

FINAL

**Corrective Action Plan for the
Risk-Based Remediation of the
Military Gas Station
Eglin Air Force Base
Florida**



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Prepared For

**Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base**

and

Eglin Air Force Base, Florida

March 1999

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Walton, Norman

From: Hansen, Jerry E, Mr, HQAFCEE [Jerry.Hansen@HQAFCEE.brooks.af.mil]

Sent: Tuesday, August 08, 2000 10:16 AM

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FINAL
CORRECTIVE ACTION PLAN FOR THE
RISK-BASED REMEDIATION OF THE
MILITARY GAS STATION
EGLIN AIR FORCE BASE, FLORIDA

AETC Contract No. F41689-96-D-0710
Order No. 5015

Prepared for
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
TECHNOLOGY TRANSFER DIVISION
BROOKS AIR FORCE BASE, TEXAS

and

EGLIN AIR FORCE BASE, FLORIDA

March 1999

Prepared by
PARSONS ENGINEERING SCIENCE, INC.
1700 Broadway, Suite 900
Denver, Colorado 80290

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ACRONYMS AND ABBREVIATIONS

°C	degrees centigrade
°F	degrees Fahrenheit
AAS	air sparge
AETC	Air Education and Training Command
AFB	Air Force Base
AFCEE/ERT	Air Force Center for Environmental Excellence, Technology Transfer Division
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Corrective Action Plan
CAR	Contamination Assessment Report
CH ₄	methane
CO ₂	carbon dioxide
COPC	chemicals of potential concern
CSM	conceptual site model
DO	dissolved oxygen
EDB	ethylene dibromide
FAC	Florida Administrative Code
Fe ²⁺	ferrous iron
Fe ³⁺	ferric iron
FDEP	Florida Department of Environmental Protection
ft/day	feet per day
ft/ft	feet per foot
ft/yr	feet per year
LCS	laboratory control samples
LTM	long-term monitoring
LNAPL	light, non-aqueous phase liquid
MDL	method detection limit
mg/L	milligrams per liter
msl	mean sea level
MS/MSD	matrix spike / matrix spike duplicate
MTBE	methyl tert-butyl ether
mV	millivolt
MW	monitoring well
N	nitrogen
NFA	No-Further-Action
O ₂	oxygen
ORP	oxidation/reduction potential
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
OVM	organic vapor meter
PAH	polynuclear aromatic hydrocarbon

Parsons ES	Parsons Engineering Science, Inc.
PEL	permissible exposure limits
POC	point of compliance
ppmv	parts per million, volume per volume
PQL	practical quantitation limit
QA	quality assurance
QC	quality control
RAP	remedial action plan
RNA	remediation by natural attenuation
SAP	sampling and analysis plan
SB	soil boring
SQL	sample quantitation limit
SVE	soil vapor extraction
Tbsp	tablespoon
TCLs	target cleanup levels
TDS	total dissolved solids
TWA-TLV	time-weighted average threshold limit value
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
UST	underground storage tank

SECTION 1

INTRODUCTION

Parsons Engineering Science, Inc. (Parsons ES) was retained by the Air Force Center for Environmental Excellence, Technology Transfer Division (AFCEE/ERT) under Air Education and Training Command (AETC) Contract No. F41689-96-D-0710, Order No. 5015 to prepare a corrective action plan (CAP) to support a risk-based remediation decision for contaminated soil and groundwater at the Military Gas Station at Eglin Air Force Base (AFB) in Florida.

1.1 DESCRIPTION OF THE RISK-BASED APPROACH

The objective of risk-based remediation is to reduce the risk of specific chemicals to human health and/or ecological receptors such as animals or plant life. For any chemical to pose a risk, four elements must exist at the site:

- A source of chemical contamination that exceeds or could generate chemical contamination above health-protective or aesthetic standards;
- A mechanism of contaminant release;
- A human or ecological receptor available for chemical contact; and
- A completed pathway through which that receptor will contact the chemical.

If any one of these four elements is absent at a site, there is no current risk. The reduction or elimination of risk can be accomplished by limiting or removing any one of these four elements from the site.

The goal of this risk-based remediation approach is to find the most cost-effective method of reducing present and future risk by combining three risk reduction techniques:

- Chemical Source Reduction - Achieved by natural attenuation processes over time or by engineered removals such as free product recovery, soil vapor extraction (SVE), or *in situ* bioventing.
- Chemical Migration Control - Examples include natural attenuation of a groundwater plume, and SVE to prevent migration of hazardous vapors to a receptor exposure point.

- Receptor Restriction - Land use controls and site fencing to eliminate chemical exposure until natural attenuation and/or engineered remediation reduce the chemical source and/or eliminate the potential for chemical migration to an exposure point.

1.2 RISK-BASED APPROACH TASKS

The major tasks of this risk-based project are:

- Assessing available data and collecting any supplemental site characterization data necessary to define the nature, magnitude, and extent of soil and groundwater contamination and to document to what degree natural attenuation processes are operating at the selected sites;
- Determining whether an unacceptable risk to human health or the environment currently exists or may exist in the foreseeable future using applicable Florida Department of Environmental Protection (FDEP) guidance and regulations, contaminant fate and transport predictions, and exposure concentration estimates;
- Evaluating and recommending a remedial alternative that both reduces the source of contamination and minimizes or eliminates risks to potential receptors; and
- Documenting the remedial action selection process in a report that satisfies FDEP requirements.

1.3 REGULATORY REQUIREMENTS

This section describes Florida's tiered approach for risk-based remedial action at sites contaminated with petroleum products. The *Petroleum Contamination Site Cleanup Criteria* rule [Chapter 62.770 of the Florida Administrative Code (FAC)] (FDEP, 1997) presents guidance for determination of remedial requirements for closure of petroleum-contaminated sites, including several mechanisms for determining matrix-specific cleanup criteria. The regulations allow closure of petroleum release sites under several different scenarios, including:

- No-Further-Action (NFA) Proposal Without Conditions,
- NFA Proposal With Conditions, or
- Monitoring-Only Proposal for Natural Attenuation.

A Remedial Action Plan (RAP) must be prepared for sites that do not meet the requirements for NFA or Natural Attenuation. Closure of a site under the NFA-Without-Conditions alternative would allow unrestricted future use of the site (e.g., residential land use), and therefore the requirements and allowable contaminant levels under this alternative are the most restrictive. The NFA-With-Conditions alternative requires that appropriate institutional or engineering controls be implemented to limit receptor exposure; sites seeking closure under this alternative are subject to potentially less stringent cleanup levels. A Natural Attenuation Monitoring Program is a

recognized means of remediating a site, with the goal of achieving the NFA cleanup target levels.

The actual or potential beneficial use of the groundwater and susceptibility of the aquifer to contamination are considered in the risk-based corrective action program to determine site-specific remediation target levels. All groundwater of the State of Florida is classified according to the following uses:

- Class F-I: Potable water use: groundwater in a single source aquifer described in Rule 62-520.460, FAC that has a total dissolved solids (TDS) content of less than 3,000 milligrams per liter (mg/L) and was specifically reclassified as Class F-I by the Commission.
- Class G-I: Potable water use: groundwater in a single-source aquifer that has a TDS content of less than 3,000 mg/L.
- Class G-II: Potable water use: groundwater in an aquifer that has a TDS content of less than 10,000 mg/L, unless otherwise classified by the Commission.
- Class G-III: Non-potable water use: groundwater in an unconfined aquifer that has a TDS content of 10,000 mg/L or greater; or that has a TDS content of 3,000-10,000 mg/L and either has been reclassified by the Commission as having no reasonable potential as a future source of drinking water, or has been designated by the FDEP as an exempted aquifer pursuant to Rule 62-28.130(3), FAC.
- Class G-IV: Non-potable water use: groundwater in a confined aquifer that has a TDS content of 10,000 mg/L or greater.

The classification of the groundwater beneath the Military Gas Station is G-II (EA Environmental, Science, and Technology [EA], 1994).

1.3.1 No Further Action

Closure of a petroleum release site under a NFA Proposal (without or with conditions) requires that a site meet the following criteria:

- No free product is present (as specified in 62-770.680 (1)(a), FAC);
- No fire or explosion hazard is present due to release of petroleum or petroleum products ;
- No "excessively contaminated soil" (as defined in 62-770.200, FAC) is present; and
- Matrix-specific target cleanup levels are met.

The *Petroleum Contamination Site Cleanup Criteria* rule (FDEP, 1997) incorporates matrix-specific Target Cleanup Levels (TCLs) for petroleum constituents in the form of

"look-up" tables or through reference to other applicable regulations (i.e., state groundwater or surface water regulations). Contaminant concentrations in all affected media at a site must be below all applicable TCLs for the site to qualify for a NFA (with or without conditions) proposal. However, the rule also allows for the development of alternative cleanup standards based on a site-specific risk assessment for use in a NFA Proposal with conditions. These site-specific alternative cleanup standards can be used in place of those presented in the look-up tables.

1.3.2 Natural Attenuation With Monitoring

The FDEP recognizes natural attenuation with monitoring as a viable site remediation strategy. The following criteria must be met to demonstrate that this strategy is appropriate for a site:

- No free product is present (as specified in 62-770.690 (1)(a),FAC);
- Contaminated soil is not present to the extent that it may increase cleanup costs;
- Groundwater contaminant concentrations above applicable target cleanup levels are not migrating beyond a temporary point of compliance (POC);
- Available data show an overall decrease in the mass of contamination; and
- Contaminant concentrations in groundwater do not exceed appropriate criteria (Table IX levels, 62-770, FAC); or the technical evaluations (as specified in 62-770.690 (1)(f), FAC) indicate that natural attenuation is an appropriate remedial alternative.

Natural attenuation with monitoring requires the establishment of a temporary POC based on site-specific conditions relating to land and groundwater use, potentially exposed populations, hydrogeology, and type and concentrations of contaminants. Concentrations of petroleum compounds at the POC cannot exceed levels presented in the rule. Monitoring of natural attenuation to show plume stability and/or contaminant reductions can eventually lead to a proposal for NFA With or Without Conditions.

1.3.3 Summary

In summary, the *Petroleum Contamination Site Cleanup Criteria* rule allows a rapid determination of whether or not a site can qualify for a NFA proposal and/or the appropriateness of natural attenuation with monitoring as a remedial strategy. The rule allows for inclusion of site-specific information in developing alternative cleanup levels for NFA with conditions, and provides guidance on preparation of a RAP if active remediation is warranted.

1.4 REPORT ORGANIZATION

This CAP consists of eight sections, including this introduction, and five appendices. Site background, including operating history and a review of environmental site investigations conducted to date, is provided in the remainder of this section. Section 2 summarizes the 1998 site characterization activities performed by Parsons ES. Physical

characteristics of the Military Gas Station and surrounding area are described in Section 3. A Tier 1 evaluation is completed in Section 4 to identify those site contaminants that are considered chemicals of potential concern (COPCs). Section 5 summarizes the nature and extent of COPC contamination at the site. Section 6 addresses the effects of natural chemical attenuation processes that are documented to be occurring at the site, and presents chemical fate and transport and receptor exposure analyses. The Tier 2 evaluation is detailed in Section 7. Section 8 presents a long-term monitoring plan (LTM). Section 9 presents references used in preparing this CAP.

Analytical data sheets and chain-of-custody records are in Appendix A. Pertinent information from prior investigations is presented in Appendix B. Boring logs, groundwater sampling forms, and well construction diagrams for all sampling activities completed by Parsons ES during the March 1998 field effort are included in Appendix C. Appendix D includes the input and output from the aquifer slug test analyses. Appendix E includes the supporting documentation for the quantitative calculations used in the predictive chemical fate assessment.

1.5 SITE DESCRIPTION AND BACKGROUND

Eglin AFB is located in the Florida panhandle on the coast of the Gulf of Mexico (Figure 1.1). The Military Gas Station is located at the intersection of Daytona Road and Okaloosa Avenue on the Eglin Main Base (Figure 1.2). The age of the gas station is unknown. Features of the site include a canopy sheltering 2 pump islands, an unmanned kiosk containing a computer system, and a tank field containing three 15,000-gallon fiberglass underground storage tanks (USTs) (Figure 1.3). Two of the tanks contain unleaded gasoline; the other tank contains diesel fuel.

Five USTs, which stored gasoline and diesel fuel, were previously located within the former tankfield (Figure 1.3). The USTs were removed in September 1991, and approximately 400 cubic yards of soil were excavated (EA, 1994b). During the tank closure assessment, the surrounding soil was screened for volatile hydrocarbons with an organic vapor analyzer (OVA). Soil in the vicinity of the south end of the tanks and near the fuel dispensers was classified as excessively contaminated [>50 parts per million, volume per volume (ppmv) for Mixed Product Analytical Group]. The contaminated soil was allowed to aerate before being returned to the excavation as fill.

The present tankfield and product piping were installed during September 1991. A Contamination Assessment Report (CAR) (EA, 1993a), CAR Addendum (EA, 1993b), and Supplemental CAR (EA, 1994a) have been completed for the site, and a RAP (EA, 1994b) has been approved. In support of the assessment and remedial action, 13 shallow monitoring wells (MWs), 2 deep MWs, 2 SVE wells, 1 air sparging (AAS) well, and 15 soil borings (SBs) were completed at the site, and an air sparging and SVE system was installed and has been operating for 2 to 3 years to remediate site soil and shallow groundwater in the source area (Parsons ES, 1997c).

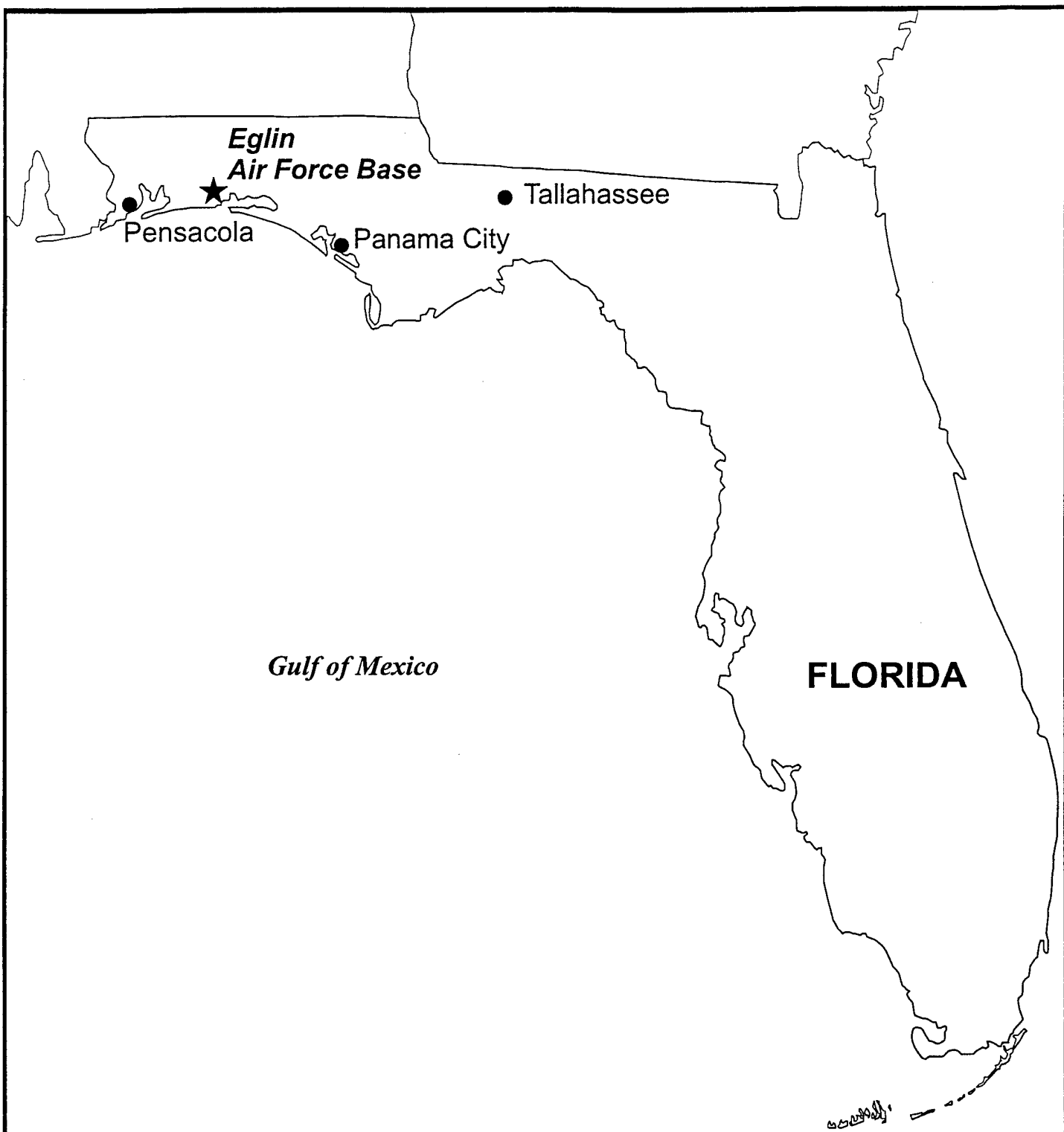


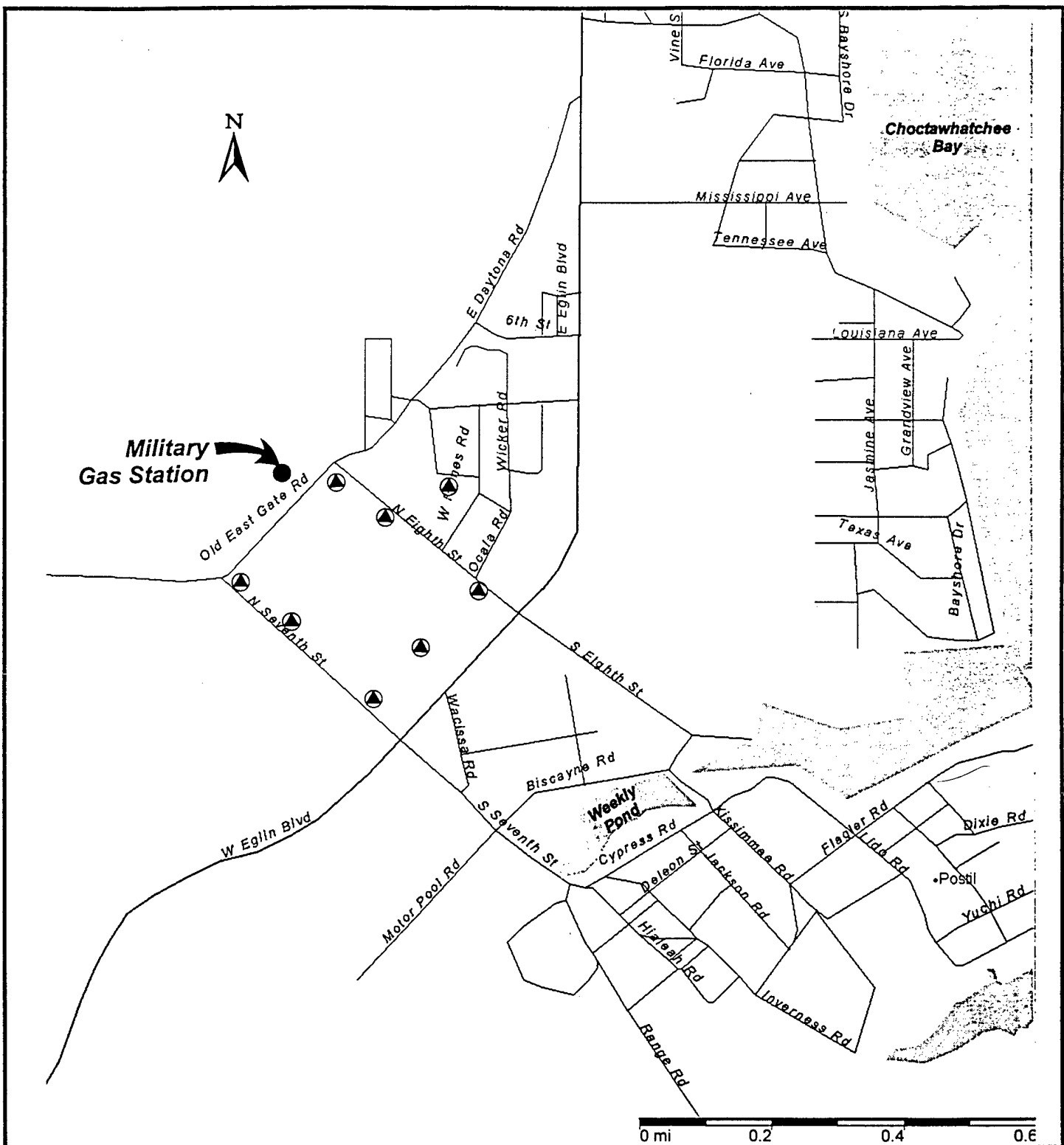
FIGURE 1.1

BASE LOCATION MAP

Risk-Based Approach to Remediation
Military Gas Station
Eglin AFB, Florida

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Legend

- ▲ Irrigation Wells

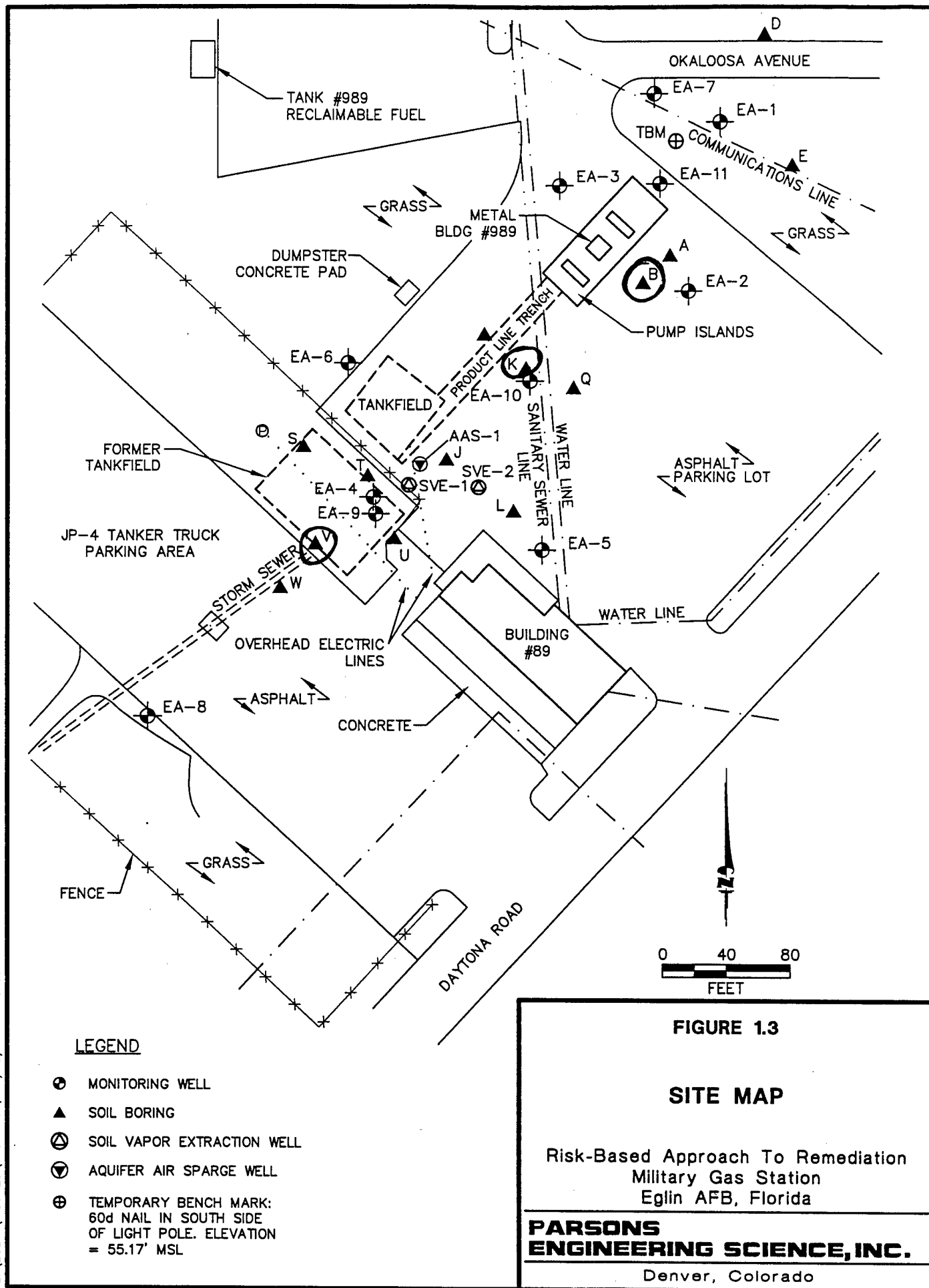
FIGURE 1.2

SITE LOCATION MAP

Risk-Based Approach to Remediation
Military Gas Station
Eglin AFB, Florida

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SECTION 2

SITE CHARACTERIZATION ACTIVITIES

Several soil and groundwater investigations have been conducted at the Military Gas Station. These investigations focused on characterizing and delineating dissolved hydrocarbons in groundwater and residual fuel hydrocarbons in soils. Parsons ES conducted an investigation at the site during March 1998 to collect site-specific data relevant to quantifying the effects of natural contaminant attenuation processes and to facilitate development and implementation of a risk-based remedial action for the Military Gas Station. Soil gas, soil, and groundwater were sampled to:

- Further delineate the extent of contamination;
- Assess temporal trends in soil and groundwater contaminant concentrations;
- Support contaminant fate and transport analyses; and
- Develop appropriate exposure-point concentrations to compare to final remediation goals.

Data collected during previous investigations were used to augment this study. Emphasis was placed on collecting data documenting the natural biodegradation and attenuation of fuel hydrocarbons in soils and groundwater at the site.

The March 1998 supplemental site characterization activities performed by Parsons ES at the Military Gas Station are briefly described in the remainder of this section. Most site characterization procedures (i.e., soil, soil gas, and groundwater sampling procedures) are described in detail in the project Sampling and Analysis Plan (SAP) (Parsons ES, 1997a).

2.1 SCOPE OF DATA COLLECTION ACTIVITIES

As part of the risk-based remedial approach for the Military Gas Station, field data collection efforts focused on investigating specific chemical constituents that potentially pose a threat to human health or the environment. The chemicals targeted for study at this site were identified from previous site investigations and the chemical composition of the primary contaminant source (i.e., release(s) of gasoline from the former USTs). The petroleum hydrocarbons and associated constituents identified and addressed as part of this study, as either historically above FDEP levels or previously unquantified, include benzene, toluene, ethylbenzene, and xylenes (BTEX); methyl tertiary butyl ether (MTBE); ethylene dibromide (EDB); polynuclear aromatic hydrocarbons (PAHs);

total recoverable petroleum hydrocarbons (TRPH); and lead. These analytes were targeted based on previous site assessment results.

The risk-based investigation for the Military Gas Station was conducted according to the methodologies presented in the *Work Plan for the Risk-Based Investigation and Closure of the Base Exchange Service Station and the Military Gas Station* (Parsons ES, 1998), hereafter referred to as the work plan. The work plan was developed according to available guidelines and requirements of the FDEP to support site closure.

The following sampling and testing activities were performed by Parsons ES during March 1998 at the site as part of this investigation:

- Conducted slug tests at two existing monitoring wells;
- Drilled three soil borings;
- Collected five subsurface soil samples for fixed-base laboratory analysis from the three boreholes;
- Collected groundwater samples from four existing groundwater monitoring wells; and
- Collected one soil gas sample for laboratory analysis.

Analytical method detection limit (MDL) requirements were considered before site characterization work was initiated. Suitable analytical methods and quality control (QC) procedures were selected (Parsons ES, 1997a) to ensure that the data collected under this program are of sufficient quality to be used in a quantitative risk assessment.

Soil and groundwater samples were analyzed in the field and by Quanterra, Inc. of Arvada, Colorado; Dallas, Texas; and Tampa, Florida. Soil gas samples were analyzed in the field and by Air Toxics, Ltd. of Folsom, California. The laboratory data sheets and chain-of-custody records are presented in Appendix A. The analytical protocol for all samples is summarized in Table 2.1. Table 2.2 summarizes the field and fixed-base laboratory analyses performed by sampling location. These analyses and measurements were performed for various inorganic, geochemical, and physical parameters to document natural biodegradation processes and to assess the potential effectiveness of low-cost source reduction technologies.

2.2 SUBSURFACE SOIL SAMPLING

Soil samples were collected adjacent to previously-drilled soil boreholes B, V, and K to obtain soil total organic carbon (TOC) data and to further characterize soil contamination at the site at locations where previous investigations indicated relatively high soil contaminant concentrations (Appendix B). The soil boring locations are presented on Figure 2.1. Soils were sampled to facilitate evaluation of the potential for contaminant partitioning from soil into groundwater and soil gas, and to assess the magnitude of any changes in contaminant concentrations that have occurred over time. These borings were advanced using a Geoprobe® hydraulic sampling rig as described in the SAP (Parsons ES, 1997a).

TABLE 2.1
ANALYTICAL PROTOCOL FOR
GROUNDWATER, SOIL, AND SOIL GAS SAMPLES
Military Gas Station
Eglin AFB, Florida

MATRIX	METHOD	WHERE ANALYZED
GROUNDWATER		
Ferrous Iron (Fe^{+2})	Colorimetric, Hach Method 8146	Field
Sulfate (SO_4^{-2})	Colorimetric, Hach Method 8051	Field
Conductivity	Direct reading meter	Field
Dissolved Oxygen	Direct reading meter	Field
pH	Direct reading meter	Field
Redox Potential	Direct reading meter	Field
Temperature	Direct reading meter	Field
BTEX	SW8020A	QUANTERRA ^{a/}
EDB	SW8011 / Method 504	QUANTERRA
Polynuclear Aromatic Hydrocarbons	SW8310	QUANTERRA
Total Recoverable Petroleum Hydrocarbons (TRPH)	FL-PRO (C8-C40)	QUANTERRA
Methane (CH_4)	RSK-175	QUANTERRA
Nitrate as Nitrogen ($\text{NO}_3^{-1}\text{-N}$)	E300.0	QUANTERRA
Lead	SW7421	QUANTERRA
SOIL		
BTEX + MTBE	SW8020A	QUANTERRA
Polynuclear Aromatic Hydrocarbons	SW8310	QUANTERRA
Total Recoverable Petroleum Hydrocarbons (TRPH)	FL-PRO (C8-C40)	QUANTERRA
Total Organic Carbon	SW9060	QUANTERRA
SOIL GAS		
BTEX	TO-3	Air Toxics ^{b/}
Total Petroleum Hydrocarbons (TPH)	TO-3	Air Toxics
Oxygen	Direct reading meter	Field
Carbon Dioxide	Direct reading meter	Field

Notes:

a/ Quanterra, Inc. of Arvada, Colorado; Dallas, Texas (methane only); and Tampa, Florida (TRPH only).

b/ Air Toxics LTD. of Folsom, California

TABLE 2.2
SAMPLE ANALYSES BY LOCATION
Military Gas Station
Eglin AFB, Florida

Sample Location Sample Matrix Sample Depth (ft. bgs)	B Soil 25 - 27	V Soil 8 - 10	V Soil 26 - 28	K Soil 8 - 10	K Soil 15 - 17	Mil SG1 Soil Gas NA	EA-4 Water NA	EA-5 Water NA	EA-8 Water NA	EA-10 Water NA
ANALYTE										
BTEX	X		X		X		X	X	X	X
MTBE	X		X		X					
EDB							X	X	X	X
PAH	X		X		X		X			X
TRPH	X		X		X		X			X
TOC		X		X						
Lead							X			X
Methane							X	X	X	X
ORP							X	X	X	X
Conductivity							X	X	X	X
Dissolved O ₂							X	X	X	X
Temperature							X	X	X	X
pH							X	X	X	X
Fe ²⁺							X	X	X	X
Sulfate							X	X	X	X
Nitrate							X	X	X	X
BTEX/TPH						X				
oxygen						X				
carbon dioxide						X				

Notes:

ft. bgs = Feet below ground surface

NA = Not applicable

BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes

MTBE = Methyl Tert Butyl Ether

EDB = Ethylene dibromide

PAH = Polynuclear Aromatic Hydrocarbons

TRPH = Total Recoverable Petroleum Hydrocarbons

TOC = Total organic carbon

ORP = Oxidation-reduction potential

Fe²⁺ = Ferrous iron

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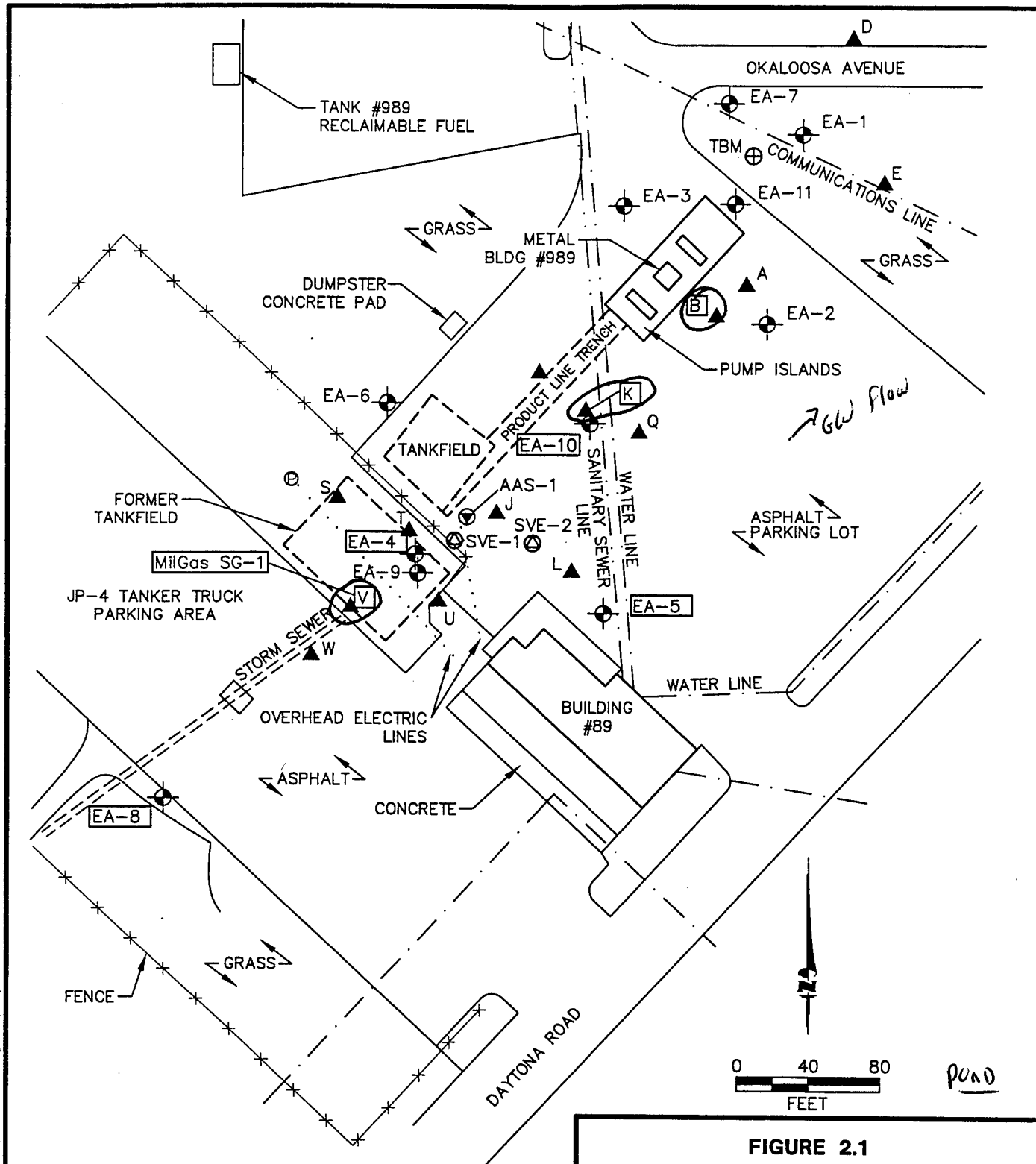


FIGURE 2.1

SAMPLING LOCATIONS

Risk-Based Approach To Remediation
Military Gas Station
Eglin AFB, Florida

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ENGINEERING SCIENCE, INC.**

Denver, Colorado

A total of five soil samples from the three boreholes were submitted to Quanterra, Inc. for laboratory analysis. Samples from all three boreholes were described for lithology and field screened for volatile organic vapors using a organic vapor meter (OVM). Soil borehole information is summarized in Table 2.3, and borehole logs are included in Appendix C. Soil analytical results are summarized and discussed in Sections 4 and 5.

2.3 GROUNDWATER SAMPLING

Groundwater samples were collected from four existing monitoring wells at the site in March 1998. The groundwater sampling locations are listed on Table 2.2 and shown on Figure 2.1. Samples collected from the four wells were analyzed for fuel-related contaminants and for various inorganic and geochemical indicators to evaluate natural chemical and physical attenuation processes that are occurring at the site. Field and laboratory analyses for each groundwater sampling location are summarized in Table 2.2.

All monitoring wells were purged using a positive displacement pump with dedicated polyvinyl chloride (PVC) tubing. Purging consisted of removing groundwater from the well until the pH, DO concentration, oxidation-reduction potential (ORP), conductivity, and temperature stabilized.

Within 24 hours of the purge event, groundwater samples were collected from the monitoring wells using dedicated teflon bailers. The water was carefully poured down the inner walls of each sample bottle to minimize aeration of the sample. Sample bottles for BTEX, MTBE, methane, and/or Hach® field analyses were filled so that there was no headspace or air bubbles within the container. One duplicate sample was collected during the groundwater sampling event.

Field and laboratory groundwater analytical results are discussed in Sections 4 and 5 of this report. These analytical results are used in Section 6 to evaluate the natural physical, chemical, and biological processes that are affecting the COPCs at this site.

2.4 SOIL GAS MEASUREMENTS

Soil gas sampling was performed at the site using both field (semi-quantitative) and fixed-base laboratory (quantitative) analyses. The purpose of soil gas sampling was to assess the potential risk to future workers at the site from inhalation of volatilized contaminants, and to determine whether or not sufficient oxygen (O₂) is available in the soil gas to sustain aerobic fuel hydrocarbon biodegradation. If O₂ concentrations are significantly lower than background values, and carbon dioxide (CO₂) concentrations are higher than background levels, then the occurrence of aerobic fuel hydrocarbon biodegradation can be inferred. In addition, the O₂ levels allow an assessment of whether there is sufficient O₂ to sustain continuing aerobic biodegradation without engineered addition of O₂ via *in situ* bioventing.

One soil gas sample was collected at the location Mil SG1 shown on Figure 2.1. The sample was screened using a field instrument to measure O₂ and CO₂, collected in a SUMMA® canister, and submitted to Air Toxics, Ltd. in Folsom, California for analysis of total petroleum hydrocarbons (TPH) and BTEX using US Environmental

TABLE 2.3
SOIL BORING SUMMARY
Military Gas Station
Eglin AFB, Florida

Boring Location	Boring Date	Total Depth (ft bgs) ^{a/}
B	3/29/98	25.0
V	3/29-30/98	29.0
K	3/29/98	20.0

a/ ft bgs = feet below ground surface

Protection Agency (USEPA) Method TO-3. Analytical results for the soil gas sample are summarized in Sections 4 and 5.

2.5 SLUG TESTS AND ANALYSIS

Four slug tests were conducted at two existing monitoring wells at the Military Gas Station in March 1998. Two tests were conducted at each of wells EA-10 and EA-11. The data were analyzed using AQTESOLV aquifer test analysis software (Geraghty & Miller, 1994). Analysis results are presented in Appendix D and discussed in Section 3.3.

2.6 EQUIPMENT DECONTAMINATION PROCEDURES

All downhole soil sampling tools (e.g., stainless steel Geoprobe® drive-shoe and sampling barrel) were cleaned prior to collection of each sample with a clean water/phosphate-free detergent mix followed by a clean water rinse. Decontaminated tools also were used for soil gas sampling.

A new, disposable Teflon® bailer was used to collect the groundwater sample from each well. The water level indicator probe and purge pump were decontaminated prior to each use with a clean water/phosphate-free detergent mix followed by a distilled water rinse.

2.7 INVESTIGATION-DERIVED WASTES (IDW)

Soil cuttings and unused soil samples were moved to an approved on-base storage area for later disposal by the Base. Purge water was discharged to the influent of the groundwater treatment system at the Base Exchange Service Station on 7th Street.

2.8 ANALYTICAL DATA QUALITY ASSESSMENT

2.8.1 Introduction

A Parsons ES electronic Level III validation was performed on the March 1998 analytical results obtained from the fixed-base laboratories. The validation included internal data checks and application of data qualifiers to the analytical results based on adherence to method protocols and project-specific control limits. Method protocols reviewed included:

- Analytical holding times,
- Method blanks,
- Trip blanks,
- Surrogate spikes,
- Matrix spikes/matrix spike duplicates (MS/MSDs),
- Laboratory control samples (LCSs), and

- Sample temperatures during shipping and storage.

Data qualifiers were applied to analytical results during the data validation process. All data were validated using method applicable guidelines and in accordance with the *National Functional Guidelines for Organic Data Review* (USEPA, 1994a) and the *National Functional Guidelines for Inorganic Data Review* (USEPA, 1994b). The following definitions provide explanations of the USEPA (1994a and 1994b) qualifiers assigned to analytical results during data validation. The data qualifiers described were applied to both inorganic and organic results.

- U - The analyte was not present above the reported sample quantitation limit (SQL).
- J1 - The analyte is qualified as an estimated value solely because it is greater than the MDL and less than the practical quantitation limit (PQL), indicating no laboratory quality issues.

2.8.2 Data Quality

Data quality for each QC parameter where exceptions were noted during the validation is summarized in this section. Only results that exceeded quality assurance (QA)/QC criteria are presented. All frequency requirements for collection of field QA/QC samples (MS/MSDs and blanks) were met. The frequency requirements for laboratory specific method QA/QC also were met.

Samples were collected and analyzed as specified in the methods. All samples are representative of the site and comparable with the results of previous and future investigations (when used in accordance with the validation qualifiers).

All sample results qualified as "U" or "J1" and used in accordance with the data validation qualifiers applied are usable for the intended purposes. Results qualified as "J1" represent an association to non-compliant QC criteria which has caused the reported concentration to be estimated. Project objectives do not exclude the use of estimated concentrations, and therefore the data value is usable for project purposes.

In summary, accuracy and precision were in control. All method specific criteria were in control.

SECTION 3

PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section describes the physical characteristics of the Military Gas Station and adjacent environs at Eglin AFB, as determined from data collected during previous site investigations (EA, 1993a; EA, 1993b; EA, 1994a; EA, 1994b) and by Parsons ES in March 1998 as part of the risk-based investigation. A summary of site characterization activities completed by Parsons ES to supplement existing data is presented in Section 2 of this CAP.

3.1 PHYSIOGRAPHY

Eglin AFB is located in the East Gulf Coastal Plain Physiographic Province. This province is characterized by relatively low topographic relief and a gradual slope toward the Gulf of Mexico. White sand beaches and sand ridges typically border the coastline, while flatlands and swamps extend 10 to 15 miles inland.

3.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

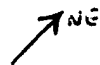
Surficial deposits are characterized by unconsolidated sands, silts, and clayey sands of Pliocene to Recent age which extend to a depth of approximately 60 feet below ground surface (bgs). The Surficial Aquifer System contains the undifferentiated Quaternary sediments and the Citronelle Formation. The typical lithology of the surficial aquifer is primarily fine to coarse quartz sand, with clay, silt and gravel, and clayey sand and sandy clay lenses. Limonite-cemented zones, shell beds, and carbonates are also common. The thickness of the surficial aquifer varies from 40 to 100 feet and the elevation of the water table varies from 0 to 30 feet above mean sea level (msl). The water within the Surficial Aquifer System is generally unconfined; however, beds of low permeability may cause semi-confined or locally confined conditions in its deeper parts. Water table elevations and horizontal gradients generally reflect contours of the land surface.

Below the surficial aquifer is the Pensacola Clay, a relatively impermeable unit separating the surficial aquifer from the Floridan Aquifer. The Floridan Aquifer System contains the Bruce Creek Limestone, St. Marks Formation, Chattahoochee Formation, Suwannee Limestone, Marianna Limestone and Ocala Limestone. The typical lithology of the Floridan Aquifer System is vuggy, fossiliferous, micro-crystalline to granular, argillaceous to sandy, porous limestone and dolomite. The limestone and dolomite may be interbedded with dolomitic sand, silt and clay beds. The Ocala Limestone forms one of the most permeable zones within the Floridan Aquifer System. The extensive development of secondary porosity by dissolution and dolomitization has greatly increased the permeability of the unit. The thickness of the

Floridan Aquifer System varies from 900 to 1,000 feet and the elevation of the top of this unit varies from 270 to 320 feet below msl.

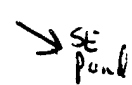
3.3 SITE GEOLOGY AND HYDROGEOLOGY

Site geology is characterized by approximately 60 feet of fine to coarse quartz sand with traces of silt and clay overlying the Pensacola Clay. Groundwater depth at the site is approximately 35 feet bgs. Groundwater surface elevations measured in March 1998 are summarized on Table 3.1 and depicted on Figure 3.1. Groundwater contour maps from previous investigations are presented in Appendix B. Groundwater flows toward the northeast at an average hydraulic gradient of approximately 0.0025 foot per foot (ft/ft) (Figure 3.1). Slug test data (Table 3.2) indicate that the hydraulic conductivity of the surficial deposits at the site ranges from approximately 15 to 56 feet per day (ft/day) with an average of approximately 34 ft/day. Literature values for the hydraulic conductivity of fine to coarse quartz sand range from 2.8 ft/day to 2,835 ft/day (Spitz and Moreno, 1996), so the slug test results are within the expected range for hydraulic conductivity at the site. Based on these data and an estimated effective porosity of 25 percent for sand (Spitz and Moreno, 1996), the average advective groundwater velocity at the site is 0.34 ft/day [124 feet per year (ft/yr)].



3.4 SITE TOPOGRAPHY AND SURFACE WATER HYDROLOGY

The Military Gas Station and the surrounding area has relatively flat topography, with ground elevations at the site at approximately 55 feet msl. Surface water hydrology around the site is dominated by the stormwater sewer system. The closest surface water body to the Military Gas Station is Weekly Pond, which is located approximately 1,200 yards to the southeast (Figure 1.2). The nearest downgradient surface water body is an inlet of Choctawhatchee Bay, which is located approximately 1,650 yards to the northeast (Figure 1.2).



3.5 CLIMATOLOGICAL CHARACTERISTICS

Eglin AFB has a humid, semitropical climate. Daily average temperature in the hottest summer months, July and August, may range from a low of 70 degrees Fahrenheit (°F) to a high of 88°F, with an average of approximately 82°F. Winters are mild, with occasional frost from November through February. During the coldest months, December and February, the temperature may be as low as 18°F or as high as 74°F, with the average around 50°F. Average annual rainfall is approximately 64 inches and ranges from 3.5 inches in October to almost 9 inches in July.

TABLE 3.1
GROUNDWATER ELEVATIONS
Military Gas Station
Eglin AFB, Florida

Location	TOC ^{a/} Elevation (ft msl) ^{b/}	Depth to Water (ft below TOC)	Groundwater Elevation (ft msl)
EA-4	55.47	33.82	21.65
EA-5	55.24	33.81	21.43
EA-8	56.04	33.96	22.08
EA-10	54.72	33.42	21.30

Notes:

a/ TOC = top of casing

b/ ft msl = feet above mean sea level

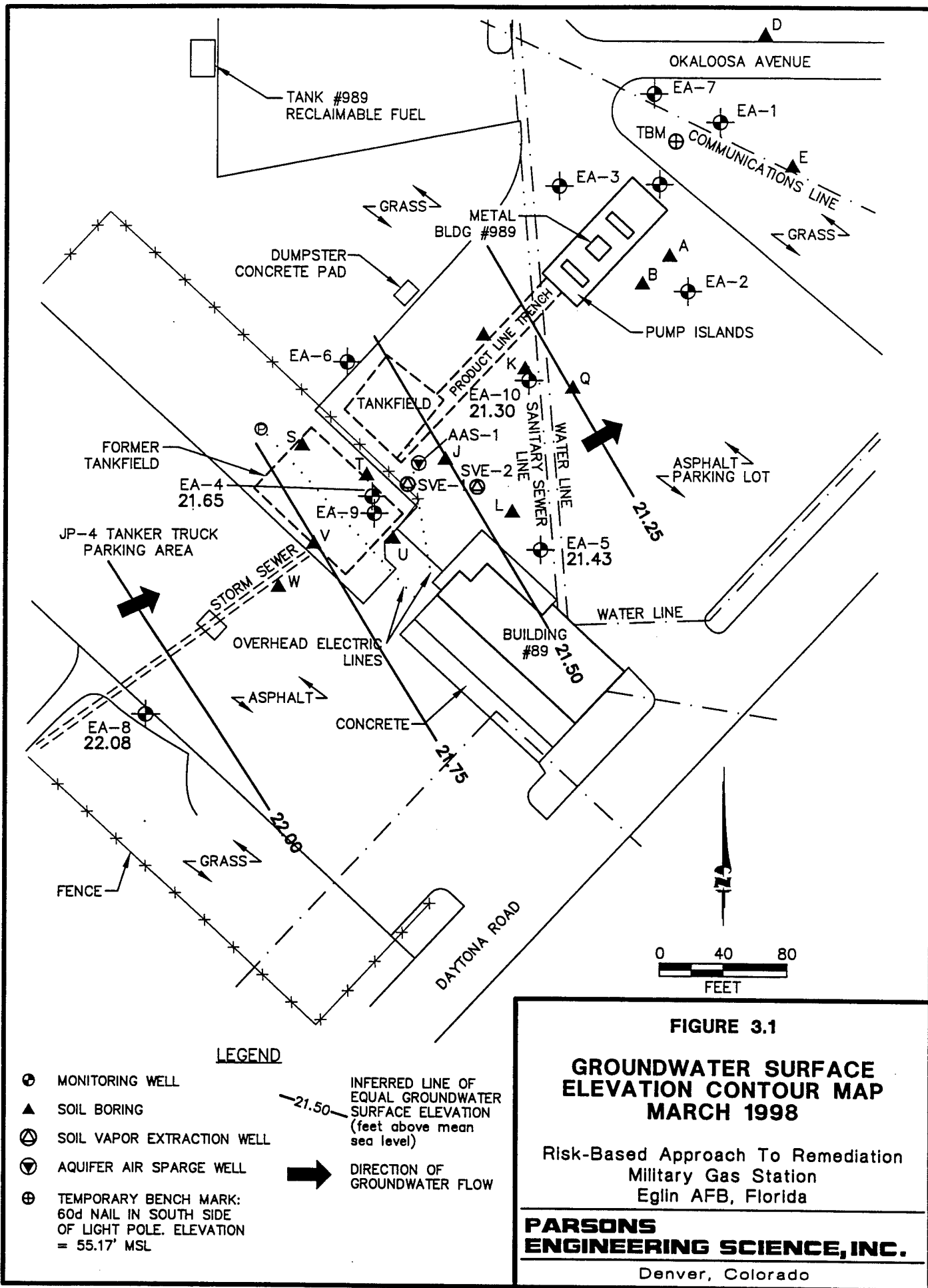


TABLE 3.2
SLUG TEST ANALYSIS RESULTS
Military Gas Station
Eglin AFB, Florida

Well	Slug Test Number	Hydraulic Conductivity		
		ft/min ^{a/}	ft/day ^{b/}	cm/sec ^{c/}
EA-10	1	0.0104	14.95	0.0053
EA-10	2	0.0205	29.48	0.0104
EA-11	1	0.0392	56.39	0.0199
AVG		0.0233	33.60	0.0119

a/ ft/min = feet per minute

b/ ft/day = feet per day

c/ cm/sec = centimeters per second

SECTION 4

TIER 1 ANALYSIS AND IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

This section provides an overview of the regulatory requirements for a risk-based, tiered approach to identification of COPCs and reviews the preliminary conceptual site model (CSM) developed for the Military Gas Station in the work plan (Parsons ES, 1998) as a means of selecting appropriate regulatory screening criteria to identify COPCs in affected site media (i.e., chemicals present at concentrations that could pose a risk to human and/or ecological receptors exposed to the affected media). This section also presents a screening-level Tier 1 analysis used to select the COPCs that are the focus of this CAP. The COPCs for the Military Gas Station are identified in the Tier 1 analysis based on estimated risks to human health posed by maximum detected contaminant concentrations. Conservative land use and exposure assumptions are used in the Tier 1 screening analysis to ensure that the nature and extent of any COPCs that could pose a risk to receptors at or near the site are fully described (Section 5), and that these chemicals are fully evaluated in subsequent analyses through quantitative fate and transport and receptor exposure evaluations (Sections 6 and 7).

4.1 REGULATORY REVIEW OF THE TIER 1 SCREENING PROCESS

As an initial step in determining the necessity for remedial action at the Military Gas Station, representative concentrations of site contaminants are compared to the generic NFA-With-Conditions TCLs for soil and groundwater presented in Tables IV and V of the *Petroleum Contamination Site Cleanup Criteria* (FDEP, 1997). Contaminant soil concentrations must be below the Direct Exposure II and the leachability target levels presented in Table IV (based on applicable groundwater criteria specified in 62-770.680 (1)(c), FAC). Concentrations of COPCs in groundwater must be below background concentrations or less than levels presented in Table V. Maximum dissolved site contaminant concentrations also are compared to the Table IX Natural Attenuation Source Default Values. This comparison provides an initial assessment of the potential appropriateness of monitored natural attenuation as a remedial alternative.

Those analytes with site concentrations that exceed the appropriate TCLs for soil and groundwater are considered to be COPCs, and are retained for further analysis concerning the risk-reduction requirements for the site. The nature and extent of these COPCs are described more fully in Section 5. Qualitative and quantitative fate and transport analyses are presented in Section 6 to evaluate the migration and persistence of COPCs in affected media.

4.2 PRELIMINARY CONCEPTUAL SITE MODEL REVIEW

Figure 4.1 presents the preliminary conceptual site model (CSM) developed for the Military Gas Station. The CSM was developed using data collected during all relevant site investigations and is based on a review of potential receptors and feasible exposure scenarios. The purpose of developing a CSM is to guide the evaluation of available site information and to determine potential data gaps, including:

- Potential contaminant sources;
- Media affected by contaminant releases;
- Mechanisms of contaminant release (e.g., leaching and volatilization);
- Routes of possible receptor exposure (e.g., inhalation, ingestion, or dermal contact).
- Potential human and ecological receptors; and
- Potential receptor exposure points based on conservative, reasonable land use assumptions.

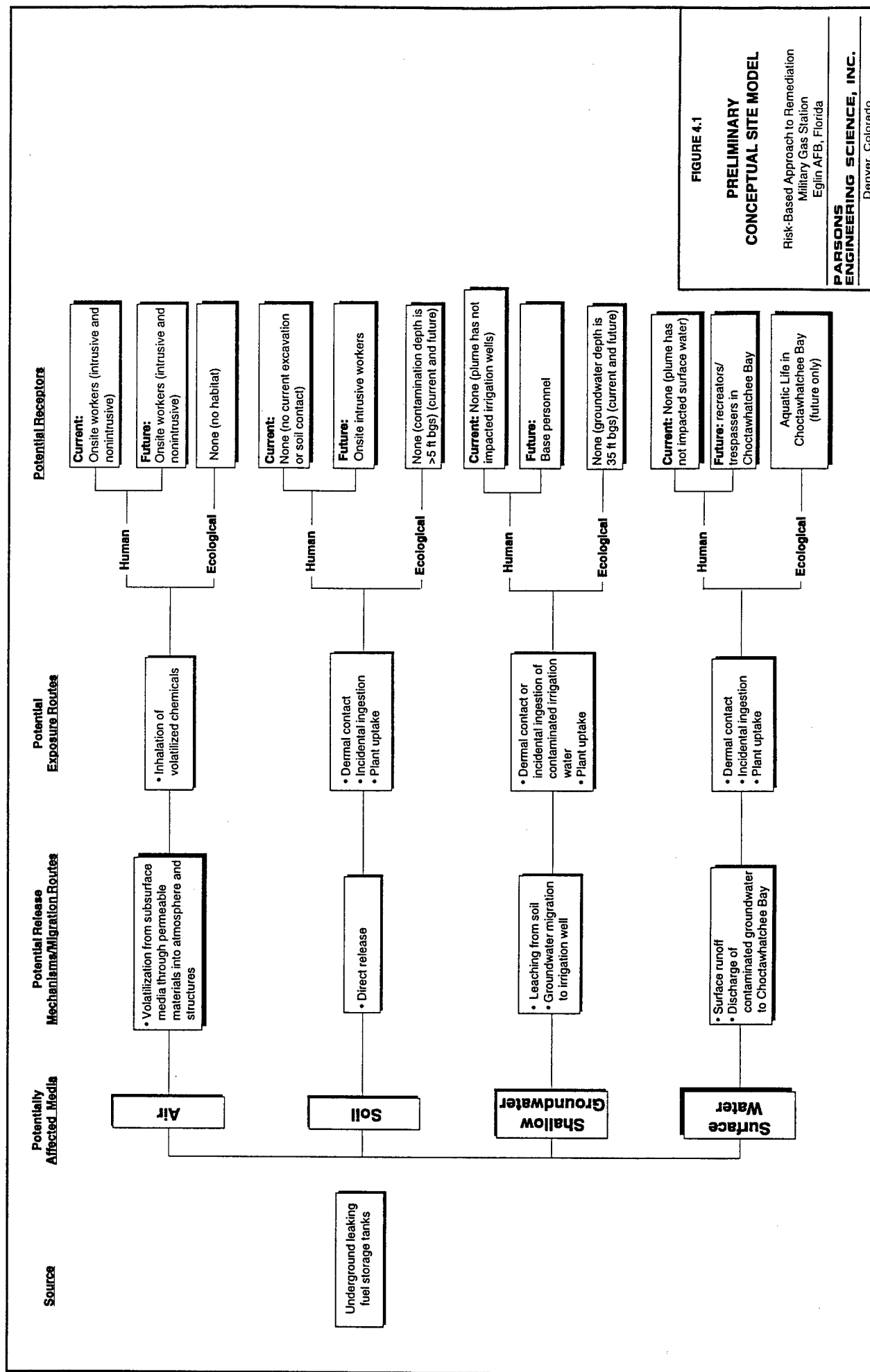
The CSM also was developed to provide an outline for addressing all media-specific, current and potential future exposure scenarios at the site. The CSM has been constructed to identify potentially completed receptor exposure pathways. For an exposure pathway to be completed, there must be a contaminant source, a release mechanism, a contaminant migration pathway, an exposure route, and a receptor. If any of these components is missing, the pathway is considered incomplete, and receptors are not at risk from exposure to site contaminants.

4.2.1 Contaminant Source Assessment

Contamination at the Military Gas Station is present as a result of past overfills of and/or leaks from the underground fuel storage tanks at the site. The USTs and surrounding contaminated soil have been removed from the site. Current soil quality data, which will be discussed in detail in Section 5, indicate that the continuing source of groundwater contamination at the site has been substantially reduced. Mobile light, non-aqueous phase liquid (LNAPL) (free product) has not been found at the site.

4.2.2 Land Use and Potential Receptors

The Military Gas Station is an active fueling station for military vehicles. This site is located within the industrial/commercial section of the main base at the intersection of Daytona Road and Okaloosa Avenue. Potential receptors include only onsite intrusive and non-intrusive industrial workers. Due to the developed, urbanized nature of the site and corresponding lack of habitat, there are no ecological receptors to be considered.



4.2.3 Exposure Pathways

An understanding of potential exposure pathways is important in determining how potential receptors could contact contaminated media and how that contact could result in the uptake of chemicals. An exposure pathway analysis reviews the contaminant sources, locations, and types of environmental releases in relation to population locations and activity patterns to determine the potentially significant pathways and routes of receptor exposure. A completed exposure pathway consists of four necessary elements:

- A source and mechanism of chemical release,
- An environmental transport medium,
- A point of potential contact with a receptor, and
- A feasible route of exposure at the exposure point.

If one or more of these elements is missing, the pathway is incomplete and there is no exposure (and therefore, no risk).

Based on the industrial land use scenario and site-specific contaminated media information, the following human receptor exposure routes may potentially be completed and were evaluated during the data analysis process:

- Inhalation of volatilized contaminants by current or future onsite intrusive and nonintrusive workers;
- Dermal contact with or incidental ingestion of contaminated soil by future onsite intrusive workers (e.g., during future excavation activities);
- Dermal contact with or incidental ingestion of irrigation water by future Base personnel; and
- Dermal contact with or incidental ingestion of downgradient surface water by future recreators or trespassers at Choctawhatchee Bay.

Available information indicates that none of these pathways currently is completed. Therefore, only potential future exposures are assessed. Future receptors may be exposed to soil contaminants by dermal contact with and/or incidental ingestion of soil during intrusive activities (e.g., building foundation excavation, utility pipeline excavation). There are no completed exposure pathways for contaminated groundwater at the site. The depth to groundwater is approximately 35 ft bgs; therefore, groundwater will not be encountered during future excavation activities. No drinking water supply wells screened within the surficial aquifer are located within one-half mile of the site. Eight irrigation wells used to water base lawns are screened in the surficial aquifer within one-half mile of the site (EA, 1994) (Figure 1.2). However, as described in Section 6, the contaminant plume (which is currently wholly contained onsite) is not expected to migrate to these wells because the plume is shrinking.

Surface water may become contaminated by contact with contaminated soil or groundwater discharge to a surface water body. The surface water runoff pathway is not considered complete because the site is mostly paved and surface soils are not contaminated. Therefore, surface water runoff, which is channeled into the storm water drainage system, should not contact contaminated soils. The nearest surface water body downgradient from the site is an inlet of Choctawhatchee Bay located 1,650 yards to the northeast of the site. As described in Section 6, the dissolved contaminant plume is not expanding, and is wholly contained on-site. Therefore, site contamination is not expected to impact Choctawhatchee Bay. The site is expected to continue as a paved, urbanized environment; therefore, future risks to ecological receptors are unlikely.

4.3 TIER 1 SCREENING ANALYSIS

It is the intention of the Air Force to obtain FDEP approval for a corrective action for the site that will protect potential receptors from unacceptable exposures to site-related chemicals. To accomplish this objective, the COPCs that drive potential risks and impact the final remedial requirements at this site were identified.

FDEP (1997) Tier 1 TCLs are based on 1) analyte-specific toxicity data; 2) an exposure-pathway-specific cancer target risk limit of 10^{-6} (i.e., one additional cancer above the background rate in a population of one million) and a noncancer hazard quotient less than or equal to 1; and 3) conservative receptor exposure assumptions.

4.3.1 Tier 1 Screening Analysis for Soil

TCLs for direct exposure of industrial workers (Direct Exposure II) were selected as the appropriate set of Tier 1 screening values for soil at the Military Gas Station. The FDEP (1997) guidance provides industrial-scenario TCLs for petroleum constituents in soil that incorporate risks posed by the dermal contact, ingestion, and inhalation exposure pathways. Table 4.1 compares the maximum site concentrations for each compound measured in soil at the site during the 1998 risk-based sampling event to the Direct-Exposure II TCLs. The 1998 soil samples were collected from the locations containing the most elevated contaminant concentrations based on results from previous sampling events. Based on these comparisons, no analytes are identified as site COPCs in soil.

4.3.2 Tier 1 Screening Analysis for Groundwater

The Tier 1 groundwater TCLs presented by the FDEP (1997) and used in this CAP are based on the conservative assumption of unrestricted future use of groundwater (e.g., use as a drinking water source). Comparisons of the TCLs for unrestricted groundwater use to March 1998 data are presented in Table 4.2. Based on these comparisons, ethylbenzene, total xylenes, lead, and naphthalene are identified as the COPCs in site groundwater. Only the total xylenes concentration in source area well EA-4 exceeded its natural attenuation source default criterion. It should be noted that future use of groundwater as a drinking water source is not anticipated. Therefore, the Tier 1 TCLs are not realistic short-term cleanup levels for the site, and are used for preliminary screening purposes only.

TABLE 4.1
TIER 1 SCREENING SUMMARY FOR SOIL
Military Gas Station
Eglin AFB, Florida

Analyte	Units	Maximum Concentration	Location (and Depth Interval in ft bgs) of Concentration	Direct Exposure ^{a/} II	Leachability ^{b/}
Benzene	mg/kg ^{c/}	0.0061 U ^{d/}	NA ^{e/}	1.50	0.007
Ethylbenzene	mg/kg	0.005 U	NA	240	0.4
Toluene	mg/kg	0.0061 U	NA	2,000	0.4
Xylenes (total)	mg/kg	0.012	V (26 - 28)	290	0.3
Methyl-tert-butyl ether	mg/kg	0.0061 U	NA	6,100	0.2
TRPH (C8-C40) ^{f/}	mg/kg	6.5 J1 ^{g/}	K (15 - 17)	2,500	340
Acenaphthene	mg/kg	0.24 U	NA	22,000	4
Acenaphthylene	mg/kg	0.24 U	NA	11,000	22
Anthracene	mg/kg	0.024 U	NA	290,000	2000
Benzo(a)anthracene	mg/kg	0.074	V (26 - 28)	5.1	2.9
Benzo(a)pyrene	mg/kg	0.069	V (26 - 28)	0.5	7.8
Benzo(b)fluoranthene	mg/kg	0.11	V (26 - 28)	5	9.8
Benzo(g,h,i)perylene	mg/kg	0.063	V (26 - 28)	45,000	13,000
Benzo(k)fluoranthene	mg/kg	0.037	V (26 - 28)	52	25
Chrysene	mg/kg	0.11	V (26 - 28)	490	80
Dibenz(a,h)anthracene	mg/kg	0.024 U	NA	0.5	14
Fluoranthene	mg/kg	0.17	V (26 - 28)	45,000	550
Fluorene	mg/kg	0.015 J1	V (26 - 28)	24,000	87
Indeno(1,2,3-cd)pyrene	mg/kg	0.036 U	NA	5.2	28
Naphthalene	mg/kg	0.24 U	NA	8,600	1
Phenanthrene	mg/kg	0.11	V (26 - 28)	29,000	120
Pyrene	mg/kg	0.16	V (26 - 28)	40,000	570

Notes:

a/ Direct Exposure II = FDEP TCLs based on No Further Action With Conditions.

b/ Leachability = Based on FDEP Table V Groundwater TCLs.

c/ mg/kg = Milligrams per kilogram.

d/ U = The analyte was analyzed for and is not present above the reporting limit.

e/ NA = Not applicable.

f/ TRPH = Total Recoverable Petroleum Hydrocarbons.

g/ J1 = The analyte was positively identified and has a concentration between the method detection limit and the reporting limit.

TABLE 4.2
TIER 1 SCREENING VALUES FOR GROUNDWATER
Military Gas Station
Eglin AFB, Florida

Analyte	Units	Maximum Detection	Detection Location	Table V Target Cleanup Level ^{a/}	Table IX Natural Attenuation Source Default ^{b/}
Benzene	µg/L ^{c/}	10 U ^{d/} (0.28) ^{c/}	NA ^{f/}	1	100
Ethylbenzene	µg/L	76	EA-4	30	300
Toluene	µg/L	10 U	NA	40	400
Xylenes (total)	µg/L	400	EA-4	20	200
TRPH (C8-C40) ^{g/}	mg/L ^{h/}	4.4	EA-4	5	50
EDB ^{i/}	µg/L	0.020 U	NA	0.02	2
Lead	µg/L	19	EA-10	15	150
Acenaphthene	µg/L	1 U	NA	20	200
Acenaphthylene	µg/L	1 U	NA	210	2,100
Anthracene	µg/L	0.1 U	NA	2,100	21,000
Benzo(a)anthracene	µg/L	0.13 U	NA	0.2	20
Benzo(a)pyrene	µg/L	0.23 U (0.066)	NA	0.2	20
Benzo(b)fluoranthene	µg/L	0.18 U	NA	0.2	20
Benzo(g,h,i)perylene	µg/L	0.2 U	NA	210	2,100
Benzo(k)fluoranthene	µg/L	0.17 U	NA	0.5	50
Chrysene	µg/L	0.2 U	NA	5	500
Dibenz(a,h)anthracene	µg/L	0.3 U (0.078)	NA	0.2	20
Fluoranthene	µg/L	0.2 U	NA	280	2,800
Fluorene	µg/L	0.085 J1 ^{j/}	EA-4	280	2,800
Indeno(1,2,3-cd)pyrene	µg/L	0.44 U (0.056)	NA	0.2	20
Naphthalene	µg/L	40	EA-4	20	200
Phenanthrene	µg/L	0.2 U	NA	210	2,100
Pyrene	µg/L	0.2 U	NA	210	2,100

Notes:

a/ Table V Target Cleanup Level = FDEP TCLs for Groundwater

b/ Table IX Natural Attenuation Source Default = FDEP TCLs for Natural Attenuation.

c/ µg/L = micrograms per liter.

d/ U = The analyte was analyzed for and is not present above the reporting limit.

e/ When the reporting limit exceeds the target cleanup level and the chemical is not detected (U), then the method detection limit (MDL) is shown in parentheses. The analyte concentration is below the MDL.

f/ NA = Not applicable.

g/ TRPH = Total Recoverable Petroleum Hydrocarbons.

h/ mg/L = milligrams per liter.

i/ EDB = ethylene dibromide.

j/ J1 = The analyte was positively identified and has a concentration between the method detection limit and the reporting limit.

4.3.3 Tier 1 Screening Analysis for Soil Gas

FDEP (1997) guidance does not provide RBSLs for screening soil gas concentrations or for directly screening ambient air values. FDEP guidance accounts for the potential for volatilization of contaminants from soils into ambient air in the calculation of the Tier 1 TCLs for direct contact with soil. There was no COPC detected above Tier 1 TCLs in soil, indicating that exposure via volatilization from soil into ambient air will not present a risk. The Tier 1 TCLs do not account for the presence of the pavement cover over much of the site, which would act to further minimize the potential for exposure via the inhalation pathway. Currently, there are no enclosed structures at the site, and therefore no indoor receptors.

As a secondary means of assessing the potential for exposure via inhalation of volatiles, the soil gas sample collected in March 1998 was analyzed for BTEX, and maximum detections of each compound were compared to the chemical-specific Occupational Safety and Health Administration (OSHA) 8-hour time-weighted average Permissible Exposure Limits (PELs) (NIOSH, 1997) and time-weighted average threshold limit values (TWA-TLVs) [American Conference of Government Industrial Hygienists (ACGIH), 1998]. Table 4.3 presents the results of this comparison. No BTEX constituents were detected above the OSHA PELs or the TLVs, indicating that inhalation of volatilized contaminants does not currently, and will not in the future, pose a risk to potential receptors.

4.3.4 Summary of Site COPCs

Based on comparisons of the maximum soil, groundwater, and soil gas concentrations to FDEP (1997) TCLs and OSHA PELs (NIOSH, 1997), dissolved ethylbenzene, dissolved xylenes, dissolved lead, and dissolved naphthalene are identified as COPCs for the Military Gas Station.

TABLE 4.3
TIER 1 SCREENING VALUES FOR SOIL GAS
Military Gas Station
Eglin AFB, Florida

Analyte	Maximum Detection (ppmv ^{a/})	OSHA PEL ^{b/} (ppmv)	TWA-TLV ^{c/} (ppmv)
Benzene	<0.020	1	0.5
Ethylbenzene	<0.020	200	100
Toluene	0.026	100	50
Xylenes (total)	0.075	100	100
TPH ^{d/}	1.5	Not available	Not available
C2-C4 Hydrocarbons ^{e/}	<0.20	Not available	Not available

Notes:

a/ ppmv = parts per million, volume per volume.

b/ OSHA PEL = Occupational Safety and Health Administration (NIOSH, 1997) 8-hour time-weighted average permissible exposure limit.

c/ TLV = Time-weighted average/threshold limit value - recommended by the American Conference of Government Industrial Hygienists (ACGIH), 1998.

d/ TPH = Total Petroleum Hydrocarbons (C5+ hydrocarbons referenced to gasoline).

e/ Referenced to gasoline.

SECTION 5

ANALYTICAL DATA SUMMARY AND MAGNITUDE AND EXTENT OF CHEMICALS OF POTENTIAL CONCERN

5.1 OVERVIEW

This section presents analytical results from the March 1998 field sampling event in tabular form, and summarizes the magnitude and extent of COPC contamination in sampled media at the Military Gas Station. Discussion in this section is primarily limited to those chemicals that were identified as COPCs based on the Tier 1 screening analysis presented in Section 4 (i.e., dissolved ethylbenzene, xylenes, lead, and naphthalene).

5.2 SOIL SAMPLING RESULTS

Soil sampling was performed as part of the recent risk-based investigation; analytical results are summarized in Table 5.1. Soil borings were advanced in areas of elevated fuel contamination (based on previous investigations) to determine worst case hydrocarbon concentrations in soil, in addition to facilitating evaluation of how concentrations have changed over time. As shown in Table 4.1, no analyte was detected above the Direct Exposure II levels. Available soil analytical data indicate that there are no exceedences of Tier I TCLs and, therefore, no soil COPCs.

5.3 GROUNDWATER SAMPLING RESULTS

Groundwater sampling was performed as part of the recent risk-based investigation; analytical results are summarized in Table 5.2. Sample locations were selected based on the results of previous investigations. The sampling objective was to determine the areal extent and magnitude of fuel hydrocarbon and lead concentrations in groundwater. As shown in Table 4.2, ethylbenzene, xylenes, lead, and naphthalene in groundwater exceeded their respective Tier I TCLs.

During the March 1998 field effort, ethylbenzene was detected above the FDEP TCL of 30 $\mu\text{g/L}$ at source area monitoring well EA-4 (76 $\mu\text{g/L}$). Xylenes also were detected above the FDEP TCL of 20 $\mu\text{g/L}$ at EA-4 (400 $\mu\text{g/L}$). Lead was detected above the FDEP TCL of 15 $\mu\text{g/L}$ at EA-4 (17 $\mu\text{g/L}$) and at EA-10 (19 $\mu\text{g/L}$). It should be noted, however, that only dissolved lead concentrations exceeded the TCL; total lead concentrations were below the TCL. Naphthalene was detected above the FDEP TCL of 20 $\mu\text{g/L}$ at EA-4 (40 $\mu\text{g/L}$). The distribution of ethylbenzene, xylenes, lead, and naphthalene in groundwater is presented on Figure 5.1.

TABLE 5.1
SUMMARY OF SOIL ANALYTICAL DATA
Military Gas Station
Eglin AFB, Florida

Analyte	Units	Sample Locations, Depth Intervals (ft bgs), and Sampling Dates				
		B 25 - 27 3/29/98	V 8 - 10 3/29/98	V 26 - 28 3/29/98	K 8 - 10 3/30/98	K 15 - 17 3/30/98
Benzene	mg/kg ^{a/}	0.0061 U ^{b/}	NA ^{c/}	0.0061 U	NA	0.0055 U
Ethylbenzene	mg/kg	0.0024 U	NA	0.005 U	NA	0.0022 U
Toluene	mg/kg	0.0061 U	NA	0.0061 U	NA	0.0055 U
Xylenes (total)	mg/kg	0.0061 U	NA	0.012	NA	0.0055 U
Methyl-tert-butyl ether	mg/kg	0.0061 U	NA	0.0061 U	NA	0.0055 U
TRPH (C8-C40) ^{d/}	mg/kg	4.4 J1 ^{e/}	NA	4.7 J1	NA	6.5 J1
Acenaphthene	mg/kg	0.24 U	NA	0.24 U	NA	0.22 U
Acenaphthylene	mg/kg	0.24 U	NA	0.24 U	NA	0.22 U
Anthracene	mg/kg	0.024 U	NA	0.024 U	NA	0.022 U
Benzo(a)anthracene	mg/kg	0.024 U	NA	0.074	NA	0.022 U
Benzo(a)pyrene	mg/kg	0.018 U	NA	0.069	NA	0.016 U
Benzo(b)fluoranthene	mg/kg	0.015 U	NA	0.11	NA	0.013 U
Benzo(g,h,i)perylene	mg/kg	0.061 U	NA	0.063	NA	0.055 U
Benzo(k)fluoranthene	mg/kg	0.013 U	NA	0.037	NA	0.012 U
Chrysene	mg/kg	0.049 U	NA	0.11	NA	0.044 U
Dibenz(a,h)anthracene	mg/kg	0.024 U	NA	0.024 U	NA	0.022 U
Fluoranthene	mg/kg	0.049 U	NA	0.17	NA	0.044 U
Fluorene	mg/kg	0.049 U	NA	0.015 J1	NA	0.044 U
Indeno(1,2,3-cd)pyrene	mg/kg	0.036 U	NA	0.036 U	NA	0.033 U
Naphthalene	mg/kg	0.24 U	NA	0.24 U	NA	0.22 U
Phenanthrene	mg/kg	0.049 U	NA	0.11	NA	0.044 U
Pyrene	mg/kg	0.049 U	NA	0.16	NA	0.044 U
TOC ^{f/}	mg/kg	NA	2000 U	NA	2000 U	NA

Notes:

a/ mg/kg = Milligrams per kilogram.

b/ U = The analyte was analyzed for and is not present above the reporting limit.

c/ NA = Not Analyzed.

d/ TRPH = Total Recoverable Petroleum Hydrocarbons.

e/ J1 = The analyte was positively identified and has a concentration between the method detection limit and the reporting limit.

f/ TOC = Total organic carbon.

TABLE 5.2
SUMMARY OF GROUNDWATER ANALYTICAL DATA
Military Gas Station
Eglin AFB, Florida

		Sample Locations and Dates				
		EA-4 3/31/98	EA-40 3/31/98 (Duplicate)	EA-5 3/27/98	EA-8 3/27/98	EA-10 3/27/98
Analyte	Units					
Benzene	µg/L ^{a/}	10 U ^{b/}	10 U	2 U	2 U	2 U
Ethylbenzene	µg/L	76	74	1.4 J1 ^{c/}	0.099 J1	2.3
Toluene	µg/L	10 U	10 U	2 U	2 U	2 U
Xylenes (total)	µg/L	400	380	6.7	4.7	11
EDB ^{d/}	µg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
TRPH (C8-C40) ^{e/}	mg/L ^{f/}	3.1	4.4	NA ^{g/}	NA	0.81
Total Lead	µg/L	15	15	NA	NA	11
Dissolved Lead	µg/L	17	17	NA	NA	19
Acenaphthene	µg/L	0.98 U	1 U	NA	NA	1 U
Acenaphthylene	µg/L	0.98 U	1 U	NA	NA	1 U
Anthracene	µg/L	0.098 U	0.1 U	NA	NA	0.1 U
Benzo(a)anthracene	µg/L	0.13 U	0.13 U	NA	NA	0.13 U
Benzo(a)pyrene	µg/L	0.23 U	0.23 U	NA	NA	0.23 U
Benzo(b)fluoranthene	µg/L	0.18 U	0.18 U	NA	NA	0.18 U
Benzo(g,h,i)perylene	µg/L	0.2 U	0.2 U	NA	NA	0.2 U
Benzo(k)fluoranthene	µg/L	0.17 U	0.17 U	NA	NA	0.17 U
Chrysene	µg/L	0.2 U	0.2 U	NA	NA	0.2 U
Dibenz(a,h)anthracene	µg/L	0.29 U	0.31 U	NA	NA	0.3 U
Fluoranthene	µg/L	0.2 U	0.2 U	NA	NA	0.2 U
Fluorene	µg/L	0.056 J1	0.085 J1	NA	NA	0.2 U
Indeno(1,2,3-cd)pyrene	µg/L	0.42 U	0.44 U	NA	NA	0.44 U
Naphthalene	µg/L	40	27	NA	NA	0.7
Phenanthrene	µg/L	0.2 U	0.2 U	NA	NA	0.2 U
Pyrene	µg/L	0.2 U	0.2 U	NA	NA	0.2 U

Notes:

a/ µg/L = Micrograms per liter.

b/ U = The analyte was analyzed for and is not present above the reporting limit.

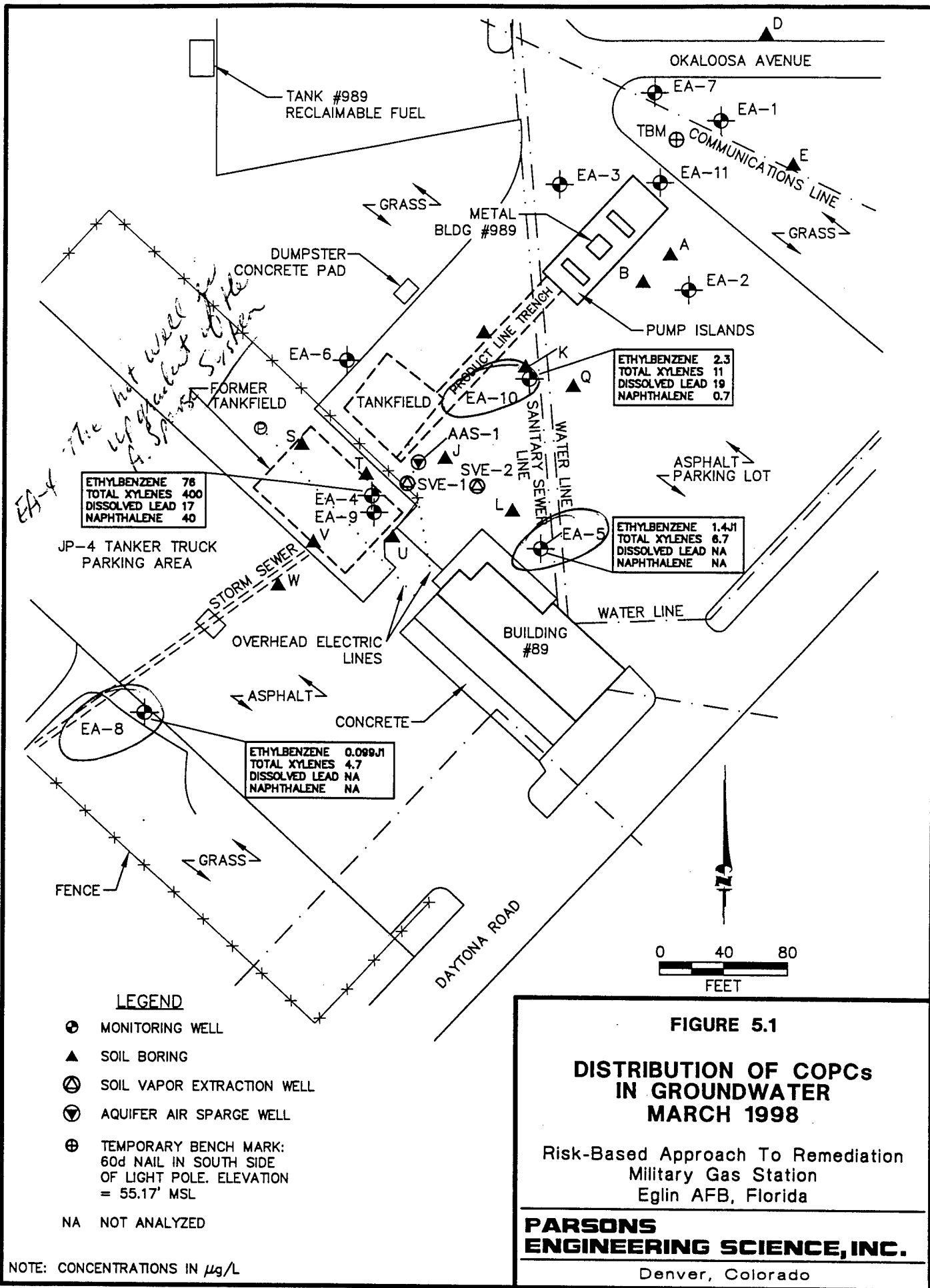
c/ J1 = The analyte was positively identified and has a concentration between the method detection limit and the reporting limit.

d/ EDB = Ethylene dibromide.

e/ TRPH = Total Recoverable Petroleum Hydrocarbons.

f/ mg/L = milligrams per liter.

g/ NA = Not analyzed.



The distribution of xylenes presented on Figure 5.1 was used to estimate the volume of this compound present in the groundwater at the Military Gas Station. Calculations are presented in Appendix E. The estimated volume of xylenes in groundwater at the Military Gas Station is 134 mL (9.1 tablespoons [tbsp]).

5.4 SOIL GAS SAMPLING RESULTS

A soil gas sample was collected at the site to facilitate assessment of the potential risk to future workers at the site from inhalation of VOCs, and to determine whether or not sufficient O₂ is available in the soil gas to sustain aerobic fuel hydrocarbon biodegradation. The soil gas sample was collected at a depth of 3 feet bgs in the contaminant source area (Figure 2.1) and analyzed in the field for concentrations of O₂ and CO₂. The sample also was submitted to Air Toxics, Ltd. of Folsom California for analysis of BTEX and TPH (referenced to gasoline and propane). Field and laboratory analytical results for the March 1998 soil gas sample are summarized in Table 5.3. Comparison of maximum soil gas BTEX concentrations to OSHA 8-hour time-weighted average PELs and TWA-TLVs (Table 4.3) indicates that hydrocarbons do not pose a potential inhalation risk to future intrusive or aboveground workers under current conditions.

It should be noted that the SVE system at the site was operating when the soil gas sample was collected, and may have affected soil gas contaminant concentrations. However, as noted in Section 4.3.1, the FDEP (1997) soil TCLs incorporate risks posed by the inhalation exposure pathway. The lack of TCL exceedences indicates that the remaining soil contamination does not pose an inhalation risk to potential receptors.

The detected O₂ concentration (14.8 percent) indicates that sufficient O₂ is present to sustain aerobic biodegradation of fuel residuals. The SVE system is creating an influx of oxygen from uncontaminated soils surrounding the site. This oxygen is promoting biodegradation of residual hydrocarbons. CO₂ is being produced during the microbially-mediated aerobic biodegradation of fuel hydrocarbons. The monitored CO₂ concentration of 3.2 percent is consistent with the ongoing biodegradation of fuel residuals in site soils.

$$\frac{1.91 (OX) + 4.78 (MX) + 1.45 (PX)}{99.94 \text{ gal}} = \frac{8.14}{99.94} = \frac{0.08144 \text{ gal Xylene}}{\text{gal fuel}} = 10.42 \text{ O}_2 \text{ xylene/gal fuel}$$

$$134 \text{ mL Xylene} \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right) \left(\frac{1 \text{ gal}}{3.78 \text{ L}} \right) \left(\frac{1280 \text{ g}}{1 \text{ gal}} \right) = 4.5 \text{ O}_2 \text{ xylene in dissolved phase}$$

$$\frac{4.5 \text{ O}_2 \text{ dissolved}}{10.42 \text{ O}_2 \text{ xylene/gal fuel}} = \boxed{0.433 \text{ gal of fuel}} \quad \begin{matrix} \text{5.5} \\ \text{SP.11} \end{matrix} \quad \text{less than } \frac{1}{2} \text{ gal}$$

TABLE 5.3
SUMMARY OF SOIL GAS ANALYTICAL DATA
Military Gas Station
Eglin AFB, Florida

Analyte	Sample Locations, Dates, and Units		
	Mil SG1 31-Mar-98		
	ppmv ^{a/}	mg/L ^{b/}	percent
Benzene	ND ^{c/}	ND	NA ^{d/}
Toluene	0.026	0.099	NA
Ethylbenzene	ND	ND	NA
Xylenes (total)	0.075	0.330	NA
TPH (C5+ Hydrocarbons) ^{e/}	1.5	6.2	NA
C2-C4 Hydrocarbons	ND	ND	NA
Oxygen	NA	NA	14.8
Carbon Dioxide	NA	NA	3.2

Notes:

a/ ppmv = parts per million, volume per volume.

b/ mg/L = milligrams per liter.

c/ ND = not detected.

d/ NA = not applicable.

e/ TPH = total petroleum hydrocarbons.

SECTION 6

CHEMICAL FATE ASSESSMENT

6.1 INTRODUCTION

Biodegradation of dissolved fuel constituents and the future migration and persistence of the dissolved COPCs identified in Section 4 are assessed in this section to support development of a long-term monitoring (LTM) plan that can be used to ensure that downgradient receptors will not be impacted by the dissolved COPCs.

As used throughout this report, the term "remediation by natural attenuation" (RNA) refers to a subsurface contaminant remediation strategy that relies on natural physical, chemical, and biological mechanisms to control exposure of potential receptors to concentrations of contaminants in soils and groundwater that exceed regulatory levels. These mechanisms include the processes of advection, hydrodynamic dispersion, dilution from recharge, sorption, volatilization, and biodegradation, which facilitate RNA of a variety of anthropogenic chemicals.

This section summarizes and interprets specific site characterization data relevant to documenting the effectiveness of RNA at minimizing dissolved COPC migration and reducing COPC concentration, mass, and toxicity over time.

6.2 OPERATIVE MECHANISMS OF CONTAMINANT ATTENUATION

Understanding the fate of COPC in environmental media is critical to evaluating and predicting contaminant distribution patterns. There are several physical, chemical, and biological processes that influence how a chemical behaves in soil and groundwater.

Nondestructive attenuation processes can be described as those physical and chemical processes that may prohibit significant contaminant migration but will not result in a permanent reduction in contaminant mass. Examples of nondestructive attenuation processes include volatilization, sorption, dilution from recharge, advection, and hydrodynamic dispersion. These processes must be evaluated when determining whether some type of remediation is warranted because chemical contamination poses or has the potential to pose a risk to human or ecological receptors. If contamination cannot reach a potential receptor exposure point, the contamination poses no risk.

In comparison to nondestructive chemical attenuation processes, destructive chemical attenuation processes result in the permanent removal of contaminant mass from the environment. Documenting and distinguishing the effects of destructive attenuation processes, such as biodegradation, from nondestructive attenuation processes is critical

to evaluating the potential for RNA to bring about a reduction in contaminant mass over time. The effectiveness of destructive attenuation processes at reducing contaminant mass at a site depends on how susceptible the chemical is to biodegradation and whether the site is characterized by physical, chemical, and biological conditions favorable to such processes.

Numerous laboratory and field studies have shown that hydrocarbon-degrading bacteria can participate in the degradation of many of the chemical components of different types of fuels (e.g., gasoline) under both aerobic and anaerobic conditions. Biodegradation of fuel hydrocarbons will occur when an indigenous population of hydrocarbon-degrading microorganisms is present in the soil and groundwater, and sufficient concentrations of electron acceptors and nutrients, including fuel hydrocarbons, are available to these organisms. Soils and groundwater with a history of exposure to fuel hydrocarbon compounds, such as at the Military Gas Station, generally contain microbial populations capable of facilitating biodegradation reactions (Wiedemeier *et al.*, 1995). The chemical basis for the biodegradation of BTEX is described in more detail in Section 6.4, where geochemical data relevant to documenting biodegradation at the field scale at the Military Gas Station are presented.

6.3 EVIDENCE OF CONTAMINANT REDUCTION OVER TIME

The first step in determining whether contaminant concentrations are being reduced in soils and groundwater at the Military Gas Station was to compare contaminant concentrations at selected sampling locations over time. The purpose of this comparison was to assess the evidence of field-scale contaminant mass loss. Decreases in the magnitude of contaminant concentrations at a site over time that cannot be explained by physical processes (e.g., source removal actions such as SVE, air sparging, mass transport in groundwater) may be the first indication that contaminants are biodegrading at the site.

6.3.1 VOC Concentration Trends in Soil

There are no historical soil contamination laboratory data to compare to the March 1998 data to demonstrate the effects of biodegradation and SVE. However, field screening data are available to indicate the changes in volatile soil contaminant concentrations at the site. In 1994, soil borings were advanced at locations B, V, and K. Organic vapor analyzer (OVA) readings were recorded on the 1994 boring logs. These data are compared in Table 6.1 to the field screening results for the 1998 borings that were advanced at adjacent locations. The data indicate that soil contaminant concentrations have been substantially reduced since 1994 due to the effects of biodegradation and SVE.

6.3.2 COPC Concentration Trends in Groundwater

COPC concentrations measured at select monitoring wells from September 1992 to March 1998 are summarized in Table 6.2. Ethylbenzene, total xylenes, and naphthalene concentrations over time are plotted on Figures 6.1 and 6.2. Figure 6.1 is a plot of the concentrations of the contaminants over time at source area well EA-4. The plot shows an overall decrease in the concentrations of the contaminants since

TABLE 6.1
COMPARISON OF 1994 AND 1998 SOIL HEADSPACE READINGS
Military Gas Station
Eglin AFB, Florida

Boring ID	Sample Depth	1994 Headspace Result (ppmv ^{a/})	1998 Headspace Result (ppmv)
B	25-27 ft bgs ^{b/}	93	60
V	26-28 ft bgs	> 1,000	20
K	15-17 ft bgs	88	20

^{a/} ppmv = parts per million, volume per volume.

^{b/} ft bgs = feet below ground surface.

TABLE 6.2
SUMMARY OF HISTORICAL DISSOLVED COPC CONCENTRATIONS
Military Gas Station
Eglin AFB, Florida

WELL	DATE	ETHYLBENZENE (µg/L) ^{a/}	TOTAL XYLENES (µg/L)	NAPHTHALENE (µg/L)	LEAD (µg/L)
EA-4	Sep-92	940	4900	190	13
	Sep-93	510	2380	170	NA ^{b/}
	Jun-94	440	2100	75	NA
	Dec-95	310	1820	300	NA
	Aug-96	480	2060	150	NA
	Nov-96	170	1010	11	NA
	Feb-97	240	1590	120	NA
	Mar-98	76	400	40	17

WELL	DATE	ETHYLBENZENE (µg/L)	TOTAL XYLENES (µg/L)	NAPHTHALENE (µg/L)	LEAD (µg/L)
EA-10	Jul-93	210	1000	62	3.9
	Jun-94	390	1440	96	NA
	Dec-95	190	915	190	NA
	Mar-98	2.3	11	0.7	19

WELL	DATE	ETHYLBENZENE (µg/L)	TOTAL XYLENES (µg/L)	NAPHTHALENE (µg/L)	LEAD (µg/L)
EA-1	Sep-92	< 0.9	< 0.9	< 1.4	< 5
	Sep-93	140	543.6	51	NA
	Jun-94	160	320	8.7	NA
	Nov-96	< 1	< 1	< 1	NA
	Feb-97	< 1	< 1	< 1	NA

a/ µg/L = micrograms per liter.

b/ NA = not analyzed.

FIGURE 6.1
COPC CONCENTRATIONS VERSUS TIME AT WELL EA-4

Military Gas Station
 Eglin AFB, Florida

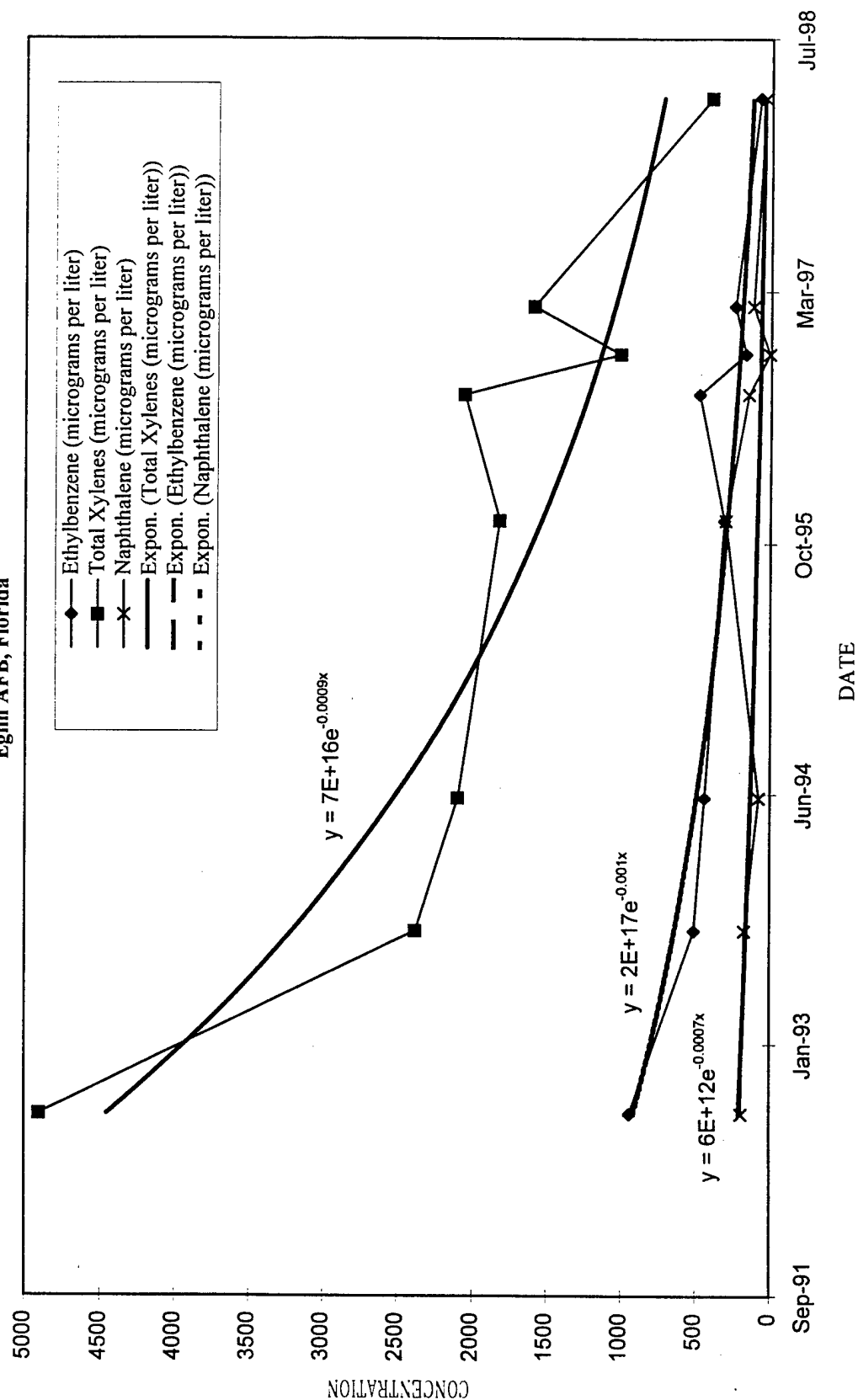
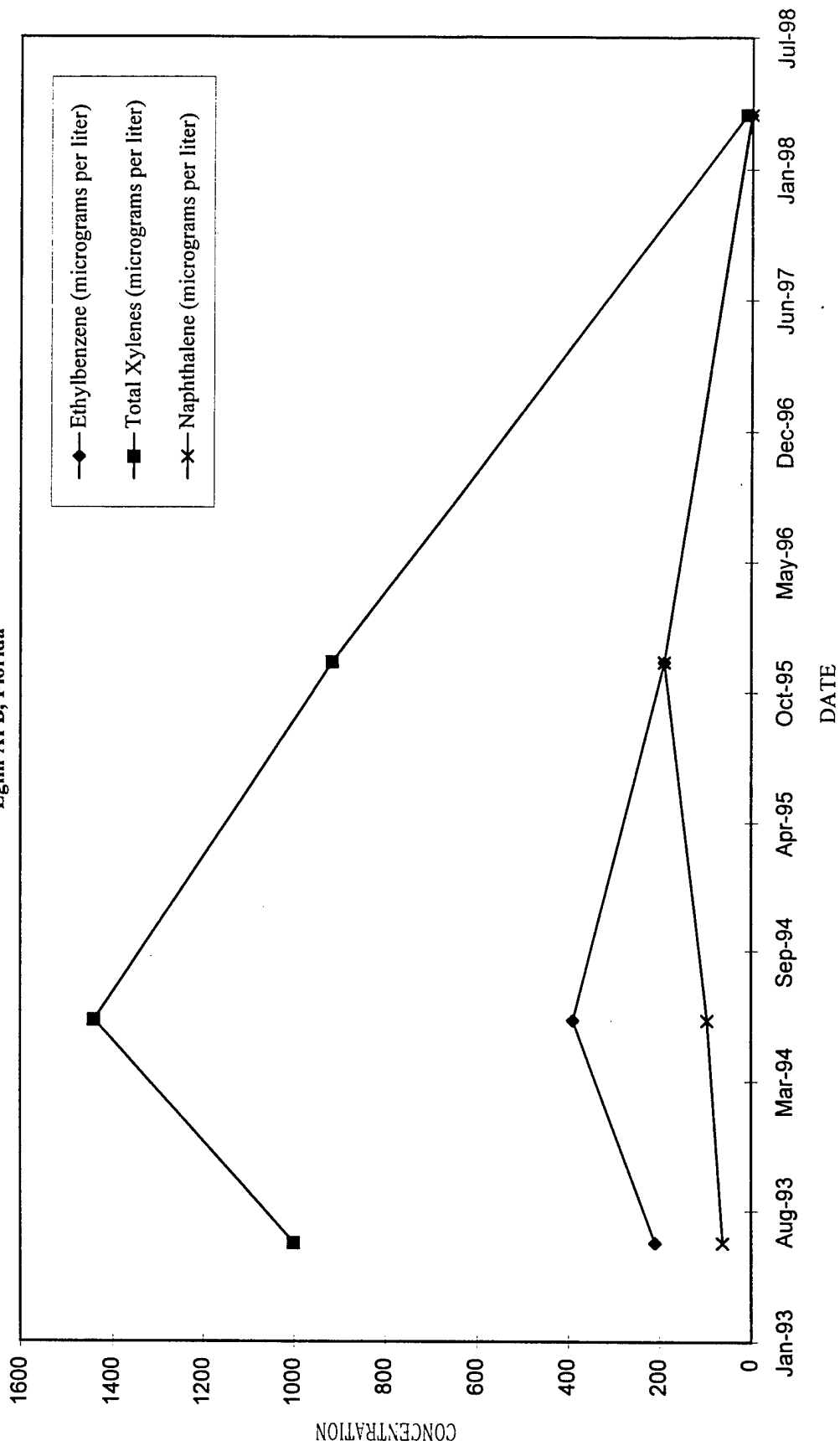


FIGURE 6.2
COPC CONCENTRATIONS VERSUS TIME AT WELL EA-10

Military Gas Station
 Eglin AFB, Florida



1992. Ethylbenzene concentrations have decreased from 940 µg/L in 1992 to 76 µg/L in 1998. Xylene concentrations have decreased from 4,900 µg/L in 1992 to 400 µg/L in 1998. Naphthalene concentrations have decreased from 190 µg/L in 1992 to 40 µg/L in 1998.

Exponential best-fit, first-order trendlines interpolated over the data for well EA-4 indicate contaminant reduction rates ranging from 0.0007 day⁻¹ for naphthalene (half-life = 2.7 years) to 0.001 day⁻¹ for ethylbenzene (half-life = 1.9 years). As with a large number of biological processes, the change in solute concentrations over time can generally be described using a first-order rate constant. The estimated time for the COPCs to decrease to below TCLs was calculated using the COPC-specific equations shown on Figure 6.1. Calculations are presented in Appendix E. The results indicate that the ethylbenzene concentration will decrease below the FDEP TCL of 30 µg/L in 2.5 years, the total xylenes concentration will be below the FDEP TCL of 20 µg/L in 9.1 years, and the naphthalene concentration will be below the FDEP TCL of 20 µg/L in 2.7 years. It should be noted that substantial decreases in COPC concentrations occurred prior to startup of the air sparging/SVE system in 1994 or 1995, most likely due to the effects of biodegradation and removal of the USTs in 1991. It should also be noted that well EA-4 is located upgradient from the air sparging well, and the observed contaminant reduction rate should not be influenced by the sparging.

Figure 6.2 is a plot of the concentrations of ethylbenzene, total xylenes, and naphthalene over time at well EA-10. The plot shows an overall decrease in the concentration of COPCs since 1993. Ethylbenzene concentrations have decreased from 210 µg/L in 1993 to 2.3 µg/L in 1998. Xylene concentrations have decreased from 1,000 µg/L in 1993 to 11 µg/L in 1998. Naphthalene concentrations have decreased from 62 µg/L in 1993 to 0.7 µg/L in 1998.

6.4 EVIDENCE OF CONTAMINANT BIODEGRADATION VIA MICROBIALY MEDIATED REDOX REACTIONS

Fuel hydrocarbons are typically utilized as electron donors in biologically mediated redox reactions under a wide range of geochemical conditions. Therefore, analytical data on potential electron acceptors can be used as geochemical indicators of fuel hydrocarbon biodegradation (Wiedemeier *et al.*, 1995). Reductions in the concentrations of oxidized chemical species that are used by microorganisms to facilitate the oxidation of fuel hydrocarbon compounds within contaminated media are an indication that contaminants are biodegrading. Alternately, an increase in the metabolic byproducts resulting from the reduction of electron acceptors can be used as an indicator of contaminant biodegradation. The availability of potential electron acceptors to participate in contaminant biodegradation reactions can be used to estimate the total contaminant mass that can be biodegraded over time at this site. This information can be used to predict how much dissolved COPC mass can be removed from saturated soils and groundwater at the Military Gas Station as a result of natural processes.

6.4.1 Relevance of Redox Couples in Biodegradation

Microorganisms obtain energy to replenish enzymatic systems and to reproduce by oxidizing organic matter. Biodegradation of dissolved fuel hydrocarbons is the result of a series of redox reactions that maintain the charge balance within the natural environment. Microorganisms facilitate the degradation of these organic compounds by transferring electrons from the electron donor (i.e., fuel hydrocarbons and native organic carbon) to available electron acceptors. Electron acceptors are elements or compounds that occur in relatively oxidized states and can participate in redox reactions involving these available electron donors. Electron acceptors known to be present in saturated soil and groundwater at the Military Gas Station are oxygen, nitrate/nitrogen, sulfate, ferric iron, and carbon dioxide.

Microorganisms facilitate fuel hydrocarbon biodegradation to produce energy for their use. The amount of energy that can be released when a reaction occurs or is required to drive the reaction to completion is quantified by the free energy of the reaction (Stumm and Morgan, 1981). Microorganisms are able to utilize electron transport systems and chemiosmosis to combine energetically favorable and unfavorable reactions to produce energy for life processes (i.e., cell production and maintenance). Microorganisms will facilitate only those redox reactions that will yield energy. By coupling the oxidation of fuel hydrocarbon compounds, which requires energy, to the reduction of other compounds (e.g., oxygen, nitrate/nitrite, manganese, ferric iron, sulfate, and carbon dioxide), which yields energy, the overall reaction will yield energy. Detailed information on the redox reactions required to biodegrade dissolved COPCs is included in Table 6.3. The reader is encouraged to review this information to more fully understand the chemical basis of biodegradation.

Figure 6.3 illustrates the sequence of microbially mediated redox processes based on the amount of free energy released for microbial use. In general, reactions yielding more energy tend to take precedence over processes that yield less energy (Stumm and Morgan, 1981). As Figure 6.3 shows, oxygen reduction would be expected to occur in an aerobic environment with microorganisms capable of aerobic respiration because oxygen reduction yields significant energy. However, once the available oxygen is depleted and anaerobic conditions dominate the interior regions of the contaminant plume, anaerobic microorganisms can utilize other electron acceptors in the following order of preference: nitrate/nitrite, manganese, ferric iron, sulfate, and finally carbon dioxide. Each successive redox reaction provides less energy to the system, and each step down in redox energy yield would have to be paralleled by an ecological succession of microorganisms capable of facilitating the pertinent redox reactions.

The expected sequence of redox processes can be estimated by the oxidation/reduction potential (ORP) of the groundwater. The ORP measures the relative tendency of a solution or chemical reaction to accept or transfer electrons, and can be measured in the field. This measurement can be used as a crude indicator of which redox reactions may be operating at a site. High ORPs mean that the solution (or available redox couple) has a relatively high oxidizing potential.

Microorganisms can only facilitate the biodegradation (oxidation) of the fuel hydrocarbon compounds using redox couples that have a higher ORP than the

TABLE 6.3
COUPLED OXIDATION REACTIONS
MILITARY GAS STATION
EGLIN AFB, FLORIDA

Coupled Ethylbenzene Oxidation Reactions	ΔG°_r (kcal/mole Ethyl- benzene)	ΔG°_r (kJ/mole Ethyl- benzene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$10.5 O_2 + C_6H_5C_2H_5 \Rightarrow 8 CO_{2,g} + 5 H_2O$ <i>Ethylbenzene oxidation / aerobic respiration</i>	-1066.13	-4461	3.17:1
$8.4 NO_3 + 8.4 H^+ + C_6H_5C_2H_5 \Rightarrow 8 CO_{2,g} + 9.2 H_2O + 4.2 N_{2,g}$ <i>Ethylbenzene oxidation / denitrification</i>	-1080.76	-4522	4.92:1
$42 H^+ + 21 MnO_2 + C_6H_5C_2H_5 \Rightarrow 8 CO_{2,g} + 21 Mn^{2+} + 26 H_2O$ <i>Ethylbenzene oxidation / manganese reduction</i>	-1066.27	-4461	17.24:1
$84 H^+ + 42 Fe(OH)_{3,a} + C_6H_5C_2H_5 \Rightarrow 8 CO_2 + 42 Fe^{2+} + 110 H_2O$ <i>Ethylbenzene oxidation / iron reduction</i>	-778.48	-3257	22:1 ^{a/}
$10.5 H^+ + 5.25 SO_4^{2-} + C_6H_5C_2H_5 \Rightarrow 8 CO_{2,g} + 5.25 H_2S^o + 5 H_2O$ Eth <i>Ethylbenzene oxidation / sulfate reduction</i>	-166.75	-697.7	4.75:1
$5.5 H_2O + C_6H_5C_2H_5 \Rightarrow 2.75 CO_{2,g} + 5.25 CH_4$ <i>Ethylbenzene oxidation / methanogenesis</i>	-39.83	-166.7	0.79:1 ^{b/}

Coupled Xylene Oxidation Reactions	ΔG°_r (kcal/mole <i>m</i> -xylene)	ΔG°_r (kJ/mole <i>m</i> -xylene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$10.5 O_2 + C_6H_4(CH_3)_2 \Rightarrow 8 CO_{2,g} + 5 H_2O$ <i>m-Xylene oxidation / aerobic respiration</i>	-1063.25	-4448	3.17:1
$8.4 NO_3 + 8.4 H^+ + C_6H_4(CH_3)_2 \Rightarrow 8 CO_{2,g} + 9.2 H_2O + 4.2 N_{2,g}$ <i>m-Xylene oxidation / denitrification</i>	-1077.81	-4509	4.92:1
$46 H^+ + 22 MnO_2 + C_6H_4(CH_3)_2 \Rightarrow 8 CO_{2,g} + 22 Mn^{2+} + 28 H_2O$ <i>m-Xylene oxidation / manganese reduction</i>	-1063.39	-4449	11.39:1
$84 H^+ + 42 Fe(OH)_{3,a} + C_6H_4(CH_3)_2 \Rightarrow 8 CO_2 + 42 Fe^{2+} + 110 H_2O$ <i>m-Xylene oxidation / iron reduction</i>	-775.61	-3245	22:1 ^{a/}
$10.5 H^+ + 5.25 SO_4^{2-} + C_6H_4(CH_3)_2 \Rightarrow 8 CO_{2,g} + 5.25 H_2S^o + 5 H_2O$ <i>m-Xylene oxidation / sulfate reduction</i>	-163.87	-685.6	4.75:1
$5.5 H_2O + C_6H_4(CH_3)_2 \Rightarrow 2.75 CO_{2,g} + 5.25 CH_4$ <i>m-Xylene oxidation / methanogenesis</i>	-36.95	-154.6	0.79:1 ^{b/}

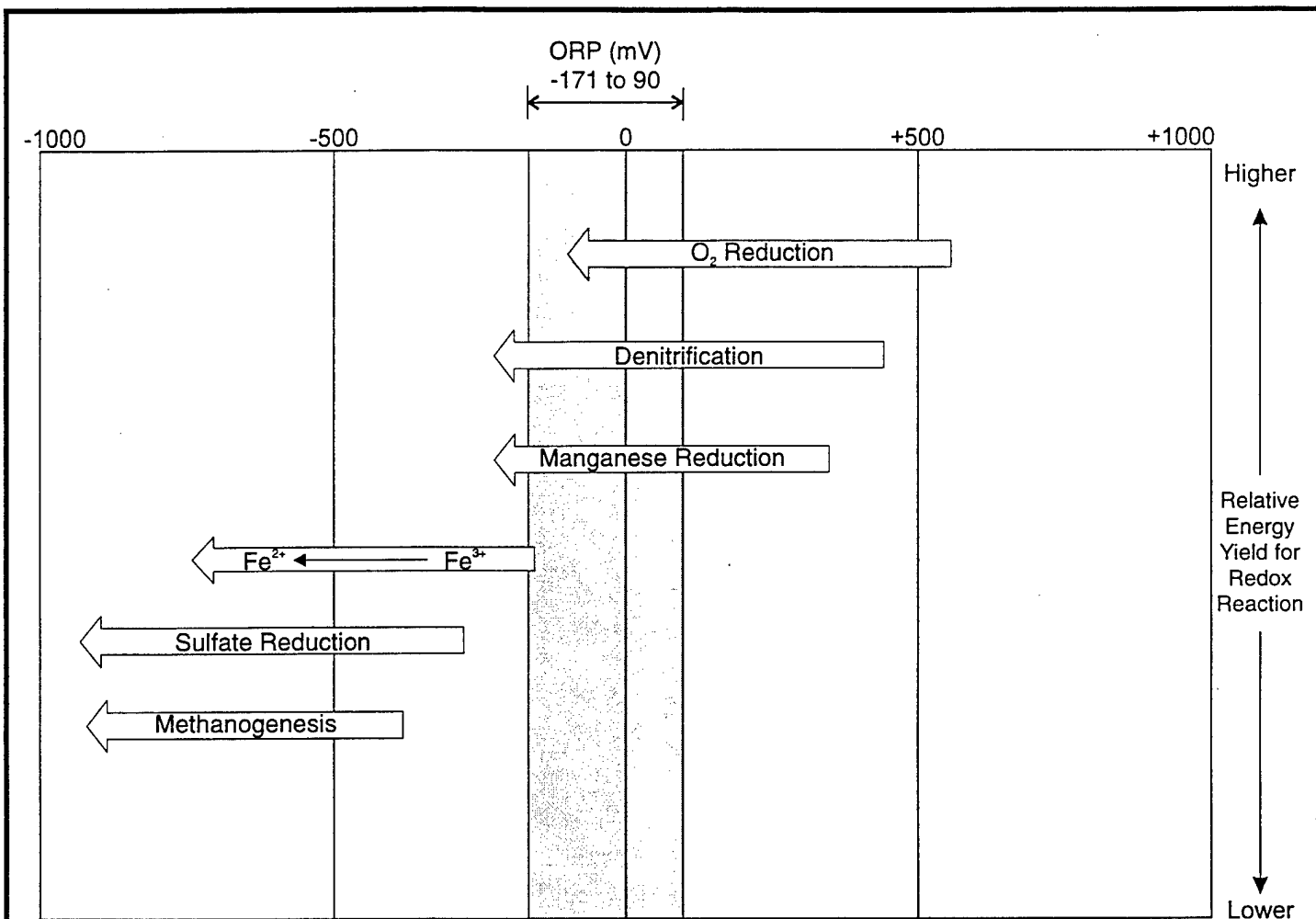
(Continued)

TABLE 6.3 (Continued)
COUPLED OXIDATION REACTIONS
MILITARY GAS STATION
EGLIN AFB, FLORIDA

Coupled Naphthalene Oxidation Reactions	ΔG°_r (kcal/mole naphthalene)	ΔG°_r (kJ/mole naphthalene)	Stoichiometric Mass Ratio of Electron Acceptor to Compound
$12O_2 + C_{10}H_8 \Rightarrow 10CO_2 + 4H_2O$ <i>Naphthalene oxidation / aerobic respiration</i>	-1217.40	-5094	3.00:1
$9.6NO_3^- + 9.6H^+ + C_{10}H_8 \Rightarrow 10CO_2 + 8.8H_2O + 4.8N_{2,g}$ <i>Naphthalene oxidation / denitrification</i>	-1234.04	-5163	4.65:1
$24MnO_2 + 48H^+ + C_{10}H_8 \Rightarrow 10CO_2 + 24Mn^{2+} + 28H_2O$ <i>Naphthalene oxidation / manganese reduction</i>	-1217.57	-5094	16.31:1
$48Fe(OH)_3 + 96H^+ + C_{10}H_8 \Rightarrow 10CO_2 + 48Fe^{2+} + 124H_2O$ <i>Naphthalene oxidation / iron reduction</i>	-932.64	-3902	40.13:1
$6SO_4^{2-} + 12H^+ + C_{10}H_8 \Rightarrow 10CO_2 + 6H_2S^0 + 4H_2O$ <i>Naphthalene oxidation / sulfate reduction</i>	-196.98	-824.2	4.50:1
$8H_2O + C_{10}H_8 \Rightarrow 4CO_2 + 6CH_4$ <i>Naphthalene oxidation / methanogenesis</i>	-44.49	-186.1	0.75:1

^{a/} Mass of ferrous iron produced during microbial respiration.

^{b/} Mass of methane produced during microbial respiration.



Notes

ORP = Oxidation Reduction Potential

 Range of ORP measured at the Military Gas Station

1. These reactions would be expected to occur in sequence if the system is moving toward equilibrium.
2. These redox processes occur in order of their energy-yielding potential (provided microorganisms are available to mediate a specific reaction). Reduction of a highly oxidized species decreases the ORP of the system.
3. The ORP of the system determines which electron acceptors are available for organic carbon oxidation.
4. Redox sequence is paralleled by an ecological succession of biological mediators.

FIGURE 6.3

SEQUENCE OF MICROBIALY MEDIATED REDOX PROCESSES

Risk-Based Approach to Remediation
Military Gas Station
Eglin AFB, Florida

**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado

contaminants. This is why these electron acceptors can be used to oxidize the fuel hydrocarbon compounds. The reduction of highly oxidized species results in an overall decrease in the oxidizing potential of the groundwater. As shown in Figure 6.3, the reduction of oxygen and nitrate will reduce the oxidizing potential to levels at which ferric iron (Fe^{3+}) reduction can occur. As each chemical species that can be used to oxidize the contaminants is exhausted, the microorganisms are forced to use other available electron acceptors with lower oxidizing capacity. When sufficiently low (negative) ORP levels have been developed as a result of these redox reactions, sulfate reduction, and methanogenesis can occur almost simultaneously (Stumm and Morgan, 1981).

ORP values measured in shallow groundwater at the Military Gas Station in March 1998 ranged from -171 to 90 millivolts (mV) (Table 6.4). Areas with the lowest ORP measurements generally coincided with the presence of fuel-contaminated groundwater, indicating that the progressive use of electron acceptors in the order shown on Figure 6.3 has caused the groundwater in the contaminated areas to become more reducing. These data imply that oxygen, nitrate, manganese, and ferric iron may be used to biodegrade fuel hydrocarbon contaminants at this site. However, many authors have noted that field ORP data alone cannot be used to reliably predict all of the electron acceptors that may be operating at a site, because the platinum electrode probes are not sensitive to some redox couples (e.g., sulfate/sulfide) (Stumm and Morgan, 1981; Godsey, 1994; Lovley *et al.*, 1994). Analytical data on oxidized and reduced species are presented in the following subsections to verify which electron acceptors are actually being used to biodegrade the BTEX in saturated soil and groundwater at the Military Gas Station.

Throughout the following subsections, the distributions of geochemical parameters are examined by comparing background concentrations to BTEX plume core concentrations. Analytical data from upgradient well EA-8 and cross-gradient well EA-5 are used for background concentrations. Analytical data from EA-4 are used for BTEX plume core concentrations.

6.4.2 Dissolved Oxygen

Almost all types of fuel hydrocarbons can be biodegraded under aerobic conditions (Borden, 1994). Mineralization of fuel hydrocarbons to carbon dioxide and water under aerobic conditions involves the use of oxygen as a cosubstrate during the initial stages of metabolism, and as a terminal electron acceptor during the later stages of metabolism for energy production. The reduction of molecular oxygen during the oxidation of the fuel hydrocarbon compounds yields a significant amount of free energy that the microorganisms could utilize.

Dissolved oxygen (DO) concentrations were measured at groundwater sampling locations in March 1998. Table 6.4 presents the analytical results for DO by sampling location. The presence of the lowest observed DO concentration (1.2 mg/L) in the core of the dissolved hydrocarbon plume (EA-4) is an indication that biodegradation through aerobic respiration is occurring.

- reach client
close to background

Parameter	Units	EA-4 31-Mar-98	EA-40 31-Mar-98	EA-5 27-Mar-98	EA-8 27-Mar-98	EA-10 27-Mar-98
Ferrous Iron	mg/L ^{a/}	0.4	0.4	0.0	0.0	0.0
Sulfate	mg/L	67	89	120	109	76
Nitrate	mg/L	4.3	4.3	3.7	1.4	1.2
Methane	mg/L	1.7	1.5	0.00054	0.00038 J1 ^{b/}	0.0012
Temperature	Deg C ^{c/}	25.0	NM ^{d/}	23.0	24.3	24.6
pH	SU ^{e/}	6.21	NM	6.33	6.27	7.54
Conductivity	μS/cm ^{f/}	0.130	NM	0.120	0.102	0.135
Dissolved Oxygen	mg/L	1.2	NM	6.0	6.1	7.5
ORP ^{g/}	mV ^{h/}	-171.4	NM	64.7	90.1	34.5

-171.4

partly negative &
positive

D.O. Powell
certifying
Andrew
leaves

See device
from
4900 (1992)
to
900 (98)

400
where not
done for
A.S. System

A. S. S. S. S.

A.S. Saper

A.S. Saper

A.S. Saper

6.4.3 Nitrate

Once available DO concentrations are depleted through aerobic respiration, nitrate can be used as an electron acceptor by indigenous facultative anaerobes that mineralize fuel hydrocarbon compounds via either denitrification or nitrate reduction processes. Concentrations of nitrate (as nitrogen [N]) measured at the site in March 1998 are summarized in Table 6.4. Background nitrate (as N) concentrations measured in the [upgradient and cross-gradient wells ranged from 1.4 to 3.7 mg/L and averaged 2.6 mg/L. Conversely, nitrate (as N) concentrations measured in plume area wells ranged from 1.2 mg/L to 4.3 mg/L and averaged 2.8 mg/L. These data indicate that nitrate concentrations within the dissolved plume are not depleted relative to measured background concentrations. The results indicate that nitrate is not being used to oxidize fuel hydrocarbons in the anaerobic core of the dissolved plumes via denitrification or nitrate reduction.

6.4.4 Ferrous Iron

Although relatively little is known about the anaerobic metabolic pathways involving the reduction of ferric iron (Fe^{3+}), this process has been shown to be a major metabolic pathway for some microorganisms (Lovley and Phillips, 1988; Chapelle, 1993). Elevated concentrations of ferrous iron (Fe^{2+}) often are found in anaerobic, fuel-contaminated groundwater systems. Concentrations of dissolved ferrous iron once were attributed to the spontaneous and reversible reduction of ferric oxyhydroxides, which are thermodynamically unstable in the presence of organic compounds such as benzene. However, more recent studies suggest that the reduction of ferric iron cannot proceed at all without microbial mediation (Lovley and Phillips, 1988; Lovley *et al.*, 1991; Chapelle, 1993). None of the common organic compounds found in low-temperature, neutral, reducing groundwater could reduce ferric oxyhydroxides to ferrous iron under sterile laboratory conditions (Lovley *et al.*, 1991). This means that the reduction of ferric iron to ferrous iron requires mediation by microorganisms with the appropriate enzymatic capabilities.

To determine if ferric iron is being used as an electron acceptor for fuel biodegradation at the Military Gas Station, ferrous (reduced) iron concentrations were measured at groundwater sampling locations in March 1998. A low ferrous iron concentration (0.4 mg/L) was detected in the plume core well EA-4 (Table 6.4). Ferrous iron was not detected in groundwater from upgradient or cross-gradient wells. The occurrence of ferrous iron within the plume core indicates that ferric iron is acting as an electron acceptor at this location. In addition, the measured redox potentials of the groundwater at this site are within the range that would be expected for the ferric iron-reducing conditions implied by the observed ferrous iron distributions (Figure 6.3).

6.4.5 Sulfate

Sulfate also may be used as an electron acceptor during microbial degradation of fuel hydrocarbons under anaerobic conditions (Grbic-Galic, 1990). Sulfate can be reduced to sulfide during the oxidation of the fuel hydrocarbon compounds. The presence of decreased concentrations of sulfate (and increased concentrations of sulfide)

in the source area relative to background concentrations indicates that sulfate is participating in redox reactions at the site. To investigate the potential for sulfate reduction at the Military Gas Station, sulfate concentrations were measured during the March 1998 groundwater sampling event.

Table 6.4 shows the analytical results for sulfate in groundwater at the Military Gas Station. In general, areas characterized by elevated concentrations of dissolved BTEX are depleted in sulfate concentrations relative to measured background concentrations. Background concentrations of sulfate at the site ranged from 109 mg/L at well EA-8 to 120 mg/L at EA-5. Sulfate concentrations measured at plume area wells exhibiting dissolved fuel contamination ranged from 67 mg/L at well EA-4 to 76 mg/L at well EA-10. This general depletion of sulfate within the contaminated areas indicates that this compound is acting as an electron acceptor during fuel biodegradation reactions.

The measured ORPs of the groundwater at this site are not within the range that would be expected for the sulfate-reducing conditions implied by the observed sulfate distributions. However, as described in Section 6.4.1, field ORP data alone cannot be used to reliably predict the electron acceptors that may be operating at a site.

6.4.6 Dissolved Methane

On the basis of free energy yield and the oxidizing potential of the site groundwater, the carbon dioxide/methane (CO_2/CH_4) redox couple also could be used to oxidize fuel hydrocarbon compounds to carbon dioxide and water once the groundwater is sufficiently reducing. To attain these reducing levels, other highly oxidizing chemical species such as oxygen, nitrate, ferric iron, and sulfate must first be reduced. This redox reaction is called methanogenesis or methane fermentation. Methanogenesis yields the least free energy to the system in comparison to other chemical species (Figure 6.3 and Table 6.3). The presence of methane in groundwater at elevated concentrations relative to background concentrations is a good indicator of methane fermentation.

Dissolved methane was measured at groundwater monitoring wells sampled during the March 1998 sampling event. Table 6.4 presents the analytical data for methane. Methane concentrations detected at the contaminant source area were elevated relative to background concentrations. The methane concentration measured at plume core area well EA-4 was 1.7 mg/L. In contrast, background concentrations were less than 0.00054 mg/L. The presence of elevated methane levels in groundwater at the Military Gas Station strongly indicates that biodegradation is occurring via methanogenesis.

6.4.7 pH

The pH of groundwater samples collected from groundwater monitoring points and monitoring wells in March 1998 was measured (Table 6.4). The pH of a solution is the negative logarithm of the hydrogen ion concentration $[\text{H}^+]$. Groundwater pH values measured at the site were within the optimal range for fuel hydrocarbon-degrading microbes of 6 to 8.

6.4.8 Temperature

Groundwater temperature was measured at groundwater monitoring wells in March 1998 (Table 6.4). Temperature affects the types and growth rates of bacteria that can be supported in the groundwater environment, with higher temperatures generally resulting in higher growth rates. The temperature of groundwater samples collected from the shallow monitoring wells varied from 23 degrees Celsius (°C) to 25 °C. These relatively warm temperatures should promote microbial growth and may enhance rates of hydrocarbon biodegradation.

6.4.9 Theoretical Assimilative Capacity Estimates

The preceding discussions have been devoted to determining if fuel hydrocarbons are biodegrading in saturated soils and groundwater at the Military Gas Station. Analytical data on reduced and oxidized chemical species indicate that indigenous microorganisms are facilitating the oxidation of fuel hydrocarbons and the reduction of electron acceptors to generate free energy for cell maintenance and production. The question of how much contaminant mass can be biodegraded must be addressed to assess the full potential for long-term intrinsic bioremediation to minimize plume size and mass over time.

Mass balance relationships can be used to determine how much contaminant mass can be degraded by each of the redox reactions that the microorganisms might use to make free energy available for cell maintenance and production. The stoichiometric relationship between the contaminant and the electron acceptor can be used to estimate the expressed assimilative capacity of the groundwater. Once the redox reactions operating at the site have been defined, it is possible to estimate how much contaminant mass can be assimilated or oxidized by available electron acceptors.

Table 6.2 presents the coupled redox reactions that represent the biodegradation of the individual COPCs, including the stoichiometric mass ratio of electron acceptors needed to oxidize each compound. These stoichiometric mass ratios can be used to estimate the assimilative capacity of the groundwater at the Military Gas Station. For oxygen, nitrate, and sulfate, this is accomplished by first determining the initial (background) mass of each electron acceptor available in the groundwater. Data on these chemical species were collected at sampling locations upgradient and cross-gradient from the dissolved plume. As groundwater slowly migrates into the source area, electron acceptors are brought into contact with hydrocarbon-degrading microorganisms and site contamination. The change in the electron acceptor mass from background sampling locations to sampling locations within the plume core is divided by the mass of electron acceptors required to mineralize the COPCs. For ferrous iron and methane, the highest observed concentration in the plume core wells is divided by the mass of electron acceptors required to mineralize the COPC. These numbers are summed to estimate the expressed intrinsic capacity of the groundwater to biodegrade each COPC.

Estimates of the background and plume core concentrations were used to calculate the expressed assimilative capacity of the groundwater system attributable to aerobic respiration, denitrification, and sulfate reduction (Table 6.5). The source area

TABLE 6.5
ESTIMATED ASSIMILATIVE CAPACITY OF
SATURATED SOIL AND GROUNDWATER
Military Gas Station
Eglin AFB, Florida

Electron Acceptor or Metabolic Byproduct	Background Concentration (mg/L) ^{a/}	Concentration in Core of Plume (mg/L)	Mass Ratio of Electron Acceptor/ Byproduct to COPCs ^{b/} (unitless)	Ethylbenzene Assimilative Capacity ^{c/} (mg/L)
Oxygen	6.1	1.2	3.17	1.55
Nitrate	1.4	4.3	4.92	NA ^{d/}
Sulfate	109	67	4.75	8.84
Ferrous Iron	0.0	0.40	22	0.02
Methane	0.00038	1.7	0.79	2.15
			Total	12.56
			Max. 1998 Concentration (mg/L)	0.076

Electron Acceptor or Metabolic Byproduct	Background Concentration (mg/L) ^{a/}	Concentration in Core of Plume (mg/L)	Mass Ratio of Electron Acceptor/ Byproduct to COPCs ^{b/} (unitless)	Xylenes Assimilative Capacity ^{c/} (mg/L)
Oxygen	6.1	1.2	3.17	1.55
Nitrate	1.4	4.3	4.92	NA
Sulfate	109	67	4.75	8.84
Ferrous Iron	0.0	0.40	22	0.02
Methane	0.00038	1.7	0.79	2.15
			Total	12.56
			Max. 1998 Concentration (mg/L)	0.400

(continued)

TABLE 6.5 (concluded)
ESTIMATED ASSIMILATIVE CAPACITY OF
SATURATED SOIL AND GROUNDWATER
Military Gas Station
Eglin AFB, Florida

Electron Acceptor or Metabolic Byproduct	Background Concentration (mg/L) ^{a/}	Concentration in Core of Plume (mg/L)	Mass Ratio of Electron Acceptor/ Byproduct to COPCs ^{b/} (unitless)	Naphthalene Assimilative Capacity ^{c/} (mg/L)
Oxygen	6.1	1.2	3.00	1.63
Nitrate	1.4	4.3	4.65	NA
Sulfate	109	67	4.50	9.33
Ferrous Iron	0.0	0.40	40.13	0.01
Methane	0.00038	1.7	0.75	2.27
Total				13.24
Max. 1998 Concentration (mg/L)				0.040

a/ mg/L = milligrams per liter.

b/ Calculation based on the ratio of the total mass of electron acceptor required to oxidize a given average of the mass of contaminants of potential concern (ethylbenzene, total xylenes, and naphthalene).

c/ Assimilative capacity is the amount of contaminant that can be degraded by a certain method.

d/ NA = Not applicable.

$$\frac{13.24}{0.04} = 331$$

more

Acc Cap

than needed

concentrations of ferrous iron and methane are used to "back-calculate" the expressed assimilative capacity that is attributable to ferric iron reduction and methanogenesis. On the basis of these calculations, one pore volume of saturated soils and groundwater at the Military Gas Station has the capacity to oxidize an ethylbenzene and xylenes concentration of 12,560 µg/L, and a naphthalene concentration of 13,250 µg/L. As shown in Table 6.5, the assimilative capacity for each COPC is substantially higher than the maximum concentration of the COPC detected in groundwater at the Military Gas Station. The assimilative capacities should not change significantly if operation of the air sparging/SVE system is discontinued.

This estimate essentially represents an estimate of the reduction capability of one pore volume of groundwater at the Military Gas Station. The estimate identifies how much contaminant mass can be theoretically oxidized as one pore volume travels through the plume core. In reality, over 2 pore volumes are expected to move through the contaminated aquifer material in the source area each year based on the estimated groundwater velocity of 124 ft/yr.

A closed system containing 2 liters of water can be used to help visualize the physical meaning of assimilative capacity. Assume that the first liter contains no fuel hydrocarbons, but it contains fuel-degrading microorganisms and has an assimilative capacity of exactly "x" mg of fuel hydrocarbons. The second liter has no assimilative capacity; however, it contains fuel hydrocarbons. As long as these 2 liters of water are kept separate, biodegradation of fuel hydrocarbons will not occur. If these 2 liters are combined in a closed system, biodegradation will commence and continue until the fuel hydrocarbons or electron acceptors are depleted. If less than "x" mg of fuel hydrocarbons are in the second liter, all of the fuel hydrocarbons will eventually degrade given a sufficient time; likewise, if greater than "x" mg of fuel hydrocarbons were in the second liter of water, only "x" mg of fuel hydrocarbons would ultimately degrade.

This example shows that in a closed system, the measured expressed assimilative capacity eventually should be equivalent to the loss in contaminant mass; however, the groundwater beneath the site is an open system. Electron acceptors can continually enter the system from upgradient flow. Furthermore, contaminant mass can be added to the system through dissolution or leaching from LNAPL or contaminated soils. This means that the assimilative capacity is not fixed as it would be in a closed system, and therefore should not be quantitatively compared to concentrations of dissolved contaminants in the groundwater. Rather, the expressed assimilative capacity of groundwater is intended to serve as a qualitative tool. The fate of BTEX in groundwater is dependent on the relationship between the kinetics of biodegradation and the solute transport velocities (Chapelle, 1994).

6.5 COPC MIGRATION

The migration velocity of the groundwater COPCs ethylbenzene, xylenes, naphthalene, and lead, would be expected to be lower than the advective groundwater velocity computed in Section 3.3 (124 ft/yr) due to the effects of retardation. Retardation coefficients are calculated using the following formula:

$$R = 1 + (K_d \rho_b / n_e)$$

where

$$K_d = (K_{oc})(f_{oc})$$

K_{oc} = Organic Carbon Partition Coefficient

f_{oc} = Fraction Organic Carbon

ρ_b = Soil Bulk Density of Aquifer Matrix

n_e = Effective Porosity

Two soil samples collected at the Military Gas Station were analyzed for total organic carbon (TOC); however, as shown in Table 5.1, organic carbon was not detected. Similarly, organic carbon was not detected in three samples collected at the Seventh Street BX Service Station. If it is assumed that the TOC content of the shallow sand aquifer beneath the site is equal to one-half the method detection limit of 550 mg/kg, then the retardation coefficients of ethylbenzene, xylenes, and naphthalene would range from 1.75 to 2.04 (Table 6.6). The resulting migration velocities of ethylbenzene, xylenes, and naphthalene would be 66 ft/yr, 71 ft/yr, and 61 ft/yr, respectively based on an estimated advective groundwater velocity of 124 ft/yr. Lead typically adsorbs strongly to aquifer matrix materials such as manganese and iron oxide, organic carbon, or clay mineral surfaces, and is relatively immobile (Rose *et al.*, 1979). Therefore, while lead resulting from gasoline contamination is not susceptible to degradation processes, it is generally restricted to the vicinity of the source area and does not pose a threat to offsite receptors.

Migration of dissolved contaminants can be assessed by comparing the estimated BTEX plume length over time. In June 1994, the dissolved BTEX plume extended approximately 450 feet downgradient from well EA-4 (see plume map in Appendix B). In contrast, the estimated plume length northeast of EA-4 in March 1998 was approximately 150 feet, indicating that the plume dimensions have been reduced considerably since 1994 due to the effects of biodegradation, air sparging, and source removal via SVE. In March 1998, Tier 1 TCLs were exceeded only in source area well EA-4; Tier 1 levels were not exceeded in groundwater from well EA-10, located approximately 120 feet downgradient from the source area.

TABLE 6.6
RETARDATION COEFFICIENTS OF COPCs
Military Gas Station
Eglin AFB, Florida

Compound	K _{oc} (L/kg ^{a/})	Average Fraction Organic Carbon ^{b/}	Average ^{c/}	Bulk Density (kg/L) ^{d/}	Effective Porosity	Average
Ethylbenzene	468	0.000275	0.129	1.72	0.25	1.89
Xylenes	395	0.000275	0.109	1.72	0.25	1.75
Naphthalene	550	0.000275	0.151	1.72	0.25	2.04

a/ L/kg = liters per kilogram.

b/ Fraction organic carbon from accepted literature values.

c/ Distribution coefficient

d/ kg/L = kilograms per liter.

SECTION 7

TIER 2 ANALYSIS AND IDENTIFICATION OF FINAL CHEMICALS OF CONCERN

7.1 OBJECTIVE OF SITE-SPECIFIC EVALUATION

The Tier 1 analysis conducted in this CAP (Section 4) identified ethylbenzene, total xylenes, naphthalene, and dissolved lead as COPCs in groundwater. These analytes are evaluated in detail to better define/assess the potential adverse health effects they may cause in current or future human receptors.

The Tier 1 screening process is considered protective of human health because the Tier 1 risk-based screening criteria are based on conservative exposure assumptions. However, analytes identified as COPCs in Section 4 of this CAP (i.e., analytes with representative site concentrations exceeding Tier 1 TCLs) should not automatically be considered to be present at the Military Gas Station at levels that pose unacceptable threats to human health given the current and future exposure potential at this site. Rather, the exceedences of the screening criteria indicate that further evaluation using more site-specific exposure scenarios is warranted.

7.2 FINAL CONCEPTUAL SITE MODEL

The preliminary CSM presented in Section 4 was used to qualitatively identify potential human and ecological receptors that may be exposed to site-related contaminants, and to define the types of these potential exposures at or in the vicinity of the Military Gas Station (Figure 4.1). The preliminary CSM describes onsite release points, the affected physical media, the types of contaminant transport and fate mechanisms that may be involved at the site, each group of potentially exposed populations or receptors, and how each receptor group could come into contact with site-related contamination. This CSM was used to identify which of the exposure assumptions used to develop generic cleanup criteria most closely approximates site conditions. The exposure assumptions incorporated into the generic industrial TCLs (i.e., Table IV Direct-Exposure II TCLs) were identified as generally representative of the types of exposure that could occur at the Military Gas Station, but perhaps greatly overestimated the magnitude of exposure specific to current and expected future site conditions. For example, Tier 1 screening of groundwater assumed unrestricted future use of groundwater. Therefore, the target cleanup criteria presented in Table V (FDEP, 1997) which were developed assuming potable use of groundwater, were used in the Tier 1 screening. The preliminary CSM exposure pathways are reevaluated in this section using the Tier 2 chemical fate information presented in Section 6. It is important to emphasize that the purpose of using the preliminary CSM and the

conservative, nonsite-specific TCLs to identify COPCs was to ensure that all subsequent assessment activities beyond the Tier 1 screening evaluation address the full range of contaminants that may present some risk to current or future receptors.

The revised CSM for the Military Gas Station, which is presented on Figure 7.1 and briefly reviewed in the following subsections, identifies only those receptors and exposure pathways that realistically may be involved in actual current or hypothetical future exposures. The outcome of the chemical fate assessment presented in Section 6 and the types of exposures likely to occur at this industrial site are reflected in this revised CSM. Justification for each site-specific exposure assumption is provided in subsequent discussions.

7.2.1 Sources, Affected Media, Release Mechanisms, and Contaminant Environmental Transport

The likelihood of release from a source, the nature of the contaminants involved, the affected environmental media, and the probable magnitude of their release all are included in the revised CSM (Figure 7.1). As described in the preliminary CSM (Figure 4.1), releases from the former gasoline USTs have contaminated site soil, soil gas, and groundwater with fuel hydrocarbons. The predominant ongoing release mechanism for groundwater COPCs is leaching from contaminated soils. The lack of mobile LNAPL (free product) detections at the site indicates that mobile LNAPL is not a significant, continuing source of groundwater contamination. Site data indicate that RNA and engineered remedial actions rates are also acting to limit migration of contaminants in concentrations above the TCLs; in fact, dissolved contaminant concentrations are being substantially reduced and the dissolved fuel hydrocarbon plume appears to be collapsing toward the source area. Therefore, future offsite migration of the contaminant plume is not anticipated. Therefore, dissolved contaminants will not impact Base irrigation wells or downgradient surface water bodies.

7.2.2 Potentially Exposed Receptors, Exposure Points, and Exposure Routes

The revised CSM for the Military Gas Station also refines the identification of potentially exposed receptor populations, receptor exposure points, and exposure routes for realistic scenarios based on specific site conditions. These components better reflect the likelihood and extent of human or ecological receptor contact with site-related contaminants. As described in Section 2, the Military Gas Station is entirely within the boundaries of the Base. Therefore, potential receptor groups are limited to onsite intrusive workers. There are no completed pathways to offsite receptors. Furthermore, the asphalt cover over much of the site, the depth to groundwater (35 feet bgs), and the lack of contamination in surface soils, prevents contact with contaminated soil or groundwater by current Base personnel.

The industrial nature of the site, and the pavement covering much of the site, precludes the existence of suitable wildlife habitat. No resident ecological receptors were identified for which soils and/or groundwater are likely contaminant exposure media. No exposure pathways involving potential offsite ecological receptors are or will be complete based on the lack of offsite contaminant migration.

Using the most conservative exposure assumptions appropriate for the Military Gas Station, the only realistic receptor that is likely to become exposed to site-related contaminants is the onsite intrusive worker involved in demolition, removal, and/or construction activities. Inhalation of VOCs (partitioning from either contaminated soil or groundwater) in ambient air at the site could result in a completed pathway for the onsite intrusive worker. However, as described in Section 4, there were no exceedances of soil TCLs, and soil gas concentrations are not expected to pose a significant inhalation risk to aboveground or intrusive workers. In addition, the water table at the site is substantially below the maximum construction depth, eliminating the risks posed by dermal contact or incidental ingestion of groundwater during construction activities. Therefore, these exposure pathways are either incomplete or are insignificant.

7.2.3 Summary of Exposure Pathway completion

Given the current and planned future uses of the Military Gas Station and the outcome of the chemical fate assessment presented in Section 6, only onsite intrusive workers could be exposed to site-related contamination in soils and soil gas during excavation activities. However, contaminant concentrations in these media are below Tier 1 action levels (Section 4), and do not pose a risk to potential receptors. Therefore, there are no currently completed exposure pathways at the Military Gas Station, and site data indicate that no exposure pathways will be completed in the future. As stated in Section 1, without a completed pathway through which a receptor will contact the contaminant(s), there is no risk posed by remaining levels of fuel hydrocarbon contamination at the site.

SECTION 8

SUMMARY AND CONCLUSIONS

Comparison of the COPC, electron acceptor, and biodegradation byproduct data for the Military Gas Station provides strong qualitative evidence of biodegradation of dissolved COPCs. Geochemical data strongly indicate that biodegradation of fuel hydrocarbons is occurring at the site, primarily via the processes of sulfate reduction and methanogenesis. The groundwater system appears to have more than enough capacity to facilitate biodegradation of all available contaminant mass dissolved in the groundwater and adsorbed to soil particles in the saturated zone. The measured decreases in dissolved contaminant concentrations in the source area prior to initiation of engineered remediation in 1994 or 1995 supports the effectiveness of natural attenuation processes in site groundwater. Direct evidence of the beneficial effects of biodegradation, in combination with the effects of air sparging and SVE, also is provided by the diminishment of the dissolved plume over time. As the contaminant source (residual LNAPL adsorbed to soil particles) is reduced over time due to biodegradation and SVE, dissolved contaminant concentrations in the source area also are reduced. The downgradient migration of the dissolved contaminants is severely restricted due to natural biodegradation. Available data indicate that the plume is entirely contained within the existing monitoring well network, and should not impact potential downgradient receptors. In addition, current and potential future onsite receptor exposure pathways are incomplete; therefore, the existing contamination does not pose a risk to potential receptors.

Because the dissolved plume is receding and is not currently impacting receptors, and because the contamination source will continue to decrease over time after the remediation system is shut off, RNA with long-term monitoring (LTM) and institutional controls is recommended for the Military Gas Station. A LTM plan is described in Section 9. The appropriateness of RNA with LTM is supported by the fact that only xylenes in source area well EA-4 exceeded the FDEP (1997) natural attenuation source default values (Table 4.2). Continued operation of the air sparging/SVE system is not necessary to minimize risks posed by site contamination, and shutoff of this system is recommended.

SECTION 9

LONG-TERM MONITORING PLAN

9.1 OVERVIEW

At the Military Gas Station, long-term monitoring (LTM) combined with RNA and institutional controls is recommended. The objectives of the LTM are as follows:

- To assess site conditions over time;
- To confirm the effectiveness of naturally occurring processes at reducing contaminant mass and minimizing contaminant migration;
- To evaluate the need for additional remediation.

The LTM plan consists of identifying groundwater sampling locations and developing a sampling and analysis strategy. The strategy described in this section is designed to assess the effectiveness of RNA through measurement of the reduction of contaminant mass, and the rate of groundwater remediation. In the event that data collected under this LTM program indicate that RNA is insufficient to be protective of human health and the environment, additional engineered controls to augment the beneficial effects of RNA may be necessary. A site-specific groundwater SAP and institutional control plan should be prepared prior to initiating the LTM program.

9.2 LONG-TERM GROUNDWATER MONITORING WELLS

Four monitoring wells should be included in the LTM program. These wells include two wells without hydrocarbon concentrations (one upgradient [EA-8] and one cross-gradient [EA-11]) and two wells with historical hydrocarbon concentrations (EA-4 and EA-10) (Figure 5.1).

9.3 SAMPLING DURATION AND FREQUENCY

Up to nine years of monitoring may be required to accomplish the LTM objectives listed in Section 9.1. As described in Section 6.3.2, this is the estimated time frame for maximum dissolved xylenes concentrations to decrease below the Tier 1 TCL for this compound. Each of the LTM wells would be sampled annually for the first three years and biannually (every other year) for the following six years. The purpose of the long term sampling is to evaluate groundwater quality and to determine if the decreases observed in the dissolved COPC concentrations (Table 6.2) continue after the interim remediation system is shut down. If the data collected during this time period support the effectiveness of the selected remedial alternative at this site, it may be possible to

reduce or eliminate sampling. If the data collected at any time during the monitoring period indicate the need for additional remedial activities at the site, sampling frequency should be adjusted accordingly.

As new analytical results are obtained, they can be added to Figure 6.1 and the best-fit curves can be revised to refine decay rate estimates. The new decay rates can then be used to re-estimate the required duration of LTM, using the first-order rate equation contained in Appendix E.

9.4 ANALYTICAL PROTOCOL

All LTM wells will be sampled and analyzed to verify the effectiveness of naturally-occurring remediation processes at the site. At the beginning of each sampling event, water levels should be measured in all site monitoring wells. Groundwater samples collected from the LTM wells should be analyzed for the parameters listed in Table 9.1.

TABLE 9.1
ANALYTICAL PROTOCOL FOR GROUNDWATER
ANALYSIS DURING LONG-TERM MONITORING

Military Gas Station
Eglin AFB, Florida

ANALYTE	RECOMMENDED METHOD	WHERE ANALYZED
Ferrous Iron (Fe^{+2})	Colorimetric, Hach Method 8146	Field
Sulfate (SO_4^{-2})	Colorimetric, Hach Method 8051	Field
Conductivity	Direct reading meter	Field
Oxygen	Direct reading meter	Field
pH	Direct reading meter	Field
Redox Potential	Direct reading meter	Field
Temperature	Direct reading meter	Field
BTEX ^{a/}	SW8021B	Fixed base lab
Naphthalene	SW8310	Fixed base lab
Total Lead	SW7421	Fixed base lab

Notes:

a/ BTEX = benzene, toluene, ethylbenzene, and total xylenes

SECTION 10

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APPENDIX A

LABORATORY ANALYTICAL DATA

LABORATORY ANALYTICAL DATA

APPENDIX A

AFCEE^Aromatic VOAs by Method 8020A with MTBE & TMBs
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-4 (0.00,0.00)
 LAB ID: 059721-0009-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: GCPID-H

Sampled: 31 MAR 98
 Prepared: 06 APR 98
 Dilution: 5.0

Received: 02 APR 98
 Analyzed: 06 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		10	0.28	ug/L
Toluene	ND		10	0.75	ug/L
Ethylbenzene	79	d	10	0.27	ug/L
Xylenes (total)	400	d	10	0.75	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	98	%	44 - 165
Fluorobenzene	86	%	44 - 165

d = See Preferred Result on Other Column
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic VOAs by Method 8020A (Second Column)
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-4 (0.00,0.00)
 LAB ID: 059721-0009-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: GCPID-H

Sampled: 31 MAR 98
 Prepared: 06 APR 98
 Dilution: 5.0

Received: 02 APR 98
 Analyzed: 06 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		10	0.28	ug/L
Toluene	ND		10	0.75	ug/L
Ethylbenzene	76	M	10	0.27	ug/L
Xylenes (total)	400	M	10	0.75	ug/L

Surrogate	Recovery	Acceptable Range
a,a,a-Trifluorotoluene	103	% 44 - 165
Fluorobenzene	87	% 44 - 165

M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic VOAs by Method 8020A with MTBE & TMBs
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-40 (0.00,0.00)
 LAB ID: 059721-0010-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: GCPID-H

Sampled: 31 MAR 98
 Prepared: 06 APR 98
 Dilution: 5.0

Received: 02 APR 98
 Analyzed: 06 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		10	0.28	ug/L
Toluene	ND		10	0.75	ug/L
Ethylbenzene	76	d	10	0.27	ug/L
Xylenes (total)	380	M	10	0.75	ug/L

Surrogate	Recovery	Acceptable Range
a,a,a-Trifluorotoluene	97	% 44 - 165
Fluorobenzene	85	% 44 - 165

d = See Preferred Result on Other Column
 M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic VOAs by Method 8020A (Second Column)
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-40 (0.00,0.00)
 LAB ID: 059721-0010-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: GCPID-H

Sampled: 31 MAR 98
 Prepared: 06 APR 98
 Dilution: 5.0

Received: 02 APR 98
 Analyzed: 06 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		10	0.28	ug/L
Toluene	ND		10	0.75	ug/L
Ethylbenzene	74	M	10	0.27	ug/L
Xylenes (total)	420	d	10	0.75	ug/L

Surrogate	Recovery	Acceptable Range
a,a,a-Trifluorotoluene	102	% 44 - 165
Fluorobenzene	85	% 44 - 165

d = See Preferred Result on Other Column
 M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic VOAs by Method 8020A with MTBE & TMBs
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-5 (0.00,0.00)
 LAB ID: 059638-0003-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98
 Instrument: GCPID-H

Sampled: 27 MAR 98
 Prepared: 31 MAR 98
 Dilution: 1.0

Received: 28 MAR 98
 Analyzed: 31 MAR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	1.4	JM	2.0	0.054	ug/L
Xylenes (total)	6.7	M	2.0	0.15	ug/L

Surrogate	Recovery	Acceptable Range
a,a,a-Trifluorotoluene	99	% 44 - 165
Fluorobenzene	89	% 44 - 165

J = Result is detected below the reporting limit or is an estimated concentration.
 M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic VOAs by Method 8020A (Second Column)
Method 8020A

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-5 (0.00,0.00)
 LAB ID: 059638-0003-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98
 Instrument: GCPID-H

Sampled: 27 MAR 98
 Prepared: 31 MAR 98
 Dilution: 1.0

Received: 28 MAR 98
 Analyzed: 31 MAR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	1.5	Jd	2.0	0.054	ug/L
Xylenes (total)	6.9	d	2.0	0.15	ug/L

Surrogate	Recovery	Acceptable Range
a,a,a-Trifluorotoluene	98	% 44 - 165
Fluorobenzene	91	% 44 - 165

d = See Preferred Result on Other Column
 J = Result is detected below the reporting limit or is an estimated concentration.
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic VOAs by Method 8020A with MTBE & TMBs
Method 8020A

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-8 (0.00,0.00)
 LAB ID: 059638-0004-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98
 Instrument: GCPID-H

Sampled: 27 MAR 98
 Prepared: 31 MAR 98
 Dilution: 1.0

Received: 28 MAR 98
 Analyzed: 31 MAR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	0.099	JM	2.0	0.054	ug/L
Xylenes (total)	4.7	d	2.0	0.15	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	98	%	44 - 165
Fluorobenzene	92	%	44 - 165

d = See Preferred Result on Other Column
 J = Result is detected below the reporting limit or is an estimated concentration.
 M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic VOAs by Method 8020A (Second Column)
Method 8020A

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-8 (0.00,0.00)
 LAB ID: 059638-0004-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98
 Instrument: GCPID-H

Sampled: 27 MAR 98
 Prepared: 31 MAR 98
 Dilution: 1.0

Received: 28 MAR 98
 Analyzed: 31 MAR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	1.1	Jd	2.0	0.054	ug/L
Xylenes (total)	4.7	M	2.0	0.15	ug/L

Surrogate	Recovery	Acceptable Range
a,a,a-Trifluorotoluene	94	% 44 - 165
Fluorobenzene	89	% 44 - 165

d = See Preferred Result on Other Column
 J = Result is detected below the reporting limit or is an estimated concentration.
 M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic VOAs by Method 8020A with MTBE & TMBs
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-10 (0.00,0.00)
 LAB ID: 059638-0002-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98
 Instrument: GCPIID-H
 Sampled: 27 MAR 98
 Prepared: 31 MAR 98
 Dilution: 1.0
 Received: 28 MAR 98
 Analyzed: 31 MAR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	2.3	M	2.0	0.054	ug/L
Xylenes (total)	11	M	2.0	0.15	ug/L
Surrogate	Recovery		Acceptable Range		
a,a,a-Trifluorotoluene	100	%	44 - 165		
Fluorobenzene	92	%	44 - 165		

M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

AFCEE^Aromatic VOAs by Method 8020A (Second Column)
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	Mil-EA-10	(0.00,0.00)	
LAB ID:	059638-0002-SA		
Matrix:	GRND-H2O	Sampled: 27 MAR 98	Received: 28 MAR 98
Authorized:	28 MAR 98	Prepared: 31 MAR 98	Analyzed: 31 MAR 98
Instrument:	GCPID-H	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	2.3	d	2.0	0.054	ug/L
Xylenes (total)	11	d	2.0	0.15	ug/L

Surrogate	Recovery	Acceptable Range
a,a,a-Trifluorotoluene	100	%
Fluorobenzene	92	%

d = See Preferred Result on Other Column
ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-4 (0.00,0.00)
 LAB ID: 059721-0009-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: HPLC-Y

Sampled: 31 MAR 98
 Prepared: 07 APR 98
 Dilution: 0.98

Received: 02 APR 98
 Analyzed: 22 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		0.98	0.091	ug/L
Acenaphthylene	ND		0.98	0.039	ug/L
Anthracene	ND		0.098	0.029	ug/L
Benzo(a)anthracene	ND		0.13	0.059	ug/L
Benzo(a)pyrene	ND		0.23	0.064	ug/L
Benzo(b)fluoranthene	ND		0.18	0.058	ug/L
Benzo(g,h,i)perylene	ND		0.20	0.070	ug/L
Benzo(k)fluoranthene	ND		0.17	0.058	ug/L
Chrysene	ND		0.20	0.072	ug/L
Dibenz(a,h)anthracene	ND		0.29	0.074	ug/L
Fluorene	0.15	Jd	0.20	0.034	ug/L
Fluoranthene	ND		0.20	0.035	ug/L
Indeno(1,2,3-cd)pyrene	ND		0.42	0.054	ug/L
Naphthalene	44	d	0.98	0.058	ug/L
Phenanthrene	ND		0.20	0.029	ug/L
Pyrene	ND		0.20	0.042	ug/L
Surrogate	Recovery		Acceptable Range		
Terphenyl-d14	106	x	25 - 157		

d = See Preferred Result on Other Column
 J = Result is detected below the reporting limit or is an estimated concentration.
 ND = Not Detected

Reported By: Blake Besser

Approved By: Barbara Sullivan

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC (Second Column)
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-4 (0.00,0.00)
 LAB ID: 059721-0009-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: HPLC-Y

Sampled: 31 MAR 98
 Prepared: 07 APR 98
 Dilution: 0.98

Received: 02 APR 98
 Analyzed: 22 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		0.98	0.091	ug/L
Acenaphthylene	ND		0.98	0.039	ug/L
Anthracene	ND		0.098	0.029	ug/L
Benzo(a)anthracene	ND		0.13	0.059	ug/L
Benzo(a)pyrene	ND		0.23	0.064	ug/L
Benzo(b)fluoranthene	ND		0.18	0.058	ug/L
Benzo(g,h,i)perylene	ND		0.20	0.070	ug/L
Benzo(k)fluoranthene	ND		0.17	0.058	ug/L
Chrysene	ND		0.20	0.072	ug/L
Dibenz(a,h)anthracene	ND		0.29	0.074	ug/L
Fluorene	0.056	JM	0.20	0.034	ug/L
Fluoranthene	ND		0.20	0.035	ug/L
Indeno(1,2,3-cd)pyrene	ND		0.42	0.054	ug/L
Naphthalene	40	M	0.98	0.058	ug/L
Phenanthrene	ND		0.20	0.029	ug/L
Pyrene	ND		0.20	0.042	ug/L

Surrogate	Recovery	Acceptable Range
Terphenyl-d14	108	x 25 - 157

J = Result is detected below the reporting limit or is an estimated concentration.
 M = Preferred Result
 ND = Not Detected

Reported By: Blake Besser

Approved By: Barbara Sullivan

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-40 (0.00,0.00)
 LAB ID: 059721-0010-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: HPLC-Y

Sampled: 31 MAR 98
 Prepared: 07 APR 98
 Dilution: 1.0

Received: 02 APR 98
 Analyzed: 22 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		1.0	0.095	ug/L
Acenaphthylene	ND		1.0	0.041	ug/L
Anthracene	ND		0.10	0.031	ug/L
Benzo(a)anthracene	ND		0.13	0.061	ug/L
Benzo(a)pyrene	ND		0.23	0.066	ug/L
Benzo(b)fluoranthene	ND		0.18	0.060	ug/L
Benzo(g,h,i)perylene	ND		0.20	0.072	ug/L
Benzo(k)fluoranthene	ND		0.17	0.060	ug/L
Chrysene	ND		0.20	0.074	ug/L
Dibenz(a,h)anthracene	ND		0.31	0.078	ug/L
Fluorene	0.16	Jd	0.20	0.036	ug/L
Fluoranthene	ND		0.20	0.037	ug/L
Indeno(1,2,3-cd)pyrene	ND		0.44	0.056	ug/L
Naphthalene	39	d	1.0	0.060	ug/L
Phenanthrene	ND		0.20	0.031	ug/L
Pyrene	ND		0.20	0.044	ug/L

Surrogate	Recovery	Acceptable Range
Terphenyl-d14	98	% 25 - 157

d = See Preferred Result on Other Column
 J = Result is detected below the reporting limit or is an estimated concentration.
 ND = Not Detected

Reported By: Blake Besser

Approved By: Barbara Sullivan

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC (Second Column)
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-40 (0.00,0.00)
 LAB ID: 059721-0010-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: HPLC-Y

Sampled: 31 MAR 98
 Prepared: 07 APR 98
 Dilution: 1.0

Received: 02 APR 98
 Analyzed: 22 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		1.0	0.095	ug/L
Acenaphthylene	ND		1.0	0.041	ug/L
Anthracene	ND		0.10	0.031	ug/L
Benzo(a)anthracene	ND		0.13	0.061	ug/L
Benzo(a)pyrene	ND		0.23	0.066	ug/L
Benzo(b)fluoranthene	ND		0.18	0.060	ug/L
Benzo(g,h,i)perylene	ND		0.20	0.072	ug/L
Benzo(k)fluoranthene	ND		0.17	0.060	ug/L
Chrysene	ND		0.20	0.074	ug/L
Dibenz(a,h)anthracene	ND		0.31	0.078	ug/L
Fluorene	0.085	JM	0.20	0.036	ug/L
Fluoranthene	ND		0.20	0.037	ug/L
Indeno(1,2,3-cd)pyrene	ND		0.44	0.056	ug/L
Naphthalene	27	M	1.0	0.060	ug/L
Phenanthrene	ND		0.20	0.031	ug/L
Pyrene	ND		0.20	0.044	ug/L

Surrogate	Recovery	Acceptable Range
Terphenyl-d14	98	% 25 - 157

J = Result is detected below the reporting limit or is an estimated concentration.
 M = Preferred Result
 ND = Not Detected

Reported By: Blake Besser

Approved By: Barbara Sullivan

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-10 (0.00,0.00)
 LAB ID: 059638-0002-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98
 Instrument: HPLC-Q

Sampled: 27 MAR 98
 Prepared: 01 APR 98
 Dilution: 1.0

Received: 28 MAR 98
 Analyzed: 18 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		1.0	0.094	ug/L
Acenaphthylene	ND		1.0	0.041	ug/L
Anthracene	ND		0.10	0.030	ug/L
Benzo(a)anthracene	ND		0.13	0.061	ug/L
Benzo(a)pyrene	ND		0.23	0.066	ug/L
Benzo(b)fluoranthene	ND		0.18	0.060	ug/L
Benzo(g,h,i)perylene	ND		0.20	0.072	ug/L
Benzo(k)fluoranthene	ND		0.17	0.060	ug/L
Chrysene	ND		0.20	0.074	ug/L
Dibenz(a,h)anthracene	ND		0.30	0.077	ug/L
Fluorene	ND		0.20	0.036	ug/L
Fluoranthene	ND		0.20	0.037	ug/L
Indeno(1,2,3-cd)pyrene	ND		0.44	0.056	ug/L
Naphthalene	0.81	Jd	1.0	0.060	ug/L
Phenanthrene	ND		0.20	0.030	ug/L
Pyrene	ND		0.20	0.044	ug/L
Surrogate	Recovery		Acceptable Range		
Terphenyl-d14	99	%	25 - 157		

d = See Preferred Result on Other Column
 J = Result is detected below the reporting limit or is an estimated concentration.
 ND = Not Detected

Reported By: Blake Besser

Approved By: Barbara Sullivan

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC (Second Column)
Method 8310

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-10 (0.00,0.00)
 LAB ID: 059638-0002-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98
 Instrument: HPLC-Q

Sampled: 27 MAR 98
 Prepared: 01 APR 98
 Dilution: 1.0

Received: 28 MAR 98
 Analyzed: 18 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		1.0	0.094	ug/L
Acenaphthylene	ND		1.0	0.041	ug/L
Anthracene	ND		0.10	0.030	ug/L
Benzo(a)anthracene	ND		0.13	0.061	ug/L
Benzo(a)pyrene	ND		0.23	0.066	ug/L
Benzo(b)fluoranthene	ND		0.18	0.060	ug/L
Benzo(g,h,i)perylene	ND		0.20	0.072	ug/L
Benzo(k)fluoranthene	ND		0.17	0.060	ug/L
Chrysene	ND		0.20	0.074	ug/L
Dibenz(a,h)anthracene	ND		0.30	0.077	ug/L
Fluorene	ND		0.20	0.036	ug/L
Fluoranthene	ND		0.20	0.037	ug/L
Indeno(1,2,3-cd)pyrene	ND		0.44	0.056	ug/L
Naphthalene	0.70	JM	1.0	0.060	ug/L
Phenanthrene	ND		0.20	0.030	ug/L
Pyrene	ND		0.20	0.044	ug/L
Surrogate		Recovery		Acceptable Range	
Terphenyl-d14		102	%	25 - 157	

J = Result is detected below the reporting limit or is an estimated concentration.
 M = Preferred Result
 ND = Not Detected

Reported By: Blake Besser

Approved By: Barbara Sullivan

Method 504 - EDB
 Method 504

Client Name: Parsons Engineering Science
 Client ID: MIL-EA-4 (0.00,0.00)
 LAB ID: 059721-0009-SA
 Matrix: GRND-H2O
 Authorized: 02 APR 98
 Instrument: GCFID-I

Sampled: 31 MAR 98
 Prepared: 13 APR 98
 Dilution: 1.0

Received: 02 APR 98
 Analyzed: 14 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
EDB (1,2-Dibromoethane)	ND		0.020	0.0060	ug/L
Surrogate		Recovery		Acceptable Range	
1,1,1,2-Tetrachloroethane		114	%	80 - 120	

ND = Not Detected

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method 504 - EDB
Method 504

Client Name: Parsons Engineering Science
Client ID: MIL-EA-40 (0.00,0.00)
LAB ID: 059721-0010-SA
Matrix: GRND-H2O
Authorized: 02 APR 98
Instrument: GCFID-I

Sampled: 31 MAR 98
Prepared: 13 APR 98
Dilution: 1.0

Received: 02 APR 98
Analyzed: 14 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
EDB (1,2-Dibromoethane)	ND		0.020	0.0060	ug/L
Surrogate		Recovery		Acceptable Range	
1,1,1,2-Tetrachloroethane		106	%	80 - 120	

ND = Not Detected

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method 504 - EDB
Method 504

Client Name: Parsons Engineering Science
Client ID: Mil-EA-5 (0.00,0.00)
LAB ID: 059638-0003-SA
Matrix: GRND-H2O
Authorized: 28 MAR 98
Instrument: GCFID-I

Sampled: 27 MAR 98
Prepared: 03 APR 98
Dilution: 1.0

Received: 28 MAR 98
Analyzed: 04 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
EDB (1,2-Dibromoethane)	ND		0.020	0.0060	ug/L
Surrogate		Recovery		Acceptable Range	
1,1,1,2-Tetrachloroethane		104	%	80 - 120	

ND = Not Detected

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method 504 - EDB
Method 504

Client Name: Parsons Engineering Science
Client ID: Mil-EA-8 (0.00,0.00)
LAB ID: 059638-0004-SA
Matrix: GRND-H2O
Authorized: 28 MAR 98
Instrument: GCFID-I

Sampled: 27 MAR 98
Prepared: 03 APR 98
Dilution: 1.0

Received: 28 MAR 98
Analyzed: 04 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
EDB (1,2-Dibromoethane)	ND		0.020	0.0060	ug/L
Surrogate		Recovery		Acceptable Range	
1,1,1,2-Tetrachloroethane		111	x	80 - 120	

ND = Not Detected

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method 504 - EDB
Method 504

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-10 (0.00,0.00)
 LAB ID: 059638-0002-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98
 Instrument: GCFID-I

Sampled: 27 MAR 98
 Prepared: 03 APR 98
 Dilution: 1.0

Received: 28 MAR 98
 Analyzed: 04 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
EDB (1,2-Dibromoethane)	ND		0.020	0.0060	ug/L
Surrogate		Recovery		Acceptable Range	
1,1,1,2-Tetrachloroethane	104	%		80 - 120	

ND = Not Detected

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method FL-PRO - TPH (C8-C40)
 Method FL-PRO

Client Name: Parsons Engineering Science		
Client ID: MIL-EA-4	(0.00,0.00)	
LAB ID: 059721-0009-SA		
Matrix: GRND-H2O	Sampled: 31 MAR 98	Received: 02 APR 98
Authorized: 02 APR 98	Prepared: 06 APR 98	Analyzed: 08 APR 98
Instrument: GCFID-I	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
TPH (C8-C40)	3.1		0.50	0.19	mg/L
Surrogate		Recovery		Acceptable Range	
o-Terphenyl		103	%	33 - 162	
Nonatriacontane		81	%	10 - 109	

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method FL-PRO - TPH (C8-C40)
 Method FL-PRO

Client Name: Parsons Engineering Science		
Client ID: MIL-EA-40	(0.00,0.00)	
LAB ID: 059721-0010-SA		
Matrix: GRND-H2O	Sampled: 31 MAR 98	Received: 02 APR 98
Authorized: 02 APR 98	Prepared: 06 APR 98	Analyzed: 08 APR 98
Instrument: GCFID-I	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
TPH (C8-C40)	4.4		0.50	0.19	mg/L
Surrogate		Recovery		Acceptable Range	
o-Terphenyl		108	%	33 - 162	
Nonatriacontane		98	%	10 - 109	

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method FL-PRO - TPH (C8-C40)
Method FL-PRO

Client Name:	Parsons Engineering Science		
Client ID:	Mil-EA-10	(0.00,0.00)	
LAB ID:	059638-0002-SA		
Matrix:	GRND-H2O	Sampled: 27 MAR 98	Received: 28 MAR 98
Authorized:	28 MAR 98	Prepared: 02 APR 98	Analyzed: 03 APR 98
Instrument:	GCFID-I	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
TPH (C8-C40)	0.81		0.50	0.19	mg/L
Surrogate		Recovery		Acceptable Range	
o-Terphenyl	102	%		33 - 162	
Nonatriacontane	39	%		10 - 109	

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name: Parsons Engineering Science
Client ID: MIL-EA-4 (0.00,0.00)
LAB ID: 059721-0009-SA
Matrix: GRND-H2O
Authorized: 02 APR 98
Instrument: GCFID-K1A

Sampled: 31 MAR 98
Prepared: N/A
Dilution: 50

Received: 02 APR 98
Analyzed: 13 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Methane	1700	B	25	2.6	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin

Approved By: Cynthia Prentice

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name: Parsons Engineering Science
Client ID: MIL-EA-40 (0.00,0.00)
LAB ID: 059721-0010-SA
Matrix: GRND-H2O
Authorized: 02 APR 98
Instrument: GCFID-K1A

Sampled: 31 MAR 98
Prepared: N/A
Dilution: 50

Received: 02 APR 98
Analyzed: 13 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Methane	1500	B	25	2.6	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin

Approved By: Cynthia Prentice

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name: Parsons Engineering Science

Client ID: Mil-EA-5 (0.00.0.00)

LAB ID: 059638-0003-SA

Matrix: GRND-H2O

Authorized: 28 MAR 98

Instrument: GCFID-K1A

Sampled: 27 MAR 98

Prepared: N/A

Dilution: 1.0

Received: 28 MAR 98

Analyzed: 07 APR 98

Parameter

Result Qualifier

RL

MDL

Units

Methane

0.54 B

0.50

0.052 ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin

Approved By: Cynthia Prentice

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name: Parsons Engineering Science
Client ID: Mil-EA-8 (0.00.0.00)
LAB ID: 059638-0004-SA
Matrix: GRND-H2O
Authorized: 28 MAR 98
Instrument: GCFID-K1A

Sampled: 27 MAR 98
Prepared: N/A
Dilution: 1.0

Received: 28 MAR 98
Analyzed: 07 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Methane	0.38	JB	0.50	0.052	ug/L

B = Compound is also detected in the blank.

J = Result is detected below the reporting limit or is an estimated concentration.

Reported By: Quanterra-Austin

Approved By: Cynthia Prentice

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name: Parsons Engineering Science

Client ID: Mil-EA-10 (0.00,0.00)

LAB ID: 059638-0002-SA

Matrix: GRND-H2O

Authorized: 28 MAR 98

Instrument: GCFID-K1A

Sampled: 27 MAR 98

Prepared: N/A

Dilution: 1.0

Received: 28 MAR 98

Analyzed: 07 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Methane	1.2	B	0.50	0.052	ug/L

8 - Compound is also detected in the blank.

Reported By: Quanterra-Austin

Approved By: Cynthia Prentice

AFCEE
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	Mil-EA-04	(0.00,0.00)	
LAB ID:	059619-0006-SA		
Matrix:	GRND-H2O	Sampled: 26 MAR 98	Received: 27 MAR 98
Authorized:	27 MAR 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Lead	0.015	1.0	0.0010	0.0050mg/L	SW7421	31 MAR 98	01 APR 98

Reported By: Robin Proctor

Approved By: Jan Ecos

AFCEE
Total Metals

Client Name: Parsons Engineering Science
Client ID: Mil-EA-40 (0.00,0.00)
LAB ID: 059619-0007-SA
Matrix: GRND-H2O
Authorized: 27 MAR 98

Sampled: 26 MAR 98
Prepared: See Below

Received: 27 MAR 98
Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep	Lim	Units	Method	Prepared Date	Analyzed Date
Lead	0.015		1.0	0.0010		0.0050	mg/L	SW7421	31 MAR 98	01 APR 98

Reported By: Robin Proctor

Approved By: Jan Ecos

AFCEE
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	Mil-EA-10	(0.00,0.00)	
LAB ID:	059638-0002-SA		
Matrix:	GRND-H2O	Sampled: 27 MAR 98	Received: 28 MAR 98
Authorized:	28 MAR 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Lead	0.011	1.0	0.0010	0.0050mg/L	SW7421	31 MAR 98	01 APR 98

Reported By: Robin Proctor

Approved By: Kathy Wakeman

AFCEE
Dissolved Metals

Client Name: Parsons Engineering Science
Client ID: Mil-EA-04 (0.00,0.00)
LAB ID: 059619-0006-SA
Matrix: GRND-H2O
Authorized: 27 MAR 98

Sampled: 26 MAR 98
Prepared: See Below

Received: 27 MAR 98
Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Lead	0.017		1.0	0.0010	0.0050mg/L	SW7421	03 APR 98	06 APR 98

Reported By: Robin Proctor

Approved By: Jan Ecos

AFCEE
Dissolved Metals

Client Name:	Parsons Engineering Science		
Client ID:	Mil-EA-40	(0.00,0.00)	
LAB ID:	059619-0007-SA		
Matrix:	GRND-H2O	Sampled: 26 MAR 98	Received: 27 MAR 98
Authorized:	27 MAR 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Lead	0.017	1.0	0.0010	0.0050mg/L	SW7421	03 APR 98	06 APR 98

Reported By: Robin Proctor

Approved By: Jan Ecos

AFCEE
Dissolved Metals

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-10 (0.00,0.00)
 LAB ID: 059638-0002-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98

Sampled: 27 MAR 98
 Prepared: See Below

Received: 28 MAR 98
 Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Lead	0.019		1.0	0.0010	0.0050mg/L	SW7421	03 APR 98	06 APR 98

Reported By: Robin Proctor

Approved By: Kathy Wakeman

General Inorganics

Client Name:	Parsons Engineering Science		
Client ID:	Mil-EA-04	(0.00,0.00)	
LAB ID:	059619-0006-SA		
Matrix:	GRND-H2O	Sampled: 26 MAR 98	Received: 27 MAR 98
Authorized:	27 MAR 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Nitrate as N	4.3	1.0	0.040	0.50 mg/L	9056	NA	27 MAR 98

Reported By: Patty Jungk

Approved By: Jan Ecos

General Inorganics

Client Name:	Parsons Engineering Science		
Client ID:	Mil-EA-40	(0.00,0.00)	
LAB ID:	059619-0007-SA		
Matrix:	GRND-H2O	Sampled: 26 MAR 98	Received: 27 MAR 98
Authorized:	27 MAR 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Nitrate as N	4.3	1.0	0.040	0.50 mg/L	9056	NA	27 MAR 98

Reported By: Patty Jungk

Approved By: Jan Ecos

General Inorganics

Client Name:	Parsons Engineering Science		
Client ID:	Mil-EA-5	(0.00,0.00)	
LAB ID:	059638-0003-SA		
Matrix:	GRND-H2O	Sampled: 27 MAR 98	Received: 28 MAR 98
Authorized:	28 MAR 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Nitrate as N	3.7	1.0	0.040	0.50 mg/L	9056	NA	29 MAR 98

Reported By: Patty Jungk

Approved By: Jan Ecos

General Inorganics

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-8 (0.00,0.00)
 LAB ID: 059638-0004-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98

Sampled: 27 MAR 98
 Prepared: See Below

Received: 28 MAR 98
 Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	1.4		1.0	0.040	0.50	mg/L	9056	NA	29 MAR 98

Reported By: Patty Jungk

Approved By: Jan Ecos

General Inorganics

Client Name: Parsons Engineering Science
 Client ID: Mil-EA-10 (0.00,0.00)
 LAB ID: 059638-0002-SA
 Matrix: GRND-H2O
 Authorized: 28 MAR 98

Sampled: 27 MAR 98
 Prepared: See Below

Received: 28 MAR 98
 Analyzed: See Below

Parameter	Result	Qual Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Nitrate as N	1.2	1.0	0.040	0.50 mg/L	9056	NA	28 MAR 98

Reported By: Patty Jungk

Approved By: Jan Ecos

AFCEE^Aromatic Volatile Organics with MTBE
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: MIL-B-S25 (0.00,0.00)
 LAB ID: 059724-0008-SA
 Matrix: SOIL
 Authorized: 02 APR 98
 Instrument: GCPID-H
 Sampled: 29 MAR 98
 Prepared: 07 APR 98
 Dilution: 1.0
 Received: 02 APR 98
 Analyzed: 07 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		0.0061	0.00061	mg/kg
Toluene	ND		0.0061	0.0015	mg/kg
Ethylbenzene	ND		0.0024	0.00061	mg/kg
Xylenes (total)	ND		0.0061	0.0018	mg/kg
Methyl-tert-butyl ether	ND		0.0061	0.0018	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	102	%	34 - 175
Fluorobenzene	108	%	34 - 175

Percent moisture is 17.7%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic Volatile Organics with MTBE
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: MIL-K-S15 (0.00,0.00)
 LAB ID: 059724-0009-SA
 Matrix: SOIL
 Authorized: 02 APR 98
 Instrument: GCPID-H
 Sampled: 30 MAR 98
 Prepared: 07 APR 98
 Dilution: 1.0
 Received: 02 APR 98
 Analyzed: 07 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		0.0055	0.00055	mg/kg
Toluene	ND		0.0055	0.0013	mg/kg
Ethylbenzene	ND		0.0022	0.00055	mg/kg
Xylenes (total)	ND		0.0055	0.0016	mg/kg
Methyl-tert-butyl ether	ND		0.0055	0.0016	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	100	%	34 - 175
Fluorobenzene	100	%	34 - 175

Percent moisture is 9.0%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic Volatile Organics with MTBE
 Method 8020A

Client Name: Parsons Engineering Science			
Client ID:	MIL-V-S26	(0.00,0.00)	
LAB ID:	059724-0010-SA		
Matrix:	SOIL	Sampled: 29 MAR 98	Received: 02 APR 98
Authorized:	02 APR 98	Prepared: 07 APR 98	Analyzed: 07 APR 98
Instrument:	GCPID-H	Dilution: 1.0	

Parameter	Result Qualifier	RL	MDL	Units
Benzene	ND	0.0061	0.00060	mg/kg
Toluene	ND	0.0061	0.0015	mg/kg
Ethylbenzene	0.0050 M	0.0024	0.00060	mg/kg
Xylenes (total)	0.012 d	0.0061	0.0018	mg/kg
Methyl-tert-butyl ether	ND	0.0061	0.0018	mg/kg

Surrogate	Recovery	Acceptable Range
a,a,a-Trifluorotoluene	101 %	34 - 175
Fluorobenzene	103 %	34 - 175

Percent moisture is 17.4%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
 M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE^Aromatic Volatile Organics with MTBE (Second Column)
 Method 8020A

Client Name: Parsons Engineering Science
 Client ID: MIL-V-S26 (0.00,0.00)
 LAB ID: 059724-0010-SA
 Matrix: SOIL
 Authorized: 02 APR 98
 Instrument: GCPID-H
 Sampled: 29 MAR 98
 Prepared: 07 APR 98
 Dilution: 1.0
 Received: 02 APR 98
 Analyzed: 07 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		0.0061	0.00060	mg/kg
Toluene	ND		0.0061	0.0015	mg/kg
Ethylbenzene	0.0050	d	0.0024	0.00060	mg/kg
Xylenes (total)	0.012	M	0.0061	0.0018	mg/kg
Methyl-tert-butyl ether	ND		0.0061	0.0018	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	101	%	34 - 175
Fluorobenzene	104	%	34 - 175

Percent moisture is 17.4%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
 M = Preferred Result
 ND = Not Detected

Reported By: Shawn Hadley

Approved By: Barbara Sullivan

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: MIL-B-S25 (0.00,0.00)
 LAB ID: 059724-0008-SA
 Matrix: SOIL
 Authorized: 02 APR 98
 Instrument: HPLC-Y

Sampled: 29 MAR 98
 Prepared: 06 APR 98
 Dilution: 1.0

Received: 02 APR 98
 Analyzed: 23 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		0.24	0.044	mg/kg
Acenaphthylene	ND		0.24	0.060	mg/kg
Anthracene	ND		0.024	0.0032	mg/kg
Benzo(a)anthracene	ND		0.024	0.0041	mg/kg
Benzo(a)pyrene	ND		0.018	0.0027	mg/kg
Benzo(b)fluoranthene	ND		0.015	0.0030	mg/kg
Benzo(g,h,i)perylene	ND		0.061	0.0036	mg/kg
Benzo(k)fluoranthene	ND		0.013	0.0043	mg/kg
Chrysene	ND		0.049	0.0024	mg/kg
Dibenz(a,h)anthracene	ND		0.024	0.0041	mg/kg
Fluorene	ND		0.049	0.0078	mg/kg
Fluoranthene	ND		0.049	0.0029	mg/kg
Indeno(1,2,3-cd)pyrene	ND		0.036	0.0036	mg/kg
Naphthalene	ND		0.24	0.056	mg/kg
Phenanthrene	ND		0.049	0.0067	mg/kg
Pyrene	ND		0.049	0.0032	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	100	%	22 - 167

Percent moisture is 17.7%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Blake Besser

Approved By: Audrey Cornell

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: MIL-K-S15 (0.00,0.00)
 LAB ID: 059724-0009-SA
 Matrix: SOIL
 Authorized: 02 APR 98
 Instrument: HPLC-Y
 Sampled: 30 MAR 98
 Prepared: 06 APR 98
 Dilution: 1.0
 Received: 02 APR 98
 Analyzed: 23 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		0.22	0.040	mg/kg
Acenaphthylene	ND		0.22	0.054	mg/kg
Anthracene	ND		0.022	0.0029	mg/kg
Benzo(a)anthracene	ND		0.022	0.0037	mg/kg
Benzo(a)pyrene	ND		0.016	0.0024	mg/kg
Benzo(b)fluoranthene	ND		0.013	0.0027	mg/kg
Benzo(g,h,i)perylene	ND		0.055	0.0033	mg/kg
Benzo(k)fluoranthene	ND		0.012	0.0038	mg/kg
Chrysene	ND		0.044	0.0022	mg/kg
Dibenz(a,h)anthracene	ND		0.022	0.0037	mg/kg
Fluorene	ND		0.044	0.0070	mg/kg
Fluoranthene	ND		0.044	0.0026	mg/kg
Indeno(1,2,3-cd)pyrene	ND		0.033	0.0033	mg/kg
Naphthalene	ND		0.22	0.051	mg/kg
Phenanthrene	ND		0.044	0.0060	mg/kg
Pyrene	ND		0.044	0.0029	mg/kg

Surrogate	Recovery	Acceptable Range
Terphenyl-d14	100 %	22 - 167

Percent moisture is 9.0%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Blake Besser

Approved By: Audrey Cornell

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: MIL-V-S26 (0.00,0.00)
 LAB ID: 059724-0010-SA
 Matrix: SOIL
 Authorized: 02 APR 98
 Instrument: HPLC-Y
 Sampled: 29 MAR 98
 Prepared: 06 APR 98
 Dilution: 1.0
 Received: 02 APR 98
 Analyzed: 23 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		0.24	0.044	mg/kg
Acenaphthylene	ND		0.24	0.059	mg/kg
Anthracene	ND		0.024	0.0031	mg/kg
Benzo(a)anthracene	0.074	M	0.024	0.0041	mg/kg
Benzo(a)pyrene	0.069	M	0.018	0.0027	mg/kg
Benzo(b)fluoranthene	0.11	M	0.015	0.0030	mg/kg
Benzo(g,h,i)perylene	0.063	M	0.061	0.0036	mg/kg
Benzo(k)fluoranthene	0.037	M	0.013	0.0042	mg/kg
Chrysene	0.11	M	0.048	0.0024	mg/kg
Dibenz(a,h)anthracene	ND		0.024	0.0041	mg/kg
Fluorene	0.015	Jd	0.048	0.0077	mg/kg
Fluoranthene	0.17	M	0.048	0.0029	mg/kg
Indeno(1,2,3-cd)pyrene	ND		0.036	0.0036	mg/kg
Naphthalene	ND		0.24	0.056	mg/kg
Phenanthrene	0.15	d	0.048	0.0067	mg/kg
Pyrene	0.18	d	0.048	0.0031	mg/kg
Surrogate	Recovery		Acceptable Range		
Terphenyl-d14	100		x	22 - 167	

Percent moisture is 17.4%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
 J = Result is detected below the reporting limit or is an estimated concentration.
 M = Preferred Result
 ND = Not Detected

Reported By: Blake Besser

Approved By: Audrey Cornell

AFCEE
 Polynuclear Aromatic Hydrocarbons, HPLC (Confirmation)
 Method 8310

Client Name: Parsons Engineering Science
 Client ID: MIL-V-S26 (0.00,0.00)
 LAB ID: 059724-0010-SA
 Matrix: SOIL
 Authorized: 02 APR 98
 Instrument: HPLC-Y
 Sampled: 29 MAR 98
 Prepared: 06 APR 98
 Dilution: 1.0
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Acenaphthylene	ND		0.24	0.059	mg/kg
Anthracene	ND		0.024	0.0031	mg/kg
Benzo(a)anthracene	0.086	d	0.024	0.0041	mg/kg
Benzo(a)pyrene	0.091	d	0.018	0.0027	mg/kg
Benzo(b)fluoranthene	0.14	d	0.015	0.0030	mg/kg
Benzo(g,h,i)perylene	0.069	d	0.061	0.0036	mg/kg
Benzo(k)fluoranthene	0.059	d	0.013	0.0042	mg/kg
Chrysene	0.14	d	0.048	0.0024	mg/kg
Dibenz(a,h)anthracene	ND		0.024	0.0041	mg/kg
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Fluoranthene	0.22	d	0.048	0.0029	mg/kg
Indeno(1,2,3-cd)pyrene	ND		0.036	0.0036	mg/kg
Naphthalene	ND		0.24	0.056	mg/kg
Phenanthrene	0.11	M	0.048	0.0067	mg/kg
Pyrene	0.16	M	0.048	0.0031	mg/kg

Surrogate	Recovery	Acceptable Range
Terphenyl-d14	96	22 - 167

Percent moisture is 17.4%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
 J = Result is detected below the reporting limit or is an estimated concentration.
 M = Preferred Result
 ND = Not Detected

Reported By: Blake Besser

Approved By: Audrey Cornell

Method FL-PRO - TPH (C8-C40)
 Method FL-PRO

Client Name: Parsons Engineering Science
 Client ID: MIL-B-S25 (0.00.0.00)
 LAB ID: 059724-0008-SA
 Matrix: SOIL
 Authorized: 02 APR 98
 Instrument: GCFID-I

Sampled: 29 MAR 98
 Prepared: 08 APR 98
 Dilution: 1.0

Received: 02 APR 98
 Analyzed: 14 APR 98

Parameter	Result	Qualifier	RL	MDL	Units
TPH (C8-C40)	4.4	J	11	9.9	mg/kg

Surrogate	Recovery	Acceptable Range
o-Terphenyl	99	22 - 166
Nonatriacontane	45	10 - 192

J = Result is detected below the reporting limit or is an estimated concentration.

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method FL-PRO - TPH (C8-C40)
 Method FL-PRO

Client Name:	Parsons Engineering Science		
Client ID:	MIL-K-S15	(0.00.0.00)	
LAB ID:	059724-0009-SA		
Matrix:	SOIL	Sampled: 30 MAR 98	Received: 02 APR 98
Authorized:	02 APR 98	Prepared: 08 APR 98	Analyzed: 14 APR 98
Instrument:	GCFID-I	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
TPH (C8-C40)	6.5	J	11	9.9	mg/kg
Surrogate		Recovery		Acceptable Range	
o-Terphenyl		93	%	22 - 166	
Nonatriacontane		59	%	10 - 192	

J = Result is detected below the reporting limit or is an estimated concentration.

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

Method FL-PRO - TPH (C8-C40)
 Method FL-PRO

Client Name:	Parsons Engineering Science		
Client ID:	MIL-V-S26	(0.00,0.00)	
LAB ID:	059724-0010-SA		
Matrix:	SOIL	Sampled: 29 MAR 98	Received: 02 APR 98
Authorized:	02 APR 98	Prepared: 08 APR 98	Analyzed: 14 APR 98
Instrument:	GCFID-I	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
TPH (C8-C40)	4.7	J	11	9.9	mg/kg

Surrogate	Recovery	Acceptable Range
o-Terphenyl	96	22 - 166
Nonatriacontane	43	10 - 192

J = Result is detected below the reporting limit or is an estimated concentration.

Reported By: Quanterra-Tampa

Approved By: Cynthia Prentice

General Inorganics

Client Name: Parsons Engineering Science
 Client ID: MIL-V-S8 (0.00,0.00)
 LAB ID: 059724-0027-SA
 Matrix: SOIL
 Authorized: 02 APR 98

Sampled: 29 MAR 98
 Prepared: See Below

Received: 02 APR 98
 Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep	Lim	Units	Method	Prepared Date	Analyzed Date
Total Organic Carbon	ND		1.0	550	2000		mg/kg	9060	09 APR 98	13 APR 98
Total Organic Carbon	ND		1.0	550	2000		mg/kg	9060	09 APR 98	13 APR 98
Total Organic Carbon	ND		1.0	550	2000		mg/kg	9060	09 APR 98	13 APR 98
Total Organic Carbon	ND		1.0	550	2000		mg/kg	9060	09 APR 98	13 APR 98

ND = Not Detected

Reported By: Patty Jungk

Approved By: Jan Ecos

SAMPLE DESCRIPTION INFORMATION
for
Parsons Engineering Science

Lab ID	Client ID	Matrix	Sampled Date	Time	Received Date
059619-0001-SA	BX-MW-C	GRND-H2O	25 MAR 98	16:00	27 MAR 98
059619-0002-SA	BX-MW-07	GRND-H2O	26 MAR 98	06:30	27 MAR 98
059619-0003-SA	BX-MW-D	GRND-H2O	26 MAR 98	07:30	27 MAR 98
059619-0004-SA	BX-MP-1	GRND-H2O	26 MAR 98	13:30	27 MAR 98
059619-0005-SA	BX-MP-2	GRND-H2O	26 MAR 98	12:30	27 MAR 98
059619-0006-SA	Mil-EA-04	GRND-H2O	26 MAR 98	14:45	27 MAR 98
059619-0007-SA	Mil-EA-40	GRND-H2O	26 MAR 98	15:00	27 MAR 98
059619-0008-TB	TRIP BLANK	WATER-QA	26 MAR 98		27 MAR 98

Sheet1

Analyze the "x" samples

Analyze the following samples—they will not be recollected						
Please hold the remaining samples until the replacement samples are received.						
	BTEX	PAHs	EDB	Methane	TRPH	
3/25/1998 COC#1						
BX-GWRW-6	x	x	x			
BX-MW-4	x	x				
BX-GWRW-4						
BX-MW-2						
BX-MW-20						
Trip Blank	x		x			
3/25/98 COC#2						
BX-MW1						
BX-MW1/MS						
BX-MW1/MSD						
Trip Blank						
BX-MW-C						
3/26/98 COC						
BX-MW-C	x			x		
BX-MW-07	x			x		
BX-MW-D						
BX-MP-1						
BX-MP-2						
Mil-EA-04						
Mil-EA-40						
Trip Blank	x					

59602

59602

NO3 only Already Analyzed

059619

Note: analyze all total and dissolved lead samples received and all nitrate samples received.

731874.02w.2wv

Post-It® Fax Note	7671	Date	3/27	# of pages	1
To	Ellen LaGrice	From	John Hines		
Co./Dept	Hunter	Co.	PRINCES		
Phone #		Phone #			
Fax #	431-7171	Fax #			

Ellen - based on these numbers, please add 2 BTEX and 1 EDB to both order if possible. Also, include extra set or 2 for potential breakage.

Thanks,
JGL

SAMPLE DESCRIPTION INFORMATION
for
Parsons Engineering Science

Lab ID	Client ID	Matrix	Sampled		Received
			Date	Time	
059638-0001-SA	BX-MW-4	GRND-H2O	27 MAR 98	07:00	28 MAR 98
059638-0002-SA	Mil-EA-10	GRND-H2O	27 MAR 98	08:30	28 MAR 98
059638-0003-SA	Mil-EA-5	GRND-H2O	27 MAR 98	09:30	28 MAR 98
059638-0004-SA	Mil-EA-8	GRND-H2O	27 MAR 98	11:30	28 MAR 98
059638-0005-TB	TRIP BLANK	WATER-QA	27 MAR 98	00:00	28 MAR 98

Client Parsons	Project Manager John Hicks	Chain of Custody Number J2305	
Address 1700 Broadway Suite 900	Telephone Number (Area Code)/Fax Number 303 831 8100	Date 3/27/98	
City Denver	State CO	Lab Number 259638	Page 1 of 1
Zip Code 80290	Site Contact Cindy Nagel	Analysis (Attach list if more space is needed)	
Project Name Eglin AFB	Carrier/Waybill Number	4 boxes PAHS EDB Lead Nitrate TCRH 75 ml	
Contract/Purchase Order/Quote No.		Special Instructions/ Conditions of Receipt	

Possible Hazard Identification		Sample Disposal		(A lee may be assessed if samples are retained longer than 3 months)	
☐ Non-Hazard	☐ Flammable	☐ Skin Irritant	☐ Poison B	☐ Unknown	
Turn Around Time Required		☐ Return To Client	☐ Disposal By Lab	☐ Archive For	Months
		QC Requirements (Specify)			

Comments

DISTRIBUTION: WHITE - Slays with the Sample; CANARY - Returned to Client with Report; PINK - Field Copy

SAMPLE DESCRIPTION INFORMATION
 for
 Parsons Engineering Science

Lab ID	Client ID	Matrix	Sampled Date	Time	Received Date
059724-0001-SA	BXSB07S4.5	SOIL	28 MAR 98	16:00	02 APR 98
059724-0002-SA	BX-SB07-S7	SOIL	28 MAR 98	16:00	02 APR 98
059724-0003-SA	BX-SB08-S5	SOIL	28 MAR 98	16:30	02 APR 98
059724-0004-SA	BX-SB09-S8	SOIL	29 MAR 98	07:45	02 APR 98
059724-0005-SA	BX-SB11-S5	SOIL	29 MAR 98	00:00	02 APR 98
059724-0006-SA	BX-SB12-S7	SOIL	30 MAR 98	00:00	02 APR 98
059724-0007-SA	BX-SB14-S7	SOIL	30 MAR 98	00:00	02 APR 98
059724-0008-SA	MIL-B-S25	SOIL	29 MAR 98	00:00	02 APR 98
059724-0009-SA	MIL-K-S15	SOIL	30 MAR 98	00:00	02 APR 98
059724-0010-SA	MIL-V-S26	SOIL	29 MAR 98	00:00	02 APR 98
059724-0010-MS	MIL-V-S26	SOIL	29 MAR 98	00:00	02 APR 98
059724-0010-SD	MIL-V-S26	SOIL	29 MAR 98	00:00	02 APR 98
059724-0011-SA	BX-MP02-S3	SOIL	26 MAR 98	10:15	02 APR 98
059724-0012-SA	BX-MP02-S5	SOIL	26 MAR 98	10:15	02 APR 98
059724-0013-SA	BX-VMP2-S3	SOIL	28 MAR 98	07:25	02 APR 98
059724-0014-SA	BX-VMP2-S5	SOIL	28 MAR 98	07:25	02 APR 98
059724-0015-SA	BX-VMP2-S7	SOIL	28 MAR 98	07:25	02 APR 98
059724-0016-SA	BX-VEW1-S3	SOIL	28 MAR 98	08:15	02 APR 98
059724-0017-SA	BX-VEW1-S5	SOIL	28 MAR 98	08:15	02 APR 98
059724-0018-SA	BX-VEW1-S7	SOIL	28 MAR 98	08:15	02 APR 98
059724-0019-SA	BXVEW2S5.5	SOIL	28 MAR 98	09:30	02 APR 98
059724-0020-SA	BX-SB06-S3	SOIL	28 MAR 98	15:00	02 APR 98
059724-0021-SA	BX-SB06-S4	SOIL	28 MAR 98	15:00	02 APR 98
059724-0022-SA	BX-SB06-S7	SOIL	28 MAR 98	15:00	02 APR 98
059724-0023-SA	BX-SB01-S7	SOIL	28 MAR 98	07:50	02 APR 98
059724-0024-SA	BX-SB02-S7	SOIL	28 MAR 98	10:40	02 APR 98
059724-0025-SA	BX-SB03-S7	SOIL	28 MAR 98	11:20	02 APR 98
059724-0026-SA	MIL-K-S8	SOIL	30 MAR 98	00:00	02 APR 98
059724-0027-SA	MIL-V-S8	SOIL	29 MAR 98	00:00	02 APR 98
059724-0028-TB	TRIP BLANK	AQUEOUS	31 MAR 98	00:00	02 APR 98
059724-0029-RB	RINSEATE	AQUEOUS	31 MAR 98	00:00	02 APR 98

Chain of Custody Record



59724

QUA-4124 0787

Client Parsons	Project Manager John Hicks	Date 3/31/98	Chain of Custody Number 02307
Address 1700 Broadway Ste 900	Telephone Number (Area Code) / Fax Number (303) 831-8100	Lab Number	Page 2 of 3
City Denver	Site Contact Cindy Nagel	Analysis (Attach list if more space is needed)	
Zip Code CO 80290	Lab Contact Ellen LaRiviere		
Project Name Englin AFB	Carrier/Waybill Number	Special Instructions/ Conditions of Receipt	
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix					Containers & Preservatives					Analysis (Attach list if more space is needed)	Special Instructions/ Conditions of Receipt
			Aqueous	Sol	Sol	Unpres	H2SO4	HNO3	HCl	NaOH	ZnAc	NaOH		
01 BX-SB07-S4.5	3/28/98	1600		X									X BTX + MTR	
02 BX-SB07-S7	3/28/98	1600		X									X PAHs	
03 BX-SB08-S5	3/28/98	1630		X									X	
04 BX-SB09-S8	3/29/98	0745		X									X	
05 BX-SB11-S5	3/29/98			X									X	
06 BX-SB12-S7	3/30/98			X									X	
07 BX-SB14-S7	3/30/98			X									X	
08 Mil-B-S25	3/29/98			X									X	
09 Mil-K-S15	3/30/98			X									X	
10 Mil-V-S26	3/29/98			X									X	
10ms Mil-V-S26/MS	3/29/98			X									X	
10s Mil-V-S26/MSD	3/29/98			X									X	

Possible Hazard Identification		Sample Disposal	
☐ Non-Hazard	☐ Flammable	☐ Skin Irritant	☐ Poison B
☐ Turn Around Time Required	☐ 24 Hours	☐ 48 Hours	☐ 7 Days
☐ 14 Days	☐ 21 Days	☐ Other	
1. Relinquished By Cindy Nagel		Date 4/1/98	Time 1530
2. Relinquished By		Date	Time
3. Relinquished By		Date	Time
Comments		1. Received By Kuster Bailey	
		Date 4-2-98	Time 0830
		Date	Time
		Date	Time

Chain of Custody Record



59724

QUA-1124 0707

Client: Parsons		Project Manager: John Hicks		Date: 3/31/98	Chain of Custody Number: 02306
Address: 1700 Broadway Suite 900		Telephone Number (Area Code)/Fax Number: (303) 831-8100		Lab Number	
City: Denver	State: CO	Zip Code: 80290	Site Contact: Lindy Nagel	Page 1 of 3	
Project Name: Edwin AFB		Lab Contact: Ellen LaRiviere			
Contract/Purchase Order/Quote No.		Carrier/Waybill Number			

Special Instructions/
Conditions of Receipt

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Agency	Sed.	Soil	Unpres.						BTEX	PAHs	TRP
						H2SO4	HNO3	HCl	NaOH	ZnAc	NaOH			
11 BX-MPO2-S3	3/26/98	1015			X							X	X	X
12 BX-MPO2-S5	3/26/98	1015			X							X	X	X
13 BX-VMP2-S3	3/28/98	0725			X							X	X	X
14 BX-VMP2-S5	3/28/98	0725			X							X	X	X
15 BX-VMP2-S7	3/28/98	0725			X							X	X	X
16 BX-VEW1-S3	3/28/98	0815			X							X	X	X
17 BX-VEW1-S5	3/28/98	0815			X							X	X	X
18 BX-VEW1-S7	3/28/98	0815			X							X	X	X
19 BX-VEW2-S5.5	3/28/98	0930			X							X	X	X
20 BX-SB06-S3	3/28/98	1500			X							X	X	X
21 BX-SB06-S4	3/28/98	1500			X							X	X	X
22 BX-SB06-S7	3/28/98	1500			X							X	X	X

Possible Hazard Identification

☐ Non-Hazard
 ☐ Flammable
 ☐ Skin Irritant
 ☐ Poison B
 ☐ Unknown
 ☐ Return To Client
 ☐ Disposal By Lab
 ☐ Archive For _____ Months
 (A fee may be assessed if samples are retained longer than 3 months)

Turn Around Time Required	☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other
1. Relinquished By: Lindy Nagel	Date: 4/1/98 Time: 1530 Date: _____ Time: _____
2. Relinquished By:	Date: _____ Time: _____ Date: _____ Time: _____
3. Relinquished By:	Date: _____ Time: _____ Date: _____ Time: _____
Comments:	Date: _____ Time: _____ Date: _____ Time: _____

Chain of Custody Record



59724

QUA-4124 0797

Client Paxsons		Project Manager John Hicks		Date 3/31/98	Chain of Custody Number 02303
Address 1700 Broadway Suite 900		Telephone Number (Area Code) Fax Number (303) 831-8100		Lab Number	Page 3 of 3
City Denver	State CO	Zip Code 80290	The Contact Indy Nagel	Analysis (Attach list if more space is needed)	
Project Name Eglin AFB			Lab Contact Elun LaRiviere	Special Instructions/ Conditions of Receipt	
Contract/Purchase Order/Quote No.			Carrier/Waybill Number		

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix			Containers & Preservatives						Analysis	Containers & Preservatives	Conditions or Receipt	
			Aqueous	Sed.	Sol.	Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc				NaOH
23 BX-SB01-S7	3/28/98	0750			X								BTX+ PAK TRPH TOC		
24 BX-SB02-S7	3/28/98	1040			X								X		
25 BX-SB03-S7	3/28/98	1120			X								X		
26 Mil-K-S8	3/30/98				X								X		
27 Mil-V-S8	3/29/98				X								X		
28 Trip Blank	3/31/98		X								X		X		
29 RB Plate	3/31/98		X										X		
												</			

Possible Hazard Identification		Sample Disposal	
☐ Non-Hazard	☐ Flammable	☐ Return To Client	☐ Disposal By Lab
☐ Skin Irritant	☐ Poison B	☐ Unknown	☐ Archive For
Turn Around Time Required		QC Requirements (Specify)	
☐ 24 Hours	☐ 48 Hours	☐ 7 Days	☐ 14 Days
☐ 21 Days	☐ Other		
1. Relinquished By Indy Nagel		1. Received By Kurt Bixby	
Date 4/1/98	Time 1530	Date 4/2/98	Time 0830
2. Relinquished By		2. Received By	
Date	Time	Date	Time
3. Relinquished By		3. Received By	
Date	Time	Date	Time
Comments			

3/25/98

1

PROJECT NAME Eglin AFB, Florida

NOTEBOOK NO. _____

Record of field analysis of groundwater samples at
the BX Service Station (1st St. Service Station)

Well	Analyte	Method	Concentration (mg/L)	Sample Time
------	---------	--------	----------------------	-------------

~~0730~~

GWRW-6	ferrous iron	HACH Colorimetric	0.00 mg/L	0730
		DR/700 V. 50.01		

GWRW-6	sulfate	HACH Colorimetric	131 mg/L	0730
		DR/700 V. 45.000		

MW-4	ferrous iron		0.03 mg/L	0900
	sulfate		71 mg/L	0900

GWRW-4	ferrous iron		0.08 mg/L	0800
	sulfate		161 mg/L	0800

MW-2	ferrous iron		0.13 mg/L	1200
	sulfate		27 mg/L	

MW-2 (dup)	ferrous iron		0.12 mg/L	1200
	sulfate		36 mg/L	

MW-1	ferrous iron		0.20 mg/L	1330
	sulfate		167 mg/L	

MW-C	ferrous iron		0.01 mg/L	1400
	sulfate		45 mg/L	

SIGNATURE

READ AND UNDERSTOOD

Cindy Nagel

DATE

March 25 19 98

DATE

19

3/26/98 2

PROJECT NAME Eglin AFB

NOTEBOOK NO. _____

Record of field analysis of ground water samples.

Using HACH colorimeter to analyze for
ferrous iron (DR/700 Method 50.01) and
sulfate (DR/700 Method 45.000)BX Service Station

0630	MW-7	ferrous iron	0.01 mg/L
		sulfate	155 mg/L

0730	MW-D	ferrous iron	0.07 mg/L
		sulfate	89 mg/L

1230	MP-2	ferrous iron	0.55 mg/L
		sulfate	152 mg/L

	MP-2 duplicate	ferrous iron	0.56 mg/L
		sulfate	150 mg/L

1330	MP-1	ferrous iron	0.00 mg/L
		sulfate	236 mg/L

Military Gas Station

1445	EA-4	ferrous iron	0.40 mg/L
		sulfate	67 mg/L

	EA-4 dup	ferrous iron	0.40 mg/L
		sulfate	89 mg/L

SIGNATURE Cindy Nagel
READ AND UNDERSTOOD _____DATE 3/26 19 98
DATE _____ 19 _____

3/27/98 3

PROJECT NAME Gaglin AFB, Florida

NOTEBOOK NO. _____

Record of field analysis of groundwater samples

Using HACH Colorimeter to analyze for
ferrous iron (DR/700 Method 50.01)
and sulfate (DR/700 Method 45.00)Military Gas Station

0830	EA-10	ferrous iron	0.00 mg/L
		sulfate	76 mg/L

0930	EA-5	ferrous iron	0.01 mg/L
		sulfate	120 mg/L

1130	EA-8	ferrous iron	0.00 mg/L
		sulfate	109 mg/L

SIGNATURE

READ AND UNDERSTOOD

Cindy Nagel

DATE

3/27

19

DATE

98
19

AIR TOXICS LTD.

SAMPLE NAME : Mil SG1

ID#: 9804028-04A

EPA Method TO-3 GC/PID/FID

File Name:	6041514	Date of Collection:	4/ 1/98
Dil. Factor:	19.7	Date of Analysis:	4/15/98

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.020	0.064	Not Detected	Not Detected
Toluene	0.020	0.075	0.026	0.099
Ethyl Benzene	0.020	0.087	Not Detected	Not Detected
Total Xylenes	0.020	0.087	0.075	0.33
TPH (C5+ Hydrocarbons) ref. to Gasoline	0.20	0.82	1.5	6.2
C2-C4 Hydrocarbons ref. to Gasoline	0.20	0.36	Not Detected	Not Detected

Container Type: 1 Liter Summa Canister

Surrogates	% Recovery	Method Limits
Fluorobenzene (PID)	116	50-150
Fluorobenzene (FID)	116	50-150

3/31/98 4

PROJECT NAME Eglin AFB, Florida

NOTEBOOK NO. _____

Record of field analysis for groundwater samples.

Using HACH colorimeter

Method DR/700 50.01 ferrous iron

Method DR/700 45.000 sulfate

BX Service Station SB-15/MP3

ferrous iron 3.2 mg/L

sulfate 340 mg/L

SIGNATURE

READ AND UNDERSTOOD

Cindy Nagel

DATE

3/3119 98

DATE

19

APPENDIX B

DATA FROM PREVIOUS INVESTIGATIONS

TABLE 1. SUMMARY OF DRILLING AND WELL CONSTRUCTION LOGS FOR MILITARY GAS STATION ON MAIN BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Drilling Location	Drill/Installation Date	Top of Casing Elevation ^(a) (ft MSL)	Ground Elevation (ft MSL)	Total Depth (ft)	Screen/Casing Interval ^(b)		Sandpack Interval (ft)	Bentonite Seal (ft)	Grout (ft)
					Screen (ft)	Riser (ft)			
EA-1	8-24-92	54.00	54.28	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-2	8-24-92	54.08	54.34	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-3	8-25-92	54.32	54.57	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-4	8-26-92	55.47	55.82	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-5	8-27-92	55.24	55.40	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-6	8-28-92	55.85	56.12	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-7	8-28-92	53.94	54.19	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-8	8-31-92	56.04	56.30	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-9	9-1-92	55.43	55.74	59	57.0-54.5	54.5-0	59.0-53.5	53.5-52.0	52.0-0
EA-10	6-14-93	54.72	55.07	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
EA-11	6-14-93	53.58	53.91	45	45.0-30.0	30.0-0	45.0-28.0	28.0-26.0	26.0-0
A	8-19-92	NA	53.9	42	--	--	--	--	42.0-0
B	8-18-92	NA	54.2	42	--	--	--	--	42.0-0
C	8-20-92	NA	53.9	42	--	--	--	--	42.0-0
D	8-20-92	NA	54.3	42	--	--	--	--	42.0-0
E	8-24-92	NA	53.6	42	--	--	--	--	42.0-0
J	8-26-92	NA	55.2	42	--	--	--	--	42.0-0
K	8-26-92	NA	55.0	42	--	--	--	--	42.0-0
L	8-26-92	NA	55.1	42	--	--	--	--	42.0-0
Q	6-15-93	NA	54.99	36	--	--	--	--	36.0-0
R	6-15-93	NA	54.97	36	--	--	--	--	36.0-0
S	6-15-93	NA	55.82	36	--	--	--	--	36.0-0

^(a) = Elevations of EA-10, EA-11, borings Q through W, AAS-1, SVE-1, and SVE-2 surveyed by George, Nielsen, and Tooke, P.A. of Crestview, Florida on 14 July 1993.

Elevations of EA-1 through EA-9 and borings A through L surveyed by Dowco Land Surveying of Ft. Walton Beach, Florida on 8 September 1992.

^(b) = All monitoring wells constructed with 2-in. diameter, Schedule 40 PVC screen and casing.

^(c) = AAS-1 has a PVC sump from 60.0 to 57.5 ft below ground surface.

TABLE 1 (Cont.)

Drilling Location	Drill/ Installation Date	Top of Casing Elevation ^(a) (ft MSL)	Ground Elevation (ft MSL)	Total Depth (ft)	Screen/Casing Interval ^(a)		Sandpack Interval (ft)	Bentonite Seal (ft)	Grout (ft)
					Screen (ft)	Riser (ft)			
T	6-15-93	NA	55.90	36	--	--	--	--	36.0-0
U	6-15-93	NA	55.63	36	--	--	--	--	36.0-0
V	6-16-93	NA	56.16	36	--	--	--	--	36.0-0
W	6-17-93	NA	56.24	36	--	--	--	--	36.0-0
AAS-1	5-13-93	55.21	55.46	61	57.5-55.0 ^(a)	55.0-0	60.0-49.0	49.0-47.0	47.0-0
SVE-1	5-11-93	55.34	55.58	32	32.0-7.0	7.0-0	32.0-5.0	5.0-3.0	3.0-0
SVE-2	5-11-93	54.54	55.22	32	32.0-7.0	7.0-0	32.0-5.0	5.0-3.0	3.0-0

TABLE 2 PUBLIC GROUNDWATER SUPPLY WELLS AT THE MAIN BASE,
EGLIN AIR FORCE BASE, VALPARAISO, OKALOOSA COUNTY, FLORIDA^(a).

WELL NO.	SIZE (in.)	DEPTH (FT.)	GPM	PUMP DEPTH (ft.)	AQUIFER	USE
1	10	575	300	168	Floridan	Drinking water
2	12	607	1000	190	Floridan	Drinking water
3	12	652	700	150	Floridan	Drinking water
4	12	550	1000	165	Floridan	Drinking water
5	16	642	950	150	Floridan	Drinking water
6	6	590	400	180	Floridan	Drinking water
61	8	702	350	unknown	Floridan	Drinking water

^(a) Information from records on file at Base Civil Engineering office, Eglin AFB.

TABLE 2 PUBLIC GROUNDWATER SUPPLY WELLS AT THE MAIN BASE,
EGLIN AIR FORCE BASE, VALPARAISO, OKALOOSA COUNTY, FLORIDA^(a).

WELL NO.	SIZE (in.)	DEPTH (FT.)	GPM	PUMP DEPTH (ft.)	AQUIFER	USE
1	10	575	300	168	Floridan	Drinking water
2	12	607	1000	190	Floridan	Drinking water
3	12	652	700	150	Floridan	Drinking water
4	12	550	1000	165	Floridan	Drinking water
5	16	642	950	150	Floridan	Drinking water
6	6	590	400	180	Floridan	Drinking water
61	8	702	350	unknown	Floridan	Drinking water

(a) Information from records on file at Base Civil Engineering office, Eglin AFB.

TABLE 4 SUMMARY OF GAUGING DATA FOR MILITARY GAS STATION ON MAIN
BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Date	Well Number	Casing Elevation (feet MSL)	Depth To LPH (feet)	LPH Elevation (feet MSL)	Depth To Water (feet)	Corrected Water Elev. (feet MSL)	LPH Thickness (feet)
01-Sep-92	EA-1	*N/A	N/A	N/A	34.50	N/A	N/A
09-Sep-92	EA-1	54.00	N/A	N/A	34.26	19.74	N/A
13-Sep-92	EA-1	54.00	N/A	N/A	34.31	19.69	N/A
22-Jan-93	EA-1	54.00	N/A	N/A	34.69	19.31	N/A
21-May-93	EA-1	54.00	N/A	N/A	35.58	18.42	N/A
18-Jun-93	EA-1	54.00	N/A	N/A	36.49	17.51	N/A
27-Jul-93	EA-1	54.00	N/A	N/A	36.69	17.31	N/A
17-Aug-93	EA-1	54.00	N/A	N/A	36.61	17.39	N/A
16-Sep-93	EA-1	54.00	N/A	N/A	36.38	17.62	N/A
05-Oct-93	EA-1	54.00	N/A	N/A	36.71	17.29	N/A
11-Feb-94	EA-1	54.00	N/A	N/A	37.34	16.66	N/A
07-Mar-94	EA-1	54.00	N/A	N/A	36.16	17.84	N/A
21-Mar-94	EA-1	54.00	N/A	N/A	35.70	18.30	N/A
08-Apr-94	EA-1	54.00	N/A	N/A	35.92	18.08	N/A
19-May-94	EA-1	54.00	N/A	N/A	36.73	17.27	N/A
02-Jun-94	EA-1	54.00	N/A	N/A	37.05	16.95	N/A
07-Jun-94	EA-1	54.00	N/A	N/A	36.91	17.09	N/A
07-Jul-94	EA-1	54.00	N/A	N/A	34.64	19.36	N/A
11-Aug-94	EA-1	54.00	N/A	N/A	31.59	22.41	N/A
22-Sep-94	EA-1	54.00	N/A	N/A	32.84	21.16	N/A
12-Oct-94	EA-1	54.00	N/A	N/A	32.13	21.87	N/A
01-Sep-92	EA-2	*N/A	N/A	N/A	34.32	N/A	N/A
09-Sep-92	EA-2	54.08	N/A	N/A	34.10	19.98	N/A
13-Sep-92	EA-2	54.08	N/A	N/A	34.16	19.92	N/A
22-Jan-93	EA-2	54.08	N/A	N/A	34.48	19.60	N/A
21-May-93	EA-2	54.08	N/A	N/A	35.40	18.68	N/A
18-Jun-93	EA-2	54.08	N/A	N/A	36.33	17.75	N/A
27-Jul-93	EA-2	54.08	N/A	N/A	36.52	17.56	N/A
17-Aug-93	EA-2	54.08	N/A	N/A	36.47	17.61	N/A
16-Sep-93	EA-2	54.08	N/A	N/A	36.30	17.78	N/A
05-Oct-93	EA-2	54.08	N/A	N/A	36.53	17.55	N/A
11-Feb-94	EA-2	54.08	N/A	N/A	37.18	16.90	N/A
07-Mar-94	EA-2	54.08	N/A	N/A	36.00	18.08	N/A
21-Mar-94	EA-2	54.08	N/A	N/A	35.56	18.52	N/A
08-Apr-94	EA-2	54.08	N/A	N/A	35.76	18.32	N/A
19-May-94	EA-2	54.08	N/A	N/A	36.54	17.54	N/A
02-Jun-94	EA-2	54.08	N/A	N/A	36.86	17.22	N/A
07-Jun-94	EA-2	54.08	N/A	N/A	36.70	17.38	N/A
28-Jun-94	EA-2	54.08	N/A	N/A	36.18	17.90	N/A
07-Jul-94	EA-2	54.08	N/A	N/A	34.71	19.37	N/A
11-Aug-94	EA-2	54.08	N/A	N/A	31.42	22.66	N/A
22-Sep-94	EA-2	54.08	N/A	N/A	32.63	21.45	N/A
12-Oct-94	EA-2	54.08	N/A	N/A	31.94	22.14	N/A
01-Sep-92	EA-3	*N/A	N/A	N/A	34.60	N/A	N/A
09-Sep-92	EA-3	54.32	N/A	N/A	34.36	19.96	N/A
13-Sep-92	EA-3	54.32	N/A	N/A	34.39	19.93	N/A
22-Jan-93	EA-3	54.32	N/A	N/A	34.73	19.59	N/A

TABLE 4 SUMMARY OF GAUGING DATA FOR MILITARY GAS STATION ON MAIN BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Date	Well Number	Casing Elevation (feet MSL)	Depth To LPH (feet)	LPH Elevation (feet MSL)	Depth To Water (feet)	Corrected Water Elev. (feet MSL)	LPH Thickness (feet)
21-May-93	EA-3	54.32	N/A	N/A	35.59	18.73	N/A
18-Jun-93	EA-3	54.32	N/A	N/A	36.48	17.84	N/A
27-Jul-93	EA-3	54.32	N/A	N/A	36.70	17.62	N/A
17-Aug-93	EA-3	54.32	N/A	N/A	36.73	17.59	N/A
16-Sep-93	EA-3	54.32	N/A	N/A	36.46	17.86	N/A
05-Oct-93	EA-3	54.32	N/A	N/A	36.78	17.54	N/A
11-Feb-94	EA-3	54.32	N/A	N/A	37.43	16.89	N/A
07-Mar-94	EA-3	54.32	N/A	N/A	36.35	17.97	N/A
21-Mar-94	EA-3	54.32	N/A	N/A	35.80	18.52	N/A
08-Apr-94	EA-3	54.32	N/A	N/A	35.99	18.33	N/A
19-May-94	EA-3	54.32	N/A	N/A	36.78	17.54	N/A
02-Jun-94	EA-3	54.32	N/A	N/A	37.11	17.21	N/A
07-Jun-94	EA-3	54.32	N/A	N/A	37.02	17.30	N/A
07-Jul-94	EA-3	54.32	N/A	N/A	35.36	18.96	N/A
11-Aug-94	EA-3	54.32	N/A	N/A	31.65	22.67	N/A
22-Sep-94	EA-3	54.32	N/A	N/A	32.84	21.48	N/A
12-Oct-94	EA-3	54.32	N/A	N/A	32.18	22.14	N/A
09-Sep-92	EA-4	55.47	N/A	N/A	34.97	20.50	N/A
13-Sep-92	EA-4	55.47	N/A	N/A	35.00	20.47	N/A
22-Jan-93	EA-4	55.47	N/A	N/A	35.22	20.25	N/A
21-May-93	EA-4	55.47	N/A	N/A	36.04	19.43	N/A
18-Jun-93	EA-4	55.47	N/A	N/A	36.93	18.54	N/A
27-Jul-93	EA-4	55.47	N/A	N/A	37.13	18.34	N/A
17-Aug-93	EA-4	55.47	N/A	N/A	37.25	18.22	N/A
16-Sep-93	EA-4	55.47	N/A	N/A	37.00	18.47	N/A
05-Oct-93	EA-4	55.47	N/A	N/A	37.33	18.14	N/A
11-Feb-94	EA-4	55.47	N/A	N/A	38.00	17.47	N/A
07-Mar-94	EA-4	55.47	N/A	N/A	36.97	18.50	N/A
21-Mar-94	EA-4	55.47	N/A	N/A	36.41	19.06	N/A
08-Apr-94	EA-4	55.47	N/A	N/A	36.58	18.89	N/A
19-May-94	EA-4	55.47	N/A	N/A	37.31	18.16	N/A
02-Jun-94	EA-4	55.47	N/A	N/A	37.64	17.83	N/A
08-Jun-94	EA-4	55.47	N/A	N/A	37.55	17.92	N/A
29-Jun-94	EA-4	55.47	N/A	N/A	37.01	18.46	N/A
07-Jul-94	EA-4	55.47	N/A	N/A	36.07	19.40	N/A
11-Aug-94	EA-4	55.47	N/A	N/A	32.22	23.25	N/A
22-Sep-94	EA-4	55.47	N/A	N/A	33.32	22.15	N/A
12-Oct-94	EA-4	55.47	N/A	N/A	32.62	22.85	N/A
02-Sep-92	EA-5	*N/A	N/A	N/A	35.06	N/A	N/A
04-Sep-92	EA-5	*N/A	N/A	N/A	34.96	N/A	N/A
09-Sep-92	EA-5	55.24	N/A	N/A	34.88	20.36	N/A
13-Sep-92	EA-5	55.24	N/A	N/A	34.93	20.31	N/A
22-Jan-93	EA-5	55.24	N/A	N/A	35.17	20.07	N/A
21-May-93	EA-5	55.24	N/A	N/A	36.03	19.21	N/A
18-Jun-93	EA-5	55.24	N/A	N/A	36.95	18.29	N/A
27-Jul-93	EA-5	55.24	N/A	N/A	37.12	18.12	N/A
17-Aug-93	EA-5	55.24	N/A	N/A	37.16	18.08	N/A

TABLE 4 SUMMARY OF GAUGING DATA FOR MILITARY GAS STATION ON MAIN
BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Date	Well Number	Casing Elevation (feet MSL)	Depth To LPH (feet)	LPH Elevation (feet MSL)	Depth To Water (feet)	Corrected Water Elev. (feet MSL)	LPH Thickness (feet)
16-Sep-93	EA-5	55.24	N/A	N/A	36.91	18.33	N/A
05-Oct-93	EA-5	55.24	N/A	N/A	37.25	17.99	N/A
11-Feb-94	EA-5	55.24	N/A	N/A	37.91	17.33	N/A
07-Mar-94	EA-5	55.24	N/A	N/A	36.75	18.49	N/A
21-Mar-94	EA-5	55.24	N/A	N/A	36.31	18.93	N/A
08-Apr-94	EA-5	55.24	N/A	N/A	36.44	18.80	N/A
19-May-94	EA-5	55.24	N/A	N/A	37.24	18.00	N/A
02-Jun-94	EA-5	55.24	N/A	N/A	37.57	17.67	N/A
08-Jun-94	EA-5	55.24	N/A	N/A	37.45	17.79	N/A
29-Jun-94	EA-5	55.24	N/A	N/A	36.90	18.34	N/A
07-Jun-94	EA-5	55.24	N/A	N/A	35.86	19.38	N/A
11-Aug-94	EA-5	55.24	N/A	N/A	32.13	23.11	N/A
22-Sep-94	EA-5	55.24	N/A	N/A	33.30	21.94	N/A
12-Oct-94	EA-5	55.24	N/A	N/A	32.59	22.65	N/A
09-Sep-92	EA-6	55.85	N/A	N/A	35.45	20.40	N/A
13-Sep-92	EA-6	55.85	N/A	N/A	35.47	20.38	N/A
22-Jan-93	EA-6	55.85	N/A	N/A	35.73	20.12	N/A
21-May-93	EA-6	55.85	N/A	N/A	36.54	19.31	N/A
18-Jun-93	EA-6	55.85	N/A	N/A	37.42	18.43	N/A
27-Jul-93	EA-6	55.85	N/A	N/A	37.64	18.21	N/A
17-Aug-93	EA-6	55.85	N/A	N/A	37.76	18.09	N/A
16-Sep-93	EA-6	55.85	N/A	N/A	37.50	18.35	N/A
05-Oct-93	EA-6	55.85	N/A	N/A	36.83	19.02	N/A
11-Feb-94	EA-6	55.85	N/A	N/A	38.50	17.35	N/A
07-Mar-94	EA-6	55.85	N/A	N/A	37.48	18.37	N/A
21-Mar-94	EA-6	55.85	N/A	N/A	36.88	18.97	N/A
08-Apr-94	EA-6	55.85	N/A	N/A	37.06	18.79	N/A
19-May-94	EA-6	55.85	N/A	N/A	37.81	18.04	N/A
02-Jun-94	EA-6	55.85	N/A	N/A	38.13	17.72	N/A
08-Jun-94	EA-6	55.85	N/A	N/A	38.06	17.79	N/A
29-Jun-94	EA-6	55.85	N/A	N/A	37.52	18.33	N/A
07-Jul-94	EA-6	55.85	N/A	N/A	36.67	19.18	N/A
08-Jul-94	EA-6	55.85	N/A	N/A	36.21	19.64	N/A
11-Aug-94	EA-6	55.85	N/A	N/A	32.69	23.16	N/A
22-Sep-94	EA-6	55.85	N/A	N/A	33.82	22.03	N/A
12-Oct-94	EA-6	55.85	N/A	N/A	33.12	22.73	N/A
09-Sep-92	EA-7	53.94	N/A	N/A	34.20	19.74	N/A
13-Sep-92	EA-7	53.94	N/A	N/A	34.24	19.70	N/A
22-Jan-93	EA-7	53.94	N/A	N/A	34.62	19.32	N/A
21-May-93	EA-7	53.94	N/A	N/A	35.52	18.42	N/A
18-Jun-93	EA-7	53.94	N/A	N/A	36.39	17.55	N/A
27-Jul-93	EA-7	53.94	N/A	N/A	36.59	17.35	N/A
17-Aug-93	EA-7	53.94	N/A	N/A	36.60	17.34	N/A
16-Sep-93	EA-7	53.94	N/A	N/A	36.33	17.61	N/A
05-Oct-93	EA-7	53.94	N/A	N/A	36.65	17.29	N/A
11-Feb-94	EA-7	53.94	N/A	N/A	37.28	16.66	N/A
07-Mar-94	EA-7	53.94	N/A	N/A	36.15	17.79	N/A

TABLE 4 SUMMARY OF GAUGING DATA FOR MILITARY GAS STATION ON MAIN BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Date	Well Number	Casing Elevation (feet MSL)	Depth To LPH (feet)	LPH Elevation (feet MSL)	Depth To Water (feet)	Corrected Water Elev. (feet MSL)	LPH Thickness (feet)
21-Mar-94	EA-7	53.94	N/A	N/A	35.64	18.30	N/A
08-Apr-94	EA-7	53.94	N/A	N/A	35.85	18.09	N/A
19-May-94	EA-7	53.94	N/A	N/A	36.66	17.28	N/A
02-Jun-94	EA-7	53.94	N/A	N/A	36.98	16.96	N/A
07-Jun-94	EA-7	53.94	N/A	N/A	36.90	17.04	N/A
07-Jul-94	EA-7	53.94	N/A	N/A	34.94	19.00	N/A
11-Aug-94	EA-7	53.94	N/A	N/A	31.52	22.42	N/A
22-Sep-94	EA-7	53.94	N/A	N/A	32.75	21.19	N/A
12-Oct-94	EA-7	53.94	N/A	N/A	32.03	21.91	N/A
09-Sep-92	EA-8	56.04	N/A	N/A	35.15	20.89	N/A
13-Sep-92	EA-8	56.04	N/A	N/A	35.17	20.87	N/A
22-Jan-93	EA-8	56.04	N/A	N/A	35.30	20.74	N/A
21-May-93	EA-8	56.04	N/A	N/A	36.09	19.95	N/A
18-Jun-93	EA-8	56.04	N/A	N/A	36.95	19.09	N/A
27-Jul-93	EA-8	56.04	N/A	N/A	37.14	18.90	N/A
17-Aug-93	EA-8	56.04	N/A	N/A	37.34	18.70	N/A
16-Sep-93	EA-8	56.04	N/A	N/A	37.13	18.91	N/A
05-Oct-93	EA-8	56.04	N/A	N/A	37.46	18.58	N/A
11-Feb-94	EA-8	56.04	N/A	N/A	38.13	17.91	N/A
07-Mar-94	EA-8	56.04	N/A	N/A	37.11	18.93	N/A
21-Mar-94	EA-8	56.04	N/A	N/A	36.56	19.48	N/A
08-Apr-94	EA-8	56.04	N/A	N/A	36.74	19.30	N/A
19-May-94	EA-8	56.04	N/A	N/A	37.41	18.63	N/A
02-Jun-94	EA-8	56.04	N/A	N/A	37.76	18.28	N/A
08-Jun-94	EA-8	56.04	N/A	N/A	37.70	18.34	N/A
07-Jul-94	EA-8	56.04	N/A	N/A	35.99	20.05	N/A
11-Aug-94	EA-8	56.04	N/A	N/A	32.34	23.70	N/A
22-Sep-94	EA-8	56.04	N/A	N/A	33.37	22.67	N/A
12-Oct-94	EA-8	56.04	N/A	N/A	32.65	23.39	N/A
09-Sep-92	EA-9	55.43	N/A	N/A	34.91	20.52	N/A
13-Sep-92	EA-9	55.43	N/A	N/A	35.07	20.36	N/A
22-Jan-93	EA-9	55.43	N/A	N/A	34.63	20.80	N/A
21-May-93	EA-9	55.43	N/A	N/A	35.38	20.05	N/A
18-Jun-93	EA-9	55.43	N/A	N/A	36.29	19.14	N/A
27-Jul-93	EA-9	55.43	N/A	N/A	36.43	19.00	N/A
17-Aug-93	EA-9	55.43	N/A	N/A	37.14	18.29	N/A
16-Sep-93	EA-9	55.43	N/A	N/A	37.00	18.43	N/A
05-Oct-93	EA-9	55.43	N/A	N/A	37.34	18.09	N/A
11-Feb-94	EA-9	55.43	N/A	N/A	37.95	17.48	N/A
07-Mar-94	EA-9	55.43	N/A	N/A	36.96	18.47	N/A
21-Mar-94	EA-9	55.43	N/A	N/A	36.38	19.05	N/A
08-Apr-94	EA-9	55.43	N/A	N/A	36.53	18.90	N/A
19-May-94	EA-9	55.43	N/A	N/A	37.25	18.18	N/A
02-Jun-94	EA-9	55.43	N/A	N/A	37.56	17.87	N/A
08-Jun-94	EA-9	55.43	N/A	N/A	37.51	17.92	N/A
29-Jun-94	EA-9	55.43	N/A	N/A	36.97	18.46	N/A
07-Jul-94	EA-9	55.43	N/A	N/A	36.00	19.43	N/A

TABLE 4 SUMMARY OF GAUGING DATA FOR MILITARY GAS STATION ON MAIN BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Date	Well Number	Casing Elevation (feet MSL)	Depth To LPH (feet)	LPH Elevation (feet MSL)	Depth To Water (feet)	Corrected Water Elev. (feet MSL)	LPH Thickness (feet)
11-Aug-94	EA-9	55.43	N/A	N/A	32.20	23.23	N/A
22-Sep-94	EA-9	55.43	N/A	N/A	33.29	22.14	N/A
12-Oct-94	EA-9	55.43	N/A	N/A	32.63	22.80	N/A
18-Jun-93	EA-10	*N/A	N/A	N/A	36.63	N/A	N/A
27-Jul-93	EA-10	54.72	N/A	N/A	36.79	17.93	N/A
17-Aug-93	EA-10	54.72	N/A	N/A	36.87	17.85	N/A
16-Sep-93	EA-10	54.72	N/A	N/A	36.60	18.12	N/A
05-Oct-93	EA-10	54.72	N/A	N/A	36.91	17.81	N/A
11-Feb-94	EA-10	54.72	N/A	N/A	37.58	17.14	N/A
07-Mar-94	EA-10	54.72	N/A	N/A	36.49	18.23	N/A
21-Mar-94	EA-10	54.72	N/A	N/A	35.96	18.76	N/A
08-Apr-94	EA-10	54.72	N/A	N/A	36.15	18.57	N/A
19-May-94	EA-10	54.72	N/A	N/A	36.91	17.81	N/A
02-Jun-94	EA-10	54.72	N/A	N/A	37.26	17.46	N/A
07-Jun-94	EA-10	54.72	N/A	N/A	37.17	17.55	N/A
29-Jun-94	EA-10	54.72	N/A	N/A	36.60	18.12	N/A
07-Jul-94	EA-10	54.72	N/A	N/A	35.62	19.10	N/A
11-Aug-94	EA-10	54.72	N/A	N/A	31.81	22.91	N/A
22-Sep-94	EA-10	54.72	N/A	N/A	32.96	21.76	N/A
12-Oct-94	EA-10	54.72	N/A	N/A	32.29	22.43	N/A
18-Jun-93	EA-11	*N/A	N/A	N/A	35.90	N/A	N/A
27-Jul-93	EA-11	53.58	N/A	N/A	36.10	17.48	N/A
17-Aug-93	EA-11	53.58	N/A	N/A	36.07	17.51	N/A
16-Sep-93	EA-11	53.58	N/A	N/A	36.81	16.77	N/A
05-Oct-93	EA-11	53.58	N/A	N/A	36.13	17.45	N/A
11-Feb-94	EA-11	53.58	N/A	N/A	36.76	16.82	N/A
07-Mar-94	EA-11	53.58	N/A	N/A	35.61	17.97	N/A
21-Mar-94	EA-11	53.58	N/A	N/A	35.12	18.46	N/A
08-Apr-94	EA-11	53.58	N/A	N/A	35.33	18.25	N/A
19-May-94	EA-11	53.58	N/A	N/A	36.13	17.45	N/A
02-Jun-94	EA-11	53.58	N/A	N/A	36.44	17.14	N/A
07-Jun-94	EA-11	53.58	N/A	N/A	36.31	17.27	N/A
07-Jul-94	EA-11	53.58	N/A	N/A	34.29	19.29	N/A
11-Aug-94	EA-11	53.58	N/A	N/A	30.98	22.60	N/A
22-Sep-94	EA-11	53.58	N/A	N/A	32.25	21.33	N/A
12-Oct-94	EA-11	53.58	N/A	N/A	31.53	22.05	N/A
21-Mar-94	EA-12	*N/A	N/A	N/A	35.46	N/A	N/A
23-Mar-94	EA-12	*N/A	N/A	N/A	35.48	N/A	N/A
08-Apr-94	EA-12	53.96	N/A	N/A	35.63	18.33	N/A
19-May-94	EA-12	53.96	N/A	N/A	36.43	17.53	N/A
02-Jun-94	EA-12	53.96	N/A	N/A	36.76	17.20	N/A
07-Jun-94	EA-12	53.96	N/A	N/A	36.58	17.38	N/A
07-Jul-94	EA-12	53.96	N/A	N/A	34.55	19.41	N/A
11-Aug-94	EA-12	53.96	N/A	N/A	31.30	22.66	N/A
22-Sep-94	EA-12	53.96	N/A	N/A	32.52	21.44	N/A
12-Oct-94	EA-12	53.96	N/A	N/A	31.82	22.14	N/A

TABLE 4 SUMMARY OF GAUGING DATA FOR MILITARY GAS STATION ON MAIN BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Date	Well Number	Casing Elevation (feet MSL)	Depth To LPH (feet)	LPH Elevation (feet MSL)	Depth To Water (feet)	Corrected Water Elev. (feet MSL)	LPH Thickness (feet)
14-Mar-94	EA-13	*N/A	N/A	N/A	36.97	N/A	N/A
21-Mar-94	EA-13	*N/A	N/A	N/A	36.90	N/A	N/A
23-Mar-94	EA-13	*N/A	N/A	N/A	36.94	N/A	N/A
08-Apr-94	EA-13	54.78	N/A	N/A	37.02	17.76	N/A
19-May-94	EA-13	54.78	N/A	N/A	37.83	16.95	N/A
02-Jun-94	EA-13	54.78	N/A	N/A	38.14	16.64	N/A
07-Jun-94	EA-13	54.78	N/A	N/A	38.05	16.73	N/A
07-Jul-94	EA-13	54.78	N/A	N/A	36.08	18.70	N/A
11-Aug-94	EA-13	54.78	N/A	N/A	32.74	22.04	N/A
22-Sep-94	EA-13	54.78	N/A	N/A	34.02	20.76	N/A
12-Oct-94	EA-13	54.78	N/A	N/A	33.32	21.46	N/A
14-Mar-94	EA-14	*N/A	N/A	N/A	35.21	N/A	N/A
21-Mar-94	EA-14	*N/A	N/A	N/A	35.23	N/A	N/A
23-Mar-94	EA-14	*N/A	N/A	N/A	35.26	N/A	N/A
08-Apr-94	EA-14	53.46	N/A	N/A	35.46	18.00	N/A
19-May-94	EA-14	53.46	N/A	N/A	36.27	17.19	N/A
02-Jun-94	EA-14	53.46	N/A	N/A	36.59	16.87	N/A
07-Jun-94	EA-14	53.46	N/A	N/A	36.31	17.15	N/A
07-Jul-94	EA-14	53.46	N/A	N/A	33.34	20.12	N/A
11-Aug-94	EA-14	53.46	N/A	N/A	31.13	22.33	N/A
22-Sep-94	EA-14	53.46	N/A	N/A	32.41	21.05	N/A
12-Oct-94	EA-14	53.46	N/A	N/A	31.70	21.76	N/A
14-Mar-94	EA-15	*N/A	N/A	N/A	35.23	N/A	N/A
21-Mar-94	EA-15	*N/A	N/A	N/A	35.25	N/A	N/A
23-Mar-94	EA-15	*N/A	N/A	N/A	35.25	N/A	N/A
08-Apr-94	EA-15	53.41	N/A	N/A	35.46	17.95	N/A
19-May-94	EA-15	53.41	N/A	N/A	36.27	17.14	N/A
02-Jun-94	EA-15	53.41	N/A	N/A	36.60	16.81	N/A
07-Jun-94	EA-15	53.41	N/A	N/A	36.31	17.10	N/A
07-Jul-94	EA-15	53.41	N/A	N/A	33.79	19.62	N/A
11-Aug-94	EA-15	53.41	N/A	N/A	31.15	22.26	N/A
22-Sep-94	EA-15	53.41	N/A	N/A	32.44	20.97	N/A
12-Oct-94	EA-15	53.41	N/A	N/A	31.72	21.69	N/A
21-May-93	SVE-1	DRY AT 32.07					
18-Jun-93	SVE-1	DRY AT 32.07					
27-Jul-93	SVE-1	DRY AT 32.07					
29-Jun-94	SVE-1	DRY AT 32.07					
21-May-93	SVE-2	DRY AT 31.82					
18-Jun-93	SVE-2	DRY AT 31.82					
27-Jul-93	SVE-2	DRY AT 31.82					
29-Jun-94	SVE-2	DRY AT 31.82					
21-May-93	AAS-1	*N/A	N/A	N/A	35.94	N/A	N/A
18-Jun-93	AAS-1	*N/A	N/A	N/A	36.82	N/A	N/A

TABLE 4 SUMMARY OF GAUGING DATA FOR MILITARY GAS STATION ON MAIN
BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Date	Well Number	Casing Elevation (feet MSL)	Depth To LPH (feet)	LPH Elevation (feet MSL)	Depth To Water (feet)	Corrected Water Elev. (feet MSL)	LPH Thickness (feet)
21-Jun-93	AAS-1	*N/A	N/A	N/A	36.95	N/A	N/A
27-Jul-93	AAS-1	55.21	N/A	N/A	37.00	N/A	N/A
17-Aug-93	AAS-1	55.21	N/A	N/A	37.10	N/A	N/A
16-Sep-93	AAS-1	55.21	N/A	N/A	36.85	N/A	N/A
05-Oct-93	AAS-1	55.21	N/A	N/A	37.21	N/A	N/A
07-Mar-94	AAS-1	55.21	N/A	N/A	36.78	N/A	N/A
21-Mar-94	AAS-1	55.21	N/A	N/A	36.24	N/A	N/A
08-Apr-94	AAS-1	55.21	N/A	N/A	36.44	N/A	N/A
19-May-94	AAS-1	55.21	N/A	N/A	37.17	N/A	N/A
02-Jun-94	AAS-1	55.21	N/A	N/A	37.51	N/A	N/A
08-Jun-94	AAS-1	55.21	N/A	N/A	37.40	N/A	N/A
29-Jun-94	AAS-1	55.21	N/A	N/A	36.86	N/A	N/A
07-Jul-94	AAS-1	55.21	N/A	N/A	35.91	N/A	N/A
11-Aug-94	AAS-1	55.21	N/A	N/A	32.06	N/A	N/A
22-Sep-94	AAS-1	55.21	N/A	N/A	33.20	N/A	N/A
12-Oct-94	AAS-1	55.21	N/A	N/A	32.51	N/A	N/A

*N/A = Elevation of index on top of casing had not been established as of this date.

TABLE 5 ORGANIC VAPOR ANALYZER (OVA) HEADSPACE ANALYSIS OF SOIL SAMPLES COLLECTED AT THE MILITARY GAS STATION ON THE MAIN BASE, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Drilling Location	Depth (feet)	Total Hydrocarbon Headspace Reading (ppm)	Filtered Headspace (Methane only) (ppm)	Corrected Headspace ^(a) (ppm)
EA-1	5-7	2.6	— ^(b)	0.0
	7-9	2.6	—	0.0
	9-11	2.6	—	0.0
	11-13	2.6	—	0.0
	13-15	2.8	—	0.2
	15-17	4.5	3.2	1.3 [*]
	17-19	4.0	3.4	0.6
	19-21	4.0	3.2	0.8
	21-23	4.0	4.0	0.0
	23-25	3.4	3.0	0.4
	25-27	5.2	4.2	1.0
	27-29	4.0	3.5	0.5
	29-31	4.1	3.5	0.6
	31-33	3.8	3.2	0.6
	33-35	2.8	—	0.2
	35-37	3.0	—	0.4
	40-42	3.6	3.0	0.6
EA-2	5-7	1.8	—	0.0
	10-12	2.3	—	0.3
	15-17	1.8	—	0.0
	20-22	2.8	2.4	0.4
	25-27	3.5	2.2	1.3 [*]
	30-32	2.0	—	0.2
	35-37	4.4	3.2	1.2
	40-42	3.2	2.8	0.4
EA-3	5-7	5.6	—	0.3
	7-9	5.6	—	0.1
	9-11	5.8	5.6	0.3
	11-13	5.8	5.6	0.2
	13-15	6.0	5.7	0.3
	15-17	5.8	5.6	0.2
	17-19	6.6	6.0	0.6
	19-21	5.8	—	0.2
	21-23	6.0	—	0.4
	23-25	5.6	—	0.0
	25-27	5.8	—	0.2
	27-29	6.8	6.2	0.6 [*]
	29-31	6.7	6.3	0.4
	31-33	6.0	5.8	0.2
	33-35	7.0	6.2	0.8
	40-42	7.2	6.3	0.9

^(a) Corrected OVA headspace determined by subtracting the ambient background reading (not shown) and the filtered (methane-only) reading from the total hydrocarbon headspace reading.

^(b) — = Methane concentration not evaluated due to low initial headspace reading.

NR = No sample recovery.

* Indicates sample sent to lab for analysis.

— Soil sample collected from cuttings.

TABLE 5 (Cont.)

Drilling Location	Depth (feet)	Total Hydrocarbon Headspace Reading (ppm)	Filtered Headspace (Methane only) (ppm)	Corrected Headspace ^(a) (ppm)
EA-4	5-7	6.0	—	0.4
	10-12	5.5	—	0.0
	15-17	6.6	6.2	0.4
	17-19	7.0	6.1	0.9
	19-21	6.6	6.0	0.6
	21-23	22.0	8.6	13.4
	23-25	7.1	6.2	0.9
	25-27	110.0	22.0	88.0
	27-29	220.0	55.0	165.0
	29-31	1000+	550.0	450+
	31-33	1000+	480.0	520+
	33-35	1000+	620.0	380+
	35-37	1000+	510.0	490+
	40-42	850	340.0	510.0
EA-5	5-7	2.4	—	0.0
	10-12	2.6	—	0.2
	15-17	2.6	—	0.2
	20-22	3.0	2.6	0.4
	25-27	2.5	—	0.1
	30-32	3.2	2.7	0.5*
	35-37	5.9	2.9	3.0
	40-42	3.0	2.7	0.3
EA-6	5-7	1.5	—	0.0
	10-12	1.5	—	0.0
	15-17	1.4	—	0.0
	20-22	2.4	1.8	0.6*
	25-27	1.7	—	0.2
	30-32	2.1	1.7	0.4
	35-37	1.6	—	0.1
	40-42	2.8	1.8	1.0
EA-7	5-7	3.3	—	0.0
	10-12	3.3	—	0.0
	15-17	3.4	—	0.1
	20-22	3.9	3.5	0.4*
	25-27	3.6	—	0.1
	30-32	3.8	—	0.2
	35-37	3.6	—	0.2
	40-42	3.8	3.6	0.2
EA-8	5-7	4.2	—	0.0
	10-12	4.2	—	0.0
	15-17	4.2	—	0.0
	20-22	4.2	—	0.0
	25-27	4.2	—	0.0
	30-32	4.2	—	0.0*
	35-37	4.2	—	0.0
	40-42	4.4	—	0.2
EA-9	43-45	22.0	5.6	16.4
	53-55	30.0	14.0	29.0
EA-10	4-6	1.5	—	0.0
	9-11	2.0	1.5	0.5
	14-16	5.2	1.6	3.6
	19-21	2.8	1.6	1.2
	24-26	3.6	1.6	2.0
	29-31	6.8	2.0	4.8
	34-36	21.0	2.0	19.0*
	39-41	NR	NR	NR
	44-46	76.0	15.0	59.0

TABLE 5 (Cont.)

Drilling Location	Depth (feet)	Total Hydrocarbon Headspace Reading (ppm)	Filtered Headspace (Methane only) (ppm)	Corrected Headspace ^(a) (ppm)
EA-11	4-6	7.0	6.9	0.1
	9-11	6.8	6.6	0.2
	14-16	6.8	6.7	0.1
	19-21	6.8	6.7	0.1
	24-26	7.3	7.0	0.3
	29-31	7.2	6.9	0.3*
	34-36	8.4	7.3	1.1
	39-41	210.0	70.0	133.0
	44-46	NR	NR	NR
EA-12	1-1.25	5.3	—	0.0
	2-2.4	5.6	—	0.0
	3-3.5	5.8	—	0.0
	4-4.1	5.8	—	0.0
	5-7	5.8	—	0.2
	7-9	6.0	—	0.0
	9-11	5.9	—	0.0
	15-17	6.0	—	0.0
	20-22	6.0	—	0.0
	25-27	6.0	—	0.0
	30-32	6.2	—	0.0
	35-37	6.2	—	0.0
	40-42	6.2	—	0.0
EA-13	1-1.1	0.6	—	0.0
	2-2.2	0.6	—	0.0
	3-3.5	0.6	—	0.0
	4-4.1	0.6	—	0.0
	5-7	0.6	—	0.0
	9-11	0.6	—	0.0
	15-17	0.6	—	0.0
	20-22	0.6	—	0.0
	25-27	0.6	—	0.0
	30-32	0.6	—	0.0
	35-37	0.6	—	0.0
	40-42	0.6	—	0.0
EA-14	1-1.4	0.3	—	0.0
	2-2.8	0.4	—	0.0
	3-3.4	0.4	—	0.0
	4-4.3	0.4	—	0.0
	5-7	0.4	—	0.0
	7-9	0.4	—	0.0
	9-11	0.4	—	0.0
	15-17	0.4	—	0.0
	20-22	0.4	—	0.0
	30-32	0.4	—	0.0
	35-37	0.4	—	0.0
	40-42	0.4	—	0.0
EA-15	1-1.2	0.3	—	0.0
	2-2.3	0.3	—	0.0
	3-3.1	0.2	—	0.0
	4-4.3	0.2	—	0.0
	5-7	0.3	—	0.0
	7-9	0.3	—	0.0
	9-11	0.3	—	0.0
	15-17	0.3	—	0.0
	20-22	0.4	—	0.0
	25-27	0.3	—	0.0
	30-32	0.3	—	0.0
	35-37	0.3	—	0.0
	40-42	0.3	—	0.0
	50~	0.3	—	0.0
	59~	0.3	—	0.0

TABLE 5 (Cont.)

Drilling Location	Depth (feet)	Total Hydrocarbon Headspace Reading (ppm)	Filtered Headspace (Methane only) (ppm)	Corrected Headspace ^(a) (ppm)
A	4-6	0.7	—	0.0
	6-8	1.3	1.1	0.2
	8-10	0.8	—	0.1
	10-12	0.9	—	0.2
	15-17	1.3	1.0	0.3
	20-22	1.1	—	0.2
	25-27	1.2	1.0	0.2
	30-32	1.0	—	0.1
	35-37	1.4	1.4	0.0
	40-42	110.0	10.0	100.0
B	4-6	0.4	—	0.2
	6-8	0.2	—	0.0
	8-10	0.3	—	0.2
	10-12	0.6	—	0.4
	15-17	0.2	—	0.0
	20-22	70.0	25.0	45.0
	25-27	210.0	117.0	93.0
	27-29	50.0	5.2	44.8
	29-31	56.0	3.0	53.0
	31-33	10.0	5.5	4.5
	33-35	12.0	5.6	6.4
	36-38	700.0	38.0	662.0
	40-42	72.0	9.4	62.6
C	5-7	3.8	—	0.2
	7-9	3.8	—	0.0
	9-11	4.0	—	0.2
	15-17	4.1	—	0.1
	20-22	4.4	4.2	0.2
	25-27	5.2	4.8	0.4
	30-32	4.6	4.3	0.3
	35-37	4.6	4.2	0.4
	40-42	430.0	14.0	416.0
D	5-7	3.8	—	0.2
	10-12	3.8	—	0.0
	15-17	3.8	—	0.0
	20-22	4.0	—	0.2
	25-27	4.3	4.0	0.3
	30-32	3.6	3.4	0.2
	35-37	3.2	—	0.4
	40-42	3.8	3.4	1.0
E	5-7	1.3	—	0.0
	10-12	1.5	—	0.2
	15-17	4.4	2.2	2.2
	20-22	2.4	2.0	0.4
	25-27	2.9	2.2	0.7
	30-32	2.6	2.0	0.6
	35-37	3.1	2.5	0.6
	40-42	2.2	1.8	0.4

TABLE 5 (Cont.)

Drilling Location	Depth (feet)	Total Hydrocarbon Headspace Reading (ppm)	Filtered Headspace (Methane only) (ppm)	Corrected Headspace ^(a) (ppm)
J	5-7	5.6	—	0.0
	7-9	6.0	5.8	0.2
	9-11	6.1	5.8	0.3
	11-13	5.6	—	0.0
	13-15	6.0	5.7	0.3
	15-17	6.1	5.7	0.4
	17-19	5.8	—	0.2
	19-21	7.2	6.2	1.0
	21-23	6.7	6.1	0.6
	23-25	5.9	5.7	0.2
	25-27	6.0	5.8	0.2
	27-29	8.1	6.4	1.7
	29-31	6.9	6.2	0.7
	31-33	25.0	10.0	15.0
	33-35	5.9	—	0.3
	40-42	15.0	8.6	6.4
K	5-7	4.2	—	0.4
	7-9	4.1	—	0.3
	9-11	4.8	4.2	0.6
	11-13	62.0	12.0	50.0
	13-15	19.0	8.5	10.5
	15-17	110.0	22.0	88.0
	17-19	28.0	10.0	18.0
	19-21	100.0	23.0	77.0
	21-23	14.0	5.5	8.5
	23-25	95.0	18.0	77.0
	25-27	77.0	16.0	61.0
	27-29	32.0	11.0	21.0
	29-31	34.0	13.0	21.0
	31-33	47.0	9.5	37.5
	33-35	20.0	7.8	12.2
	35-37	15.0	5.0	10.0
	40-42	12.0	6.2	5.8
L	5-7	3.0	—	0.0
	10-12	3.4	—	0.2
	15-17	3.6	3.2	0.4
	20-22	3.3	—	0.3
	25-27	4.0	3.3	0.7
	30-32	4.4	3.4	1.0
	35-37	6.4	3.8	2.6
	40-42	3.8	3.4	0.4
Q	4-6	2.6	—	0.0
	6-8	2.6	—	0.0
	8-10	2.7	2.6	0.1
	10-12	2.6	—	0.0
	12-14	2.7	2.6	0.1
	14-16	3.0	2.8	0.2
	16-18	2.9	2.8	0.1
	18-20	2.9	2.9	0.0
	20-22	3.1	3.0	0.1
	24-26	3.0	—	0.0
	29-31	3.0	—	0.0
	34-36	3.2	3.1	0.1

TABLE 5 (Cont.)

Drilling Location	Depth (feet)	Total Hydrocarbon Headspace Reading (ppm)	Filtered Headspace (Methane only) (ppm)	Corrected Headspace ^(a) (ppm)
R	4-6	6.6	NA	0.0
	6-8	7.0	6.8	0.2
	8-10	13.0	7.4	5.6
	10-12	7.3	7.0	0.3
	12-14	15.0	7.2	7.8
	14-16	7.4	7.0	0.4
	16-18	13.0	7.6	5.4
	18-20	14.0	8.0	6.0
	24-26	74.0	27.0	47.0*
	29-31	8.4	7.4	1.0
	34-36	14.0	8.2	5.8
S	4-6	5.4	—	0.0
	6-8	5.4	—	0.0
	8-10	5.5	5.4	0.1
	10-12	5.8	5.5	0.3
	12-14	5.6	5.5	0.1
	14-16	6.4	5.7	0.7
	16-18	6.9	5.8	1.1
	18-20	6.9	5.8	1.1*
	24-26	5.9	5.6	0.3
	29-31	6.2	5.6	0.6
	34-36	5.9	5.6	0.3
T	4-6	4.4	—	0.0
	6-8	4.5	4.4	0.1
	8-10	4.6	4.4	0.2
	10-12	4.4	—	0.0
	12-14	4.4	—	0.0
	14-16	4.5	—	0.1
	16-18	4.5	4.4	0.1
	18-20	4.6	4.4	0.2
	24-26	5.4	4.6	0.8
	29-31	6.8	5.5	1.3*
	34-36	10.0	5.4	4.6
U	4-6	6.0	—	0.0
	6-8	6.0	—	0.0
	8-10	5.7	—	0.0
	10-12	6.2	5.8	0.4
	12-14	5.8	5.7	0.1
	14-16	5.9	5.7	0.2
	16-18	6.0	5.8	0.2
	18-20	6.2	5.8	0.4
	20-22	7.4	5.9	1.5
	22-24	7.4	5.8	1.6
	24-26	6.0	5.7	0.3
	26-28	6.2	5.8	0.4
	28-30	9.4	5.8	3.6
	30-32	15.0	6.0	9.0*
	32-34	9.2	6.2	3.0
	34-36	68.0	12.0	56.0

TABLE 5 (Cont.)

Drilling Location	Depth (feet)	Total Hydrocarbon Headspace Reading (ppm)	Filtered Headspace (Methane only) (ppm)	Corrected Headspace ^(a) (ppm)
V	4-6	5.0	—	0.0
	6-8	6.0	—	0.0
	8-10	7.1	—	0.1
	10-12	7.4	—	0.0*
	12-14	100.0	10.0	90.0
	14-16	90.0	9.0	81.0
	16-18	220.0	18.0	202.0
	18-20	120.0	15.0	105.0
	20-22	590.0	22.0	568.0
	22-24	1000+	32.0	1000+
	24-26	1000+	40.0	1000+
	26-28	1000+	45.0	1000+
	28-30	1000+	52.0	1000+
	30-32	940.0	30.0	910.0
	32-34	1000+	45.0	1000+
	34-36	960	26.0	934.0
W	4-6	7.2	—	0.0
	6-8	7.3	7.2	0.1
	8-10	7.4	7.2	0.2
	10-12	7.5	7.3	0.3
	12-14	7.2	—	0.0
	14-16	7.2	—	0.0
	16-18	7.6	7.2	0.4*
	18-20	7.2	—	0.0
	24-26	7.6	7.3	0.3
	29-31	7.4	7.2	0.2
	34-36	7.4	7.2	0.2
SVE-1	24-26	1.2	— ^(a)	0.4 ^(a)
SVE-2	24-26	3.8	3.8	0 ^(a)
AAS-1	4-6	0.6	0.6	0
	9-11	0.8	0.2	0.4
	14-16	0.2	0.2	0
	19-21	0.2	0.2	0
	24-26	0.8	0.2	0.4
	29-31	1.2	0.2	0.6
	34-36	2.6	0.2	1.4
	39-41	600	37	565 ^(a)
	44-46	380	4.0	372
	49-51	780	2.8	772
	54-56	120	0	115
	59-61	16	0	11

**TABLE 6: Summary of Analytical Data Results for Soil Samples Collected at the Military Gas Station
Eglin AFB, Vaparaíso, Okaloosa County, Florida.**

Parameter			TRPH	TPH	Total Kjeldahl Nitrogen	Total Nitrate	Total Ortho- Phosphate	Ammonia Nitrogen	Total Hydrocarbon Degraders
Method			9073	418.1	356.2	300	300	350.1	9215B
Unit			mg/Kg	mg/L	mg N/Kg	mg/Kg	mg/Kg	mg N/Kg	Colonies/ML
Detection limit			5	1	12.4-12.6	2.1	2.0-2.2	2.6-2.9	1
Date	Sample I.D.	Depth	Concentration						
8/19/92 through 9/1/92	Ea-1	15-17	BDL						
	Ea-2	25-27	BDL						
	EA-3	27-29	BDL						
	EA-4	31-33	BDL						
	EA-5	30-32	BDL						
	EA-6	20-22	BDL						
	EA-7	20-22	BDL						
	EA-8	30-32	BDL						
	K	15-17	BDL						
	EA-1(Dup) Equipment Blank	15-17 —	BDL	BDL					
11/5/93 through 5/13/93	SVE-1	24-26		40.2	20	7.9	BDL	6.89	BDL
	SVE-2	24-26		BDL	11.4	6.2	BDL	BDL	BDL
	AAS-1	39-41		40.8	BDL	6.9	BDL	BDL	11
	AAs-1	49-51		—	BDL	BDL	BDL	BDL	10
6/14/93 through 17/6/93	EA-10	34-36		BDL					
	EA-11	29-31		BDL					
	Q	14-16		BDL					
	R	24-26		BDL					
	S	18-20		BDL					
	T	29-31		BDL					
	U	30-32		BDL					
	V	10-12		BDL					
	V	32-34		BDL					
	W	16-18		BDL					
	R (Dup) Field Blank	24-26 —		BDL					

BDL
Dup

Below Detection Limit
Sample duplicate

TABLE 4 SUMMARY OF ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES COLLECTED AT THE MILITARY GAS TANK ON THE MAIN BASE, IRP SITE ST-58, EGLIN AFB, VALPARAISO, OKALOOSA COUNTY, FLORIDA.

Analyte	EPA Method Number	MDL ^m	Florida Target Cleanup Concentration ⁿ	Units	WELL IDENTIFICATION AND SAMPLE DATE				
					9/13/92	9/16/93	6/7/94	11/26/96	2/10/97
Volatiles Organic Aromatics^o									
Benzene	602/8020	0.6-1	1	µg/L	<0.6	4.8	<1	<1	<1
Toluene	602/8020	1	NA	µg/L	<1	8.1	1.7	<1	<1
Ethylbenzene	602/8020	0.9-1	NA	µg/L	<0.9	140	160	<1	<1
Xylenes, Total	602/8020	0.9-1	NA	µg/L	<0.9	543.6	320	<1	<1
Total VOA	602/8020	0.6-1	50	µg/L	<0.6	696.5	481.7	<1	<1
Methyl Tert-Butyl Ether	602	5-25	50	µg/L	<5	<25	---	<1	<1
1,3-Dichlorobenzene ⁿ	602/8020	1-1.1	NA	µg/L	<1.1	<1	<1	<1	<1
1,4-Dichlorobenzene ⁿ	602/8020	1	NA	µg/L	<1	<1	2.9	<1	<1
1,2-Dichlorobenzene ⁿ	602/8020	1	NA	µg/L	<1	<1	37	<1	<1
Chlorobenzene	602/8020	1-1.3	NA	µg/L	<1.3	<1	<1	<1	<1
Polynuclear Aromatic Hydrocarbons^o									
Naphthalene	610/8100/8270	1-10	NA	µg/L	<1.4	51	8.7	<1	<1
1-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	---	---	---	<1	<1
2-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	<1.2	27	---	1.2	3.7
Total Naphthalene	610/8100/8270	1-10	100	µg/L	<1.2	78	8.7	1.2	3.7
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<3.1	<10	<1	<1	<1
Acenaphthene	610/8100/8270	0.3-10	MDL	µg/L	<1.7	<10	1	<1	5.3
Fluorene	610/8100/8270	0.2-10	MDL	µg/L	<0.3	<10	2	<1	1.3
Phenanthrene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1	<1	1.2
2,4-Dimethylphenol	8100/8270	10	NA	µg/L	---	<10	---	<1	<1
Dibenzofluanthracene	610/8100/8270	0.4-10	MDL	µg/L	<0.4	<10	<1	<1	<1
Anthracene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1	<1	<1
Volatiles Organic Halocarbons^o									
Tetrachloroethane	8010	1	NA	µg/L	<1	---	---	---	---
1,4-Dichlorobenzene	8010	1	NA	µg/L	<1	---	---	---	---
1,2-Dichlorobenzene	8010	1	NA	µg/L	<1	---	---	---	---
1,3-Dichlorobenzene	8010	1	NA	µg/L	<1	---	---	---	---
1,2-Dibromoethane ED3	504	0.02	0.02	µg/L	<0.02	---	---	---	---
1,2-Dichloroethane	601/8010	1	3	µg/L	<1	---	---	---	---
Total Petroleum Hydrocarbon	418.1	1	NA	mg/L	<1	---	---	---	---
Lead	239.2	5	15	µg/L	<5	---	---	---	---
Notes:									
^m MDL = Method Detection Limit. The MDLs are given as a range for some analytes due to differences in dilution and methodologies over the time interval represented by the data.									
ⁿ The Florida Target Cleanup Concentrations were extracted from Section 17-770.710(5)(a)(2), F.A.C.									
^o Only those VOAs detected in any sample are shown.									
^p The alchlorobenzene isomer concentrations are suspect as Method 8020 does not employ a halogen detector to confirm the presence of halogenated compounds.									
^q Only those PAHs detected in any sample are shown.									
^r Only those VOHs detected in any sample are shown.									
^s The laboratory reported a negative bias for this sample. Actual concentrations may have been higher than those reported.									
^t NA = No applicable Florida target cleanup concentration.									

^m MDL = Method Detection Limit. The MDLs are given as a range for some analytes due to differences in dilution and methodologies over the time interval represented by the data.
ⁿ The Florida Target Cleanup Concentrations were extracted from Section 17-770.710(5)(3)(2), F.A.C.
^o Only those VOAs detected in any sample are shown.
^p The dichlorobenzene isomer concentrations are suspect as Method 8020 does not employ a halogen detector to confirm the presence of halogenated compounds.
^q Only those PAHs detected in any sample are shown.
^r Only those VOHs detected in any sample are shown.
^s The laboratory reported a negative bias for this sample. Actual concentrations may have been higher than those reported.
^t NA = Not applicable Florida target cleanup concentration.

TABLE 4 (cont.)

Analyte	EPA Method Number	MDL ^a	Florida Target Cleanup Concentration ^b	Units	WELL IDENTIFICATION AND SAMPLE DATE				
					EA-2				
					9/13/92	9/16/93	6/7/94	6/28/94	
Volatile Organic Aromatics^c									
Benzene	602/8070	0.6-1	1	µg/L	<0.6	<1	<1	<1	<1
Toluene	602/8070	1	NA	µg/L	<1	110	<1	<1	<1
Ethylbenzene	607/8070	0.9-1	NA	µg/L	<0.9	210	<1	<1	3
Xylenes, Total	607/8070	0.9-1	NA	µg/L	<0.9	1,180	<1	<1	<1
Total VOA	602/8070	0.6-1	50	µg/L	<0.6	1,510	<1	<1	3
Methyl Tertiary Butyl Ether	602/8070	5-25	50	µg/L	<5	<25	...	...	...
1,3-Dichlorobenzene ^d	607/8070	1-1.1	NA	µg/L	<1.1	<1	<1	<1	<1
1,4-Dichlorobenzene ^d	607/8070	1	NA	µg/L	<1	<1	<1	<1	<1
1,2-Dichlorobenzene ^d	607/8070	1	NA	µg/L	<1	<1	<1	<1	<1
Chlorobenzene	607/8070	1-1.3	NA	µg/L	<1.3	<1	<1	<1	<1
Semi-volatile Aromatic Hydrocarbons^c									
Naphthalene	610/8100/8270	1-10	NA	µg/L	<1.4	43	<1	<1	<1
1-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	...	...	...	...	<1
2-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	<1.2	23	...	...	<1
Total Naphthalene	610/8100/8270	1-10	100	µg/L	<1.2	66	<1	<1	<1
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<3.1	<10	<1	<1	<1
Acenaphthene	610/8100/8270	0.3-10	MDL	µg/L	<1.7	<10	<1	<1	1.5
Fluorene	610/8100/8270	0.2-10	MDL	µg/L	<0.3	<10	<1	<1	<1
Phenanthrene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1	<1	<1
2,4-Dimethylphenol	8100/8270	10	NA	µg/L	...	<10	...	...	...
Dibenz(a,h)anthracene	610/8100/8270	0.4-10	MDL	µg/L	<0.4	<10	<1	<1	<1
Anthracene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1	<1	<1
Volatile Organic Halocarbons^c									
Trichloroethane	8010	1	NA	µg/L	<1	...	...	...	...
1,4-Dichlorobenzene	8010	1	NA	µg/L	<1	...	...	...	...
1,2-Dichlorobenzene	8010	1	NA	µg/L	<1	...	...	...	...
1,1,2-Trichloroethane	8010	1	NA	µg/L	<1	...	...	...	...
1,2-Dibromoethane	504	0.02	0.02	µg/L	<0.02	...	...	...	...
1,2-Dichloroethane	601/8070	1	3	µg/L	<1	...	...	...	...
Total Petroleum Hydrocarbon	418.1	1	NA	mg/L	<1	...	...	...	...
Lead	219.2	5	1.5	µg/L	<5	...	...	...	...

TABLE 4 (cont.)

Analyte	EPA Method Number	MDL ¹⁴	Florida Target Cleanup Concentration ¹⁵	Units	WELL IDENTIFICATION AND SAMPLE DATE		
					EA-3		
					9/13/92	9/16/93	6/7/94
Volatiles Organic Aromatics¹⁴							
Benzene	602/8020	0.6-60	1	µg/L	<0.6	<1	<1
Toluene	602/8020	1-100	NA	µg/L	<1	<1	<1
Ethylbenzene	602/8020	0.9-90	NA	µg/L	<0.9	<1	<1
Xylenes, Total	602/8020	0.9-90	NA	µg/L	<0.9	<1	<1
Total VOC	602/8020	0.6-60	50	µg/L	<0.6	<1	<1
Methyl Tert-Butyl Ether	602	5-500	50	µg/L	<5	<5	---
1,3-Dichlorobenzene ¹⁶	602/8020	1-110	NA	µg/L	<1.1	<1	<1
1,4-Dichlorobenzene ¹⁶	602/8020	1-160	NA	µg/L	<1	<1	<1
1,2-Dichlorobenzene ¹⁶	602/8020	1-130	NA	µg/L	<1	<1	<1
Chlorobenzene	602/8020	1-130	NA	µg/L	<1.3	<1	<1
Polynuclear Aromatic Hydrocarbons¹⁴							
Naphthalene	610/8100/8270	1-20	NA	µg/L	<1.4	<10	<1
1-Methylnaphthalene	610/8100/8270	1-20	NA	µg/L	---	---	---
2-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	<1.2	<10	<1
Total Naphthalene	610/8100/8270	1-10	100	µg/L	<1.2	<10	<1
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<3.1	<10	<1
Acenaphthene	610/8100/8270	0.3-10	MDL	µg/L	<1.7	<10	1.9
Fluorene	610/8100/8270	0.3-10	MDL	µg/L	<0.3	<10	2.4
Phenanthrene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	1.5
2,4-Dimethylphenol	8100/8270	0.2-10	NA	µg/L	---	<10	---
Dibenz(a,h)anthracene	610/8100/8270	0.4-10	MDL	µg/L	<0.4	<10	<1
Anthracene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1
Volatiles Organic Halocarbons¹⁶							
Tetrachloroethane	601/8010	1	NA	µg/L	<1	---	---
1,4-Dichlorobenzene	601/8010	1	NA	µg/L	<1	---	---
1,2-Dichlorobenzene	601/8010	1	NA	µg/L	<1	---	---
1,2-Dibromomethane	504	0.02	0.02	µg/L	<0.02	---	---
1,2-Dichloroethane	601/8010	1-100	3	µg/L	<1	---	---
Total Petroleum Hydrocarbon	418.1	1	NA	mg/L	<1	---	---
Lead	239.2	5	15	µg/L	<5	---	---

TABLE 4 (cont.)

Analyte	EPA Method Number	MDL ¹⁴	Florida Target Cleanup Concentration ¹⁵	Unit	WELL IDENTIFICATION AND SAMPLE DATE						
					EA-4						
					9/14/92	9/16/93	6/8/94	12/1/95	8/20/96	11/8/96	2/10/97
Volatile Organic Aromatics¹⁶											
Benzene	602/8020	0.6-60	1	µg/L	<60	3.5	<1	<1	<1	<1	<1
Toluene	602/8020	1-100	NA	µg/L	110	11	23	1	<1	<1	<1
Ethylbenzene	602/8020	0.9-90	NA	µg/L	940	510	440	310	480	170	240
Xylenes, Total	602/8020	0.9-90	NA	µg/L	4,900	2,380	2,100	1820	2060	1010	1590
Total VOCs	602/8020	0.6-60	50	µg/L	5,950	2,904.5	2,563	2131	2540	1180	1830
Methyl Tertiary-Butyl Ether	602/8020	5-500	50	µg/L	<500	<50	...	<1	<1	<1	<1
1,3-Dichlorobenzene ¹⁶	602/8020	1-110	NA	µg/L	<110	270	<1	<1	<1	<1	<1
1,4-Dichlorobenzene ¹⁶	602/8020	1-160	NA	µg/L	<100	<160	18	<1	<1	<1	<1
1,2-Dichlorobenzene ¹⁶	602/8020	1-330	NA	µg/L	<100	<330	120	<1	<1	<1	<1
Chlorobenzene	602/8020	1-130	NA	µg/L	<130	<1	1.9	<1	<1	<1	<1
Polycyclic Aromatic Hydrocarbons¹⁶											
Naphthalene	610/8100/8270	1-20	NA	µg/L	190	170	75	300	150	11	120
1-Methylnaphthalene	610/8100/8270	1-20	NA	µg/L	...	...	...	140	81	2.9	68
2-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	110	130	...	170	74	8.5	70
Total Naphthalene	610/8100/8270	1-10	100	µg/L	300	300	75	610	305	22.4	258
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	24	<10	8.3	29	2.1	<1	2.5
Acenaphthene	610/8100/8270	0.3-10	MDL	µg/L	<1.7	<10	9	55	<1	3.2	3.5
Fluorene	610/8100/8270	0.3-10	MDL	µg/L	3.7	<10	4.5	46	<1	5.0	2.8
Phenanthrene	610/8100/8270	0.2-10	MDL	µg/L	3.5	<10	4.2	18	6.0	1.2	12
2,4-Dimethylphenol	8100/8270	0.2-10	NA	µg/L	...	<10	...	...	...	...	...
Dibenz(a,h)anthracene	610/8100/8270	0.4-10	MDL	µg/L	<0.4	<10	<1	<10	<1	<1	<1
Anthracene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	2	<10	<1	<1	<1
Volatile Organic Hydrocarbons¹⁶											
Tetrachloroethane	601/8010	1	NA	µg/L	<1	...	...	...	...	...	...
1,4-Dichlorobenzene	601/8010	1	NA	µg/L	<1	...	...	...	...	...	...
1,2-Dichlorobenzene	601/8010	1	NA	µg/L	<1	...	...	...	...	...	...
1,2-Dibromochloroethane	504	0.02	0.02	µg/L	<0.02	...	...	...	...	...	...
1,2-Dichloroethane	601/8010	1-100	3	µg/L	<100	...	...	...	...	...	...
Total Petroleum Hydrocarbon	418.1	1	NA	mg/L	18	...	...	...	...	...	...
Lead	219.2	5	15	µg/L	13	...	...	...	...	...	...

TABLE 4 (cont.)

Analyte	EPA Method Number	MDL ¹⁰	Florida Target Cleanup Concentration ¹⁰	Units	WELL IDENTIFICATION AND SAMPLE DATE		
					EA-5		
					9/13/92	9/16/93	6/8/94
Volatile Organic Aromatics¹⁰							
Benzene	602/8020	0.6-1	1	µg/L	<0.6	<1	<1
Toluene	602/8020	1	NA	µg/L	<1	<1	<1
Ethylbenzene	602/8020	0.9-1	NA	µg/L	<0.9	<1	<1
Xylenes, Total	602/8020	0.9-1	NA	µg/L	<0.9	<1	<1
Total VOA	602/8020	0.6-1	50	µg/L	<0.6	<1	<1
Methyl Tertiary-Butyl Ether	602	5	50	µg/L	<5	<5	---
1,3-Dichlorobenzene ¹⁰	602/8020	1-1.1	NA	µg/L	<1.1	<1	<1
1,4-Dichlorobenzene ¹⁰	602/8020	1	NA	µg/L	<1	<1	<1
1,2-Dichlorobenzene ¹⁰	602/8020	1	NA	µg/L	<1	<1	<1
Chlorobenzene	602/8020	1-1.3	NA	µg/L	<1.3	<1	<1
Polynuclear Aromatic Hydrocarbons¹⁰							
Naphthalene	610/8100/8270	1-10	NA	µg/L	<1.4	<10	<1
1-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	---	---	---
2-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	<1.2	<10	<1
Total Naphthalene	610/8100/8270	1-10	100	µg/L	<1.2	<10	<1
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<1.1	<10	<1
Acenaphthene	610/8100/8270	0.3-10	MDL	µg/L	<1.7	<10	<1
Fluorene	610/8100/8270	1-10	MDL	µg/L	<0.3	<10	<1
Phenanthrene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1
2,4-Dimethylphenol	8100/8270	0.2-10	NA	µg/L	---	<10	<1
Dibenz(a,h)anthracene	610/8100/8270	0.4-10	MDL	µg/L	<0.4	<10	<1
Anthracene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1
Volatile Organic Halocarbons¹⁰							
Trichloroethane	601/8010	1	NA	µg/L	<1	---	---
1,4-Dichlorobenzene	601/8010	1	NA	µg/L	<1	---	---
1,2-Dichlorobenzene	601/8010	1	NA	µg/L	<1	---	---
1,2-Dibromochloroethane	504	0.02	0.02	µg/L	<0.02	---	---
1,2-Dichloroethane	601/8010	1	3	µg/L	<1	---	---
Total Petroleum Hydrocarbon	418.1	1	NA	mg/L	<1	---	---
Lead	219.2	5	15	µg/L	<5	---	---

TABLE 4 (cont.)

Analyte	EPA Method Number	MDL ¹	Florida Target Cleanup Concentration ²	Units	WELL IDENTIFICATION AND SAMPLE DATE		
					EA-6		
					9/14/92	9/16/93	6/8/94
Yalallik Organic Aromatics³							
Benzene	607/1020	0.6-1	1	µg/L	<0.6	<1	<1
Toluene	607/1020	1	NA	µg/L	<1	<1	<1
Ethylbenzene	607/1020	0.9-1	NA	µg/L	<0.9	<1	<1
Xylenes, Total	607/1020	0.9-1	NA	µg/L	<0.9	<1	<1
Total VOA	607/1020	0.6-1	50	µg/L	<0.6	<1	<1
Methyl Tertiary Butyl Ether	602	5	50	µg/L	<5	<5	...
1,3-Dichlorobenzene ⁴	607/1020	1-1.1	NA	µg/L	<1.1	<1	<1
1,4-Dichlorobenzene ⁴	607/1020	1	NA	µg/L	<1	<1	<1
1,2-Dichlorobenzene ⁴	607/1020	1	NA	µg/L	<1	<1	<1
Chlorobenzene	607/1020	1-1.3	NA	µg/L	<1.3	<1	<1
Polynuclear Aromatic Hydrocarbons⁵							
Naphthalene	610/100/1270	1-10	NA	µg/L	<1.4	<10	<1
1-Methylnaphthalene	610/100/1270	1-10	NA	µg/L	...	...	...
2-Methylnaphthalene	610/100/1270	1-10	NA	µg/L	<1.2	<10	<1
Total Naphthalene	610/100/1270	1-10	100	µg/L	<1.2	<10	<1
Acenaphthylene	610/100/1270	1-10	MDL	µg/L	<3.1	<10	<1
Acenaphthene	610/100/1270	0.3-10	MDL	µg/L	<1.7	<10	<1
Fluorene	610/100/1270	1-10	MDL	µg/L	<0.3	<10	<1
Phenanthrene	610/100/1270	0.2-10	MDL	µg/L	<0.2	<10	<1
2,4-Dimethylphenol	8100/1270	0.2-10	NA	µg/L	...	<10	...
Dibenz(a,h)anthracene	610/100/1270	0.4-10	MDL	µg/L	<0.4	<10	<1
Anthracene	610/100/1270	0.2-10	MDL	µg/L	<0.2	<10	<1
Yalallik Organic Halocarbons⁶							
Tetrachloroethane	601/1010	1	NA	µg/L	<1	...	...
1,4-Dichlorobenzene	601/1010	1	NA	µg/L	<1	...	...
1,2-Dichlorobenzene	601/1010	1	NA	µg/L	<1	...	...
1,2-Dibromooethane	304	0.02	0.02	µg/L	<0.02	...	...
1,2-Dichloroethane	601/1010	1	3	µg/L	<1	...	...
Total Petroleum Hydrocarbons	418.1	1	NA	mg/L	<1	...	...
Lead	219.2	5	15	µg/L	<5	...	...

TABLE 4 (cont.)

Analyte	EPA Method Number	MDL**	Florida Target Cleanup Concentration**	Units	WELL IDENTIFICATION AND SAMPLE DATE					
					EA-7 12/12/96					
					9/14/92	9/16/93	6/7/94	8/20/96	11/2/96	2/10/97
Volatiles Organic Compounds**										
Benzene	602/8020	0.6-1	1	µg/L	<0.6	<1	<1	<1	<1	<1
Toluene	602/8020	1	NA	µg/L	<1	<1	<1	<1	<1	<1
Ethylbenzene	602/8020	0.9-1	NA	µg/L	<0.9	<1	19	<1	<1	<1
Xylenes, Total	602/8020	0.9-1	NA	µg/L	<0.9	<1	7.4	<1	<1	<1
Total VOA	602/8020	0.6-1	50	µg/L	<0.6	<1	26.4	<1	<1	<1
Methyl Tertiary Butyl Ether	602	5	50	µg/L	<5	<5	—	<1	<1	<1
1,3-Dichlorobenzene**	602/8020	1-1.1	NA	µg/L	<1.1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene**	602/8020	1	NA	µg/L	<1	<1	2.1	<1	<1	<1
1,2-Dichlorobenzene**	602/8020	1	NA	µg/L	<1	<1	12	<1	<1	<1
Chlorobenzene	602/8020	1-1.3	NA	µg/L	<1.3	<1	<1	<1	<1	<1
Polynuclear Aromatic Hydrocarbons**										
Naphthalene	610/8100/8270	1-10	NA	µg/L	<1.4	<10	1.5	<1	23	<1
1-Methylphenanthrene	610/8100/8270	1-10	NA	µg/L	—	—	—	—	4.5	2.3
2-Methylphenanthrene	610/8100/8270	1.2-10	NA	µg/L	<1.2	<10	—	<1	4.5	<1
Total Naphthalene	610/8100/8270	1-10	100	µg/L	<1.2	<10	1.5	<1	32	2.3
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<1.7	<10	1.9	<1	<1	1.1
Acenaphthene	610/8100/8270	1-10	MDL	µg/L	<1.7	<10	1	<1	<1	1.1
Fluorene	610/8100/8270	1-10	MDL	µg/L	<0.3	<10	1.9	<1	<1	4.9
Phenanthrene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1	<1	<1	—
2,4-Dimethylphenol	8100/8270	10	NA	µg/L	—	<10	—	—	—	—
Dibenz(a,h)anthracene	610/8100/8270	0.4-10	MDL	µg/L	<0.4	<10	<1	<1	<1	<1
Anthracene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1	<1	<1	<1
Fluoranthene	610/8100/8270	1-10	MDL	µg/L	<1	<10	<1	<1	<1	1.0
Volatiles Organic Halocarbons**										
Tetrachloroethene	601/8010	1	NA	µg/L	<1	—	—	—	—	—
1,4-Dichlorobenzene	601/8010	1	NA	µg/L	<1	—	—	—	—	—
1,2-Dichlorobenzene	601/8010	1	NA	µg/L	<1	—	—	—	—	—
1,2-Dibromochloroethane	504	0.02	0.02	µg/L	<0.02	—	—	—	—	—
1,2-Dichloroethane	601/8010	1	3	µg/L	<1	—	—	—	—	—
Total Petroleum Hydrocarbons	418.1	1	NA	mg/L	<1	—	—	—	—	—
Lead	239.2	5	15	µg/L	<5	—	—	—	—	—

TABLE 4 (con.)

Analyte	EPA Method Number	MDL ^m	Florida Target Cleanup Concentration ^m	Units	WELL IDENTIFICATION AND SAMPLE DATE		
					EA-8		
					9/14/92	9/16/93	6/18/94
Volatiles Organic Aromatics^m							
Benzene	602/8020	0.6-1	1	µg/L	<0.6	<1	<1
Toluene	602/8020	1	NA	µg/L	<1	<1	<1
Ethylbenzene	602/8020	0.9-1	NA	µg/L	<0.9	<1	<1
Xylenes, Total	602/8020	0.9-1	NA	µg/L	<0.9	<1	<1
Total VOA	602/8020	0.6-1	50	µg/L	<0.6	<1	<1
Methyl Tert-Butyl Ether	602	5	50	µg/L	<5	<5	...
1,3-Dichlorobenzene ^m	602/8020	1-1.1	NA	µg/L	<1.1	<1	<1
1,4-Dichlorobenzene ^m	602/8020	1	NA	µg/L	<1	<1	<1
1,2-Dichlorobenzene ^m	602/8020	1	NA	µg/L	<1	<1	<1
Chlorobenzene	602/8020	1-1.3	NA	µg/L	<1.3	<1	<1
Polynuclear Aromatic Hydrocarbons^m							
Naphthalene	610/8100/8270	1-10	NA	µg/L	<1.4	<10	<1
1-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	...	...	...
2-Methylnaphthalene	610/8100/8270	1.2-10	NA	µg/L	<1.2	<10	<1
Total Naphthalene	610/8100/8270	1-10	100	µg/L	<1.2	<10	<1
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<1.1	<10	<1
Acenaphthene	610/8100/8270	1-10	MDL	µg/L	<1.7	<10	<1
Fluorene	610/8100/8270	1-10	MDL	µg/L	<0.1	<10	<1
Pyrene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1
2,4-Dinitrophenol	8100/8270	10	NA	µg/L	...	<10	...
Dibenz(a,h)anthracene	610/8100/8270	0.4-10	MDL	µg/L	<0.4	<10	<1
Anthracene	610/8100/8270	0.2-10	MDL	µg/L	<0.2	<10	<1
Volatiles Organic Halocarbons^m							
Tetrachloroethane	601/8010	1	NA	µg/L	<1	...	...
1,4-Dichlorobenzene	601/8010	1	NA	µg/L	<1	...	...
1,2-Dichlorobenzene	601/8010	1	NA	µg/L	<1	...	...
1,2-Dibromomethane	504	0.02	0.02	µg/L	<0.02	...	...
1,3-Dichloroethane	601/8010	1	3	µg/L	<1	...	...
Total Petroleum Hydrocarbon	418.1	1	NA	mg/L	<1	...	...
Lead	239.2	5	15	µg/L	<5	...	...

TABLE 4 (cont.)

Analyte	EPA Method Number	MDL ^{1a}	Florida Target Cleanup Concentration ^{2a}	Units	WELL IDENTIFICATION AND SAMPLE DATE		
					EA-9		
					9/14/92	9/16/93	6/8/94
Volatile Organic Aromatics^{1a}							
Benzene	602/8020	0.6-1	1	µg/L	<0.6	<1	<1
Toluene	602/8020	1	NA	µg/L	<1	<1	<1
Ethylbenzene	602/8020	0.9-1	NA	µg/L	<0.9	<1	<1
Xylenes, Total	602/8020	0.9-2	NA	µg/L	2.4	<1	<1
Total VOA	602/8020	0.6-1	50	µg/L	2.4	<1	<1
Methyl Tertiary Butyl Ether	602	1-25	50	µg/L	<5	<5	---
1,3-Dichlorobenzene ^{2a}	602/8020	1-1.1	NA	µg/L	<1.1	<1	<1
1,4-Dichlorobenzene ^{2a}	602/8020	1	NA	µg/L	<1	<1	<1
1,2-Dichlorobenzene ^{2a}	602/8020	1	NA	µg/L	<1	<1	<1
Chlorobenzene	602/8020	1-1.3	NA	µg/L	<1.3	<1	<1
Polynuclear Aromatic Hydrocarbons^{2a}							
Naphthalene	610/8100/8270	1-10	NA	µg/L	<1.4	<10	<1
1-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	---	---	---
2-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	<1.2	<10	---
1-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	---	---	---
Total Naphthalene	610/8100/8270	1-10	100	µg/L	<1.2	<10	<1
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<3.1	<10	<1
Acenaphthene	610/8100/8270	1-10	MDL	µg/L	<1.7	<10	<1
Fluorene	610/8100/8270	1-10	MDL	µg/L	<0.3	<10	<1
Phenanthrene	610/8100/8270	1-10	MDL	µg/L	<0.2	<10	<1
2,4-Dimethylphenol	8100/8270	10	NA	µg/L	---	<10	---
Dibenz(a,h)anthracene	610/8100/8270	1-10	MDL	µg/L	<0.4	<10	<1
Anthracene	610/8100/8270	1-10	MDL	µg/L	<0.2	<10	<1
Benzo(a)pyrene	8100/8270	10	NA	µg/L	---	18	---
Volatile Organic Halocarbons^{2a}							
Tetrachlorobenzene	8010	1	NA	µg/L	<1	---	---
1,4-Dichlorobenzene	8010	1	NA	µg/L	<1	---	---
1,2-Dichlorobenzene	8010	1	NA	µg/L	---	---	---
1,3-Dichlorobenzene	8010	1	NA	µg/L	---	---	---
1,2-Dibromodichloroethane	504	0.02	0.02	µg/L	<0.02	---	---
1,2-Dichloroethane	601/8010	1-5	3	µg/L	<1	---	---
Total Petroleum Hydrocarbon	418.1	0.6-1	NA	mg/L	<1	---	---
Lead	239.2	1-5	15	µg/L	<5	---	---

TABLE 4 (cont.)

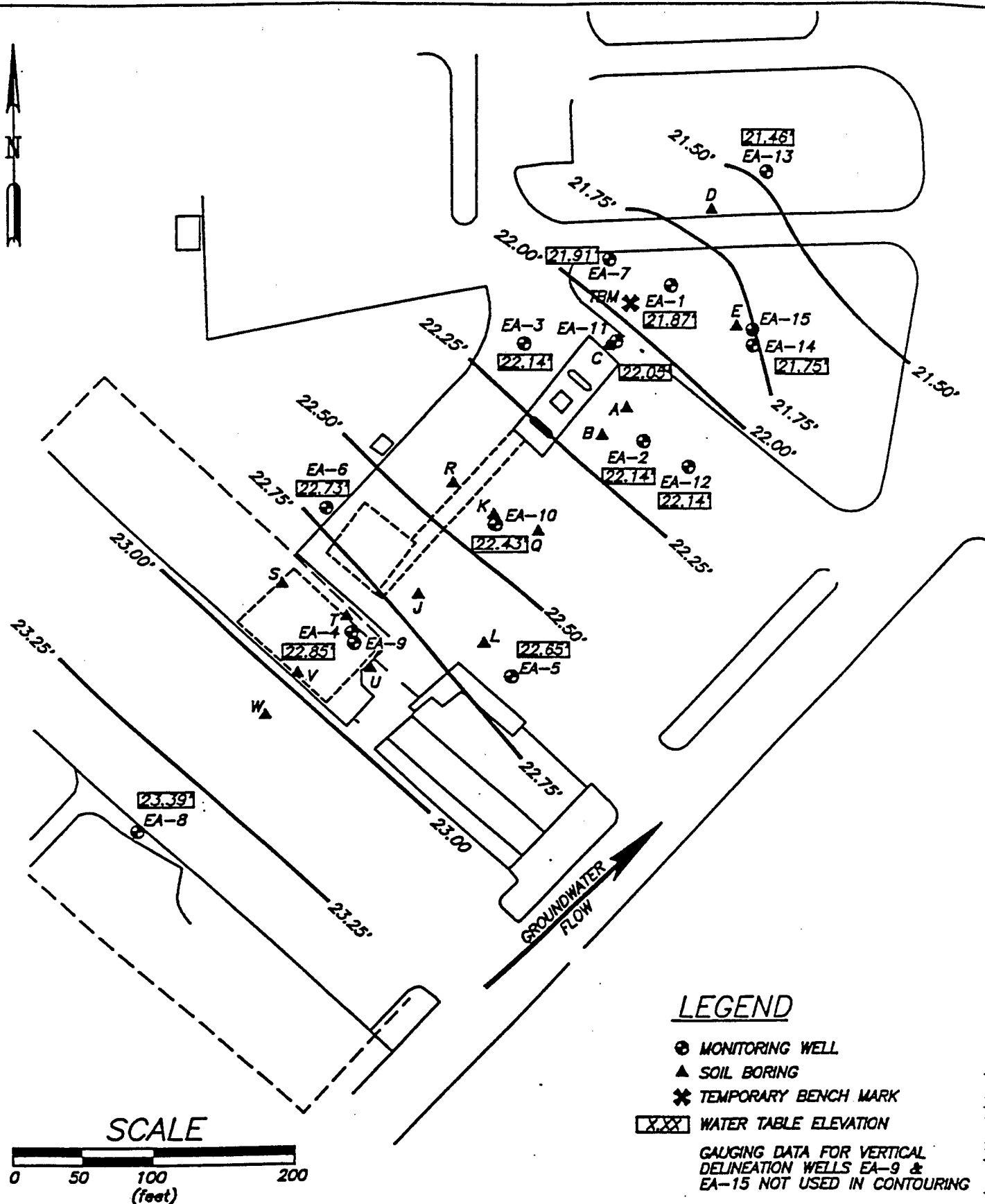
Analyte	EPA Method Number	MDL ¹⁴	Florida Target Cleanup Concentration ¹⁵	Units	WELL IDENTIFICATION AND SAMPLE DATE					
					EA-10					
					7/7/93	6/7/94	12/13/95	8/20/96	11/8/96	2/10/97
Volatile Organic Analytes¹²										
Benzene	602/8020	0.6-1	1	µg/L	1	<1	<1	<1	<1	<1
Toluene	602/8020	1	NA	µg/L	32	80	9	<1	<1	<1
Ethylbenzene	602/8020	0.9-1	NA	µg/L	210	390	190	<1	<1	<1
Xylenes, Total	602/8020	0.9-2	NA	µg/L	1,000	1,440	915	<1	<1	<1
Total VOA	602/8020	0.6-1	50	µg/L	1,244	1,830	1,114	<1	<1	<1
Methyl Tert-Butyl Ether	602	1-25	50	µg/L	<25	...	<1	<1	<1	<1
1,3-Dichlorobenzene ¹⁶	602/8020	1-1.1	NA	µg/L	24	<1	<1	<1	<1	<1
1,4-Dichlorobenzene ¹⁶	602/8020	1	NA	µg/L	130	7.4	<1	<1	<1	<1
1,2-Dichlorobenzene ¹⁶	602/8020	1	NA	µg/L	62	98	<1	<1	<1	<1
Chlorobenzene	602/8020	1-1.3	NA	µg/L	<1	<1	<1	<1	<1	<1
Polynuclear Aromatic Hydrocarbons¹³										
Naphthalene	610/8100/8270	1-10	NA	µg/L	62	96	190	<1	<1	<1
1-Methylanthracene	610/8100/8270	1-10	NA	µg/L	...	...	94	<1	<1	<1
2-Methylanthracene	610/8100/8270	1-10	NA	µg/L	33	...	87	<1	<1	<1
Total Naphthalene	610/8100/8270	1-10	100	µg/L	95	96	371	<1	<1	<1
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<10	2.5	40	<1	<1	<1
Acenaphthene	610/8100/8270	1-10	MDL	µg/L	<10	5	110	<1	<1	<1
Fluorene	610/8100/8270	1-10	MDL	µg/L	<10	4.6	110	<1	<1	<1
Phenanthrene	610/8100/8270	1-10	MDL	µg/L	<10	2.8	57	<1	<1	<1
2,4-Dimethylphenol	8100/8270	10	NA	µg/L	10	...	...	...	...	...
Dibenz(a,h)anthracene	610/8100/8270	1-10	MDL	µg/L	<10	<1	<10	<1	<1	<1
Anthracene	610/8100/8270	1-10	MDL	µg/L	<10	<1	<10	<1	<1	<1
Hexachlorobenzene	8100/8270	10	NA	µg/L	<10	...	...	...	<1	<1
Volatile Organic Halocarbon¹⁴										
Tetrachloroethene	8010	1	NA	µg/L	4	...	...	...	...	...
1,4-Dichlorobenzene	8010	1	NA	µg/L	1	...	...	...	...	...
1,2-Dichlorobenzene	8010	1	NA	µg/L	1	...	...	...	...	...
1,3-Dichlorobenzene	8010	1	NA	µg/L	<1	...	...	...	...	...
1,2-Dibromochloroethane	504	0.02	0.02	µg/L	<0.02	...	...	...	...	...
1,2-Dichloroethane	601/8010	1-5	3	µg/L	<5	...	...	...	...	...
Total Petroleum Hydrocarbon	418.1	0.6-1	NA	mg/L	0.82	...	...	...	...	...
Lead	239.2	1-5	15	µg/L	3.9	...	...	...	...	...

TABLE 4 (cont.)

Analyte	EPA Method Number	MDL ¹⁴	Florida Target Cleanup Concentration ¹⁵	Units	WELL IDENTIFICATION AND SAMPLE DATE					
					EA-11					
					7/7/93	6/7/94	3 ¹ (12/13/95)	8/20/96	11/8/96	2/10/97
Volatile Organic Aromatics¹⁴										
Benzene	602/8020	0.6-1	1	µg/L	<1	<1	<1	<1	<1	<1
Toluene	602/8020	1	NA	µg/L	<1	71	<1	<1	<1	<1
Ethylbenzene	602/8020	0.9-1	NA	µg/L	34	190	2.3	6.4	5.3	2.8
Xylenes, Total	602/8020	0.9-2	NA	µg/L	62	487	<1	2.0	5.4	3.0
Total VOA	602/8020	0.6-1	50	µg/L	96	748	2.3	8.4	10.7	5.8
Methyl Tert-Butyl Ether	602	1-25	50	µg/L	<10	...	<1	<1	<1	<1
1,3-Dichlorobenzene ¹⁴	602/8020	1-1.1	NA	µg/L	<1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene ¹⁴	602/8020	1	NA	µg/L	4	5	<1	<1	<1	<1
1,2-Dichlorobenzene ¹⁴	602/8020	1	NA	µg/L	29	<1	<1	<1	<1	<1
Chlorobenzene	602/8020	1-1.3	NA	µg/L	<1	<1	<1	<1	<1	<1
Polynuclear Aromatic Hydrocarbons¹⁴										
Naphthalene	610/8100/8270	1-10	NA	µg/L	42	94	23	7.7	<1 ¹⁶	5.6
1-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	...	...	32	13	<1 ¹⁶	2.9
2-Methylnaphthalene	610/8100/8270	1-10	NA	µg/L	15	...	24	3.4	<1 ¹⁶	3.8
Total Naphthalene	610/8100/8270	1-10	100	µg/L	57	94	79	24.1	<1 ¹⁶	12.3
Acenaphthylene	610/8100/8270	1-10	MDL	µg/L	<10	3.8	8.4	2.1	<1 ¹⁶	<1
Acenaphthene	610/8100/8270	1-10	MDL	µg/L	<10	6.7	6.0	2.9	<1 ¹⁶	<1
Fluorene	610/8100/8270	1-10	MDL	µg/L	<10	<1	21	1.1	<1 ¹⁶	<1
Phenanthrene	610/8100/8270	1-10	MDL	µg/L	<10	<1	7.5	1	<1 ¹⁶	<1
2,4-Dimethylphenol	8100/8270	10	NA	µg/L	<10	...	...	...	...	...
Dibenz(a,h)anthracene	610/8100/8270	1-10	MDL	µg/L	<10	<1	<1	<1	<1 ¹⁶	<1
Anthracene	610/8100/8270	1-10	MDL	µg/L	<10	<1	7.6	<1	<1 ¹⁶	<1
Hexachlorobutadiene	8100/8270	10	NA	µg/L	<10	...	...	...	<1 ¹⁶	<1
Volatile Organic Hydrocarbons¹⁴										
Tetrachloroethene	8010	1	NA	µg/L	3	...	...	...	...	...
1,4-Dichlorobenzene	8010	1	NA	µg/L	<1	...	...	...	...	...
1,2-Dichlorobenzene	8010	1	NA	µg/L	<1	...	...	...	...	...
1,3-Dichlorobenzene	8010	1	NA	µg/L	<1	...	...	...	...	...
1,2-Dibromodibutene	504	0.02	0.02	µg/L	<0.02	...	...	...	...	...
1,2-Dichloroethane	601/8010	1-5	3	µg/L	<2	...	...	...	...	...
Total Petroleum Hydrocarbon	418.1	0.6-1	NA	mg/L	<0.6	...	...	...	...	...
Lead	239.2	1-5	15	µg/L	<1	...	...	...	...	...

TABLE 4 (cont.)

Analytic	EPA Method Number	MDL ^a	Florida Target Cleanup Concentration ^{b,c}	Units	WELL IDENTIFICATION AND SAMPLE DATE							
					EA-12		EA-13		EA-14		EA-15	
					3/23/94	6/7/94	3/23/94	6/7/94	3/23/94	6/7/94	3/23/94	6/7/94
<u>Volatile Organic Aromatics^d</u>												
Benzene	602/8020	1	1	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	602/8020	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	602/8020	1	NA	μg/L	<1	<1	3.2	1.8	<1	<1	<1	<1
Xylenes, Total	602/8020	1	NA	μg/L	<1	<1	<1	2.4	<1	<1	<1	<1
Total VOC	602/8020	1	50	μg/L	<1	<1	3.2	4.2	<1	<1	<1	<1
Methyl Tertiary Butyl Ether	602/8020	1	50	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
1,3-Dichlorobenzene ^e	602/8020	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene ^e	602/8020	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichlorobenzene ^e	602/8020	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	602/8020	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
<u>Polynuclear Aromatic Hydrocarbons^d</u>												
Naphthalene	610/8100/8170	1	NA	μg/L	<1	<1	1.2	<1	<1	<1	<1	<1
1-Methylanthracene	610/8100/8170	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
2-Methylanthracene	610/8100/8170	1	100	μg/L	<1	<1	1.2	<1	<1	<1	<1	<1
Total Naphthalenes	610/8100/8170	1	MDL	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Acenaphthylene	610/8100/8170	1	MDL	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Acenaphthene	610/8100/8170	1	MDL	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Fluorene	610/8100/8170	1	MDL	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Phenanthrene	610/8100/8170	1	MDL	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
2,4-Dimethylphenol	8100/8170	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Dibenz(a,h)anthracene	610/8100/8170	1	MDL	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Anthracene	610/8100/8170	1	MDL	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
<u>Volatile Organic Hydrocarbons^d</u>												
Tetrachloroethane	601/8010	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene	601/8010	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichlorobenzene	601/8010	1	NA	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dibromochloroethane	504	1	0.02	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
1,2-Dichloroethane	8010	1	3	μg/L	<1	<1	<1	<1	<1	<1	<1	<1
Total Petroleum Hydrocarbons	418.1	1	NA	mg/L	<1	<1	<1	<1	<1	<1	<1	<1
Lead	239.2	1	15	μg/L	<1	<1	<1	<1	<1	<1	<1	<1



LEGEND

- ⊙ MONITORING WELL
 - ▲ SOIL BORING
 - ✕ TEMPORARY BENCH MARK
 - XXX WATER TABLE ELEVATION
- GAUGING DATA FOR VERTICAL
DELINEATION WELLS EA-9 &
EA-15 NOT USED IN CONTOURING

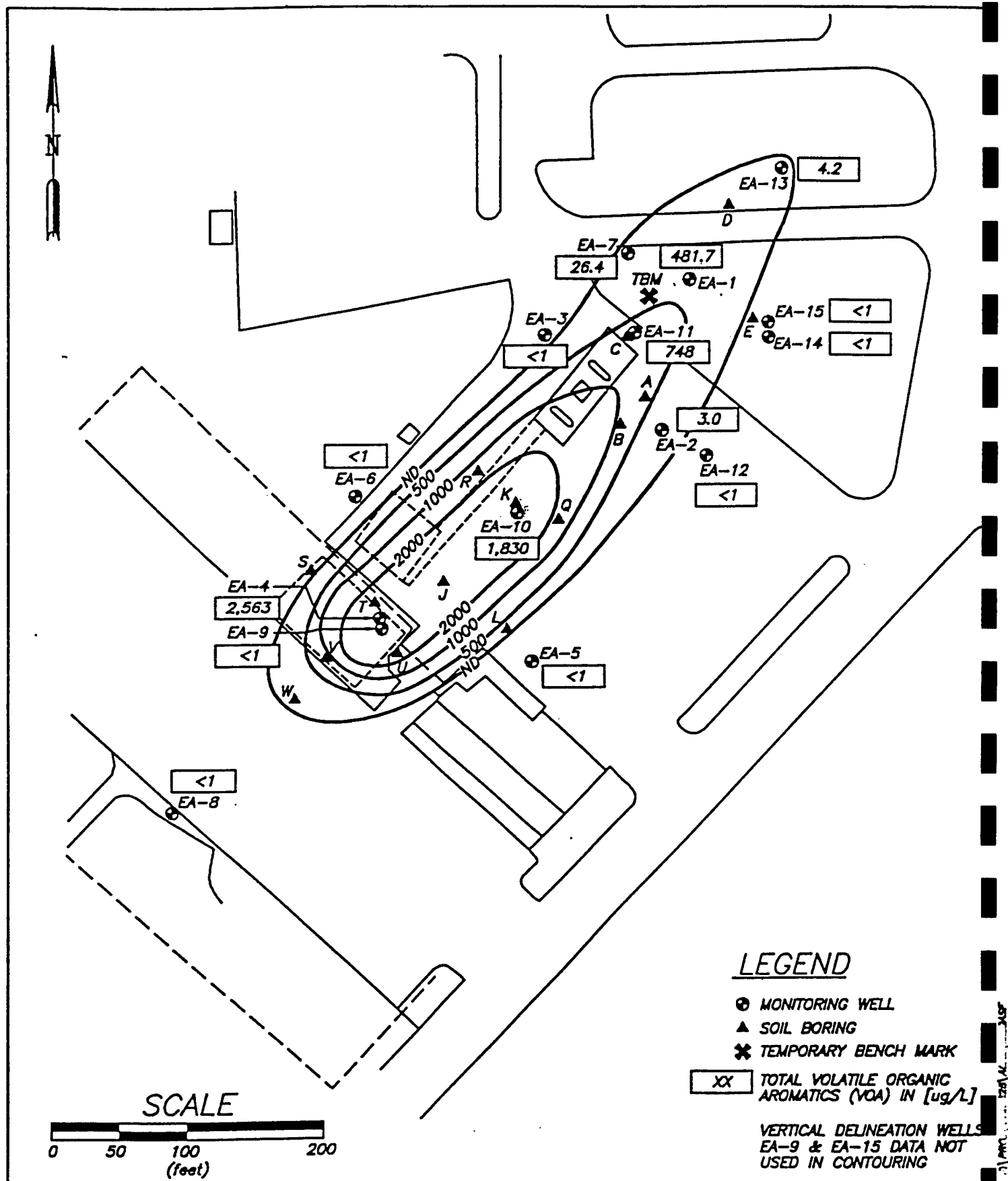


EA ENGINEERING,
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TECHNOLOGY, INC.

MILITARY GAS STATION
ON THE MAIN BASE
EGLIN AFB, VALPARAISO,
OKALOOSA COUNTY, FL

WATER TABLE
ELEVATION,
12 OCTOBER 1994

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO.	FIGURE
R. OWENS	E. REID	J. ANGELO		1" = 100'	5/27/94	11206.25	7

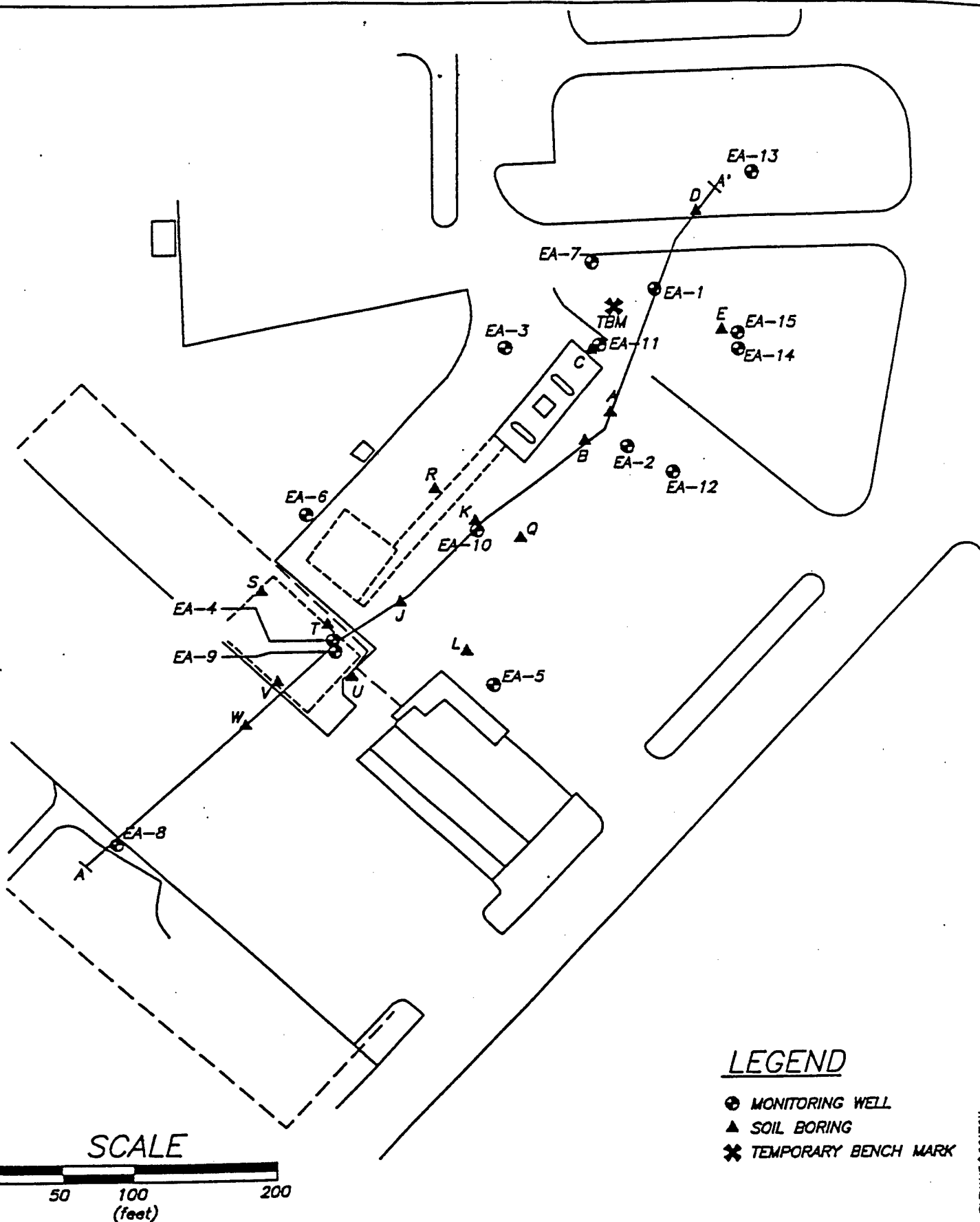


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MILITARY GAS STATION
ON THE MAIN BASE
EGLIN AFB, VALPARAISO,
OKALOOSA COUNTY, FL

TOTAL VOA
CONCENTRATIONS, ug/L,
7 to 8 JUNE 1994

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO.	FIGURE
R. OWENS	E. REID	J. ANGELO		1" = 100'	5/27/94	11206.25	8



LEGEND

- ⊕ MONITORING WELL
- ▲ SOIL BORING
- ✕ TEMPORARY BENCH MARK



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MILITARY GAS STATION
ON THE MAIN BASE
EGLIN AFB, VALPARAISO,
OKALOOSA COUNTY, FL

CROSS-SECTION A-A' LOCATION

PROJECT MGR.
R. OWENS

DESIGNED BY
E. REID

DRAWN BY
J. ANGELO

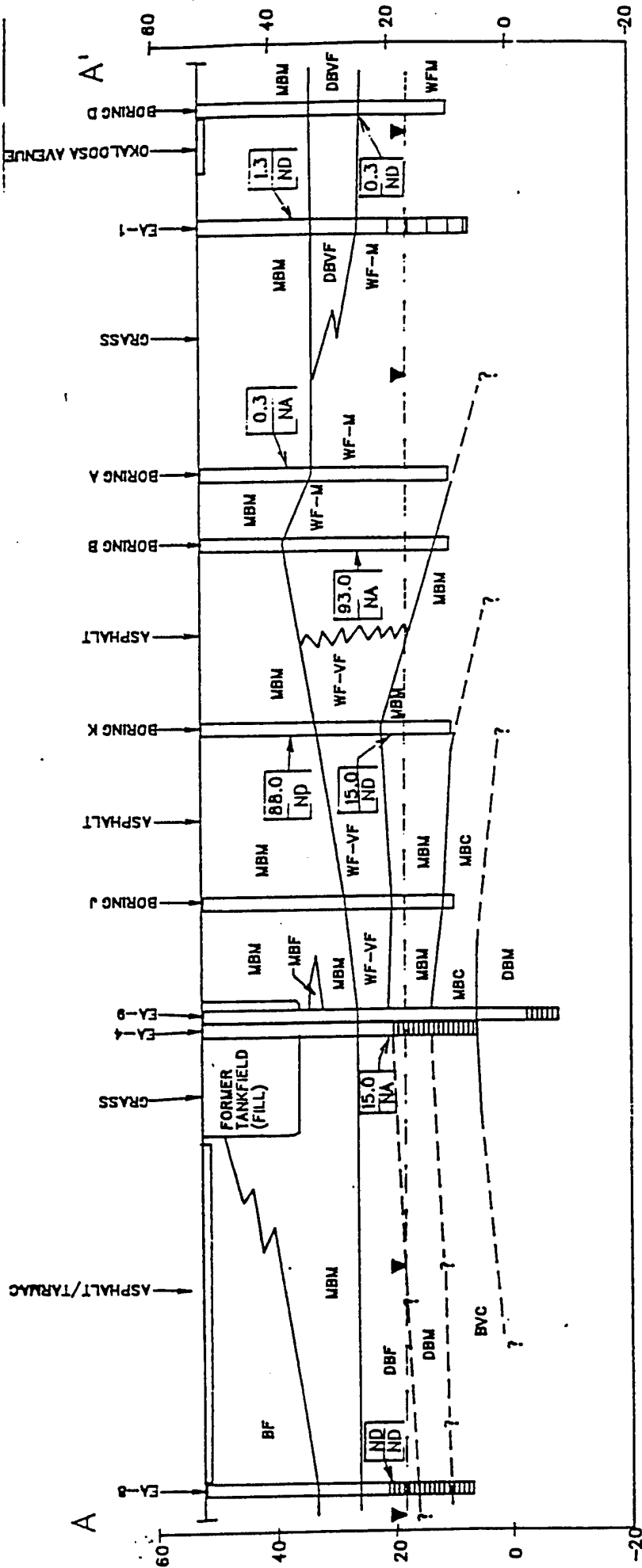
CHECKED BY

SCALE
1" = 100'

DATE
10/27/94

PROJECT NO.
11206.25

FIGURE
10



BF = BROWN FINE SAND
 BVC = BROWN VERY COARSE SAND
 DBF = DARK BROWN FINE SAND
 DBVF = DARK BROWN VERY FINE SAND
 DBM = DARK BROWN MEDIUM SAND
 MBM = MEDIUM BROWN MEDIUM SAND
 MBF = MEDIUM BROWN FINE SAND
 MBC = MEDIUM BROWN COARSE SAND
 WF-VF = WHITE FINE TO VERY FINE SAND
 WF-M = WHITE FINE TO MEDIUM SAND

EA ENGINEERING,
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EGLIN AFB
 OKALOOSA COUNTY, FLORIDA

Site Geologic Cross-section
 A-A': Military Gas Station

DESIGNED BY J. HUTTON	DRAWN BY EJR	DATE 10/14/94	PROJECT NO. 11206.25
CHECKED BY	PROJECT MGR. OWH	SCALE	FIGURE

APPENDIX C

FIELD DATA FORMS

Sheet 1 of 1

Elev (ft)	Depth (ft)	Pro- file	US CS	Geologic Description	Sample	Sample	Penet	PD(ppm)	TLV(ppm)	TOTAL BTX(ppm)	TPH (ppm)
					No.	Depth (ft)	Type				
	1			<i>no recovery</i>							
	5										
	10										
	15										
	20										
	25										
	30										
	35										
	40										
	45										
	50										
	55										
	60										
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	210										
	215										
	220										
	225										
	230										
	235										
	240										
	245										
	250										
	255										
	260										
	265										
	270										
	275										
	280										
	285										
	290										

GASTECH

SAMPLE TYPE

D - DRIVE
C - CORE
G - GRAB



GEOLOGIC BORING LOG

Risk-Based Approach to Remediation

**PARSONS
ENGINEERING SCIENCE, INC.**

Denver, Colorado

GEOLOGIC BORING LOG

Sheet 1 of 1

BORING NO.: K CONTRACTOR: Parsons DATE SPUD: 3/29/98 1300
 CLIENT: AFCEE/Eglin AFB RIG TYPE: Geoprobe DATE CMPL: 3/29/98
 JOB NO.: 731854.03000 DRLG METHOD: Geoprobe ELEVATION: _____
 LOCATION: Military Gas Sta. BORING DIA.: 2" TEMP: 75°F
 GEOLOGIST: Cindy Nagel DRLG FLUID: none WEATHER: 75F Sunny, breezy
 COMMENTS: _____

Elev (ft)	Depth (ft)	Pro- file	US CS	Geologic Description	Sample		Penet Res	TOTAL				TPH (ppm)
					No.	Depth (ft)		PID(ppm)	TLV(ppm)	BTEX(ppm)		
	1			orange-brown silty f.-med SAND				20				
			1.5	lt brown silty f.-med SAND				0				
	5							0				
								0				
	10							0				
								20				
	15							20				
								20				
	20							20				
								20				
	25							0				
	30											
	35											

GASTECH

NOTES

bgs - Below Ground Surface
 GS - Ground Surface
 TOC - Top of Casing
 NS - Not Sampled
 SAA - Same As Above
 U - Undetected

SAMPLE TYPE

D - DRIVE
 C - CORE
 G - GRAB

▼ Water level drilled

GEOLOGIC BORING LOG

Risk-Based Approach to Remediation

**PARSONS
 ENGINEERING SCIENCE, INC.**

Denver, Colorado

GEOLOGIC BORING LOG

Sheet 1 of 1

BORING NO.: V CONTRACTOR: Parsons DATE SPUD: 3/29/98
 CLIENT: AFCEE/Eglin AFB RIG TYPE: Geoprobe DATE CMPL: 3/30/98
 JOB NO.: _____ DRLG METHOD: _____ ELEVATION: _____
 LOCATION: Mil Gas Station BORING DIA.: 2" TEMP: 70°F
 GEOLOGIST: Cindy Nagel DRLG FLUID: none WEATHER: Sunny, Windy
 COMMENTS: _____

Elev (ft)	Depth (ft)	Pro- file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1			<i>no recovery</i>								
	5							5				
	10							10				
	15							15				
	20							20				
	25			<i>buff f-med Qtz SAND</i>				23	φ			
	25							25	φ			
	27							27	20			
	29							29	20			
	30			<i>TD 29' bgs</i>								
	35											

NOTES

bgs - Below Ground Surface
 GS - Ground Surface
 TOC - Top of Casing
 NS - Not Sampled
 SAA - Same As Above
 U - Undetected

SAMPLE TYPE

D - DRIVE
 C - CORE
 G - GRAB



Water level drilled

GEOLOGIC BORING LOG

Risk-Based Approach to Remediation

**PARSONS
 ENGINEERING SCIENCE, INC.**

Denver, Colorado

Groundwater Sampling Record

Monitoring Well No. FA 4 (Continued)

5 []

SAMPLE EXTRACTION METHOD:

☒ Bailer made of: disposable
☒ Pump, type: peristaltic
☐ Other, describe: _____

Sample obtained is ☒ GRAB; ☐ COMPOSITE SAMPLE

6 []

ON-SITE MEASUREMENTS:

Time						Measured with
Temp (°C)	25.9	25.0	26.1	26.0	26.0	YSI 55
pH	8.25	6.26	6.20	6.20	6.19	Orión 250A
Cond (µS/cm)	130	133	1.33	1.33	1.32	Hach
DO (mg/L)	1.20	2.02	1.55	1.19	1.18	YSI 55
Redox (mV)	-157.5	-171.1	-175.7	-179.4	-181.0	Orión 250A
gallons purged		5	6	7	8	

7 []

SAMPLE CONTAINERS (material, number, size): 9-40ml glass vials, 5-1-liter glass
2-500ml poly

8 []

ON-SITE SAMPLE TREATMENT:

☐ Filtration: Method 0.45 µm filter Containers: 500ml poly
 Method _____ Containers: _____
 Method _____ Containers: _____

☐ Preservatives added:

Method TRIM Containers: 1-liter amber HCL
 Method STEX Containers: 40ml vial HCL
 Method methane Containers: 40ml vial HCL
 Method Total lead Containers: 500ml poly HNO3
dissolved lead 500ml poly HNO3

9 []

CONTAINER HANDLING:

☒ Container Sides Labeled
☐ Container Lids Taped
☒ Containers Placed in Ice Chest

10 []

OTHER COMMENTS:

GROUNDWATER SAMPLING RECORD

Sampling Location Edgemoor AFB FLSampling Dates 3-26-98GROUND WATER SAMPLING RECORD - MONITORING WELL Mil EA-4
(Identification)REASON FOR SAMPLING: ☒ Regular Sampling; ☐ Special Sampling;DATE AND TIME OF SAMPLING: 3-26-98 at 14:45 a.m./p.m.SAMPLE COLLECTED BY: ROM of Parsons ESWEATHER: Hot, clear sunny ~ 75°FDATUM FOR WATER DEPTH MEASUREMENT (Describe): 100 Top of casing

MONITORING WELL CONDITION:

☒ LOCKED:☐ UNLOCKEDWELL NUMBER 09 - IS NOT APPARENTSTEEL CASING CONDITION IS: OKINNER PVC CASING CONDITION IS: OK

WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT

☐ DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR☐ MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 ☐ EQUIPMENT CLEANED BEFORE USE WITH alcohol, di, iso, di
Items Cleaned (List): all instrument probes2 ☐ PRODUCT DEPTH none FT. BELOW DATUM
Measured with: Model 121 interface meterWATER DEPTH 33.82 FT. BELOW DATUM
Measured with: slate water level indicator3 ☐ WATER-CONDITION BEFORE WELL EVACUATION (Describe):Appearance: clearOdor: slight

Other Comments:

4 ☐ WELL EVACUATION:Method: pumpVolume Removed: ~ 8 galObservations: Water (slightly - very) cloudy clearWater level (rose - fell) no changeWater odors: slight

Other comments:

3-31-98

Groundwater Sampling Record

Monitoring Well No. EA-4 (Continued)

5 []

SAMPLE EXTRACTION METHOD:

- [] Bailer made of: _____
 [x] Pump, type: peristaltic
 [] Other, describe: _____

Sample obtained is [X] GRAB; [] COMPOSITE SAMPLE

6 []

ON-SITE MEASUREMENTS:

↓

Time							Measured with
Temp (°C)	<u>25.8</u>	<u>25.0</u>	<u>25.1</u>	<u>25.0</u>			<u>YSI 55</u>
pH	<u>6.25</u>	<u>6.26</u>	<u>6.20</u>	<u>6.21</u>			<u>ORION 250A</u>
Cond (µS/cm)	<u>-129</u>	<u>-130</u>	<u>-130</u>	<u>-130</u>			<u>Hach</u>
DO (mg/L)	<u>1.21</u>	<u>1.20</u>	<u>1.20</u>	<u>1.20</u>			<u>YSI 55</u>
Redox (mV)	<u>-163.1</u>	<u>-170</u>	<u>-171.3</u>	<u>-171.4</u>			<u>ORION 250A</u>
gallons purged		<u>1</u>	<u>2</u>	<u>3</u>			

7 []

SAMPLE CONTAINERS (material, number, size): 9-40ml glass vials, 4-1 liter glass amber

8 []

ON-SITE SAMPLE TREATMENT:

- [] Filtration: Method _____ Containers: _____
 Method _____ Containers: _____
 Method _____ Containers: _____

- [] Preservatives added:
 Method HCl-Acetic Containers: 40ml vials HCL
 Method Tris Containers: 1 liter glass
 Method _____ Containers: _____
 Method _____ Containers: _____

9 []

CONTAINER HANDLING:

- [x] Container Sides Labeled
 [] Container Lids Taped
 [x] Containers Placed in Ice Chest

10 []

OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Eglin AFB MilGas/static

Sampling Location ~~Homestead AFB~~Sampling Dates 7-31-98

GROUND WATER SAMPLING RECORD - MONITORING WELL

EA-4

Dup

EA-40

(Identification)

REASON FOR SAMPLING: ☒ Regular Sampling; ☐ Special Sampling;DATE AND TIME OF SAMPLING: 7-31-98 at 0815 a.m./p.m.SAMPLE COLLECTED BY: KOP of Parsons ESWEATHER: Warm ~ 65°F SunnyDATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC Top of casing

MONITORING WELL CONDITION:

☒ LOCKED:☐ UNLOCKED

WELL NUMBER (IS - IS NOT) APPARENT

STEEL CASING CONDITION IS: OKINNER PVC CASING CONDITION IS: OK

WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT

☐ DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR☐ MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 ☐EQUIPMENT CLEANED BEFORE USE WITH alcohol, di, is, diItems Cleaned (List): all instrument probes2 ☐PRODUCT DEPTH None FT. BELOW DATUMMeasured with: model 121 interface metersWATER DEPTH 33.8' FT. BELOW DATUMMeasured with: Slope water level indicator3 ☐

WATER-CONDITION BEFORE WELL EVACUATION (Describe):

Appearance: clearOdor: none

Other Comments:

4 ☐

WELL EVACUATION:

Method: pumpVolume Removed: ~ 3 galObservations: Water (slightly - very) cloudy clear

Water level (rose - fell - no change)

Water odors: none

Other comments:

Groundwater Sampling Record

Monitoring Well No. EA-5 (Continued)

5 []

SAMPLE EXTRACTION METHOD:

☒ Bailer made of: depressable

☒ Pump, type: Parastatic 2 stage

☐ Other, describe: _____

Sample obtained is ☒ GRAB; ☐ COMPOSITE SAMPLE

6 []

ON-SITE MEASUREMENTS:

Time						Measured with
Temp (°C)	22.6	23.0	22.8	23.0	23.0	
pH	6.75	6.63	6.27	6.34	6.33	
Cond (µS/cm)	.114	.116	.122	.119	.120	
DO (mg/L)	6.31	6.03	6.30	6.37	6.02	
Redox (mV)	76.1	67.3	73.6	68.6	64.7	
gallons purged	0	1	2	3	4	

7 []

SAMPLE CONTAINERS (material, number, size): 9-40ml glass vials, 1-liter glass

8 []

ON-SITE SAMPLE TREATMENT:

☐ Filtration: Method _____ Containers: _____
 Method _____ Containers: _____
 Method _____ Containers: _____

☐ Preservatives added:

Method STEP Containers: 40ml vial HCL
 Method Methane Containers: 40ml vial HCL
 Method _____ Containers: _____
 Method _____ Containers: _____

9 []

CONTAINER HANDLING:

☒ Container Sides Labeled
☐ Container Lids Taped
☒ Containers Placed in Ice Chest

10 []

OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Elgin AFB FL

Sampling Location ~~Homestead ARB~~

Sampling Dates 3-27-98

GROUND WATER SAMPLING RECORD - MONITORING WELL M:1 EA-5

(Identification)

REASON FOR SAMPLING: ☒ Regular Sampling; ☐ Special Sampling;

DATE AND TIME OF SAMPLING: 3-27-98 at 0930 a.m.

SAMPLE COLLECTED BY: RDA of Parsons ES

WEATHER: Warm, Sunny ~ 65°F

DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC Top of casing

MONITORING WELL CONDITION:

☒ LOCKED:☐ UNLOCKED

WELL NUMBER (IS - IS NOT) APPARENT

STEEL CASING CONDITION IS: OK

INNER PVC CASING CONDITION IS: OK

WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT

☐ DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR☐ MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 ☐

EQUIPMENT CLEANED BEFORE USE WITH Alconox, Di, Iso, Di.

Items Cleaned (List): all instrument probes

2 ☐

PRODUCT DEPTH none FT. BELOW DATUM

Measured with: Model 121 interface meter

WATER DEPTH 33.81 FT. BELOW DATUM

Measured with: slope water level indicator

3 ☐

WATER-CONDITION BEFORE WELL EVACUATION (Describe):

Appearance: clear

Odor: none

Other Comments:

4 ☐

WELL EVACUATION:

Method: pump

Volume Removed: ~3 gal

Observations: Water (slightly - very) cloudy clear

Water level (rose - fell - no change)

Water odors: none

Other comments:

Groundwater Sampling Record

Monitoring Well No. EA-8 (Continued)

5 []

SAMPLE EXTRACTION METHOD:

☒ Bailer made of: disposable (poly)
☐ Pump, type: _____
☐ Other, describe: _____

Sample obtained is ☒ GRAB; ☐ COMPOSITE SAMPLE

6 []

ON-SITE MEASUREMENTS:

Time							Measured with
Temp (°C)	23.4	24.0	24.0	24.3	24.3		YSI 55
pH	6.16	6.27	6.27	6.27	6.27		Orion 250A
Cond (µS/cm)	.096	.102	.102	.102	.102		Hach
DO (mg/L)	7.26	6.18	6.15	6.08	6.11		YSI 55
Redox (mV)	98.6	94.5	93.2	89.1	90.1		Orion 250A
gallons purged		1	2	3	4		

7 []

SAMPLE CONTAINERS (material, number, size): 9-60ml glass vials, 1-1 Liter glass

8 []

ON-SITE SAMPLE TREATMENT:

☐ Filtration: Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

☐ Preservatives added:

Method BTEX Containers: 40ml vial HCL
Method Methanol Containers: 40ml vial HCL
Method _____ Containers: _____
Method _____ Containers: _____

9 []

CONTAINER HANDLING:

☒ Container Sides Labeled
☐ Container Lids Taped
☒ Containers Placed in Ice Chest

10 []

OTHER COMMENTS:

GROUNDWATER SAMPLING RECORD

ELLIN AFB FL

Sampling Location Homestead ARBSampling Dates 3-27-98GROUND WATER SAMPLING RECORD - MONITORING WELL M-1 EA-8

(Identification)

REASON FOR SAMPLING: ☒ Regular Sampling; ☒ Special Sampling;DATE AND TIME OF SAMPLING: 3-27-98 at 1130 a.m./p.m.SAMPLE COLLECTED BY: LAG of Parsons ESWEATHER: Warm Sunny ~ 71°FDATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC Top of Casing

MONITORING WELL CONDITION:

☒ LOCKED:☐ UNLOCKEDWELL NUMBER (S) IS NOT APPARENTSTEEL CASING CONDITION IS: OKINNER PVC CASING CONDITION IS: OKWATER DEPTH MEASUREMENT DATUM (S) IS NOT APPARENT☐ DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR☐ MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 ☐EQUIPMENT CLEANED BEFORE USE WITH alconox, di, iso, diItems Cleaned (List): all instrumen + probes2 ☐PRODUCT DEPTH none FT. BELOW DATUMMeasured with: mobel 121 intex base meter

WATER DEPTH _____ FT. BELOW DATUM

Measured with: slope water level indicator3 ☐

WATER-CONDITION BEFORE WELL EVACUATION (Describe):

Appearance: clearOdor: none

Other Comments:

4 ☐

WELL EVACUATION:

Method: pumpVolume Removed: ~4 galObservations: Water (slightly - very) cloudy clearWater level (rose - fell) no changeWater odors: none

Other comments:

Groundwater Sampling Record

Monitoring Well No. EA-10 (Continued)

5 []

SAMPLE EXTRACTION METHOD:

☒ Bailer made of: disposable

☒ Pump, type: _____

☐ Other, describe: _____

Sample obtained is ☒ GRAB; ☐ COMPOSITE SAMPLE

6 []

ON-SITE MEASUREMENTS:

Time							Measured with
Temp (°C)	24.8	24.4	23.9	24.6			YSI 55
pH	7.62	7.58	7.54	7.54			Orion 250A
Cond (µS/cm)	140	135	135	135			Hach
DO (mg/L)	7.50	6.56	7.90	7.51			YSI 55
Redox (mV)	62.1	68.5	74.7	74.5			Orion 250A
gallons purged							

7 []

SAMPLE CONTAINERS (material, number, size): 9-40ml glass vials, 5-1-liter glass
2-500ml poly

8 []

ON-SITE SAMPLE TREATMENT:

☐ Filtration: Method dissolved lead Containers: 500ml poly
Method _____ Containers: _____
Method _____ Containers: _____

☐ Preservatives added:

Method BTEX Containers: 40ml vial HCL
Method Methane Containers: 40ml vial HCL
Method TRPH Containers: 1-liter amber HCL
Method Total lead Containers: 500ml poly HNO3
dissolved lead 500ml poly HNO3

9 []

CONTAINER HANDLING:

☒ Container Sides Labeled
☐ Container Lids Taped
☒ Containers Placed in Ice Chest

10 []

OTHER COMMENTS:

GROUNDWATER SAMPLING RECORD

Eglin AFB FL.

Sampling Location Homestead ARB
Sampling Dates 3-27-98GROUND WATER SAMPLING RECORD - MONITORING WELL Mil EA-10
(Identification)REASON FOR SAMPLING: ☒ Regular Sampling; ☐ Special Sampling;
DATE AND TIME OF SAMPLING: 3-27-98 at 0730 (a.m.) p.m.
SAMPLE COLLECTED BY: RDM of Parsons ES
WEATHER: Warm, Sunny ~ 62°F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC top of casing

MONITORING WELL CONDITION:

☒ LOCKED: ☐ UNLOCKED
WELL NUMBER (IS) IS NOT APPARENT
STEEL CASING CONDITION IS: OK
INNER PVC CASING CONDITION IS: OK
WATER DEPTH MEASUREMENT DATUM (IS) IS NOT APPARENT
☐ DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
☐ MONITORING WELL REQUIRED REPAIR (describe):

Check-off

- 1 ☐ EQUIPMENT CLEANED BEFORE USE WITH alcanox, di, isy, di
Items Cleaned (List): all instrument probes
- 2 ☐ PRODUCT DEPTH none FT. BELOW DATUM
Measured with: model 121 interface meter
- WATER DEPTH 33.42 FT. BELOW DATUM
Measured with: slope water level indicator
- 3 ☐ WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: clear
Odor: none
Other Comments:
- 4 ☐ WELL EVACUATION:
Method: pump
Volume Removed: ~3 gal
Observations: Water (slightly - very) cloudy: clear
Water level (rose - fell - no change): no change
Water odors: none
Other comments:

APPENDIX D

SLUG TEST DATA ANALYSIS

CLIENT: AFCEE/Eglin AFB

COMPANY: Parsons Eng Sci

LOCATION: Military Gas Station

PROJECT: 731854.03000

Slug Test Analysis

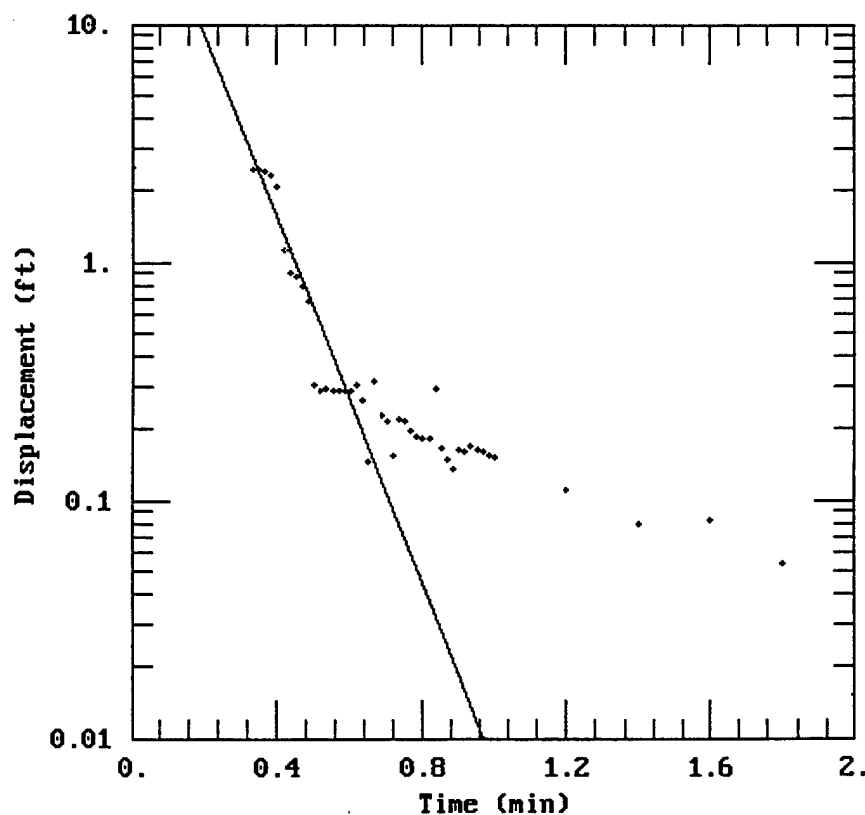
DATA SET:
EA10_1.DAT
07/01/98

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: 3/30/98
test well: NA
obs. well: EA-10

TEST DATA:
 $H_0 = 2.5$ ft
 $r_c = 0.083$ ft
 $r_w = 0.177$ ft
 $L = 15.$ ft
 $b = 60.$ ft
 $H = 9.$ ft

PARAMETER ESTIMATES:
 $K = 0.01038$ ft/min
 $y_0 = 54.88$ ft



AQTESOLV

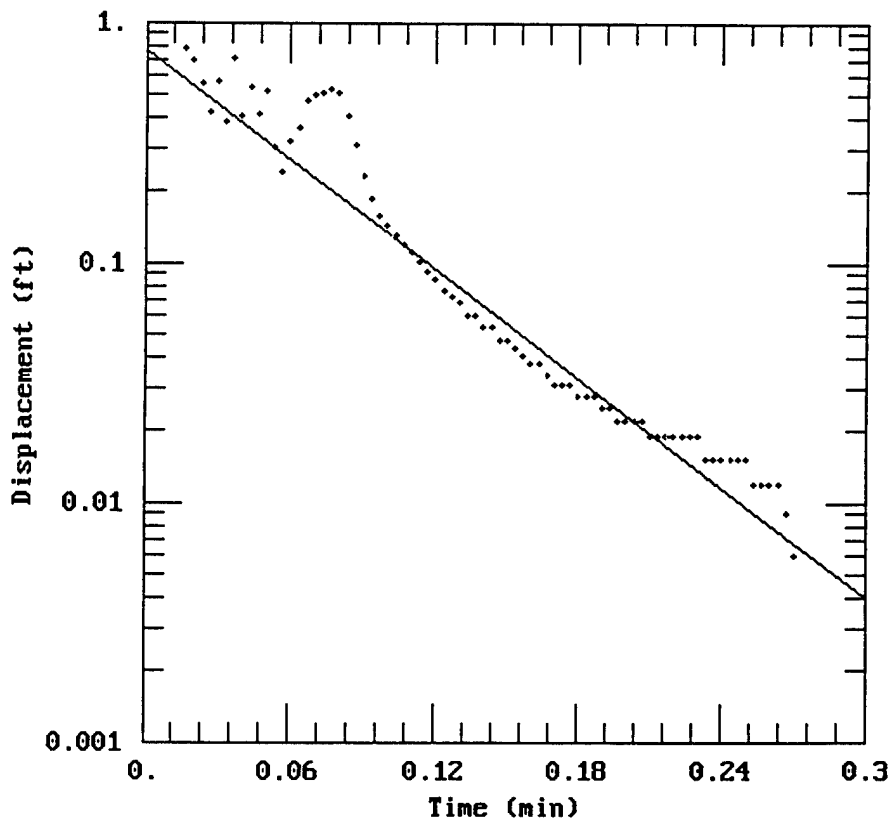
CLIENT: AFCEE/Eglin AFB

COMPANY: Parsons Eng Sci

LOCATION: Military Gas Station

PROJECT: 731854.03000

Slug Test Analysis



DATA SET:
EA10_2.DAT
07/01/98

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: 3/30/98
test well: NA
obs. well: EA-10

TEST DATA:
 $H_0 = 0.8$ ft
 $r_c = 0.083$ ft
 $r_w = 0.177$ ft
 $L = 15.$ ft
 $b = 60.$ ft
 $H = 9.$ ft

PARAMETER ESTIMATES:
 $K = 0.02047$ ft/min
 $y_0 = 0.7694$ ft

AQTESOLU

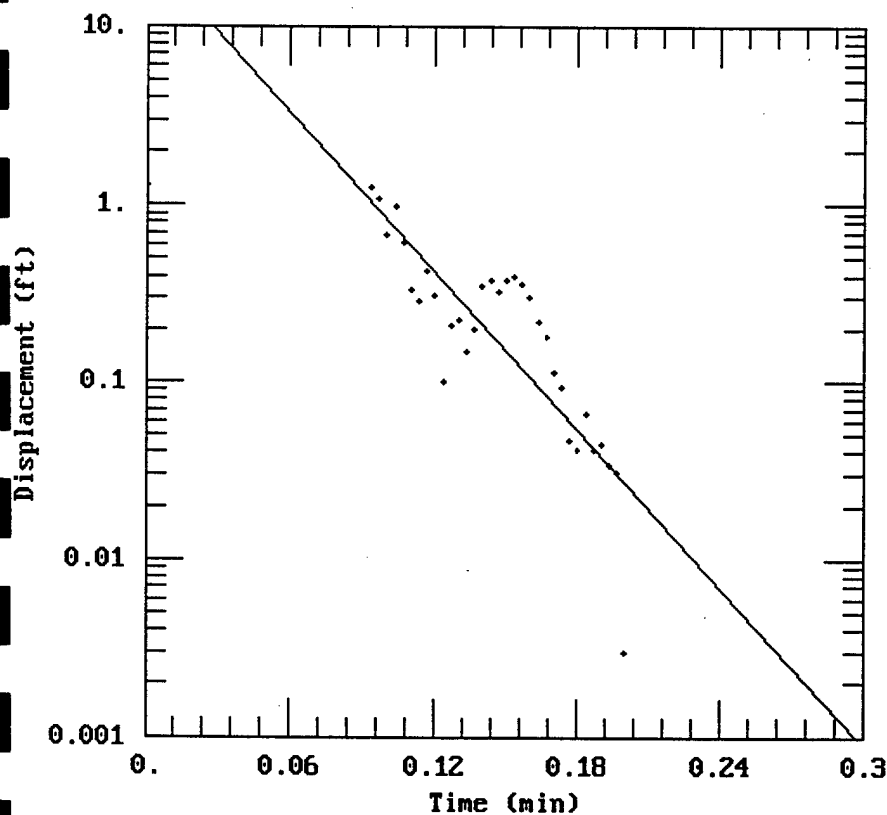
CLIENT: AFCEE/Eglin AFB

COMPANY: Parsons Eng Sci

LOCATION: Military Gas Station

PROJECT: 731854.03000

Slug Test Analysis



DATA SET:
EA11_1.DAT
07/01/98

AQUIFER MODEL:

Unconfined

SOLUTION METHOD:

Bouwer-Rice

PROJECT DATA:

test date: 4/1/98

test well: NA

obs. well: EA-11

TEST DATA:

H₀ = 1.3 ft

r_c = 0.083 ft

r_w = 0.177 ft

L = 15. ft

b = 60. ft

H = 8. ft

PARAMETER ESTIMATES:

K = 0.03916 ft/min

y₀ = 26.14 ft

AQTESOLV

APPENDIX E
CALCULATIONS

PORE VOLUME CALCULATION

Source Area length 50 ft.

Groundwater Velocity 124 ft/yr

$$\frac{50 \text{ ft}}{124 \text{ ft/yr}} = 0.4 \text{ yr} \text{ for 1 pore volume to migrate through the source area.}$$

$$\therefore 2.5 \text{ pore volumes/yr}$$

Find t.

$$C = C_0 e^{-kt}$$

$$C_0 = 400 \text{ mg/L (Xylenes @ EA-4, 1998)}$$

$$C = 20 \text{ mg/L (FDEP TCL for Xylenes)}$$

$$-k = -0.001/\text{day}$$

$$20 \text{ mg/L} = 400 \text{ mg/L} \times e^{(0.001 t/\text{day})}$$

$$0.05 = e^{-0.001 t/\text{day}}$$

$$\ln(0.05) = \frac{-0.001 t}{\text{day}}$$
$$-3 = \frac{-0.001 t}{\text{day}}$$

$$2996 \text{ day} = t$$

$$t = 8.2 \text{ yr}$$

Client AFCEE Mil Gas Eglon AFB
Proj. No. 731854.03000.045.01.3000
By Cindy Nagel Date June 25, 1998
Chkd. Wendy Brown Date 6/25/98
Revision _____

Decay Calc

$$C = C_0 e^{(-kt)}$$

Xylenes

$$C = 20 \text{ } \mu\text{g/L}$$

$$C_0 = 400 \text{ } \mu\text{g/L}$$

$$k = -0.0009 \text{ day}^{-1}$$

$$t = \text{???? days}$$

$$t = 3329 \text{ days}$$

$$t = 9.1 \text{ years}$$

Ethylbenzene

$$C = 30 \text{ } \mu\text{g/L}$$

$$C_0 = 76 \text{ } \mu\text{g/L}$$

$$k = -0.001 \text{ day}^{-1}$$

$$t = \text{???? days}$$

$$t = 930 \text{ days}$$

$$t = 2.5 \text{ years}$$

Naphthalene

$$C = 20 \text{ } \mu\text{g/L}$$

$$C_0 = 40 \text{ } \mu\text{g/L}$$

$$k = -0.0007 \text{ day}^{-1}$$

$$t = \text{???? days}$$

$$t = 990 \text{ days}$$

$$t = 2.7 \text{ years}$$

PARSONS ENGINEERING SCIENCE, INC.

Client Esj. AFB

Job No. 731854.03000

Sheet 1 of 1

Subject Xylene Volumes

By Steve Hicks

Date 3/8/99

Checked _____

Rev. _____

$$200+ \text{Area} = 0.8" \times 0.35" = 64' \times 28' = 1792 \text{ft}^2$$

$$1 \text{ in} = 80 \text{ ft}$$

$$20+ \text{Area} = 2.15" \times 0.8" = 172' \times 64' = 11,008 \text{ft}^2$$

$$5+ \text{Area} = 3.5" \times 2" = 280' \times 160' = 44,800 \text{ft}^2$$

$$200+ \text{Vol} = 1792 \text{ft}^2 \times 5 \text{ft} = 8960 \text{ft}^3$$

$$20+ \text{Vol} = 11,008 \text{ft}^2 \times 8 \text{ft} = 88,064 \text{ft}^3 \text{ (Includes } 200+ \text{ Volume)}$$

$$5+ \text{Vol} = 44,800 \text{ft}^2 \times 10 \text{ft} = 448,000 \text{ft}^3 \text{ (Includes } 200+ \text{ and } 20+ \text{ Volume)}$$

Actual Volume of Soil and Water

$$5+ \text{Vol} = 448,000 \text{ft}^3 - 88,064 \text{ft}^3 = 359,936 \text{ft}^3$$

$$20+ \text{Vol} = 88,064 \text{ft}^3 - 8960 \text{ft}^3 = 79,104 \text{ft}^3$$

$$200+ \text{Vol} = 8960 \text{ft}^3$$

Actual Volume of Water fine sand, $\phi = 30\%$

$$5+ \text{Vol} = 359,936 \text{ft}^3 \times 30\% = 107,980.8 \text{ft}^3 = 3,057,676 \text{L} = 5+ \text{Vol}$$

$$20+ \text{Vol} = 79,104 \text{ft}^3 \times 30\% = 23,731.2 \text{ft}^3 = 671,993 \text{L} = 20+ \text{Vol}$$

$$200+ \text{Vol} = 8,960 \text{ft}^3 \times 30\% = 2,688 \text{ft}^3 = 76,116 \text{L} = 200+ \text{Vol}$$

Volume of Contaminant

$$5+ \text{Vol} = 3,057,676 \text{L} \times 10 \mu\text{g}/\text{L} = 30,576,760 \mu\text{g}$$

$$20+ \text{Vol} = 671,993 \text{L} \times 100 \mu\text{g}/\text{L} = 67,199,300 \mu\text{g}$$

$$200+ \text{Vol} = 76,116 \text{L} \times 300 \mu\text{g}/\text{L} = 22,834,800 \mu\text{g}$$

(CRC Handbook)

$$120,610,860 \mu\text{g} = 120,611 \text{mg} = 120.6 \text{g}$$

$$120.6 \text{g} \times \frac{\text{mL}}{0.95} = 134 \text{mL Xylene} = 9.06 \text{tbsp}$$