3 CONCEPTUAL SITE MODEL

Information obtained during previous environmental investigations and site visits to Carswell AFB concerning the waste sources, pathways, and receptors at each site was used to develop a conceptual understanding of the two sites in order to evaluate potential risks to human health and the environment. Previous investigations include a staged investigation conducted by Radian Corporation under the Installation Restoration Program (IRP). These investigations, Phase II Stage I and Phase II Stage 2 are discussed in Sections 1.0 and 2.0, above. This information was

compiled to produce a preliminary conceptual site model (CSM) for the POL Tank Farm and the Unnamed Stream site area.

The CSM includes known and suspected sources of contamination and affected media, potential routes of migration, and potential human and environmental receptors. The preliminary conceptual site models for the POL Tank Farm area and Unnamed Stream Site are presented graphically as Figure 2-14 and Figure 2-15, respectively. The Conceptual Site Model Summaries, which identify sources, pathways, and receptors are provided as Tables 2-3 and 2-4. The geologic and hydrogeologic data for each site are presented in Figures 2-16 through 2-20. The data presented in the table have been obtained through the review of existing reports (Radian, 1986 and 1991a).

Data for background concentrations of constituents have not been identified by a review of previous reports. Where practicable, samples from upgradient areas will be used for site-specific background levels.

### 2.3.1 Potential Sources

There are two potential sources of constituents of concern for the sites of concern. The potential sources are:

- Leaks and/or spills from aboveground tanks or a pipeline that previously existed at the POL Tank Farm Area

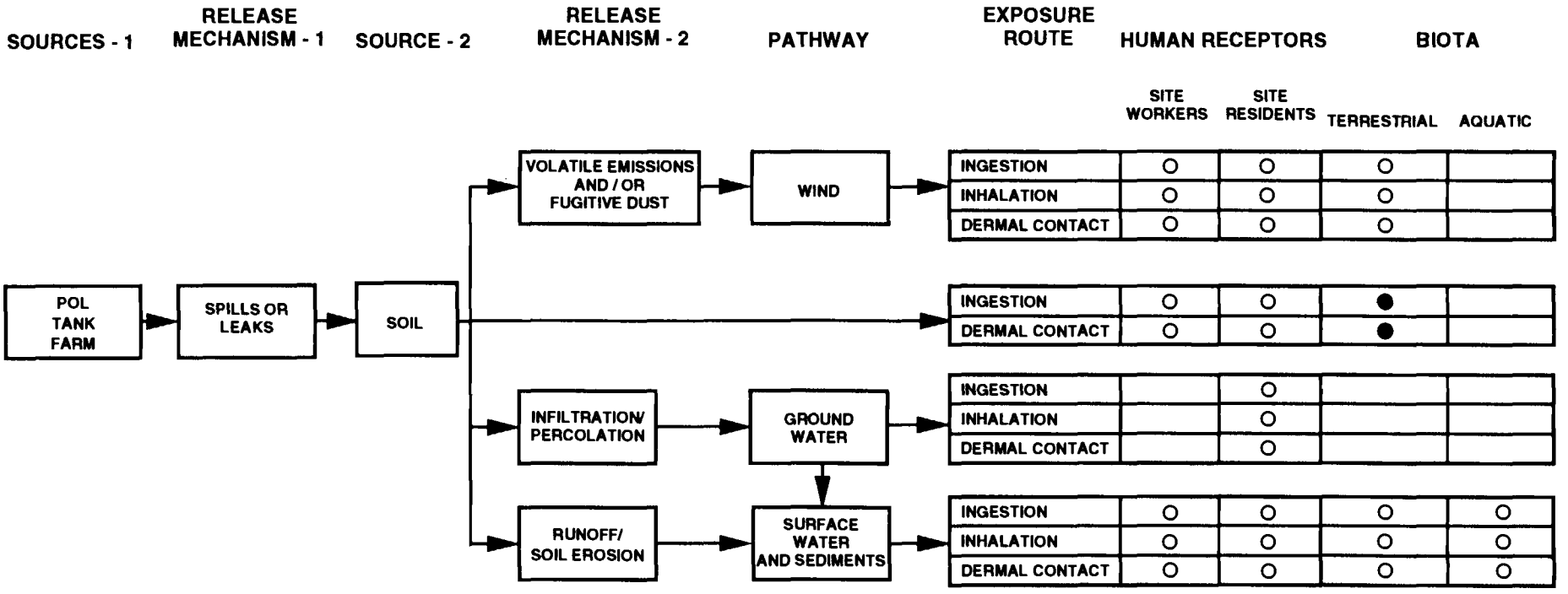
- Leaks and/or spills from the Abandoned Service Station at the Unnamed Stream Site

According to Radian (Radian, 1986), fuel was discovered in the 1960s in the ground at the POL Tank Farm Area and downgradient.

FIGURE 2-14

# CONCEPTUAL SITE MODEL
# POL TANK FARM AREA

CARSWELL AIR FORCE BASE




LEGEND

● - POTENTIALLY COMPLETE PATHWAY UNDER CURRENT OR FUTURE LAND USE

O - POTENTIALLY COMPLETE PATHWAY UNDER FUTURE USE ONLY

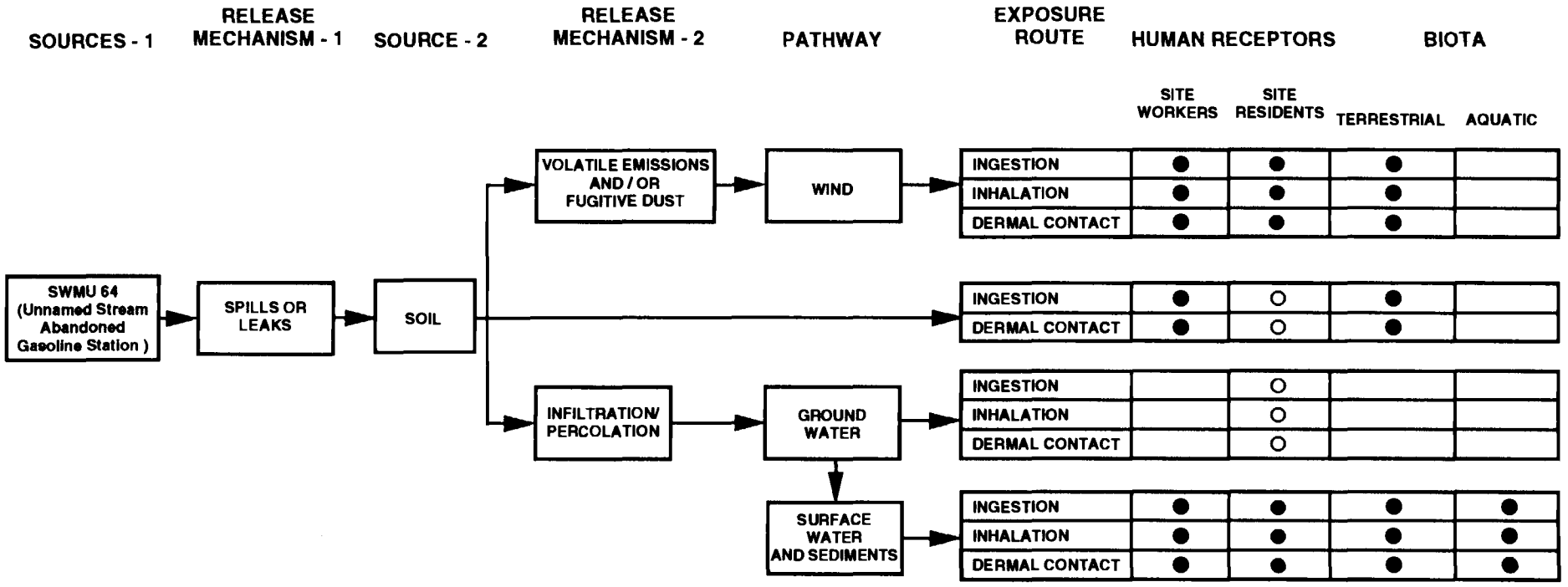
BLANK - CONSIDERED AN INCOMPLETE PATHWAY

3517-0111.02

FIGURE 2-15

# CONCEPTUAL SITE MODEL
# UNNAMED STREAM SITE

CARSWELL AIR FORCE BASE




LEGEND

● - POTENTIALLY COMPLETE PATHWAY UNDER CURRENT OR FUTURE LAND USE

○ - POTENTIALLY COMPLETE PATHWAY UNDER FUTURE USE ONLY

BLANK - CONSIDERED AN INCOMPLETE PATHWAY

185 56

3517-0111.02

## TABLE 2-3

## CONCEPTUAL SITE MODEL SUMMARY
## POL Tank Farm Area
## Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | POTENTIAL RECEPTOR/ EXPOSURE PATHWAY |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| POL Tank Farm Area (ST-14) | Nearly level, with a slight gradient to the east, southeast. Two aboveground fuel storage tanks are located at the site. Three tanks that were previously in use have been removed. | No data | PHASE II STAGE 1 DATA[d] | | | | |
| | | | Organic Indicators | µg/g | | | |
| | | | Oil and grease | 1,300 | Soil | Ground Water | Site Residents; potential future use, ingestion, inhalation of VOCs and dermal contact. |
| | | | PHASE II STAGE 2 DATA[d] | | | Surface Water/ Sediments | Humans: dermal contact and ingestion of fish; inhalation of volatile compounds |
| | | | No soil samples analyzed. | | | | Local fauna: direct ingestion or foodchain impacts |
| | | | | | | Surface Soil (future use, soils are currently covered with gravel) | Humans: ingestion, dermal contact<br>Local fauna: ingestion, dermal contact |
| | | | | | | Air-fugitive dust and release of volatile compounds (future use, soils are currently covered with gravel) | Humans: ingestion, inhalation, and/or dermal contact (with dust)<br>Local fauna: ingestion, inhalation, and/or dermal contact (with dust) |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

## TABLE 2-3

## CONCEPTUAL SITE MODEL SUMMARY
## POL Tank Farm Area
## Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | POTENTIAL RECEPTOR/ EXPOSURE PATHWAY |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| POL Tank Farm Area (ST-14) | Nearly level, with a slight gradient to the east, southeast. Two aboveground fuel storage tanks are located at the site. Three tanks that were previously in use have been removed. | No data | PHASE II STAGE 1 DATA[e] | | | | |
| | | | Organic Indicators | mg/L | | Primary: | |
| | | | Oil and grease | 31,000 | Ground Water | Ground Water | Site residents, potential future use: ingestion, inhalation and dermal contact of volatile chemicals |
| | | | TOC | 190 | Ground Water | | |
| | | | TOX | 0.12 | Ground Water | Surface Water/ Sediments | Humans; dermal contact, inhalation of VOCS, and ingestion of fish |
| | | | Purgeable Aromatics | | | | Local fauna; direct ingestion or foodchain |
| | | | Not analyzed. | | | | |
| | | | Purgeable Hydrocarbons | | | | |
| | | | Not Detected | | | | |
| | | | PHASE II STAGE 2 DATA[e] | | | | |
| | | | Metals | mg/L | | | |
| | | | Aluminum | 36.0 | Ground Water | | |
| | | | Arsenic | 0.039 | Ground Water | | |
| | | | Barium | 0.58 | Ground Water | | |
| | | | Beryllium | 0.007 | Ground Water | | |
| | | | Boron | 3.8 | Ground Water | | |
| | | | Cadmium | 0.007 | Ground Water | | |
| | | | Calcium | 550.0 | Ground Water | | |
| | | | Chromium | 0.066 | Ground Water | | |
| | | | Cobalt | 0.029 | Ground Water | | |
| | | | Copper | 0.07 | Ground Water | | |
| | | | Iron | 0.72 | Ground Water | | |
| | | | Lead | 0.69 | Ground Water | | |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

## TABLE 2-3

## CONCEPTUAL SITE MODEL SUMMARY
## POL Tank Farm Area
## Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | POTENTIAL RECEPTOR/ EXPOSURE PATHWAY |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| POL Tank Farm Area (ST-14) | Nearly level, with a slight gradient to the east, southeast. Two aboveground fuel storage tanks are located at the site. Three tanks that were previously in use have been removed. | No data | PHASE II STAGE 2 DATA[a] (Continued) | | | Primary: | |
| | | | Magnesium | 14.0 | Ground Water | Ground Water | Site resident: potential future use; ingestion, inhalation of VOCs and dermal contact |
| | | | Manganese | 0.73 | Ground Water | | |
| | | | Nickel | 0.072 | Ground Water | | |
| | | | Potassium | 7.3 | Ground Water | | |
| | | | Silicon | 75.0 | Ground Water | | |
| | | | Silver | 0.036 | Ground Water | | |
| | | | Sodium | 32.0 | Ground Water | | |
| | | | Strontium | 0.71 | Ground Water | Surface Water/ Sediments | Humans; dermal contact, inhalation of VOCs and ingestion of fish |
| | | | Vanadium | 0.17 | Ground Water | | |
| | | | Zinc | 0.12 | Ground Water | | Local fauna; ingestion, inhalation and/or dermal contact, impact through the foodchain |
| | | | Volatile Organics | µg/L | | | |
| | | | Benzene | 16.0 | Ground Water | | |
| | | | Chlorobenzene | 38.0 | Ground Water | | |
| | | | Ethylbenzene | 35.0 | Ground Water | | |
| | | | Toluene | 22.0 | Ground Water | | |
| | | | Xylenes | 300 | Ground Water | | |
| | | | Water Quality Indicators | | | | |
| | | | Chloride | 35.0 | | | |
| | | | Fluoride | 0.3 | | | |
| | | | Nitrate as N | 1.1 | | | |
| | | | Sulfate | 37.0 | | | |
| | | | Total Dissolved solids | 1200.0 | | | |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

## TABLE 2-4

## CONCEPTUAL SITE MODEL SUMMARY
## Unnamed Stream Site
## Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | RECEPTOR/ EXPOSED POPULATION |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| Unnamed Stream Site (SD-13) | The Unnamed Stream is a man-made outfall to the Farmer's Branch. It receives its perennial flow from an oil/water separator at the end of a french underdrain system. The abandoned gas station is a nearly level, paved area where a base gasoline station was formerly located. | No data | PHASE II STAGE 1 DATA[a] | | | | |
| | | | Metals | µg/g | | | |
| | | | Arsenic | 11 | Soil | Surface Soil (future use, site is currently paved) | Human: ingestion, dermal contact |
| | | | Barium | 85 | Soil | | |
| | | | Cadmium | 0.89 | Soil | | Local fauna: ingestion, dermal contact |
| | | | Chromium (total) | 13 | Soil | | |
| | | | Lead | 20 | Soil | Surface Water/Sediments | Humans; dermal contact and ingestion of fish from Farmer's Branch |
| | | | Mercury | 0.10 | Soil | | |
| | | | Selenium | 41 | Soil | | Local fauna: ingestion, inhalation, and/or dermal contact |
| | | | Silver | 1.2 | Soil | | |
| | | | Organics | µg/g | | | |
| | | | Oil and grease | 240 | Soil | | |
| | | | Purgeable Aromatics | | | Ground Water | Site Residents; potential future use; ingestion, inhalation of volatiles, and dermal contact |
| | | | Toluene | 0.54 | Soil | | |
| | | | Purgeable Halocarbons | Not Detected | Soil | Air volatile emissions from stream bank (current and future use) and fugitive dust or volatile emissions from gas station area (future use, site is mostly paved) | Site workers and on-site residents (potential future use) via inhalation |
| | | | | | | | Local fauna: inhalation |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

## TABLE 2-4

## CONCEPTUAL SITE MODEL SUMMARY
### Unnamed Stream Site
### Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | RECEPTOR/ EXPOSED POPULATION |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| Unnamed Stream Site (SD-13) | The Unnamed Stream is a man-made outfall to the Farmer's Branch. It receives its perennial flow from an oil/water separator at the end of a french underdrain system. The abandoned gas station is a nearly level, paved area where a base gasoline station was formerly located. | No data | PHASE II STAGE 1 DATA[b] | | | | |
| | | | Metals | mg/L | | | |
| | | | Arsenic | 0.16 | Surface Water | Surface Water/ Sediments | Humans: dermal contact and ingestion of fish from Farmer's Branch |
| | | | Barium | 0.29 | Surface Water | | |
| | | | Cadmium | 0.007 | Surface Water | | Local fauna: ingestion, inhalation and/or dermal contact |
| | | | Chromium | 0.017 | Surface Water | | |
| | | | Lead | 0.081 | Surface Water | Air volatile emissions from stream bank (current and future land use) or fugitive dust and VOC release from former gas station site (future use, site is currently paved) | Site workers and on-site residents (potential future use); via inhalation |
| | | | Mercury | 0.0004 | Surface Water | | Local fauna: inhalation |
| | | | Organic Indicators | mg/L | | Ground Water | Site residents; potential future use; ingestion, inhalation of volatiles, and dermal contact |
| | | | Oil and grease | 640 | Surface Water | | |
| | | | Total organic carbon (TOC) | 200 | Surface Water | | |
| | | | Total Halocarbons (TOX) | 0.01 | Surface Water | | |
| | | | Purgeable Aromatics | Not Detected | Surface Water | | |
| | | | Purgeable Halocarbons | µg/L | | | |
| | | | Trichlorofluoromethane | 2.9 | Surface Water | | |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

## TABLE 2-4

## CONCEPTUAL SITE MODEL SUMMARY
## Unnamed Stream Site
## Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | RECEPTOR/ EXPOSED POPULATION |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| Unnamed Stream Site (SD-13) | The Unnamed Stream is a man-made outfall to the Farmer's Branch. It receives its perennial flow from an oil/water separator at the end of a french underdrain system. The abandoned gas station is a nearly level, paved area where a base gasoline station was formerly located. | No data | PHASE II STAGE 2 DATA[c] | | | | |
| | | | Metals | mg/L | | | |
| | | | Arsenic | 0.086 | Surface Water | | |
| | | | Barium | 0.29 | Surface Water | | |
| | | | Calcium | 130 | Surface Water | Surface Water/ Sediments | Humans: dermal contact and ingestion of fish from Farmer's Branch |
| | | | Cobalt | 0.011 | Surface Water | | |
| | | | Iron | 26.0 | Surface Water | | Local fauna: ingestion, direct contact and impact through the food chain |
| | | | Lead | 0.066 | Surface Water | | |
| | | | Magnesium | 6.4 | Surface Water | Air (volatile emissions) from water | Site workers (current and future use) and on-site residents (potential future use); via inhalation |
| | | | Manganese | 0.21 | Surface Water | | Local fauna: inhalation |
| | | | Selenium | 30.0 | Surface Water | | |
| | | | Volatile Organics | µg/L | | | |
| | | | 1,3-Dichlorobenzene | 1.2 | Surface Water | | |
| | | | 1,4-Dichlorobenzene | 1.7 | Surface Water | | |
| | | | Benzene | 0.31 | Surface Water | | |
| | | | Chlorobenzene | 2.8 | Surface Water | | |
| | | | Ethylbenzene | 0.97 | Surface Water | | |
| | | | Toluene | 0.59 | Surface Water | | |
| | | | Xylenes | 0.53 | Surface Water | | |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

## TABLE 2-4

## CONCEPTUAL SITE MODEL SUMMARY
### Unnamed Stream Site
### Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | RECEPTOR/ EXPOSED POPULATION |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| Unnamed Stream Site (SD-13) | The Unnamed Stream is a man-made outfall to the Farmer's Branch. It receives its perennial flow from an oil/water separator at the end of a french underdrain system. The abandoned gas station is a nearly level, paved area where a base gasoline station was formerly located. | No data | Non-Metals | mg/L | | | |
| | | | Chloride | 26.0 | Surface Water | Surface Water/ Sediments | Humans: dermal contact and ingestion of fish |
| | | | Fluoride | 0.29 | Surface Water | | |
| | | | Nitrate as N | 0.56 | Surface Water | | Local fauna: ingestion, direct contact and impact through the food chain |
| | | | Orthophosphate | 0.024 | Surface Water | | |
| | | | Sulfate | 16.0 | Surface Water | Air (volatile emissions) from water | Site workers (current and future use) and on-site residents (potential future use); via inhalation |
| | | | Total Dissolved Solids | 470 | Surface Water | | Local fauna: inhalation |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

## TABLE 2-4

## CONCEPTUAL SITE MODEL SUMMARY
## Unnamed Stream Site
## Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | RECEPTOR/ EXPOSED POPULATION |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| Unnamed Stream Site (SD-13) | The Unnamed Stream is a man-made outfall to the Farmer's Branch. It receives its perennial flow from an oil/water separator at the end of a french underdrain system. The abandoned gas station is a nearly level, paved area where a base gasoline station was formerly located. | No data | PHASE II STAGE 1 DATA[d] | | | | |
| | | | Metals | mg/L | | Primary: | |
| | | | Barium | 1.3 | Ground Water | Ground Water | Site residents (potential future use); ingestion, inhalation of volatiles, and dermal contact |
| | | | Mercury | 0.0006 | Ground Water | | |
| | | | Organic Indicators | mg/L | | Surface Water/ Sediments | Humans: dermal contact and ingestion of fish |
| | | | Oil and grease | 7,100 | Ground Water | | |
| | | | TOC | 420 | Ground Water | | |
| | | | TOX | 0.04 | Ground Water | | |
| | | | Purgeable Halocarbons | µg/L | | | |
| | | | Trichlorofluoromethane | 4.2 | Ground Water | | |
| | | | 1,1,1-trichloroethane | 2.9 | Ground Water | | |
| | | | trans-1,2-dichloroethene | 0.1 | Ground Water | | |
| | | | Purgeable Aromatics | µg/L | | | |
| | | | 1,4-Dichlorobenzene | no data; reported as "very high" | Ground Water | | |
| | | | 1,2-Dichlorobenzene | no data; reported as "very high" | Ground Water | | |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

## TABLE 2-4

## CONCEPTUAL SITE MODEL SUMMARY
## Unnamed Stream Site
## Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | RECEPTOR/ EXPOSED POPULATION |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| Unnamed Stream Site (SD-13) | The Unnamed Stream is a man-made outfall to the Farmer's Branch. It receives its perennial flow from an oil/water separator at the end of a french underdrain system. The abandoned gas station is a nearly level, paved area where a base gasoline station was formerly located. | No data | PHASE II STAGE 2 DATA* | | | | |
| | | | Metals | mg/L | | Primary: | |
| | | | Aluminum | 12.0 | Ground Water | Ground Water | Site residents; potential future use; ingestion, dermal contact, and inhalation of VOCs |
| | | | Arsenic | 0.042 | Ground Water | | |
| | | | Barium | 0.63 | Ground Water | Surface Water/ Sediments | Humans: dermal contact and ingestion of fish |
| | | | Boron | 1.1 | Ground Water | | |
| | | | Calcium | 270.0 | Ground Water | | Local fauna: Direct contact and possible food chain contamination |
| | | | Chromium | 0.024 | Ground Water | | |
| | | | Cobalt | 0.017 | Ground Water | | |
| | | | Copper | 0.023 | Ground Water | | |
| | | | Iron | 44.0 | Ground Water | | |
| | | | Lead | 0.031 | Ground Water | | |
| | | | Magnesium | 9.5 | Ground Water | | |
| | | | Manganese | 0.46 | Ground Water | | |
| | | | Nickel | 0.041 | Ground Water | | |
| | | | Potassium | 3.6 | Ground Water | | |
| | | | Silicon | 36.0 | Ground Water | | |
| | | | Silver | 0.012 | Ground Water | | |
| | | | Sodium | 29.0 | Ground Water | | |
| | | | Strontium | 0.56 | Ground Water | | |
| | | | Vanadium | 0.058 | Ground Water | | |
| | | | Zinc | 0.13 | Ground Water | | |

[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
* Radian Corporation, 1991

## TABLE 2-4

## CONCEPTUAL SITE MODEL SUMMARY
### Unnamed Stream Site
### Carswell Air Force Base, Texas

| SITE IDENTIFICATION | SITE DESCRIPTION | BACKGROUND CONC. | SOURCE | | | MIGRATION PATHWAY | RECEPTOR/ EXPOSED POPULATION |
|---|---|---|---|---|---|---|---|
| | | | Contaminants | Maximum Concentration | Media | | |
| Unnamed Stream Site (SD-13) | The Unnamed Stream is a man-made outfall to the Farmer's Branch. It receives its perennial flow from an oil/water separator at the end of a french underdrain system. The abandoned gas station is a nearly level, paved area where a base gasoline station was formerly located. | No data | PHASE II STAGE 2 DATA[e] (continued) | | | | |
| | | | Volatile Organics | µg/L | | | |
| | | | Benzene | 2.0 | Ground Water | Ground Water | Site residents; potential future use; ingestion, inhalation of volatiles, and dermal contact |
| | | | Chlorobenzene | 3.6 | Ground Water | | |
| | | | Toluene | 59.0 | Ground Water | Surface Water/Sediment | Humans: dermal contact and ingestion of fish from Farmer's Branch |
| | | | Water Quality Indicators | mg/L | | | |
| | | | Chloride | 26.0 | Ground Water | | Local Fauna: Direct contact and possible food chain impact |
| | | | Fluoride | 0.29 | Ground Water | | |
| | | | Nitrate | 0.14 | Ground Water | | |
| | | | Sulfate | 13.0 | Ground Water | | |
| | | | Total Dissolved Solids | 460.0 | Ground Water | | |

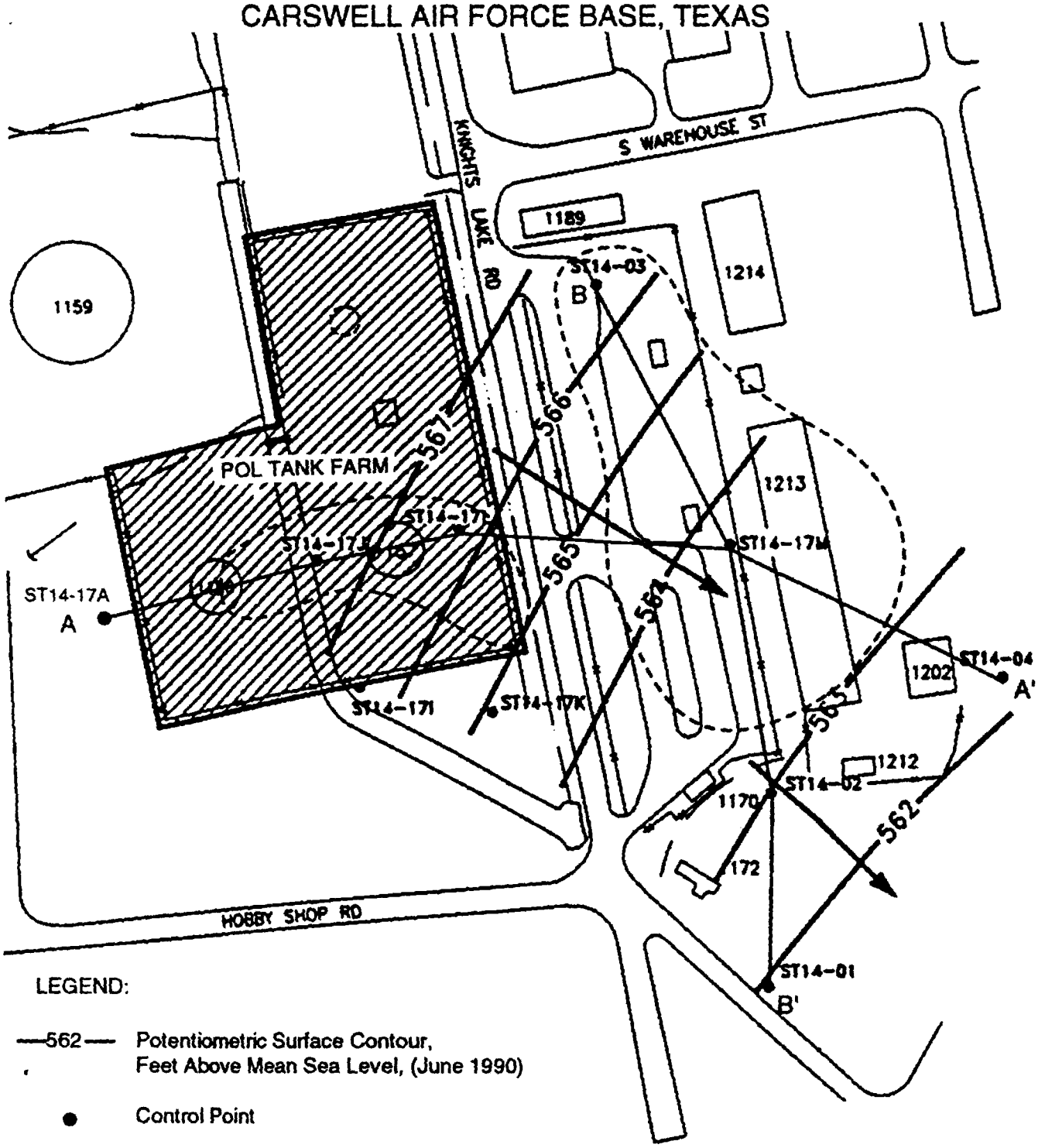
[a] Concentrations were determined from surface and subsurface soil samples and reported in Radian Corporation, 1986.
[b] Samples collected from oil/water separator and reported in Radian Corporation, 1986.
[c] Samples collected from Unnamed Stream and data reported by Radian, 1991.
[d] Radian Corporation, 1986
[e] Radian Corporation, 1991

FIGURE 2-16

# SITE CHARACTERIZATION PLAN VIEW
# POL TANK FARM AREA
# BENZENE DETECTION AND POTENTIOMETRIC CONTOURS

CARSWELL AIR FORCE BASE, TEXAS

185 67

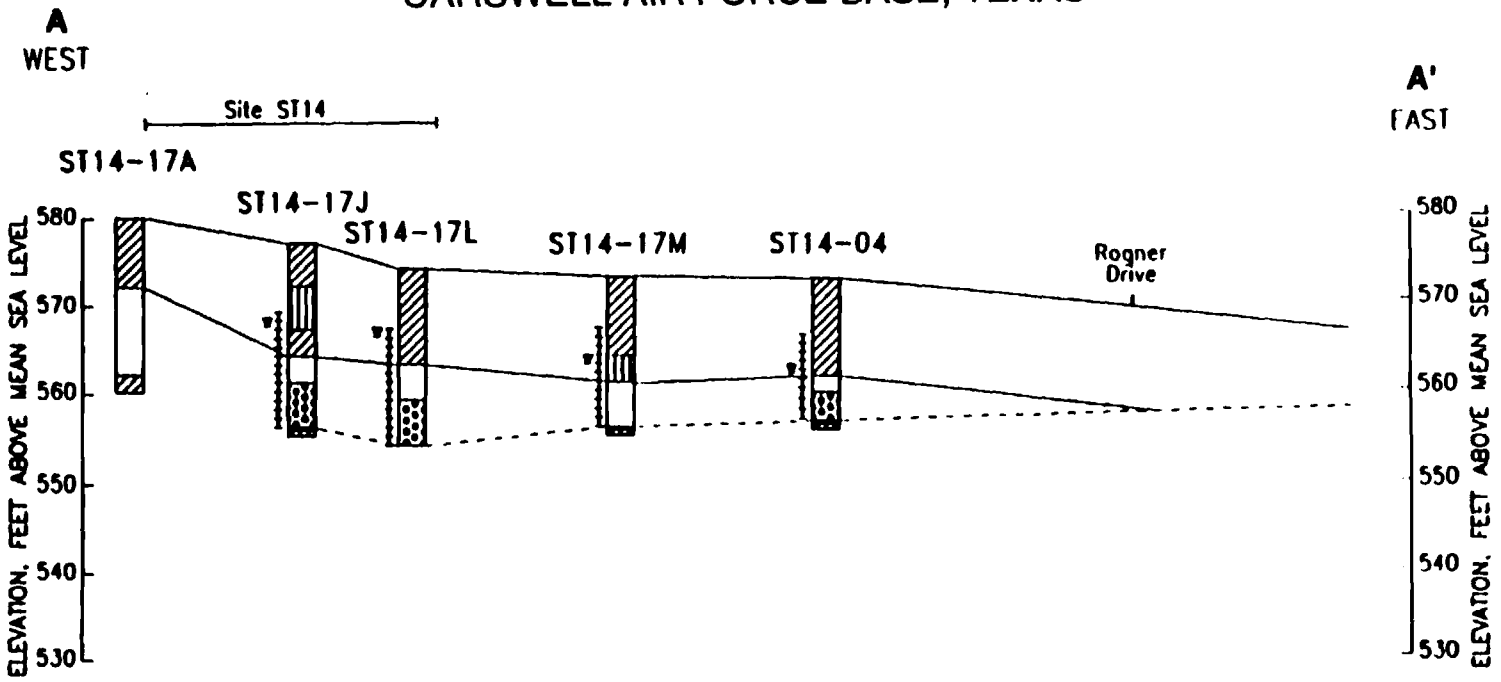



DATA COMPILED FROM STAGE 1 AND STAGE 2 RI REPORTS PREPARED BY RADIAN CORPORATION

FIGURE 2-17

# CROSS-SECTION A-A'
# POL TANK FARM AREA

## CARSWELL AIR FORCE BASE, TEXAS




**LEGEND:**

- Clay and Fill Material
- Silt
- Sand
- Sand and Gravel
- Limestone and Shale
- Top of Bedrock
- Soil Contact
- Water Level, June/1990
- Screened Interval

0 100 200 400

FEET

Vertical Exaggeration: 12.5x

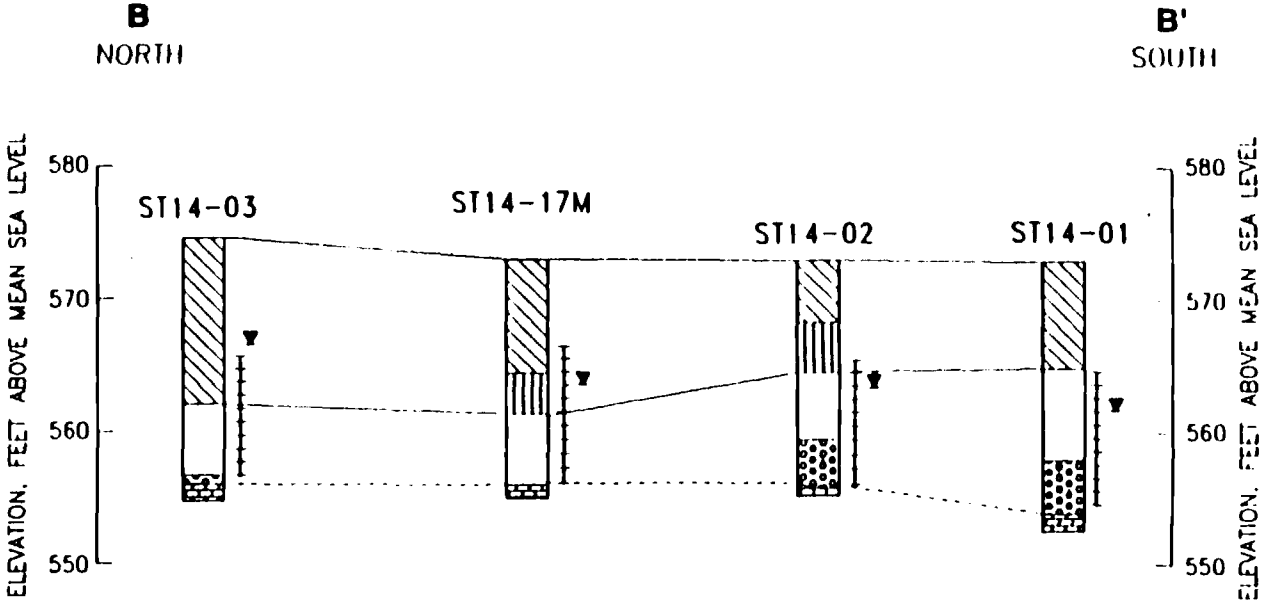
185 68

*DATA COMPILED FROM STAGE 1 AND STAGE 2 RI REPORTS*
*PREPARED BY RADIAN CORPORATION*

CP

FIGURE 2-18

# CROSS-SECTION B-B'
# POL TANK FARM AREA
## CARSWELL AIR FORCE BASE, TEXAS




LEGEND:

- Clay and Fill Material
- Silt
- Sand
- Sand and Gravel
- Limestone and Shale
- Top of Bedrock
- Soil Contact
- Water Level, June/1990
- Screened Interval

0 100 200 400
FEET
Vertical Exaggeration: 12.5x

(DATA COMPILED FROM STAGE 1 AND STAGE 2 RI REPORTS PREPARED BY RADIAN CORP.)

185 63

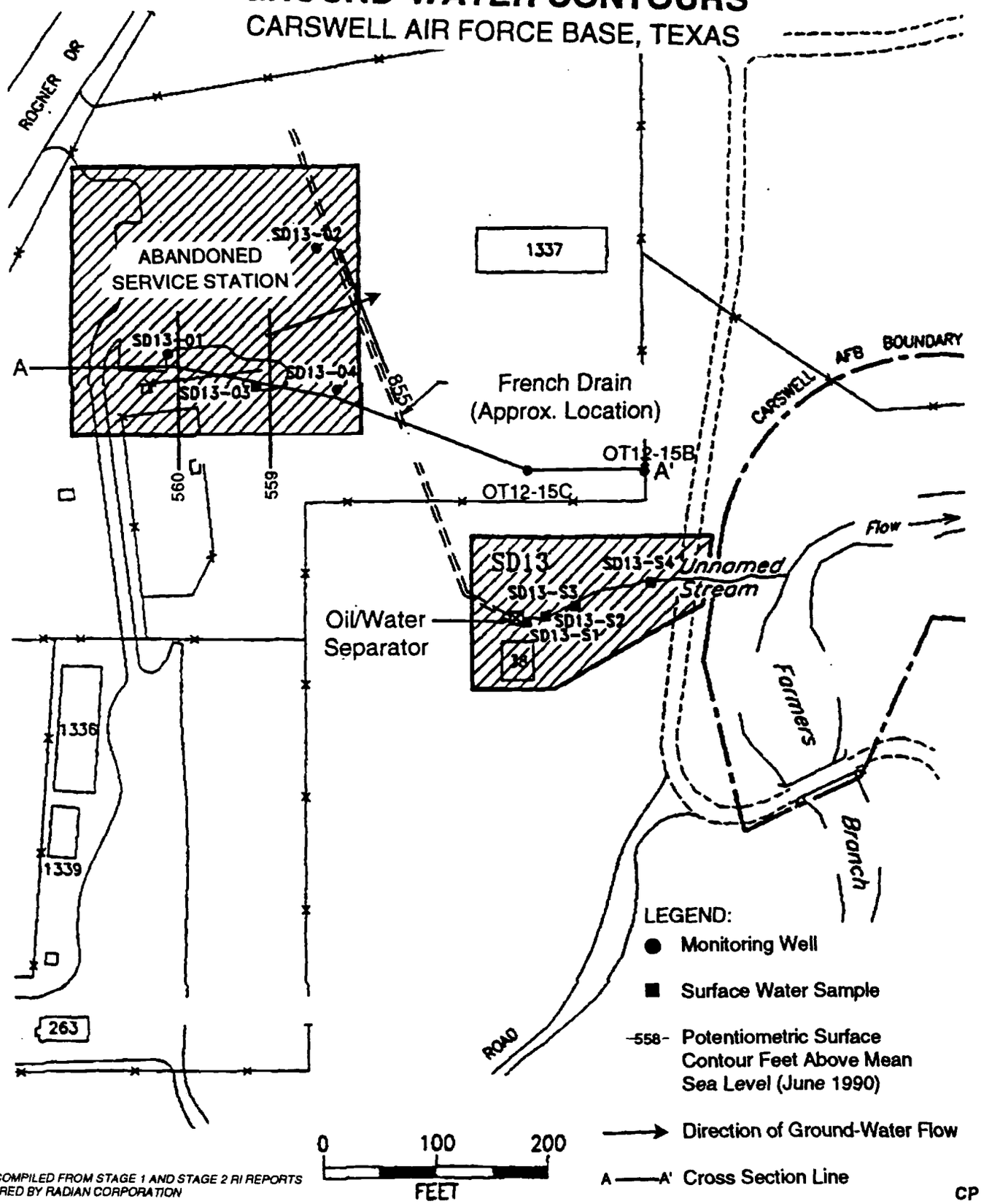
CP

FIGURE 2-19

# SITE CHARACTERIZATION PLAN VIEW
# UNNAMED STREAM SITE
# GROUND-WATER CONTOURS

CARSWELL AIR FORCE BASE, TEXAS

185 70

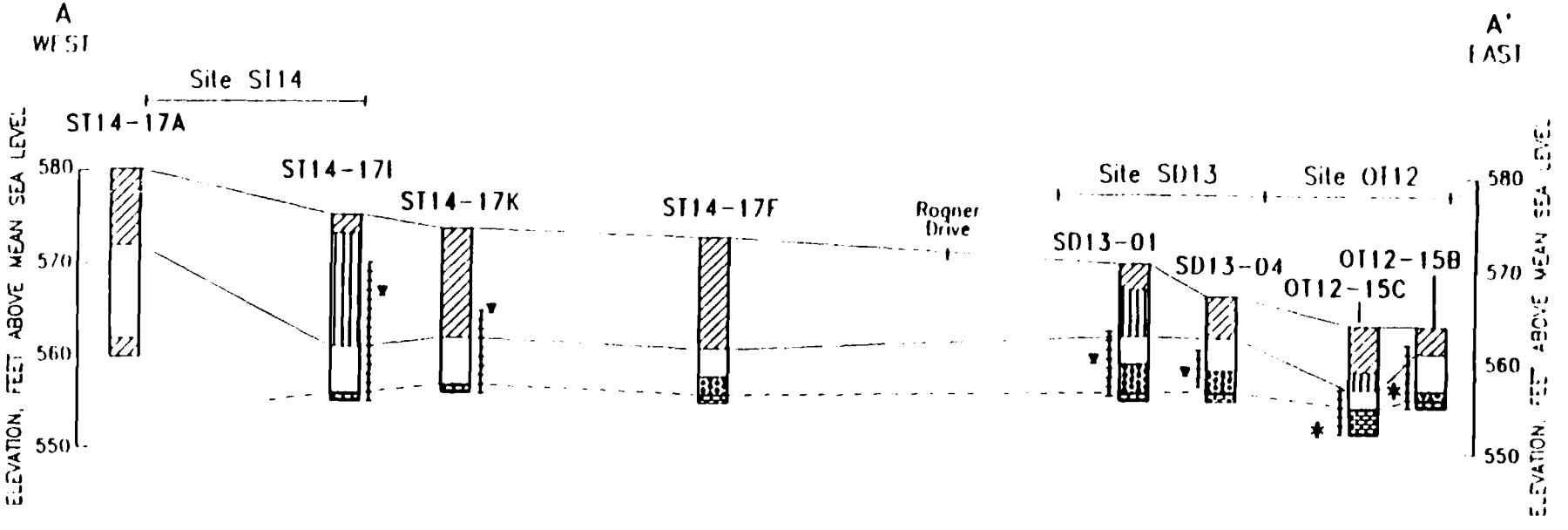



DATA COMPILED FROM STAGE 1 AND STAGE 2 RI REPORTS PREPARED BY RADIAN CORPORATION

CP

FIGURE 2-20

# CROSS-SECTION A-A'
# UNNAMED STREAM SITE
## CARSWELL AIR FORCE BASE, TEXAS




LEGEND:

- Clay and Fill Material
- Silt
- Sand
- Sand and Gravel
- Limestone and Shale
- Top of Bedrock
- Soil Contact
- Water Level, June/1990
- Screened Interval
- * Water Level Not Taken

0 100 200 400

FEET

Vertical Exaggeration 12.5x

(DATA COMPILED FROM STAGE 1 AND STAGE 2 RI REPORTS PREPARED BY RADIAN CORP.)

CP

185 71

The report does not state whether fuel was originally discovered by observation, or by collection of soil or ground-water samples. Following the discovery, a french drain collection system was reportedly installed in 1965 downgradient of the Tank Farm. The french drain has its outlet at an underground oil/water separator which discharges to the Unnamed Stream. A review of reports from previous investigations did not establish the source of the constituents collected by the French drain system. Information on suspect leaks or spills from the Abandoned Service Station was also unavailable.

The CSM considers that the potential sources of contamination may be affecting the following media:

| | |
|---|---|
| Ground Water: | The upper zone aquifer |
| Surface Water: | Unnamed Stream and Farmer's Branch (tributary of the West Fork of the Trinity River) |
| Sediment: | Unnamed Stream and Farmer's Branch |
| Soil: | Surface Soil<br>Subsurface Soil |

### 2.3.2 Potential Exposure Routes and Receptors

This section presents the assumptions and rationale used for developing the preliminary CSM. In the preliminary CSM, exposure routes will be assumed based on the potential presence of chemicals of concern in environmental media at the site. Once the analytical data from the field effort is evaluated, the conceptual site model should be refined based on the actual media that contain chemicals

of concern, if any. This section follows the format of Figures 2-14 and 2-15; potential exposures due to release of volatile compounds to the atmosphere from surface water and ground water are discussed under their respective paragraphs, and not under the air pathway.

2.3.2.1 POL Tank Farm Area - At the POL Tank Farm Area, chemicals of potential concern may be present in soils or ground water (Radian, 1991a).

Air Pathway

Two mechanisms were evaluated for release of chemicals of concern to the atmosphere at this site: volatilization from surface soil and release of fugitive dust due to wind erosion. The volatile chemicals associated with petroleum-based fuels are readily soluble in water and have significant vapor pressures. For example, benzene has a solubility of $1.77 \times 10^3$ and a vapor pressure of 0.125 atmosphere (Montgomery and Welkon, 1990). Because of water solubility, chemicals in this group are likely to be leached downward with rainfall. Because the release at the site is a historic release and not an ongoing release, any remaining chemical near the surface would probably have volatilized to the atmosphere. Therefore, the exposure pathway for volatilized chemicals is incomplete under current land use. The pathway is considered complete under future use because soil disturbance could expose deeper soils where volatile organic compounds (VOCs) could be present. Because semi-volatile organic compounds and metals are components of fuels, the potential for wind erosion should be considered. During wind erosion, chemicals attached to dust could be transported downwind to potential receptors. The POL Tank Farm Area is covered with grass, gravel, or paved and therefore, wind erosion is an incomplete pathway under current land use. The CSM considers the wind erosion pathway complete under future land use

because ground cover could be removed if site usage were to change. Potential receptors under current land use are Base personnel ("site workers") that work in and around the area. Under future land use, site workers and downwind residents could be exposed by the air pathway. The exposure mechanism for the air pathway is inhalation of volatilized chemicals or dust. The CSM considers a potentially complete pathway for ecological receptors under future land use. Visual observations during the site visit conducted by Law in October 1993 suggest a lack of habitat for ecological receptors. Fauna could be exposed off-site under future land use conditions, if soil disturbance were to occur. The exposure mechanism for ecological receptors (fauna) could be inhalation of dust or volatile compounds transported downwind.

Soil Pathway

Exposure of humans receptors to surface soil via dermal contact or incidental ingestion is considered an incomplete pathway under current use because the site is covered and complete under future land use, because the cover may be removed. Potential receptors include site workers and local residents. Exposure to local residents would require residential development and/or trespass. Residential development is not anticipated at this time. There is no vegetation or sources of surface water at the POL Tank Farm Area that would provide habitat for ecological receptors (site visit, 1993), but exposure to terrestrial biota could occur through the foodchain. For example, insects that live in the soil can be consumed by birds or animals passing through the area. Therefore, the CSM assumes a complete exposure pathway exists for terrestrial biota for the soil pathway, for current and future land use.

Ground Water

Under current land use, the upper zone aquifer is not known to be used as a source of potable water. Radian Corp reviewed records of

the Texas Water Commission (TWC) to conduct an inventory of water wells located within one mile of the Base boundary (Radian, 1986). Thirty-nine wells were identified from TWC records, but none were in the upper zone aquifer. Therefore, there are no known receptors for the ground-water pathway, and exposure to ground water is considered an incomplete pathway under current land use. The community of River Oaks, immediately east of Carswell AFB, previously had supply wells near the current location of the USAF Hospital. These wells were developed in the alluvial deposits, and were abandoned when Carswell AFB purchased the property (Radian, 1991a). Due to previous use, exposure to site workers and local residents by the ground-water pathway is considered a potentially complete pathway for local residents under future land use because use of the aquifer cannot be ruled out. Exposure could occur by inhalation of chemicals that are volatilized during domestic use, by dermal contact, and by direct ingestion. Site workers are not considered potential receptors because the Base is supplied by a municipal system that does not use water in the upper zone aquifer. The Twin Mountains aquifer is the primary aquifer for municipal water supply in the Fort Worth area (U.S. Army Corps of Engineers, 1991). The pathway for exposure to ecological receptors is incomplete because there is no mechanism for ecological receptors to be directly exposed to ground water.

Surface Water

The evaluation of potential migration routes for chemicals of concern in media at the POL Tank Farm Area included soil erosion, runoff to surface water, and the migration of shallow ground water to Farmer's Branch. A previous report stated that ground-water flow is toward the southeast, towards Farmers Branch (Radian, 1991a). Migration of ground water to surface water is considered incomplete because previous reports did not provide evidence that ground water is released to surface water. Another potential migration pathway is surface runoff and soil erosion. This is

considered an incomplete migration pathway under current land use because the surface at the site is covered. The pathway is considered potentially complete under future land use, because soils could be exposed by removal of cover, excavation or shallow soil disturbance. Surface drainage at the site is mainly towards Farmers Branch (Radian, 1991a). Farmers Branch downgradient of the site is outside of the Carswell AFB boundary, therefore local residents are considered potential receptors in the CSM. Potential exposure mechanisms for residents include direct contact with sediment and water when wading or fishing, ingestion of fish, and incidental ingestion of sediment. In the event that chemicals of concern are released to the atmosphere by volatilization from surface water during a storm runoff event, the CSM considers that there is a potentially complete pathway under future land use for exposure to site workers and residents via inhalation. In respect to ecological receptors, a potentially complete pathway (under future land use) may exist for fauna in and along Farmers Branch. Again, this assumes removal of gravel, and runoff or erosion. Terrestrial biota could be exposed through ingestion of surface water, dermal contact with water and sediments, inhalation of volatilized chemicals, and through ingestion of chemicals that bioconcentrate in the foodchain. Aquatic receptors could be exposed through ingestion, inhalation (i.e., through the gills), direct contact with surface water, and through the food chain.

2.3.2.2 Potential Exposure Pathways and Receptors, Unnamed Stream Site - The following section describes the rationale behind the selection of potential exposure pathways and receptors for the Unnamed Stream Site.

Air Pathway

Chemicals of concern in surface soil may be released to the atmosphere by volatilization (if volatile chemicals are present) or by release due to wind erosion. In the later case, chemicals

attached to soil particles can be transported downwind. The air pathway is considered potentially complete for current and future land use because soil or sediment may be exposed along the banks of the Unnamed Stream. Site workers and downwind residents are considered potential receptors by the air pathway. Soils at the Abandoned Service Station are mostly covered with pavement, therefore these soils do not present a potential for release to the air under current land use. A release is considered possible under future land use because excavation, utility work or other soil disturbance could result in release of dust or volatile chemicals. The Unnamed Stream appears to provide suitable habitat for ecological receptors. Therefore, a potentially complete pathway exists for exposure to fauna via inhalation of chemicals present in the air as volatile compounds or as dust.

Soil Pathway

Exposure to surface soil by human receptors is considered a complete pathway under current and future use for both humans and ecological receptors because of the exposed soils and sediments along the Unnamed Stream. Due to the stream's location inside the facility boundary, site workers (under current land use) and local residents (under future land use) are considered potential receptors in the CSM. The exposure mechanism for humans could include incidental ingestion or dermal contact with soil. The surface water and surrounding vegetation along the stream could provide habitat for ecological receptors. Therefore, soil exposure to terrestrial biota is include in the CSM. Terrestrial biota could be exposed through the food chain, if chemicals of concern bioconcentrate in living systems. They may also be exposed by direct contact with or ingestion of soil.

Ground Water

Under current land use, the upper zone aquifer is not known to be used as a source of potable water. Radian Corp reviewed records of

the Texas Water Commission (TWC) to conduct an inventory of water wells located within one mile of the Base boundary (Radian, 1986). Thirty-nine wells were identified from TWC records, but none were in the upper zone aquifer. Therefore, there are no known receptors for the ground-water pathway, and exposure to ground water is considered an incomplete pathway under current land use. The community of River Oaks, immediately east of Carswell AFB, previously had supply wells near the current location of the USAF Hospital. These wells were developed in the alluvial deposits, and were abandoned when Carswell AFB purchased the property (Radian, 1991a). Because of this previous use, exposure to site workers and local residents by the ground-water pathway is considered a potentially complete pathway under future land use because use of the aquifer cannot be ruled out. Exposure could occur by inhalation of chemicals that are volatilized during domestic use, by dermal contact, and by direct ingestion. There is no mechanism for ecological receptors to be directly exposed to ground water.

Surface Water

A potentially complete pathway via direct contact with surface water may exist under current and future land use for site workers and local residents. Potential receptors include site workers who may have occasion to work around the Unnamed Stream and local residents that use Farmers Branch for recreation. Exposure mechanisms that were considered for site workers include dermal contact with and incidental ingestion of surface water and sediment. Farmers Branch downgradient of this site is outside of the Carswell AFB boundary, therefore use by local residents is possible. Potential exposure mechanisms for residents include direct contact with sediment and water when wading or fishing in Farmers Branch, ingestion of fish, and incidental ingestion of sediment. Because of the shallow, rocky nature of the stream, swimming does not appear to be likely. In the event that chemicals of concern are released to the atmosphere by volatilization from

surface water, the CSM considers that there is a potentially complete pathway under current and future land use for exposure via inhalation. In respect to ecological receptors, a potentially complete pathway may exist for fauna in and along the stream. Terrestrial biota could be exposed through ingestion of surface water, dermal contact with water and sediments, inhalation of volatilized chemicals, and through ingestion of chemicals that bioconcentrate in the foodchain. Aquatic receptors could be exposed through ingestion, inhalation (i.e., through the gills), direct contact with surface water, and through the food chain.

## 2.4 DATA NEEDS

Information required to characterize the site and complete the conceptual site model include the following:

- Characterization of human receptors including the number and location of potentially exposed populations such as Air Force employees and off-site residential or recreational receptors

- Characterization of ecological receptors including common biotic communities, endangered/threatened species, the presence of sensitive habitats or environments

- The location and use of ground-water wells within a one mile radius of the sites

- The uses of local surface water, (i.e., recreational, fishing, water source) and the distances to downstream water bodies

- Upstream and downstream levels of constituents currently detectable in site surface water (the adjacent stream) and sediment

- Physical characteristics of surface soil; particle size distribution, bulk density, porosity and moisture content

- Meteorological data, including wind speed and prevailing direction, and seasonal average temperature

- Regional data which characterize levels of naturally occurring (ambient) concentrations of metals in environmental media at or near the base

# 3.0 RCRA FACILITY INVESTIGATION TASKS

## 3.1 SITE OBJECTIVES

Previous sections of this plan have identified waste management practices and investigative activities at Carswell AFB. The objectives of these investigations are intended to improve site characterizations that would ultimately lead to remediation of the sites. The purpose of this RCRA Facility Investigation (RFI) at Carswell AFB is to collect assessment data from soil, surface water, sediment, and ground water at two sites on the base. The focus of this work will be to characterize the spatial distribution of contamination at each site and its potential for transport.

Field work will be conducted at two sites at Carswell AFB. The primary objectives of the field work are as follows:

- Develop the data base at each site
- Confirm the presence/absence of any previously-detected contaminants
- Improve understanding of spatial distribution of contaminants
- Improve understanding of contaminant migration
- Assess variations in shallow subsurface stratigraphy

## 3.2 FIELD INVESTIGATION

Field tasks to be performed at each of the sites during this RFI are discussed in subsequent sections of this plan and are discussed

in detail in the Sampling and Analysis Plan. The field tasks are also summarized in Table 3-1. These tasks include:

- Geophysical Survey
- Ground-Water Screening
- Monitoring Well Installation and Subsurface Soil Sampling
- Ground-Water Sampling
- Aquifer Testing (In-Situ Hydraulic Conductivity)
- Surface Water/Sediment Sampling

All previously installed monitoring wells and borings name designations will remain the same. Ground-water samples will be identified with the monitoring well from which they are collected.

### 3.2.1 Field Tasks

The following section summarizes specific field operations at each RFI site, included in this study. Details of the execution of the field tasks are presented in the SAP.

3.2.1.1 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. Ground Penetrating Radar (GPR) is a geophysical technique which can provide high resolution data on surficial geology. The technique is used to map shallow bedrock, soil and water table features, and locate underground pipes and tanks. The GPR technique is not subject to interference from power lines or fences found at both sites. 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. Typically in geologic

**TABLE 3-1**

**FIELD TASKS FOR RFI INVESTIGATION**
**Carswell Air Force Base, Texas**

| SITE | FIELD TASKS | RATIONALE |
|---|---|---|
| Unnamed Stream Site | 1. Perform geophysical survey. | 1. Determine locations of USTs, piping and utilities. |
| | 2. Install three new monitoring wells. Screen soils with HNU. Collect two soil samples per boring for lab analyses, one from the ground-water interface and one from the sample interval exhibiting the highest head space analysis. Two additional soil samples will be collected from the upgradient soil boring. Install 4-inch PVC screen and riser. Screen length will be 10 feet, slotted: slot size .010. | 2. Assess hydrocarbon impact to native soil. Determine nature and extent of ground-water contamination and expand ground-water database. |
| | 3. Sample three new monitoring wells and six existing wells, during three separate sampling events. | 3. Determine nature and extent of ground-water contamination and expand ground-water data base. |
| | 4. Aquifer testing (slug testing). | 4. Determine hydraulic characteristics of Upper Zone Aquifer. |
| | 5. Surface water/sediment sampling. | 5. Determine extent of contamination released from the oil/water separator. |
| POL Tank Farm | 1. Perform geophysical survey. | 1. Determine the location of any pipechases or utilities. |
| | 2. Perform ground-water screening, collect 25 upper zone ground-water samples with push probe device (TEG Strataprobe) and screen for contamination. | 2. Determine the nature and extent of ground-water contamination and expand ground-water database. |

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 GPR 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 ut through cables. Only the timing signals, the audio frequency facsimile of the received signal, and the DC voltage are carried on this cable.

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.

3.2.1.2 Ground-Water Screening - A ground-water screening survey will be performed at the POL Tank Farm Area. The survey is intended to delineate the extent of ground-water contamination. Up to twenty-five upper zone ground-water samples will be collected

with ground-water sampling equipment, at the POL Tank Farm Area. Sampling technologies to be considered include direct-push technology (DPT). The ground-water samples will be analyzed with a gas chromatograph to characterize contamination extent at the site.

3.2.1.3 Monitoring Well Installation and Subsurface Soil Sampling - Three shallow monitoring wells will be installed at the Unnamed Stream site. These wells will be drilled to approximately 10 feet below ground-water surface unless auger refusal is encountered. Wells will be sampled using hollow-stem auger techniques. Subsurface soil samples will be collected continuously from ground surface to total depth using procedures outlined in the Sampling and Analysis Plan (SAP). Ten-foot screens will be installed, along with 4-inch interior diameter (I.D.) polyvinyl chloride (PVC) casing. Two additional soil samples, for a total of four subsurface soil borings, will be collected from the upgradient well (Figure 2-12) to be used as background data for this site.

3.2.1.4 Ground-Water Sampling - Three rounds of ground-water sampling will be conducted after the wells are properly developed as specified in the Field Sampling Plan of the SAP. Sampling from six existing wells will be included in each of the sampling events. The six existing wells have been identified by AFCEE to include: SD13-S1, SD13-S2, SD13-S3, SD13-S4, B-1337-MW14A, and B-1337-MW14B. Ground-water samples taken from the upgradient well (Figure 2-12) will be used as background data for this site.

3.2.1.5 Aquifer Testing (Slug Tests) - An in-situ permeability test will be performed on each new monitoring well following well development. The permeability tests to be performed are known as the "falling head" and "rising head" tests. The "falling head" test involves inserting a slug (solid PVC rod) into the water

column in the well to raise the water level. The water level recovery to static water level is recorded over time using a pressure transducer and Hermit 2000C Datalogger. Readings will be taken continuously and recorded until the static water level is reached. The slug is removed for the "rising head" test and the water level recovery back to static water level is recorded over time. Because the monitoring wells will be constructed with a portion of the well screen situated above the water level, only the results of the rising head tests will be used.

The data results of the permeability test are then plotted on semi-logarithmic paper. The following formula (Bouwer and Rice, 1976) is utilized to calculate hydraulic conductivity (K):

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

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 $Y_0$

The formation permeability will be computed using appropriate predictive equations.

3.2.1.6 Surface Water/Sediment Samples - Samples of surface water and sediments will be collected from the Unnamed Stream Site between the oil/water separator and Farmer's Branch. Three samples of surface water and sediment will be taken at this site. However,

no surface water will be obtained if it is not present during the sampling event. The surface water will be collected in a Pyrex beaker in low flow areas of running water. VOA samples will be collected directly in the VOA sampling jar. The sediment samples will be collected with a stainless-steel spoon or hand auger in low flow (eddy type) areas. A Wildco sediment sampler will be kept on site in case conditions preclude the use of the stainless-steel spoon or hand auger for sample collection. At each sample location, the surface water samples will be collected first, then the sediment samples will be obtained. Sample collections will begin downstream and proceed upstream to avoid cross contamination by upstream disturbed sediments.

### 3.2.2 Sampling and Analysis Activities

The samples and analyses to be performed for each of the two sites considered under this RFI are summarized in Tables 3-2 through 3-6.

## 3.3 LITERATURE SEARCH

A literature search will be conducted to obtain information pertinent to the study and integrate that information into the investigation. Sources for historical records include the base engineering office, interviews with base personnel, municipal and state records, and publications. A summary of major publications used in the literature search is listed below.

Installation Restoration Program - IRP RI/FS Stage 1, Carswell AFB, Forth Worth, Texas, Final Radian Report, 1986

Installation Restoration Program - IRP RI/FS Stage 2, Carswell AFB, Forth Worth, Texas, Final RI Report, Radian, 1991

TABLE 3-2

SAMPLING AND ANALYSIS PLAN SUMMARY: SUB-SURFACE SOIL FROM BORINGS
RCRA Facility Investigation - Carswell Air Force Base, Texas

| PARAMETER | TOTAL NO. FIELD LOCATIONS | SAMPLES PER LOCATION | FIELD QC SAMPLES | | | | TOTAL NO. FIELD SAMPLES | LAB QC SAMPLES | | | | 2ND (c) COLUMN CONFIRM. ANALYSES | TOTAL NO. LAB SAMPLES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Field Duplicate | Equipment Blank | Amb Cond Blank | Trip Blank (a) | | MS | MSD | Lab Duplicate | Spiked Blank (b) | | |
| Volatile Organics (SW 8240) | | | | | | | | | | | | | |
| Unnamed Stream: Downgradient (d) | 2 | 2 | 1 | 1 | 1 | 1 | 8 | 1 | 1 | 0 | 1 | 1 | 12 |
| Unnamed Stream: Upgradient (e) | 1 | 4 | 1 | 1 | 1 | 1 | 8 | 0 | 0 | 0 | 0 | 1 | 9 |
| TOTALS | 3 | | 2 | 2 | 2 | 2 | 16 | 1 | 1 | 0 | 1 | 2 | 21 |
| Aromatic Volatiles (SW 8020) | | | | | | | | | | | | | |
| Unnamed Stream: Downgradient | 2 | 2 | 1 | 1 | 1 | 1 | 8 | 1 | 1 | 0 | 1 | 1 | 12 |
| Unnamed Stream: Upgradient | 1 | 4 | 1 | 1 | 1 | 1 | 8 | 0 | 0 | 0 | 0 | 1 | 9 |
| TOTALS | 3 | | 2 | 2 | 2 | 2 | 16 | 1 | 1 | 0 | 1 | 2 | 21 |
| Total Recoverable Petroleum Hydrocarbons (E 418.1) | | | | | | | | | | | | | |
| Unnamed Stream: Downgradient | 2 | 2 | 1 | 1 | 0 | 0 | 6 | 1 | 1 | 0 | 1 | 0 | 9 |
| Unnamed Stream: Upgradient | 1 | 4 | 1 | 1 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| TOTALS | 3 | | 2 | 2 | 0 | 0 | 12 | 1 | 1 | 0 | 1 | 0 | 15 |
| ICP Screen for Metals (gas 3050/6010) | | | | | | | | | | | | | |
| Unnamed Stream: Downgradient | 2 | 2 | 1 | 1 | 0 | 0 | 6 | 1 | 1 | 0 | 1 | 0 | 9 |
| Unnamed Stream: Upgradient | 1 | 4 | 1 | 1 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| TOTALS | 3 | | 2 | 2 | 0 | 0 | 12 | 1 | 1 | 0 | 1 | 0 | 15 |
| Toxicity Characteristic Leaching Procedure (SW 1311) (f) | | | | | | | | | | | | | |
| Unnamed Stream | 3 | 1 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 0 | 7 |
| TOTALS | 3 | | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 0 | 7 |

Note: Analytical methodologies are presented in Section 1.8.1 of the Sampling and Analysis Plan.
(a) Volatile Organics only; number to be initiated will depend upon number of shipments.
(b) Estimated; number to be determined by batch preparation.
(c) Methods SW 8240 and SW 8020 will have 2nd column confirmation performed on all samples exhibiting positive results.
(d) Soil samples from oil/water separator and Unnamed Stream monitoring well locations.
(e) Soil samples from single upgradient monitoring well installation.
(f) TCLP analyses will be performed on the containerized waste material generated from the drill cuttings.

TABLE 3-3

SAMPLING AND ANALYSIS PLAN SUMMARY: GROUND WATER - MONITORING WELLS
RCRA Facility Investigation - Carswell Air Force Base, Texas

| PARAMETER | TOTAL NO. FIELD LOCATIONS | TOTAL NO. SAMPLING EPISODES | FIELD QC SAMPLES | | | | TOTAL NO. FIELD SAMPLES | LAB QC SAMPLES | | | | 2ND (c) COLUMN CONFIRM. ANALYSES | TOTAL NO. LAB SAMPLES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Field Duplicate | Equipment Blank | Ambient Blank | Trip Blank (a) | | MS | MSD | Lab Duplicate | Spiked Blank (b) | | |
| Volatile Organics (SW 8240) | | | | | | | | | | | | | |
| Unnamed Stream | 9 | 3 | 3 | 3 | 3 | 3 | 39 | 3 | 3 | 0 | 3 | 0 | 48 |
| TOTALS | 9 | 3 | 3 | 3 | 3 | 3 | 39 | 3 | 3 | 0 | 3 | 0 | 48 |
| Total Recoverable Petroleum Hydrocarbons (E 418.1) | | | | | | | | | | | | | |
| Unnamed Stream | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| TOTALS | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| Oil and Grease (SW 9071) | | | | | | | | | | | | | |
| Unnamed Stream | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| TOTALS | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| Screen for 24 Metals (SW 6010) | | | | | | | | | | | | | |
| Unnamed Stream: Total | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| Unnamed Stream: Dissolved | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| TOTALS | 18 | 6 | 6 | 6 | 0 | 0 | 66 | 6 | 6 | 0 | 6 | 0 | 84 |
| Arsenic (SW 7060) | | | | | | | | | | | | | |
| Unnamed Stream: Total | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| Unnamed Stream: Dissolved | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| TOTALS | 18 | 6 | 6 | 6 | 0 | 0 | 66 | 6 | 6 | 0 | 6 | 0 | 84 |
| Mercury (SW 7470) | | | | | | | | | | | | | |
| Unnamed Stream: Total | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| Unnamed Stream: Dissolved | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| TOTALS | 18 | 6 | 6 | 6 | 0 | 0 | 66 | 6 | 6 | 0 | 6 | 0 | 84 |
| Selenium (SW 7740) | | | | | | | | | | | | | |
| Unnamed Stream: Total | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| Unnamed Stream: Dissolved | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| TOTALS | 18 | 6 | 6 | 6 | 0 | 0 | 66 | 6 | 6 | 0 | 6 | 0 | 84 |
| Lead (SW 7421) | | | | | | | | | | | | | |
| Unnamed Stream: Total | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| Unnamed Stream: Dissolved | 9 | 3 | 3 | 3 | 0 | 0 | 33 | 3 | 3 | 0 | 3 | 0 | 42 |
| TOTALS | 18 | 6 | 6 | 6 | 0 | 0 | 66 | 6 | 6 | 0 | 6 | 0 | 84 |
| Toxicity Characteristic Leaching Procedure (SW 1311) (d) | | | | | | | | | | | | | |
| Unnamed Stream | 5 | 1 | 0 | 0 | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 0 | 7 |
| TOTALS | 5 | 1 | 0 | 0 | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 0 | 7 |

Note: Analytical methodologies are presented in Section 1.8.1 of the Sampling and Analysis Plan.
(a) Volatile Organics only; number ot be initiated will depend upon number of shipments.
(b) Estimated; number to be determined by preparation batch.
(c) Method SW 8240 will have 2nd column confirmation performed on all samples exhibiting positive results.
(d) The purge water will be analyzed for the parameters of concern in the TCLP list.

TABLE 3-4

SAMPLING AND ANALYSIS PLAN SUMMARY: GROUND WATER - FIELD SCREEN
RCRA Facility Investigation - Carswell Air Force Base, Texas

| PARAMETER | | TOTAL NO. FIELD LOCATIONS | FIELD QC SAMPLES | | | | TOTAL NO. FIELD SAMPLES | LAB QC SAMPLES | | | | 2ND (c) COLUMN CONFIRM. ANALYSES | TOTAL NO. LAB SAMPLES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Field Duplicate | Equipment Blank | Ambient Blank | Trip Blank (a) | | MS | MSD | Lab Duplicate | Spiked Blank (b) | | |
| Aromatic Volatiles (SW 8020) | | | | | | | | | | | | | |
| POL Tank Farm | | 22 | 1 | 1 | 1 | 1 | 26 | 2 | 2 | 0 | 1 | 10 | 41 |
| Reserve (d) | | 3 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 1 | 8 |
| | TOTALS | 25 | 2 | 2 | 1 | 1 | 31 | 3 | 3 | 0 | 1 | 11 | 49 |
| Petroleum Hydrocarbons (SW 8015M) | | | | | | | | | | | | | |
| POL Tank Farm | | 22 | 2 | 2 | 0 | 0 | 26 | 2 | 2 | 0 | 1 | 20 | 51 |
| Reserve (d) | | 3 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 1 | 0 | 8 |
| | TOTALS | 25 | 3 | 3 | 0 | 0 | 31 | 3 | 3 | 0 | 2 | 20 | 59 |
| Lead (SW 6010) | | | | | | | | | | | | | |
| POL Tank Farm | | 22 | 1 | 1 | 0 | 0 | 24 | 2 | 2 | 0 | 1 | 0 | 29 |
| Reserve (d) | | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 5 |
| | TOTALS | 25 | 1 | 1 | 0 | 0 | 27 | 3 | 3 | 0 | 1 | 0 | 34 |

Note: Analytical methodologies are presented in Section 1.8.1 of the Sampling and Analysis Plan.
(a) Volatile Organics only; number to be initiated will depend upon number of shipments.
(b) Estimated; number to be determined by preparation batch.
(c) Methods SW 8020 and SW 8015M will have ten percent of all samples sent to an off-site laboratory for confirmatory analyses.
(d) Three ground-water sampling locations will be reserved for discretionary use during the implementation of the field work.

TABLE 3-5

SAMPLING AND ANALYSIS PLAN SUMMARY: SURFACE WATER
RCRA Facility Investigation - Carswell Air Force Base, Texas

| PARAMETER | TOTAL NO. FIELD LOCATIONS | SAMPLES PER LOCATION | FIELD QC SAMPLES | | | | TOTAL NO. FIELD SAMPLES | LAB QC SAMPLES | | | | 2ND (c) COLUMN CONFIRM. ANALYSES | TOTAL NO. LAB SAMPLES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Field Duplicate | Equipment Blank | Ambient Blank | Trip Blank (a) | | MS | MSD | Lab Duplicate | Spiked Blank (b) | | |
| Volatile Organics (SW 8240) | | | | | | | | | | | | | |
| Unnamed Stream | 3 | 1 | 1 | 1 | 1 | 1 | 7 | 1 | 1 | 0 | 1 | 0 | 10 |
| TOTALS | 3 | 1 | 1 | 1 | 1 | 1 | 7 | 1 | 1 | 0 | 1 | 0 | 10 |
| Total Recoverable Petroleum Hydrocarbons (E 418.1) | | | | | | | | | | | | | |
| Unnamed Stream | 3 | 1 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 1 | 0 | 8 |
| TOTALS | 3 | 1 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 1 | 0 | 8 |
| Oil and Grease (SW 9071) | | | | | | | | | | | | | |
| Unnamed Stream | 3 | 1 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 1 | 0 | 8 |
| TOTALS | 3 | 1 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 1 | 0 | 8 |

Note: Analytical methodologies are presented in Section 1.8.1 of the Sampling and Analysis Plan.
(a) Volatile Organics only; number to be initiated will depend upon number of shipments.
(b) Estimated; number to be determined by preparation batch.
(c) Method SW 8240 will have 2nd column confirmation performed on all samples exhibiting positive results.

**TABLE 3-6**

**SAMPLING AND ANALYSIS PLAN SUMMARY: SEDIMENT**
**RCRA Facility Investigation - Carswell Air Force Base, Texas**

| PARAMETER | TOTAL NO. FIELD LOCATIONS | FIELD QC SAMPLES | | | | TOTAL NO. FIELD SAMPLES | LAB QC SAMPLES | | | | TOTAL NO. LAB SAMPLES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Field Duplicate | Equipment Blank | Amb Cond Blank | Trip Blank (a) | | MS | MSD | Lab Duplicate | Spiked Blank (b) | |
| ICP Screen for 24 Metals (SW 3050/6010) | | | | | | | | | | | |
| Unnamed Stream | 3 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 1 | 8 |
| TOTALS | 3 | 1 | 1 | 0 | 0 | 5 | 1 | 1 | 0 | 1 | 8 |

Note: Analytical methodologies are presented in Section 1.8.1 of the Sampling and Analysis Plan.
(a) Volatile Organics only; number to be initiated will depend upon number of shipments.
(b) Estimated; number to be determined by preparation batch.

Installation Restoration Program - IRP RI/FS Stage 2, Carswell AFB, Forth Worth, Texas, Final FS Report, Radian, 1991

In addition to the above described literature search, historical maps and aerial photographs (if available) will be reviewed to determine site features and conditions. Additional information to be evaluated (if available) will include U.S. Geological Survey well logs, Texas Water Commission sampling data, and Soil Conservation Service data. This information will be utilized to direct field activities, specifically with respect to underground storage tank areas.

## 3.4 RECORD KEEPING

This section discusses and describes field and laboratory record keeping.

### 3.4.1 Field Record Keeping

Field records will be maintained in order to document field work, sampling events, and personnel at the site. This information will be used to assist in the preparation of the RCRA Facility Investigation report document. A summary of field record documents that will be used during field work follows.

#### Field Log Book

A field log book will be maintained during operations at Carswell AFB. The log book will be hard bound and the pages will be sequentially numbered. The log book will be completed by the site manager and notes will be kept throughout the day, recording pertinent events and time of occurrence.

Daily Quality Control Reports

Figure 3-1 illustrates the Daily Quality Control Report form used to summarize daily activity. The report summarizes work performed, sampling activities, and personnel working or visiting the sites. The Daily Quality Control Reports will be forwarded to the AFCEE Team Chief on a weekly basis during field operations.

Soil Test Boring Records

Figure 3-2 illustrates the Soil Test Boring Record form used to record boring activities. Each monitoring well boring will be logged by a qualified geologist or engineer, and relevant field observations will be recorded.

Monitoring Well Installation Diagrams

Figure 3-3 illustrates the Type II Monitoring Well Installation Diagram form that will be used upon completion of shallow monitoring wells. The field geologist/engineer will record information pertaining to drilling, materials used, and actual well construction for each well.

Well Development Data

Figure 3-4 illustrates the Well Development Data form used to record the well development process. The form includes information about well construction and the processes used in development of each well. During well development, specific conductivity, temperature, and pH will be recorded approximately every 15 minutes and turbidity will be measured upon completion of well development.

Chain of Custody Record

Figure 3-5 illustrates the Chain of Custody Record form used to transfer custody of the samples from Law Environmental, Inc., to

FIGURE 3-1

# DAILY QUALITY CONTROL REPORT

185 95

REPORT No. _____ CONTRACT No. _____ DATE _____

LOCATION OF WORK _____

DESCRIPTION OF WORK _____

WEATHER _____ RAINFALL (INCHES) _____ TEMPERATURE _____ MIN _____MAX

WIND DIRECTION _____

1. WORK PERFORMED _____

2. SAMPLES COLLECTED _____

3. PERSONNEL AND VISITORS AT SITE _____

SITE MANAGER: _____

HF

FIGURE 3-2

185 96

# SOIL TEST BORING RECORD

JOB NO. _____
JOB NAME _____
DATE: _____
WEATHER _____
DRILLER _____

BORING NO. _____
G.S. ELEV. _____
HOURS MOVING _____
HOURS DRILLING _____
PAGE _____ OF _____

| DEPTH (FEET) | STRATA DESCRIPTION | # | "N" 1 | 2 | 3 | 4 | N | PID | REC | SOIL CLASSIFICATON AND REMARKS | DEPTH (FEET) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

| | | |
|---|---|---|
| BORING TERMINATED: _____ | METHOD OF ADVANCING BORING | DEPTH |
| BORING REFUSAL: _____ | POWER AUGER | TO |
| WATER TOB DEPTH _____ | HAND CHOP: W/MUD: W/WATER | TO |
| WATER 24 HR.: DEPTH _____ | ROTARY DRILL: W/MUD: W/WATER | TO |
| WATER LOSSES _____ | DIAMOND CORE | TO |
| CASING: SIZE _____ LENGTH _____ | | |

QA / QC INSTALLED BY: _____ CHECKED BY: _____ DISCREPANCIES: _____

HF

FIGURE 3-3

# TYPE II MONITORING WELL INSTALLATION DIAGRAM

JOB NAME _____

WELL NO. _____ JOB NO. _____

DATE _____ TIME _____

WELL LOCATION _____

GROUND SURFACE ELEVATION _____

TOP OF SCREEN ELEVATION _____

REFERENCE POINT ELEVATION _____

TYPE SAND PACK _____ GRADATION _____

SAND PACK MANUFACTURER _____

SCREEN MATERIAL _____

MANUFACTURER _____

RISER MATERIAL _____

MANUFACTURER _____

RISER DIAMETER _____

DRILLING TECHNIQUE _____

AUGER SIZE AND TYPE _____

BENTONITE TYPE _____

MANUFACTURER _____

CEMENT TYPE _____

MANUFACTURER _____

BOREHOLE DIAMETER _____

SCREEN DIAMETER _____ SLOT SIZE _____

LAW ENVIRONMENTAL, INC.

FIELD REPRESENTATIVE _____

DRILLING CONTRACTOR _____

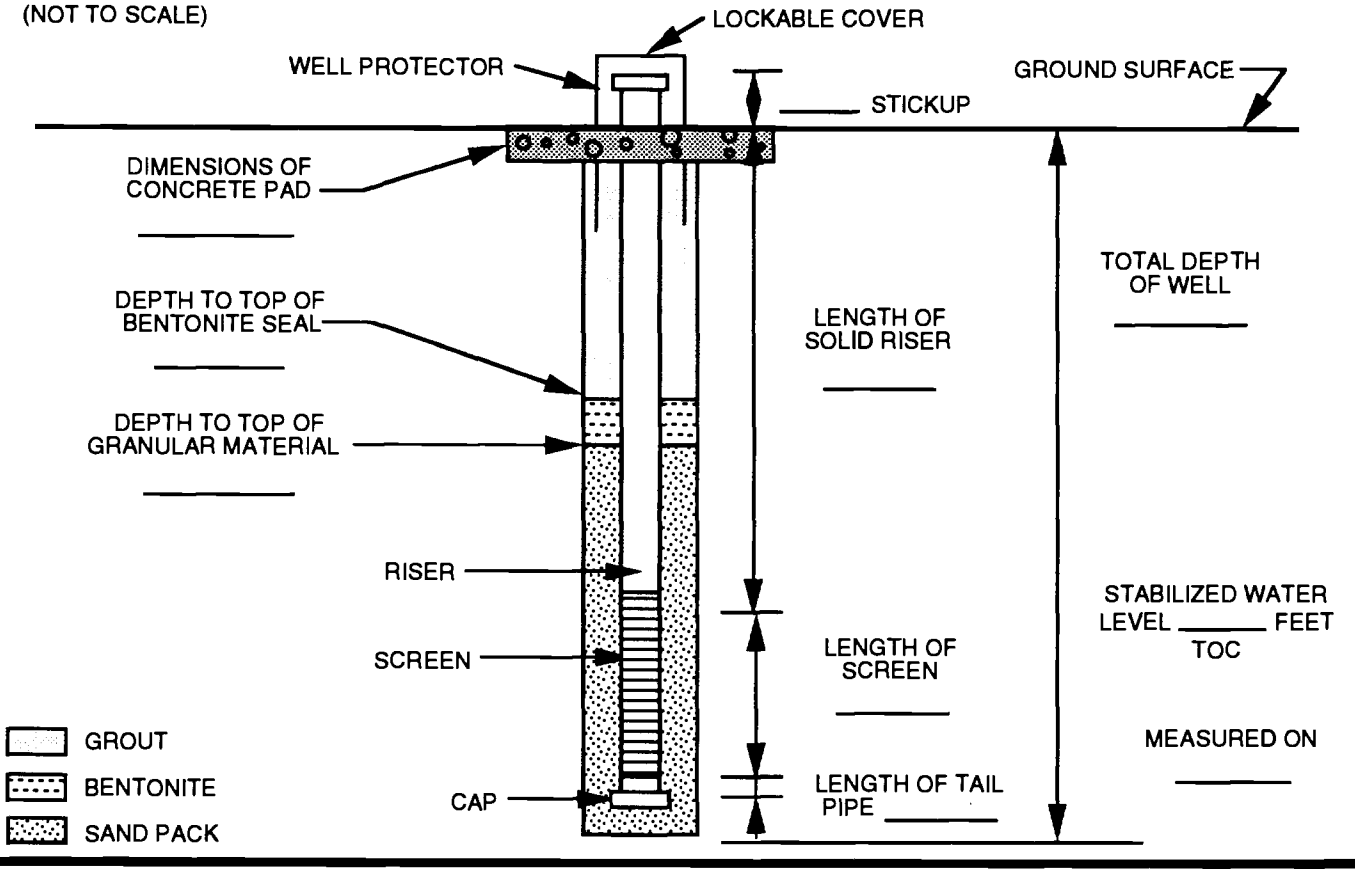
AMOUNT BENTONITE USED _____

AMOUNT CEMENT USED _____

AMOUNT SAND USED _____

STATIC WATER DEPTH (after dev.) _____

REMARKS _____




**QA / QC**

INSTALLED BY: _____ INSTALLATION OBSERVED BY: _____

DISCREPANCIES: _____

HF MWID-II-6

FIGURE 3-4

**WELL DEVELOPMENT DATA**

185 96

JOB NAME _____ JOB No. _____

BY _____ CHECKED_____ SHEET _____ OF _____

1. Well No. _____
2. Date of Installation : _____
3. Date of Redevelopment : _____
4. Static Water Level : Before Development _____ ft.: 24 Hours After _____ ft
5. Quantity of Water Loss During Drilling, If Used _____ Gal.
6. Quantity of Standing Water in Well and Annulus Before Development _____ Gal.

| | Start | During | | End |
|---|---|---|---|---|
| 7. Physical Appearance | _____ | _____ | _____ | _____ |
| Specific Conductance (umhos/cm) | _____ | _____ | _____ | _____ |
| Temperature (c°) | _____ | _____ | _____ | _____ |
| pH (s.u.) | _____ | _____ | _____ | _____ |

8. Depth From Top of Well Casing to Bottom of Well _____ ft.
9. Screen Length _____ ft.
10. Depth to Top of Sediment : Before Development _____ ft.; After Development _____ ft.
11. Type and Size of Well Development Equipment : _____

_____

12. Description of Surge Technique, If Used : _____

_____

13. Height of Well Casing Above Ground Surface : _____ ft.
14. Quantity of Water Removed : _____ Gal. Time for Removal : _____ Hr./Min.
15. 1-Liter Water Sample Collected : _____ (Time)
16. Turbidity in Nephelometric Units _____ NTUs

*Development Conditions : 1) Well Water if Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

**HF WDDR-4**

FIGURE 3-5

# CHAIN OF CUSTODY RECORD

4636

**SAMPLING INFORMATION**

NAME OF FACILITY: _____

STREET ADDRESS: _____

CITY/STATE: _____ ZIP: _____

| PROJECT NAME | JOB NO. |
|---|---|
| SAMPLERS (SIGNATURE) | |
| SAMPLING DATE | |

| TIME | GRAB | COMP. | SOURCE CODE* | SAMPLE STATION DESCRIPTION | TOTAL NO. OF CONTAINERS | CONTAINER TYPE: 40 ml/G ($Na_2S_2O_3$) • $5H_2O$ | 1 L G, P ($HNO_3$) | 1 L G, P (NaOH) | 1 L G, P ($H_2SO_4$) | 1 L G, P | 1 L P, (NaOH + Ascorbic Acid) | 1 L, Teflon | 1 L G, P (Zn Acetate + NaOH) | 8oz. G, P | 1 L G - Amber | 1 L P - Opaque | 250 ml/G - Amber |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | |

| RELINQUISHED BY: | DATE / TIME | RECEIVED BY: | RELINQUISHED BY: | DATE / TIME | RECEIVED BY: |
|---|---|---|---|---|---|
| (SIGNATURE) | | (SIGNATURE) | (SIGNATURE) | | (SIGNATURE) |
| RELINQUISHED BY: | DATE / TIME | RECEIVED BY: | RELINQUISHED BY: | DATE / TIME | RECEIVED AT LABORATORY: |
| (SIGNATURE) | | (SIGNATURE) | (SIGNATURE) | | (SIGNATURE) |

**DISTRIBUTION:** ORIGINAL AND PINK COPIES ACCOMPANY SAMPLE SHIPMENT TO LABORATORY. PINK COPY RETAINED BY LABORATORY. YELLOW COPY RETAINED BY SAMPLERS.

**REMARKS:** _____

* SOURCE CODES:
RECOVERY WELL - RW
RCRA MONITORING WELL - MW
SOIL/SEDIMENT - SO
SLUDGE - SL
NPDES DISCHARGE - ND
DRINKING WATER - DW

HF

the shipping agent, and ultimately to the analyzing laboratory. Sample identification names and required signatures will be recorded on this form prior to shipment.

### 3.4.2 Laboratory Record Keeping

The laboratory will maintain records sufficient to document phases of sample control, from initial receipt of the samples through all stages of analysis and data generation. The laboratory will maintain written procedures for the analytical methods, and adhere to strict QA/QC guidelines. In-depth laboratory procedures are outlined in the Sampling and Analysis Plan.

## 3.5 DATA ASSESSMENT

### Present Investigation

Quality assurance is an important factor in maintaining the integrity of a project in which data collection consumes much of the project time and effort. A structured process of quality control is needed through all stages of the project and should be designed so that the project effort can build on data confidence as the investigation data base expands. Data quality assurance commences with the Notice to Proceed. The following steps will be followed to maintain this effort.

- A complete and thorough knowledge of the Statement of Work

- Open channels of communication between Law and AFCEE and documentation of that communication

- Completeness and accuracy of the project Work Plan, Sampling and Analysis, Safety and Health Plan, and all documents submitted

- Field investigations and laboratory analysis will follow procedures outlined in the Work Plan and Sampling and Analysis Plan

- Field records will be complete and all activities will be documented (Section 3.4)

- Laboratory methods and QA/QC will be complete and all activities will be documented (Sampling and Analysis Plan)

The field and laboratory data will be reviewed for precision, accuracy, representativeness, comparability, and completeness. Discrepancies in any data set will be noted.

## 3.6 RISK ASSESSMENT

Risk assessment evaluation of the data generated by this project will not be required. However, data generated by this investigation will be evaluated by State of Texas Risk Reduction Rules and background comparisons.

# 4.0 REPORTING REQUIREMENTS

## 4.1 DELIVERABLES

Draft and final documents outlining the project requirements and procedures, and the results of the procedures will be prepared and submitted for review. Other documents, such as interim reports of information or progress will also be submitted.

### 4.1.1 R&D Status Reports

Monthly reports will be prepared at the end of each billing period to describe the progress of the project. These reports will discuss the following items:

- Identification of installation and activity in progress
- Status of work at each site and progress to date
- Percentage completion of each task, sections of reports, and schedule status
- Difficulties encountered during the reporting period
- Actions being taken to rectify problems
- Activities planned for the next month
- Changes in personnel

The monthly progress report will list target and actual completion dates for each element of activity, including project completion, and will provide an explanation for no table deviations from the milestones in the Work Plan. The report will support the hours claimed for the same time period. The report will identify activities such as well installation and sampling, analysis of

data, report writing and other items requiring major manpower commitments. Analytical results generated during the reporting period will be submitted with the next R&D Status Report. Chapters or sections of the technical report may be submitted with the R&D Status Report as they are drafted.

### 4.1.2 RFI Work Plan

The RFI Work Plan will be prepared pursuant to the project activities outlined in the Statement of Work. The work plan will present evaluations and decisions made during the scoping process, and will present a detailed plan for conducting tasks associated with RFI work at Carswell AFB.

### 4.1.3 RFI Sampling and Analysis Plan

The RFI Sampling and Analysis Plan (SAP) will consist of two parts: the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The FSP will present detailed data collection methods to be followed during the RFI and the QAPP will outline policy, organization, functional activities, and detailed laboratory and quality control procedures necessary to achieve stated data quality objectives (DQOs).

### 4.1.4 RFI Health and Safety Plan

The RFI Health and Safety Plan will describe safety requirements and procedures to be implemented while conducting field activities. The Health and Safety Plan will be tailored to fit the needs of this specific site investigation.

4.1.5 Informal Technical Information Reports (ITIRs)

This section outlines the various ITIRs required by the Scope of Work for this project.

4.1.5.1 Analytical Data Report - This report will include the submission of analytical data, including QC results and cross reference tables. The report will include information regarding sampling locations (wells, boreholes, surface water and sediment sampling locations, etc.) with their respective sites. Monitoring wells will be identified as being upgradient, downgradient, or side gradient of the site. Document format will follow guidelines defined in Section 4.2 of the Handbook to Support the Installation Restoration Program (IRP) Statements of Work.

4.1.5.2 Mylar Map - A mylar map will be constructed which shows the location of all sites and related sampling locations. The mylar map will contain the date of completion, title block, scale, and legend.

4.1.5.3 Ground-Water Field Screening Map - A map showing the results of ground-water screening superimposed on sampling locations will be provided and results of screening will be interpreted and presented as an ITIR.

4.1.5.4 Confirmation Notices - A record will be kept of conferences, meetings, discussions, verbal directions, telephone conversations, etc. between AFCEE and Law on matters relating to this project. These records (confirmation notices) will be numbered sequentially and will identify participants, subjects discussed, and any guidance given or conclusions reached. The confirmation notices will be distributed within ten calendar days of the event.

4.1.5.5 Geophysical Surveys - A report detailing the geophysical surveying methodology and results will be submitted to the AFCEE Team Chief. The report will include maps generated from the geophysical survey and the logic used in data interpretation.

4.1.6 Technical Report

The RFI Technical Report will document the findings of the RFI. The RFI Technical Report will include documentation of geologic and hydrologic data and environmental samples, analytical methods performed on the samples, and the evaluation of the analytical results and field measurements in relation to QC data.

4.1.7 Data Management

Law will establish a data management plan to meet the data deliverable requirements of the Installation Restoration Program Information Management System (IRPIMS). Field and laboratory data will be recorded in a computerized format as required by the most current version of the IRPIMS Data Loading Handbook.

Law shall prepare the IRPIMS data files using IRP project data as instructed in the IRPIMS Data Loading Handbook. Individual IRPIMS data files (e.g., analytical results, ground-water level data, etc.) shall be delivered by Law to AFCEE/ESB in sequence according to a controlled time schedule.

Law will be responsible for the accuracy and completeness of data submitted. Data entered into the IRPIMS data files and submitted will correspond with the data contained in the original laboratory reports and other documents associated with sampling and laboratory contractual tasks. Data (as per the IRP Data Loading Handbook)

generated under this effort will be submitted. Any exceptions shall be coordinated, in writing, with the AFCEE Team Chief (AFCEE TC).

## 4.2 SPECIAL NOTIFICATION

The AFCEE TC and Carswell AFB Point of Contact (POC) will be contacted immediately by telephone and receive written notification of imminent health hazards along with the supporting documentation within three days after telephone notification.

## 4.3 VARIATIONS

If variations in technical efforts, including field work are necessary, written concurrence from the Contracting Officer's Technical Representative will be obtained prior to proceeding with the variation. Under such circumstances, the ceiling price of the order will remain unchanged. Should an increase in the ceiling amount be necessary, contracting officer authorization will be required prior to proceeding with the variations.

# 5.0 PROJECT SCHEDULE

The summary schedule for the Carswell AFB RCRA Facility Investigation will be updated on a quarterly basis and submitted with the respective R & D status report to show any changes for each of the projected tasks for the work plan, field activities and reports.

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