Kirtland Air Force Base
Albuquerque, New Mexico

RCRA Facility Investigation Report
Appendix III Non-Wasteline Sites

DRAFT FINAL - October 23, 1995

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INSTALLATION RESTORATION PROGRAM
KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

DRAFT FINAL
RCRA FACILITY INVESTIGATION (RFI) REPORT
APPENDIX III NON-WASTELINE SITES

OCTOBER 23, 1995

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This RCRA Facility Investigation Report addresses 14 sites listed as solid waste management units associated with non-wastelines in Appendix III of Module IV to the RCRA Part B Permit (No. NM9 570 024-423) for Kirtland AFB and summarizes the RFI conducted at these sites during 1994.

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PREFACE

This RCRA Facility Investigation (RFI) Report summarizes the RFI conducted during 1994 at 14 sites listed as solid waste management units in Appendix III of Module IV to the RCRA Part B Permit for Kirtland AFB. This report was prepared to address the requirement of the USAF Statement of Work, dated March 7, 1994, and also the requirements for an RFI Report as specified in the RCRA Part B Permit for Kirtland AFB. This report was prepared by Halliburton NUS Corporation from July through October 1994. Mr. Bassim D. Shebaro of the Air Force Center for Environmental Excellence was the Restoration Team Chief and Mr. Rodney C. Arnold served as the Contracting Officer's Representative.

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ABW	Air Base Wing
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AFFF	aqueous film-forming foam
AFMC	Air Force Materiel Command
AFWL	Air Force Weapons Laboratory
AMC	Air Mobility Command
amsl	above mean sea level
AOC	area of concern
ASTM	American Society of Testing Materials
BCF	bioconcentration factor
bgs	below ground surface
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
CCTW	Combat Crew Training Wing
CTW	Combat Training Wing
DCQAP	Data Collection Quality Assurance Plan
DDD	(1,1-bis(chlorophenyl)-2,2-dichloroethane)
DDE	(1,1-bis(chlorophenyl)-2,2-dichloroethene)
DDT	(1,1-bis(chlorophenyl)-2,2,2-trichloroethane)
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
DRO	diesel range organics
EM	Environmental Management Division
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
FTL	Field Team Leader
GFAA	graphite furnace atomic absorption
GRO	gasoline range organics

HHRB	human health risk-based
HPD	horizontal polarized dipole
ICP	inductively coupled plasma
ICS	interference check sample
IDL	instrument detection limit
INWS	Interservice Nuclear Weapons School
IRP	Installation Restoration Program
ITRI	Inhalation Toxicology Research Institute
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LIMS	Laboratory Information Management System
MS/MSD	matrix spike/matrix spike duplicate
MWSA	Manzano Weapons Storage Area
NaI	sodium iodide
NCP	National Contingency Plan
NFA	no further action
NGVD29	1929 National Geodetic Vertical Datum
NIST	National Institute of Standards and Technology
NMED	New Mexico Environment Department
OWS	oil/water separator
%Ds	percent differences
%Rs	percent recoveries
%RSD	percent relative standard deviation
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDS	post digestion spike
PID	photoionization detector
POC	point of contact
POTW	publicly owned treatment works
PR/VSI	Preliminary Review/Visual Site Inspection
PVC	polyvinyl chloride
QAP	Quality Assurance Program
QA/QC	quality assurance/quality control

RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
RRE	relative risk evaluation
RRF	relative response factor
SAP	Sampling and Analysis Plan
SNL	Sandia National Laboratories
SOP	standard operating procedure
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCLP	Toxicity Characteristic Leaching Procedure
TPH	total petroleum hydrocarbons
USAF	U.S. Air Force
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
VOA	volatile organic aromatic
VOC	volatile organic compound
VSI	Visual Site Inspection

Executive Summary

EXECUTIVE SUMMARY

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Kirtland Air Force Base (AFB) was performed to fulfill the requirements of the Kirtland AFB RCRA Part B Permit. Kirtland AFB is located in central New Mexico, southeast of and adjacent to the City of Albuquerque and the Albuquerque International Airport. Kirtland AFB encompasses 52,287± acres, and is host to the 377th Air Base Wing of the Air Force Materiel Command.

This RFI Report presents the Appendix III (Stage 2C) non-wasteline investigation results. This investigation was performed in support of the United States Air Force Installation Restoration Program (IRP). Developed by the U.S. Department of Defense (DOD), this program identifies and evaluates hazardous waste storage and disposal sites on DOD property and mitigates any potential adverse effects to human health and the environment caused by management of hazardous waste at these sites. This investigation was performed after a RCRA Facility Assessment and previous IRP environmental investigations were conducted that identified various solid waste management units (SWMUs) where contaminants may have been released to the environment. The principal objectives of this investigation were to (1) confirm the presence or absence of contaminants at the sites evaluated, (2) determine which sites would require additional investigation to further define the nature and extent of contamination, if present, and (3) evaluate any actual and/or potential risk to public health and the environment.

Site investigations were prioritized by the U.S. Environmental Protection Agency based on the assumed potential for release and damage to the environment. Those sites having a similar potential were grouped together as appendices in the Kirtland AFB RCRA Part B Permit. Originally, three appendices (Appendix I, II, and III) were established, and each was scheduled as a separate investigation stage. Appendix I sites were previously investigated during the Stage 2A investigation (USAF, 1993b), and Appendix II sites during the Stage 2B RFI. This RFI report presents the investigation results for sites contained in Appendix III.

The Appendix III non-wasteline RFI sites include: three battery storage areas, two waste accumulation areas, an effluent transmission line, a jet engine burn area, a jet engine test cell, a waste oil tank, a condensate holding tank, a contractor storage yard, a vehicle maintenance yard, a paint shop and sink drain, and a drum rack.

Fieldwork for the Appendix III non-wasteline RFI was conducted from May 23 to August 1, 1994. RFI activities included surface and subsurface soil sample collection (using a Geoprobe and/or hand auger), and laboratory analysis. Soil samples were analyzed for numerous parameters including volatile organics, semivolatile organics, metals, and petroleum hydrocarbons.

Of the 14 sites investigated, nine sites did not have evidence of a contaminant release and No Further Action proposals are recommended. The remaining five sites had evidence of contaminant release or had anomalous detections of one or more constituents of concern and will require additional data collection. Neither Corrective Measure Studies nor Corrective Measure Actions are currently recommended for any of these five sites. Table ES-1 summarizes the recommendations for sites requiring additional data.

Table ES-1. Summary of Recommendations for Selected Sites

SWMU	Description	Acquire Additional Data	Text Section
9-4	Building 617, Waste Accumulation Area (ST-276)	X	9
9-20	Building 909, Inactive Waste Accumulation Area (ST-277)	X	10
ST-64	Building 20212, U.S. Army Corps of Engineers Vehicle Maintenance Yard (ST-64) (former ST-337)	X	14
WP-339	Contractor Yard West of Building 20423 (WP-339)	X	16
ST-341	Building 1033, Condensate Holding Tank (ST-341)	X	18

1.0 Introduction

Halliburton NUS Corporation (Halliburton NUS) has prepared this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for Kirtland Air Force Base (AFB) as part of the United States Air Force (USAF) Installation Restoration Program (IRP) under Contract Number F33615-90-D-4011, Delivery Order 0022. This report summarizes the RFI conducted at the 13 non-wasteline sites listed as solid waste management units (SWMUs) in Appendix III, and one non-wasteline site listed as a SWMU in Appendix II of Module IV to the RCRA Part B Permit for Kirtland AFB. Currently, Kirtland AFB is modifying the permit to transfer two of the Appendix III sites to Appendix II. This RFI Report was prepared to meet the requirements of the RCRA Part B Permit and the U.S. Air Force (USAF) Statement of Work dated March 7, 1994.

The purpose of this RFI was to obtain data to determine if a release of hazardous waste or hazardous waste constituents occurred at the 14 sites. The data are used to identify the nature of any releases or to justify No Further Action (NFA).

The Kirtland AFB RCRA Part B Permit originally required submittal of three separate RCRA RFI Work Plans. Separate work plans were developed for Appendix I and II sites as identified in the permit. A third set of two work plans addresses the SWMUs contained in Appendix III of the permit. After petitioning by Kirtland AFB, the U.S. Environmental Protection Agency (EPA) approved the development of a fourth set of sites (Appendix IV), which were reassigned from Appendix II and Appendix III. The Appendix IV sites are associated with former radiological activities at the base and include two radiological burial sites (SWMUs 6-30 and 6A-1), five underground emergency holding tanks (SWMU 6A-2), the Radium Dump/Slag Piles and Cratering Area (SWMU RW-68), and the Drum Storage Area (SWMU SS-69).

An additional appendix, Appendix V, has been included in the Kirtland AFB RCRA Part B Permit as a result of the discovery of nine sites where potential releases to the environment may have occurred. These sites include six SWMUs, one of which consists of three distinct areas of concern (AOCs). The EPA Region 6 did not require a separate RFI Work Plan for these new sites. Rather, the investigations were conducted in accordance with the plans approved by the EPA on April 7, 1994, for the investigation of the Appendix III SWMUs.

1.1 USAF Installation Restoration Program

In 1995, Kirtland AFB, Federal and State regulators, and local citizen groups completed relative risk evaluations (RREs) at all IRP sites; a modification to the RCRA Part B Permit based on RREs is pending at the EPA. Sites evaluated as *high*, *medium*, or *low* risk will be realigned into Appendix I, II, or III, respectively. Appendix IV will remain unchanged and is reserved for sites having potential radiological or mixed waste contamination.

The IRP was developed to identify, confirm/quantify, and remedy problems caused by past management of hazardous waste at USAF facilities; it is the basis for assessment and response actions at all USAF installations. The IRP guidance was initially published in January 1982 under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and was developed as a four-phased program:

- Phase I—Installation Assessment.
- Phase II—Confirmation/Quantification.
- Phase III—Technology Base Development.
- Phase IV—Remedial Action Plan/Operations.

Following passage of the Superfund Amendments and Reauthorization Act in October 1986, the USAF altered the IRP by combining Phases II and IV into one investigative/remedial stage to parallel the EPA CERCLA Remedial Investigation/Feasibility Study (RI/FS) process. The Appendix III RFI was performed under the guidance of the *Handbook for the Installation Restoration Program Remedial Investigations and Feasibility Studies (RI/FS),* September 1993 (AFCEE, 1993). Although CERCLA guidelines are generally the basis for activities conducted under the IRP, this project was performed under the authority of RCRA in accordance with the Kirtland AFB RCRA Part B Permit. The field, analytical, and reporting procedures were performed in accordance with the 1993 IRP Handbook and in compliance with EPA and New Mexico Environment Department (NMED) requirements for RFIs as contained in the approved Appendix III RFI Wasteline Investigation Work Plan.

1.2 Installation Description

1.2.1 Base Location

Kirtland AFB is located in central New Mexico, southeast of and adjacent to the City of Albuquerque and next to the Albuquerque International Airport (Figure 1-1). The base is in Bernalillo County at an approximate latitude of 36° 46′ 00″ N and longitude of 108° 21′ 15″ W. The approximate area of the base is 52,287 acres. A general site plan for the base is presented in Figure 1-2.

1.2.2 Base History

Prior to 1928, the area where Kirtland AFB is now situated was rangeland. Construction of Albuquerque's first municipal airport, Oxnard Field, occurred between 1928 and 1930. The airfield was expanded in the mid-1930s to provide U.S. Army and U.S. Navy pilots with a transient refueling and maintenance stop. In the late 1930s to early 1940s, Oxnard Field was used as a transient stop for aircrews ferrying bomber aircraft to England. In 1939, the City of Albuquerque began planning a new municipal airport and the U.S. Army leased 2,000 acres of land adjacent to Oxnard Field.

The Albuquerque Army Air Base (home of the 19th Bombardment Group) was constructed in 1941 for B-17 and B-18 bomber combat crew training. In late 1941, the Bombardier School/Air Force Advanced Flying School opened at Albuquerque Army Air Base; training was expanded to include B-24s and AT-11 aircraft. In February 1942, Albuquerque Army Air Field was renamed Kirtland Field. Later that year, the Army Air Forces acquired Oxnard Field (approximately 11,000 acres east of Kirtland Field). Construction began on Albuquerque Air Depot Training Station, a training depot for aircraft mechanics (which later became Sandia Base).

From 1944 to 1945, Kirtland Field was used as an Army Air Force Medical Convalescent Center for returning veterans and a dismantling and storage facility for war-weary and surplus planes. In 1946, the base became involved in activities supporting special weapons development. In 1947, Kirtland Field was

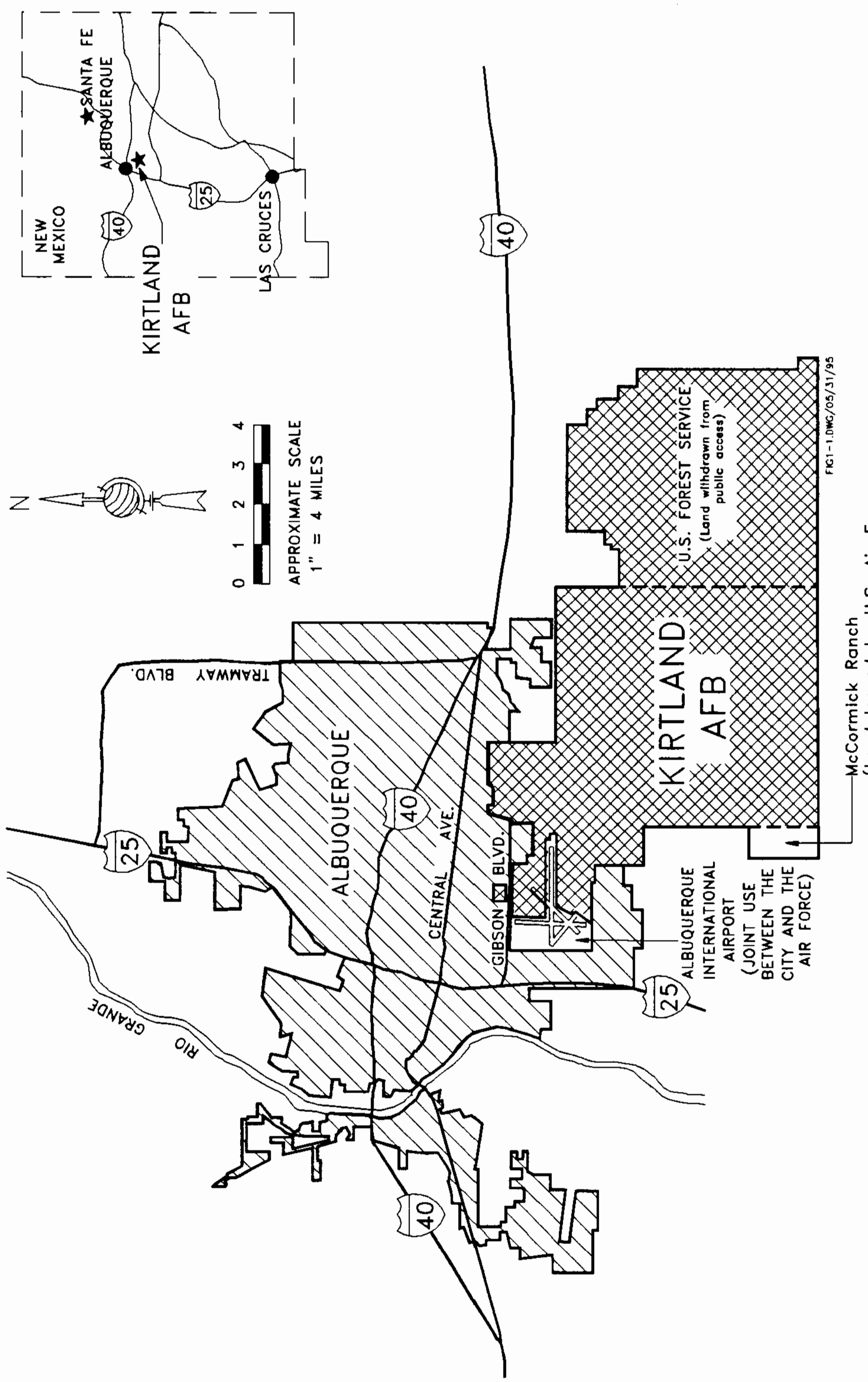

Figure 1-1. Location of Kirtland AFB, Albuquerque, New Mexico

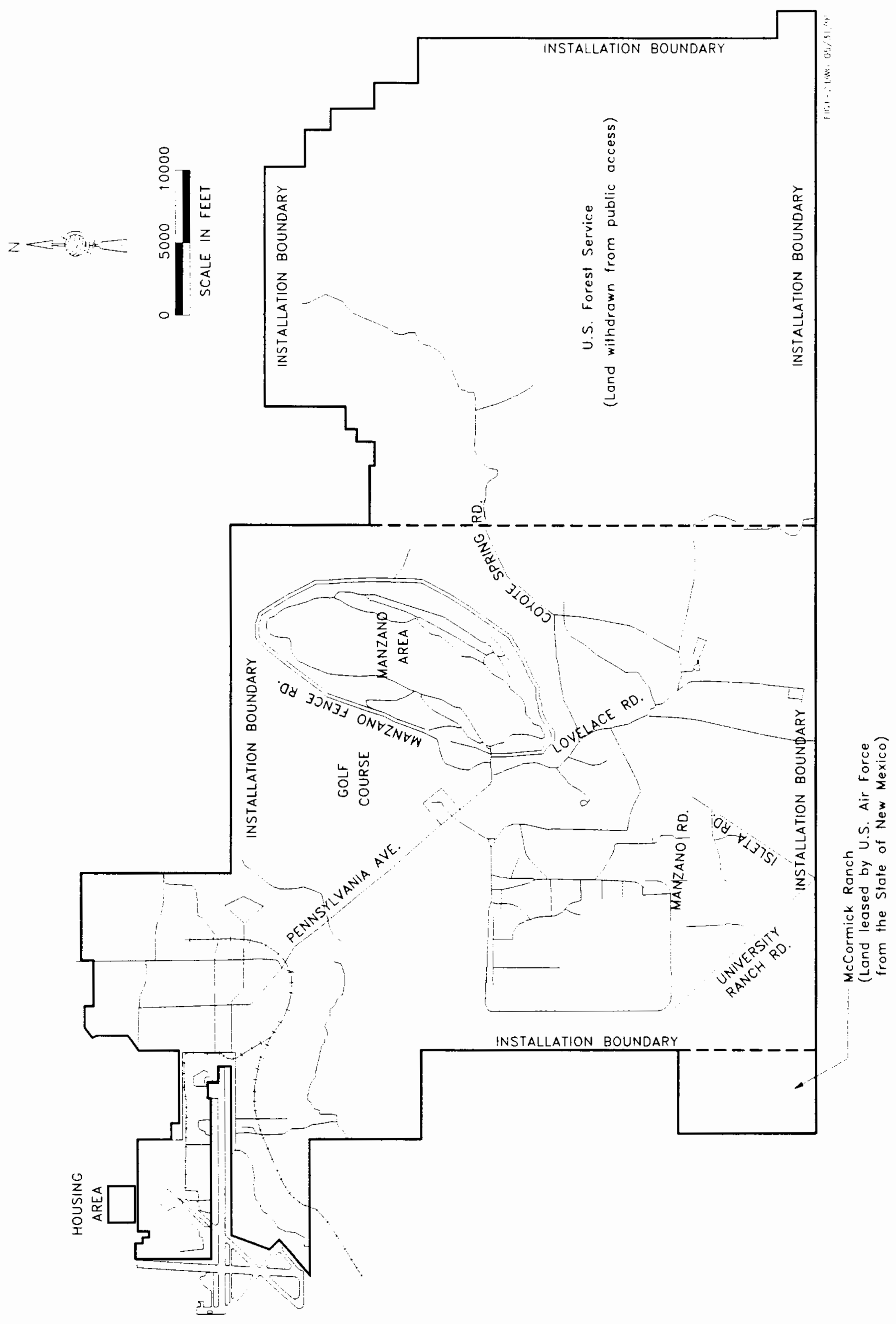

Figure 1-2. General Site Plan Kirtland AFB, Albuquerque, New Mexico

redesignated Kirtland AFB. During 1947, the main mission of the base involved a continuation of World War II weapons development, ballistics, equipment handling, aircraft modification, and development tests for existing and proposed nuclear weapons (USAF, 1993).

In 1945, portions of Los Alamos Laboratory moved to Albuquerque Air Depot Training Station to manage development of special weapons assembly, and the station was redesignated as the Armed Forces Special Weapons Project (which later became the Air Force Special Weapons Center, then the Air Force Weapons Laboratory). The Sandia Branch of the Los Alamos Scientific Laboratory later became Sandia National Laboratories (SNL), the largest tenant at Kirtland AFB. SNL is involved in researching and developing energy source systems, as well as developing and testing special weapons.

Initial construction of a weapons storage area began in 1947. This storage area is in a small foothill range of the Manzano Mountains, known locally as Four Hills, near the southwestern boundary of what was then Sandia Base. The storage area, initially known as Site Able, later became Manzano Base and was later redesignated the Manzano Weapons Storage Area (MWSA).

In the 1960s, both Kirtland AFB and Sandia Base were primarily known as nuclear testing and development facilities. In 1963, the Air Force Weapons Laboratory (AFWL) was established at Kirtland AFB to undertake weapons research and to develop simulation techniques. The AFWL was one of the major tenants at Kirtland AFB. During this period, the AFWL constructed facilities to simulate nuclear blast effects, including transient radiation, x-rays, and electromagnetic pulses (USAF, 1981). The AFWL became part of Air Force Phillips Laboratory in December 1990.

In 1966, the airfield, taxiways, and attendant properties were sold to the City of Albuquerque to become the Albuquerque International Airport, and Kirtland AFB initiated a leased arrangement with the City to conduct its military flying operations. In July 1971, Manzano and Sandia Bases merged with Kirtland AFB and became the eastern side of Kirtland AFB; the Air Force Special Weapons Center assumed management responsibilities. In the 1970s, Kirtland AFB evolved into essentially a research and development base, hosting other military organizations. The research and development activities were primarily in the areas of nuclear weapons and nuclear blast effects, electronics, lasers, and explosives. During the early 1970s, the Air Force Contract Management Division was in command of the base.

In 1976, the 4900th Air Base Wing (ABW) was created to oversee operational testing of emergency aircraft systems, and the 1550th Aircrew Training and Test Wing (later designated the Combat Crew Training Wing [CCTW]) brought regular flight operations to Kirtland AFB. Beginning in 1977, the Military Airlift Command (MAC) became responsible for host activities and the 1606 ABW was designated the host organization. The host supports the needs of all of the facility's associates (except SNL), including maintenance, transportation, and administration.

In 1982, Kirtland AFB became the hub of USAF space technology when the Air Force Space Technology Center was activated. In 1990, the Air Force Phillips Laboratory was established and became responsible for the missions of the Space Technology Center and Weapons Laboratory.

In October 1991, the 1550 CCTW merged with the 1606 ABW to form the 542d Combat Training Wing (CTW), the host organization at Kirtland AFB. The operational mission was to train all USAF helicopter and HC-130 crews and all pararescue personnel for worldwide operations.

In January 1993, the 542 CTW split from the host wing to once again become a separate flying/training wing under Air Mobility Command (AMC) (formerly MAC), and the 377 ABW was activated as the new host base wing. Kirtland AFB was reassigned from AMC to Air Force Materiel Command (AFMC), headquartered at Wright-Patterson AFB, Ohio. The 542 CTW continued its role of training aircrews and pararescue specialists for worldwide duty with Air Force Special Operations Command and Air Rescue Service. On April 1, 1994, the 542 CTW became the 58th Special Operations Wing under the Air Education and Training Command. Kirtland AFB continues to be one of the nation's leading research, development, test, and evaluation facilities.

1.2.3 Current Base Activities

As the host organization at Kirtland AFB, the 377 ABW provides support to organizations and aids in war-time mobility requirements in various critical specialties. The wing has 2,522 employees, including 166 officers, 1,375 enlisted personnel, and 981 civilian employees who assist Kirtland's nearly 21,000 employees in more than 150 associate units. The two largest associates are Phillips Laboratory and SNL (operated for the U.S. Department of Energy (DOE) under separate EPA identification numbers). Other major tenants include the Air Force Operational Test and Evaluation Center, the Defense Nuclear Agency's Field Command, the Air Force Safety Agency, the Air Force Inspection Agency, and the Air Force Security Police Agency. The 377 ABW furnishes the resources, equipment, and facilities necessary to support these complex and varied organizations.

Traditionally, Kirtland AFB has been divided into west and east sides based on the original demarcation line between the original Kirtland AFB and Sandia Army Base. For this report, all references to the western or eastern portions of the base encompass the entire area, including the United States Forest Service (USFS) withdrawn portion.

The Environmental Management Division (EM) of the 377th Air Base Wing is responsible for waste management activities and environmental restoration efforts at Kirtland AFB. As of 1987, 806 buildings housed industrial shops, laboratories, and administrative activities. Over the years of facility operation, numerous functional changes have occurred for various buildings (e.g., from shop to laboratory to administration). Changes in laboratory research projects have resulted in changes in the waste stream composition and volume. Consequently, waste generation areas and the types of waste generated have changed over time (EPA, 1983; Atchue, 1988; and Gupta and La Russo, 1988). The facility EPA identification number was issued to the Installation Commander, who is considered the owner and operator of the U.S. Department of Defense (DOD) facility. The objectives of the Kirtland AFB environmental restoration program are as follows:

- Provide staff resources necessary to complete the environmental restoration program.
- Protect human health and the environment.
- Comply with applicable statutes and regulations.
- Meet EPA Region 6 and NMED schedules in any agreements and permits.
- Complete RFIs as soon as practicable for SWMUs.
- Identify all potential source areas.

- Establish areas of no suspected contamination.

- Initiate removal actions where necessary to control, eliminate, or reduce the risks to manageable levels.

- Characterize risks associated with releases of hazardous substances, pollutants, contaminants, or hazardous wastes.

- Develop, screen, and select Corrective Measures Implementations (CMIs) that reduce risks in a manner consistent with statutory requirements.

- Commence CMIs for SWMUs as soon as practicable.

1.3 Report Format

This report has been prepared to present information about the 14 sites studied during the Appendix III non-wasteline RFI at Kirtland AFB. These sites are listed or are related to sites listed in the RCRA Part B Permit and include waste accumulation areas and storage yards, battery storage yards, underground storage tanks (USTs), a jet engine burn area, a jet engine test cell, a paint shop and sink drain, and a drum rack. The 14 Appendix III RFI non-wasteline sites are listed in Table 1-1. The report is organized into 18 sections plus appendices. The format for this RFI Report was developed in consultation with the USAF using site groupings consistent with the requirements of the Kirtland AFB RCRA Part B Permit and the Appendix III Non-Wasteline RFI Work Plan.

- ***Section 1.0 – Introduction***. This section outlines the current study and scope of this RFI, as well as general installation background information.

- ***Section 2.0 – Environmental Setting***. This section focuses on environmental data and information that are common to the sites throughout the base. It includes information on climate, topography, geology, hydrogeology, soil, and surface water.

- ***Section 3.0 – Investigation Procedures***. The field and laboratory procedures used during this investigation are described in this section.

- ***Section 4.0 – Facility-Wide Results Summary***. This section presents an overview of the contaminants detected, the physical properties, and methodology for determining background metal concentrations.

- ***Sections 5.0 through 18.0 – Site Descriptions***. These sections present information that is specific to each site. Each section contains a study area description, details on the investigation conducted at the site, and site-specific geologic and hydrogeologic characteristics. In addition, each section presents the analytical results for the samples collected and the nature and extent of any contamination as defined by those samples. Finally, each section contains a summary and conclusions subsection that, based on analytical results, either outlines any further data needs and makes recommendations for future action or proposes that a NFA decision document be prepared at each site.

- *Appendices.* Appendix information is as follows:

Appendix A	USAF Statement of Work
Appendix B	Biographies of Key Personnel
Appendix C	Soil Borehole Logs
Appendix D	Surveying Data
Appendix E	Chain-of-Custody Forms
Appendix F	Analytical Data
Appendix G	Correspondence with Federal, State, and Local Government Agencies
Appendix H	Data from Previous Investigations
Appendix I	Not used to avoid confusion with citation of previous Appendix I documents
Appendix J	Quality Assurance/Quality Control (QA/QC) for Production of Documents
Appendix K	Analytical Data Quality Assurance/Quality Control

Table 1-1. Summary of Non-Wastelines

SWMU No.	Description
6-14	Sewage Effluent Transmission Line (ST-51)
6-16	Jet Engine Burn Area (part of Kirtland Fire Training Area [FT-13]) (FT-52)
10-3	Building 20205, Waste Oil Tank 20215 (AAFES East Service Station) (ST-249)
8-41	Building 20423, Waste Battery Storage Area (ST-274)
8-49	Building 20677, Fuel Shop Battery Storage Area (ST-275)
9-4	Building 617, Waste Accumulation Area (ST-276)
9-20	Building 909, Inactive Waste Accumulation Area (ST-277)
8-58	Battery Storage Area (ST-321)
8-53	Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)
10-2E	Building 702, Jet Engine Test Cell (SS-63) (former ST-336)
S-64	Building 20212, U.S. Army Corps of Engineers Vehicle Maintenance Yard (ST-64) (former ST-337)
SS-65	Horizontal Polarized Dipole (HPD) Drum Rack (SS-65) (former ST-338)
WP-339	Contractor Yard West of Building 20423 (WP-339)
ST-341	Building 1033, Condensate Holding Tank (ST-341)

1.4 Previous Investigations

Formal environmental investigative design and remediation work has been performed at Kirtland AFB during the past 10 years. This work was performed to meet the corrective action schedule in Module IV of the RCRA Part B Permit issued in 1990. Table 1-2 and the following text describe these studies.

- ***Phase I.*** IRP investigations at Kirtland AFB began with the Phase I – Records Search Report (USAF, 1981). This report consisted of a search of pertinent installation records, a literature search of published and unpublished reports, discussions with key installation personnel (both active and retired), an examination of topographic and geologic maps, an examination of aerial photographs and site visits, and an assessment of the hazard potential of each waste disposal site identified. Phase I identified 25 disposal sites on Kirtland AFB as potential contamination sources; these sites were prioritized for a Phase II evaluation.

- ***Phase II, Stage 1.*** This phase consisted of acquisition and analysis of preliminary site-specific environmental data to identify the environmental status of seven sites and propose remedial actions where applicable (USAF, 1985). The final report was issued in March 1995.

- ***Phase II, Stage 2.*** Ten sites were studied by the U.S. Geological Survey (USGS), New Mexico District, in Phase II, Stage 2, beginning in 1988. Based upon earlier studies and sampling done by the NMED, these 10 sites were selected because potential contaminants were stored, discharged, or applied at the sites. The final report was issued in December 1993.

- ***RCRA PR/VSI.*** In April 1988, EPA Region 6 performed a Preliminary Review/Visual Site Inspection (PR/VSI) (Kearney/Centaur, 1988) under RCRA as part of the process for approving the RCRA Part B Permit Application for Kirtland AFB. Appendices I, II, and III of the RCRA Corrective Action Compliance Schedule identified numerous SWMUs requiring further investigation and characterization.

- ***RCRA Phase II, Stage 2A.*** After the PR/VSI, the Kirtland AFB IRP began site characterization studies following RCRA guidance and began addressing the SWMUs generally as distributed in the EPA Appendix I, II, and III site list. Twenty-one of the SWMUs listed in Appendix I and Appendix II were investigated in Stage 2A. The 21 sites, which included nine of the first 10 sites already under investigation, were selected because they had the greatest potential for soil and groundwater contamination from past disposal and landfill activities. The results of the Phase II, Stage 2A investigation were presented in an RFI Report, issued in draft final form to EPA in December 1993.

- ***RCRA Phase II, Stage 2B.*** The Phase II, Stage 2B RFI addressed 73 sites, including a fire training area, a laser lab water disposal site, and numerous oil/water separators (OWS), area drains, holding tanks, underground storage tanks (USTs), and sewage ejector units. These sites are identified as SWMUs in Appendix II of the RCRA Corrective Action Compliance Schedule. A work plan prepared for the Stage 2B RFI sites was finalized in January 1992 and approved by the EPA in June 1993. At six of the Stage 2B RFI sites, field work was implemented by the USGS. The remaining 67 Phase II, Stage 2B RFI sites were investigated by Halliburton NUS. Kirtland AFB described the Scope of Work and the investigation was performed in accordance with the USAF 1991 IRP Handbook and 1994 Scope of Work. The Final Stage 2B RFI Report was submitted July 5, 1995, to the EPA after comments were addressed in response to a May 1995 Notice of Deficiency.

- ***RCRA Phase II, Appendix III.*** This current study is described in Section 1.5.

Table 1-2. Environmental Investigations Performed at Kirtland AFB

Study	Organization	Date
Phase I – Records Search	Engineering Science, Inc.	1981
Phase II – Stage 1	SAIC	1985
Phase II – Stage 2	USGS	1988-1993
RCRA PR/VSI	Kearney/Centaur for EPA	1988
RCRA Phase II – Stage 2A RFI at Appendix I SWMUs	USGS	1990–1993
RCRA Phase II – Stage 2B RFI at Appendix II SWMUs	USGS & Halliburton NUS	1993–1994
RCRA Phase II – RFI at Appendix III SWMUs	Halliburton NUS	1993–1994 Draft report to EPA in November 1995
RCRA Phase II – Stage 2D-1 RFI at 2 Appendix IV SWMUs	Halliburton NUS	1993–1994
RCRA Phase II – RFI at 5 Appendix IV SWMUs	Halliburton NUS	In progress Draft report to EPA in February 1996
RCRA Phase II – RFI at Appendix V SWMUs	Halliburton NUS	In progress Draft report to EPA in December 1995

- ***RCRA Phase II, Stage 2D-1.*** The Phase II, Stage 2D-1 investigation addressed sites associated with former radiological activities at the base; it addressed two radiological burial sites (RW-21 and RW-06). These sites are identified as SWMUs in Appendix IV of the RCRA Part B Permit for Kirtland AFB. The Stage 2D-1 RFI used the applicable portions of the Stage 2B and Appendix III Work Plans which were approved by the EPA in letters dated June 8, 1993, and April 7, 1994, respectively. The Draft Stage 2D-1 RFI Report was submitted to the EPA in December 1994.

- ***RCRA Phase II, Appendix IV SWMUs.*** The Phase II, Appendix IV RFI addressed sites associated with former radiological activities at the base; it included five underground emergency holding tanks. The Appendix IV RFI Work Plan was approved by the EPA in a letter dated August 11, 1994. The first draft of the RFI for this stage is due to the EPA in February 1996.

- ***RCRA Phase II, Appendix V SWMUs.*** The Phase II, Appendix V RFI addresses nine newly identified sites where potential releases to the environment may have occurred. These nine sites include six SWMUs, one of which consists of three distinct AOCs. The EPA Region 6 did not require a separate RFI Work Plan for these sites. Rather, the investigations were conducted in accordance with the plans approved by the EPA on April 7, 1994, for the investigation of the Appendix III SWMUs. The first draft of the Appendix V RFI Report is due to the EPA in December 1995.

1.5 Description of Current Study

The Appendix III non-wasteline RFI addresses the 14 sites listed in Table 1-1. All are listed as SWMUs in the RCRA Part B Permit. These sites include waste accumulation areas and storage yards, battery storage yards, USTs, a jet engine burn area, a jet engine test cell, a paint shop and sink drain, and a drum rack.

1.5.1 Project Objectives

The overall goal of the environmental investigative work at Kirtland AFB is to adequately characterize any environmental contamination to determine whether further investigation activities are needed and/or whether a NFA designation is appropriate for any of the sites.

1.5.2 Investigative Process

This investigative process requires data collection and the development or refinement of a conceptual model for each site. A conceptual model consists of the following:

- Identification of any contaminants present and concentrations.
- Source characterization including location, source volume or quantity, and concentrations of hazardous constituents at the source.
- Identification of potential migration pathways.
- Identification of potential receptors.

The degree of refinement necessary for a conceptual model at a site will depend in part on the type and extent of contamination identified. The RFI collected data to gain an understanding of the nature of potential contamination at the sites.

1.5.3 Scoping Documents

The following project scoping documents were used to implement the Appendix III RFI at Kirtland AFB:

- IRP Appendix III Wasteline Investigation Work Plan (USAF, 1994b).
- IRP Appendix III Non-Wasteline Investigation Work Plan (USAF, 1994c).

- IRP Appendix III Data Collection Quality Assurance Plan (includes the Quality Assurance Plan and Field Sampling Plan) (USAF, 1994d).
- IRP Appendix III RFI Health and Safety Plan (Halliburton NUS, 1994).
- IRP Conceptual Site Model Informal Technical Information Report for Kirtland AFB (USAF, 1994e).

These documents describe the scope of the RFI and address the requirements in Module IV of the Kirtland AFB RCRA Part B Permit.

1.5.4 Identity of Subcontractors and Their Roles

Specific subcontractors were required to assist with the implementation of the RFI activities. The following subcontractors were retained under subcontract to Halliburton NUS during the investigation:

- ***Surveyor.*** Albuquerque Surveying Co., Inc., (Albuquerque, New Mexico) served as the licensed New Mexico land surveyor to determine the vertical and horizontal coordinates of soil borings and sediment sampling locations.
- ***Analytical Laboratory.*** Halliburton NUS Laboratory (Pittsburgh, Pennsylvania) performed all laboratory analyses during the Appendix III RFI.

2.0 Environmental Setting

This section contains general information that is common to all of the sites under investigation. The environmental setting includes the climatology, topography, surface water hydrology, geology, hydrogeology, biology, and land use.

2.1 Climate

The climate of Kirtland AFB and vicinity is typical of a high-desert plateau, with low precipitation, wide temperature extremes, and, typically, clear sunny days. It is classified as Arid Continental. The mean annual precipitation ranges from 8.8 in. at Albuquerque International Airport at the western boundary of the base, to nearly 20 in. at about an 8,000-ft elevation in the Manzano Mountains near the southeastern boundary of the base. The average monthly precipitation in the Albuquerque area ranges from less than 0.5 in. during the winter to more than 1.5 in. during the summer. Typically, almost half of the annual moisture is received in the summer months as brief, but locally heavy, precipitation during thunderstorms. Prolonged periods of continuous precipitation are rare. Average annual snowfall for Albuquerque is 14.7 in. (SNL, 1994). Snow rarely accumulates or remains longer than 24 hrs in the nonmountainous areas. In mountainous areas, snow cover is common from late fall to early spring.

The annual mean maximum temperature at Kirtland AFB is 69°F; the annual mean minimum temperature is 44°F. The highest mean maximum temperature is 91°F in July and the lowest mean minimum temperature is 24°F in January.

The prevailing wind direction from May through October is south to southeast and the mean wind speed is about 8 knots. From November through April, the prevailing wind direction is north to north-northwest and the mean wind speed is about 7 knots.

Potential evapotranspiration (evaporation occurring when no soil-water deficit exists) for the Albuquerque area is 30.9 in. per year. Actual evapotranspiration has been determined to be about 95 percent of precipitation in this climatic regime, and the remaining 5 percent is divided equally between runoff and recharge (USACE *et al.,* 1979).

2.2 Topography

Kirtland AFB is located within the Rio Grande Valley of the Mexican Highland Subdivision of the Basin and Range physiographic province. The Rio Grande Valley is a depressed linear rift feature extending from the headwaters of the Rio Grande in the central Rocky Mountains in southern Colorado, through New Mexico and Texas to the western edge of the Gulf of Mexico. Kirtland AFB is located on a high, semiarid piedmont alluvial plain and mesa and adjacent foothills, about 5 mi east of the Rio Grande. The alluvial plain is cut by the east-west trending the Tijeras Arroyo, which drains into the Rio Grande. Most of the base is relatively flat, sloping gently west toward the Rio Grande. However, the eastern USFS withdrawn portion of Kirtland AFB extends into the Manzano Mountains. The western slope of the Manzano Mountains is precipitous, rough, and has numerous canyons and arroyos. Elevations range from 5,170 ft above mean sea level (amsl) where the Tijeras Arroyo crosses the western boundary of the base, to 7,988 ft amsl at the Manzano Lookout Tower in the Manzano Mountains. The mean elevation of Kirtland AFB is 5,348 ft (SNL, 1994).

2.3 Surface Water Hydrology

The Albuquerque area is drained by a single perennial river, the Rio Grande, which is about 5 mi west of the base. Drainage from land that parallels the river valley occurs by overland flow to arroyos and then to off-base flood canals and drains (manmade drainage canals or other similar features), or by infiltration into surface soil. Water reaching canals or drains is directed to the Rio Grande. Flooding is not a typical problem in the Kirtland area, although localized flooding may occur for brief periods where drainage flows exceed the capacity of arroyos and drains. This occurs almost exclusively during the summer thunderstorm season (July through September). Primary surface water drainage through Kirtland AFB occurs in the Tijeras Arroyo, Arroyo del Coyote, and an unnamed drainage channel south of Arroyo del Coyote.

The Tijeras Arroyo drains an area of about 150 sq mi bounded on the north by the Sandia Mountains and on the south by the Manzano Mountains. The Arroyo del Coyote drains an area of about 30 sq mi on the west face of the Manzano Mountains. Discharges to the arroyos are generally intermittent; water flowing in the arroyos typically evaporates or infiltrates over short distances. In flat-lying areas, overland sheet flow toward the arroyos can develop during intense rainfall. Because of the arid environment, the typically short duration of storms, and the permeable nature of surface soil, most of this flow tends to infiltrate before reaching the arroyos (Kearney, 1986; Kearney and Harding Lawson, 1987).

The USACE determined that the locations of the 100-year and 500-year flood plains at Kirtland AFB are confined to areas immediately adjacent to the Tijeras Arroyo and Arroyo del Coyote (USACE *et al.*, 1979). None of the Appendix III RFI sites are located in either of the flood plains.

2.4 Geology and Soil

2.4.1 Geologic Setting

The geology of the Kirtland AFB area is complex and varied. The western portion of the base lies within the Albuquerque-Belen Basin. A bedrock geology map of Kirtland AFB and the surrounding area is shown in Figure 2-1. A generalized geologic section of the Albuquerque-Belen Basin and adjacent areas are shown in Figure 2-2. The eastern portion of the base is mountainous with elevations reaching more than 7,900 ft amsl within the Manzano Mountains. These mountains are composed primarily of Precambrian crystalline rock and Paleozoic marine carbonate rock.

The Albuquerque-Belen structural basin contains the through-flowing Rio Grande (the basin is approximately 90 mi x 30 mi). The basin is bounded by the Nacimiento uplift to the north; the Sandia, Manzanita, and Manzano-Los Piños uplifts to the east; the Socorro basin to the south; and the Lucero uplift and Puerco plateau to the west (Figure 2-3).

The Albuquerque-Belen Basin lies within a series of grabens and structural basins called the Rio Grande Rift that has a general north-south alignment and is bordered on the east and west by up-faulted blocks (Figure 2-4). The basin consists of a north, east-tilted half-graben and a south, west-tilted half-graben. The Tijeras fault, which crosses Kirtland AFB, may be the transition zone between the two half-grabens (Lozinski, 1988). Igneous, metamorphic, and sedimentary rocks exposed in the Albuquerque area range in age from Precambrian to Holocene. Rock older than Tertiary is exposed in the Sandia and Manzano Mountains to the east and in the Rio Puerco Valley west of the Rio Grande.

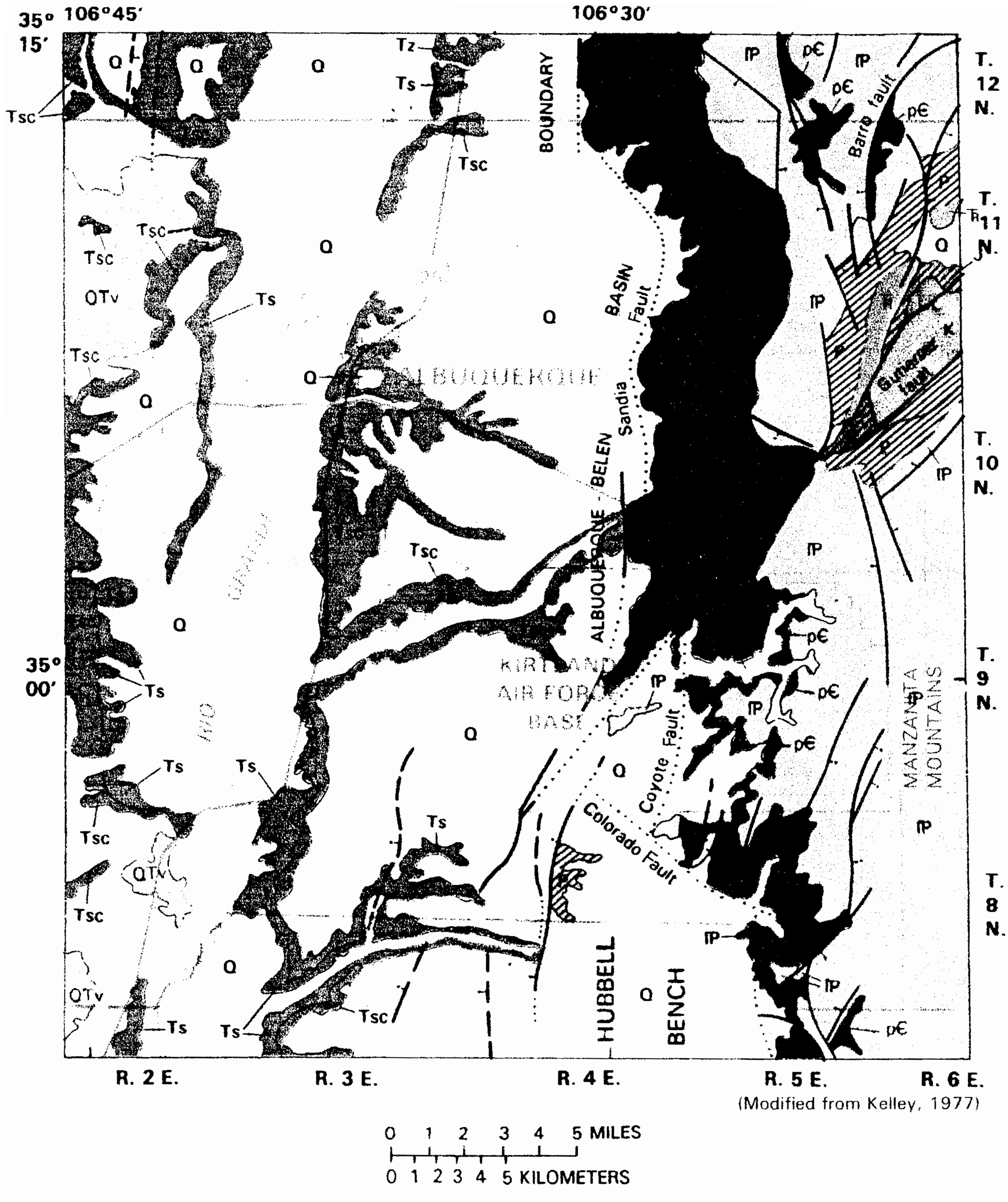

Figure 2-1. Bedrock Geology of Kirtland AFB and Vicinity

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LEGEND

Q QUATERNARY AND HOLOCENE DEPOSITS--Includes alluvium, landslide deposits, eolian deposits, caliche, and gravel pediment

QTV QUATERNARY AND TERTIARY VOLCANIC ROCK

TERTIARY SANTA FE GROUP OF KELLEY, 1977--Ts, undivided: sandstone, mudstone, claystone, conglomerate, and fanglomerate. Tsc, Ceja Member of Kelley (1977), sandstone, and conglomerate. Tz, Zia Member of Kelley (1977), sandstone, mudstone, and conglomerate

K CRETACEOUS, UNDIVIDED--Includes Mesaverde Formation, Mancos Shale, and Dakota Sandstone

JURASSIC, UNDIVIDED--Includes Morrison Formation, Bluff Sandstone, Summerville and Todilto Formations, and Entrada Sandstone

TRIASSIC, UNDIVIDED--Includes Chinle Formation and Santa Rosa Sandstone

PERMIAN ROCK,UNDIVIDED--Includes San Andres Formation, Glorieta Sandstone, and Yeso and Abo Formations

PENNSYLVANIAN ROCK, UNDIVIDED--Includes Madera and Sandia Formations, thin Mississippian rock locally at base

PRECAMBRIAN ROCK

CONTACT

FAULT--Bar and ball on downthrown side. Dashed where approximately located; dotted where concealed

Figure 2-1. Bedrock Geology of Kirtland AFB and Vicinity (Continued)

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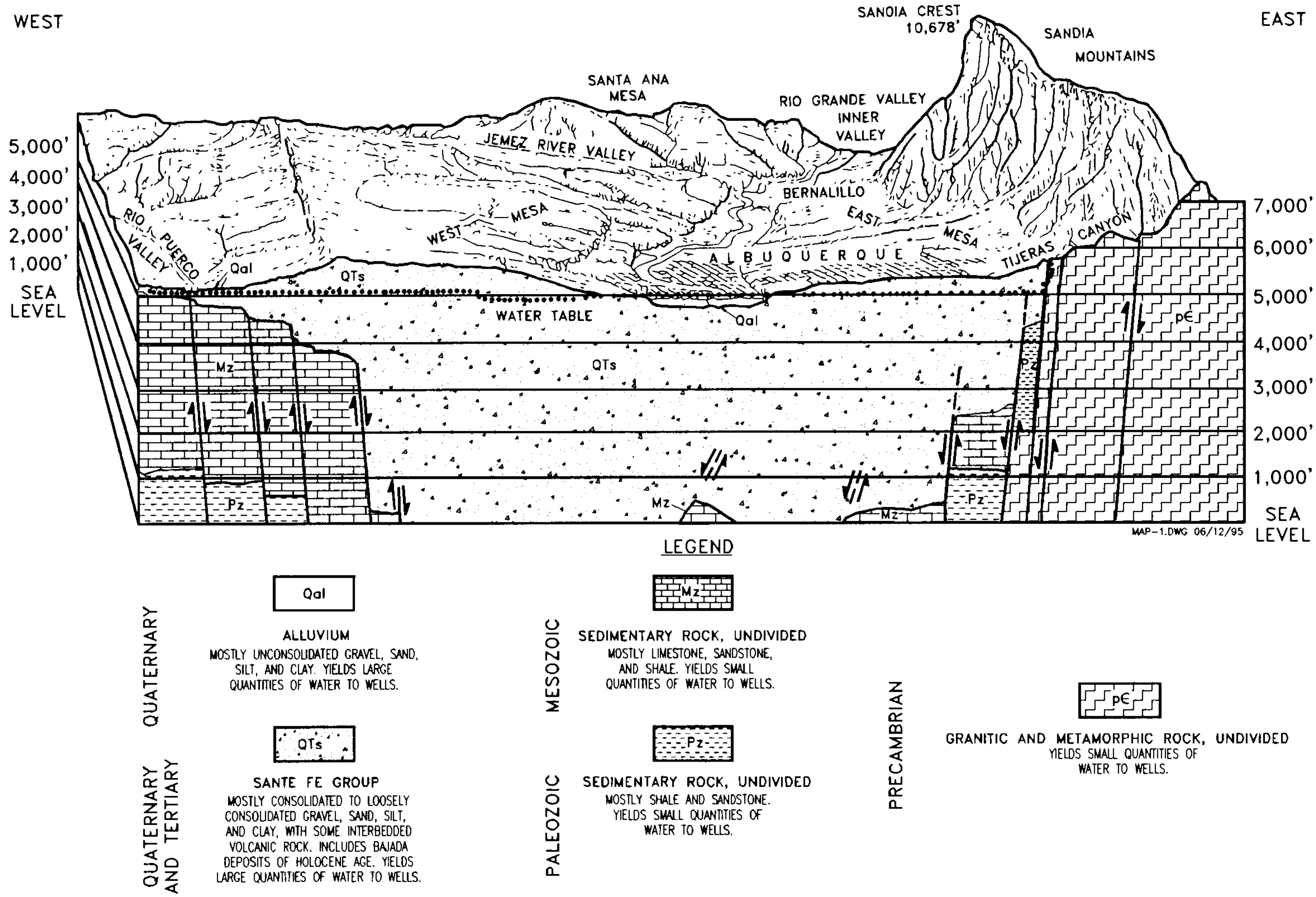

(MODIFIED FROM BJORKL AND MAXWELL, 1961)

Figure 2-2. Generalized Geologic Cross-Section

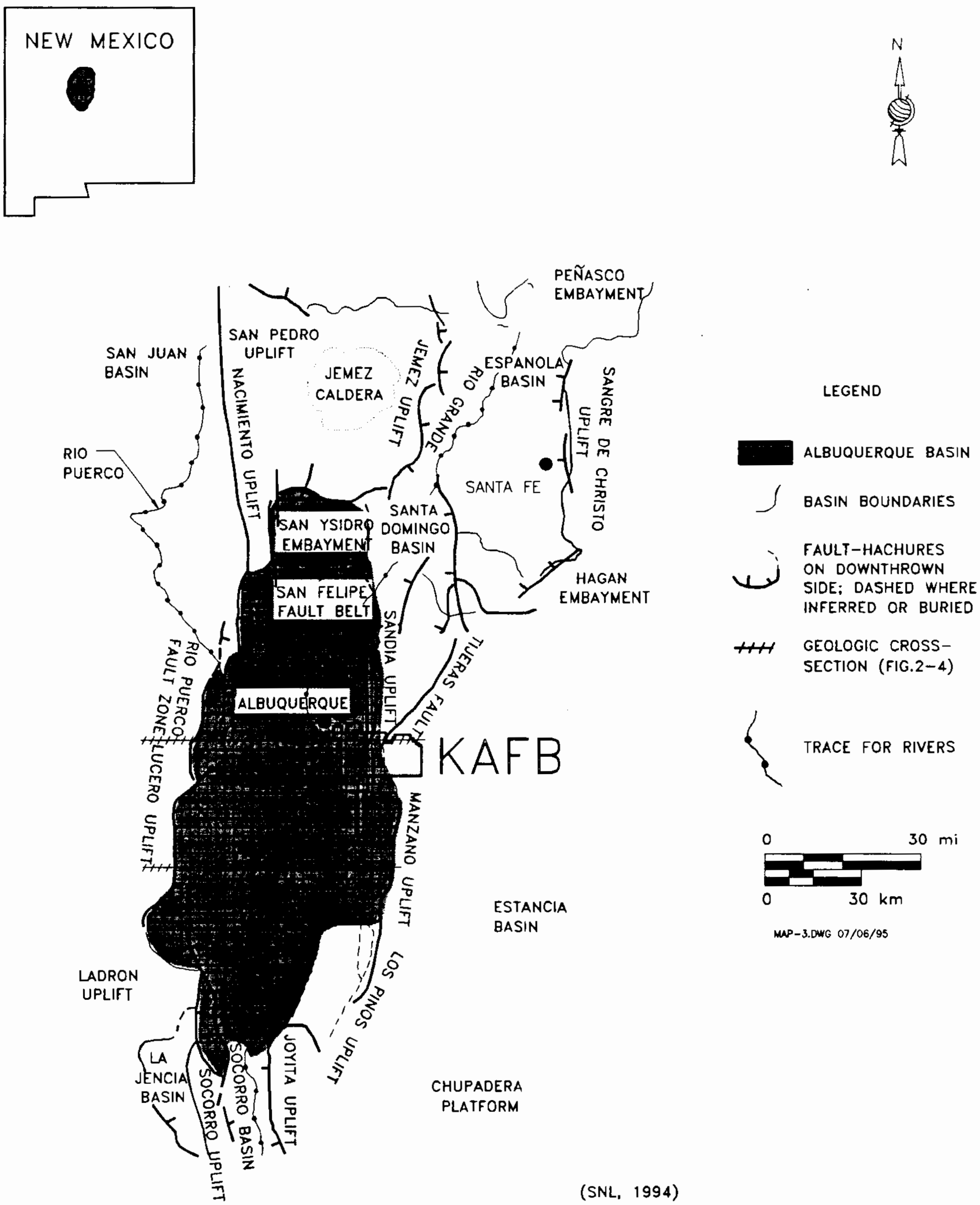

Figure 2-3. Regional Tectonic Setting of the Albuquerque Basin, North Central New Mexico

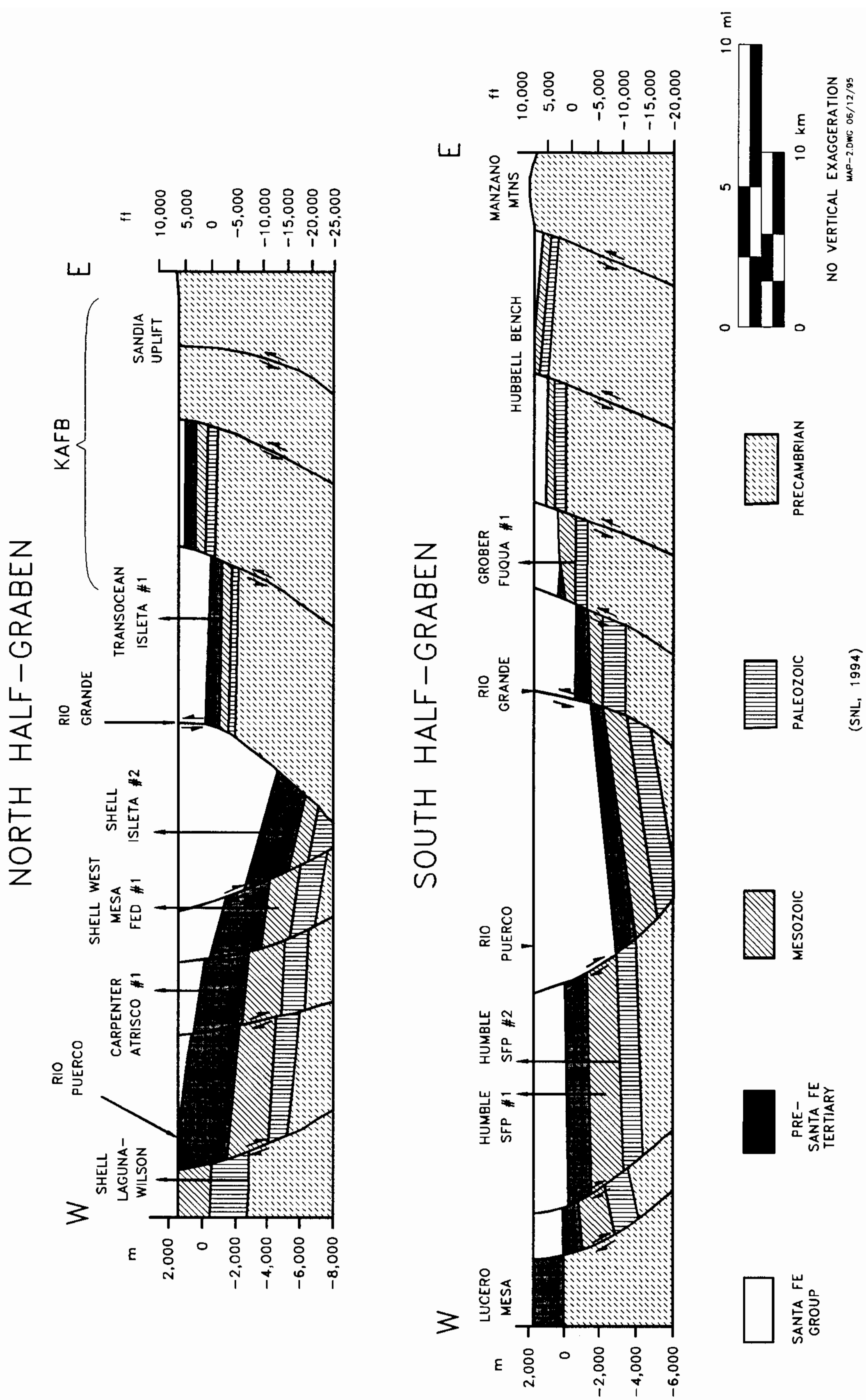

Figure 2-4. Diagrammatic Geologic Cross-Sections of the Central Albuquerque Basin, North and South of Tijeras Fault Zone as Located on Figure 2-3

The deposits within the Albuquerque-Belen Basin consist of interbedded gravel, sand, silt, and clay, the bulk of which are referred to as the Santa Fe Group. These sediments were deposited during the Late Tertiary and Quaternary as alluvial fan, playa, and fluvial deposits that filled the subsiding basin. The thickness of most basin-fill deposits is greater than 3,000 ft, although the thickness varies considerably because of faulting in the basin. In most areas, it is not possible to correlate lithologies between wells because of the lenticularity of the units and offsets that occurred during and after deposition (Anderholm, 1987).

The Santa Fe Group is comprised of beds of unconsolidated to loosely consolidated sediment and interbedded volcanic rock. The materials range in size from boulders to clay. Well-sorted stream channel deposits to poorly sorted slopewash deposits are found. The thickness of the Santa Fe Group beneath Kirtland AFB ranges from less than 100 ft to greater than 6,500 ft on the basis of gravity data (Kernodle and Scott, 1986). Eroded from the surrounding mountains, coalescing alluvial fans of materials were deposited on the Santa Fe Group. The alluvial fans extend west from the base of the Sandia and Manzano Mountains to the eastern edge of the Rio Grande floor. The fan sediments, which range from poorly sorted mud-flow material to well-sorted stream gravel, consist of channel fill and interchannel deposits. The fan deposits thicken going eastward toward the mountains and range from 0 to 200 ft in thickness (Cardenas and Associates, 1985).

2.4.2 Soil

Information regarding surface soil is derived from the Stage 2B Work Plan (USAF, 1993c). Surface soil, described by Hacker (1977), generally includes the first 5 ft of unconsolidated material belowground surface. The following, a description of surface soil, is not applicable to the deeper part of the vadose zone (alluvium and Santa Fe Group) through which potential contaminants could migrate toward the water table. Most soil on the western part of Kirtland AFB is loamy sand. Loam denotes a mixture of clay (7 to 27 percent), silt (28 to 50 percent), and sand (less than 52 percent). The soil tends to be finer-grained on gentler slopes than on steeper slopes. On the hills near the Tijeras Arroyo, soil tends to be more stony or gravelly than on the more level land. Soil in the mountains, where slopes are the steepest, tends to be stony, gravelly, and shallow, with some bedrock outcroppings.

Mapped soil units at Kirtland AFB are shown in Figure 2-5. Although soil is described by series, soil is highly variable in the field, and mapping units generally include areas that have more than one soil series.

2.5 Hydrogeology

2.5.1 Groundwater Occurrence and Movement

Three potential groundwater aquifers are present at Kirtland AFB: fractured bedrock, shallow alluvial deposits, and unconsolidated and semiconsolidated sedimentary deposits of the Santa Fe Group. Wells east of Kirtland AFB typically penetrate fractured or naturally permeable rocks for water. Along the Rio Grande flood plain, the shallow alluvial deposits are used as a source of potable water.

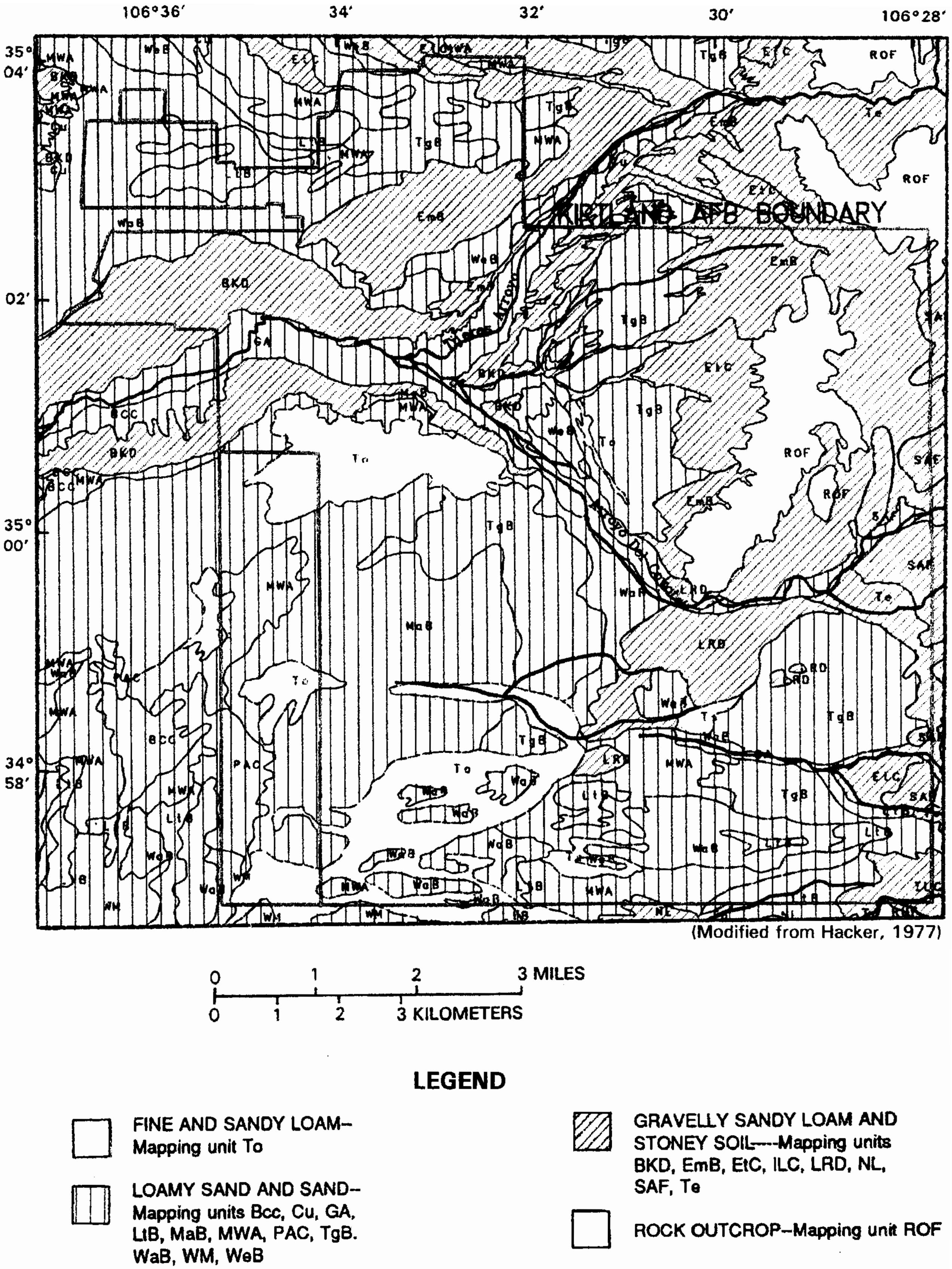

Figure 2-5. Soil of Kirtland Air Force Base

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The stratigraphy of the basin fill is divided into the Lower, Middle, and Upper Santa Fe Group (SNL, 1994). The majority of the water supply wells for the City of Albuquerque and Kirtland AFB are completed within the Upper Santa Fe Group; a few extend into the Middle Santa Fe Group. The majority of the RFI study sites overlies this aquifer. The sediment of the Upper Santa Fe Group attains local depths of 1,500 ft (USAF, 1993c).

The Santa Fe aquifer is recharged by groundwater underflow from adjacent areas; by infiltration of precipitation; seepage from streams, drains, canals, and surface reservoirs; and infiltration of applied irrigation water. Groundwater in the valley fill generally is under water table (unconfined) or semiconfined conditions.

The regional potentiometric surface in the Albuquerque-Belen Basin slopes northwest diagonally from the bases of the Sandia and Manzano Mountains on the east toward a groundwater depression, or trough, about 8 mi west of the Rio Grande. The water table beneath the Rio Grande slopes southwest at approximately the same gradient as the river. A localized groundwater depression has formed in the eastern part of Albuquerque north of Kirtland AFB as the result of pumping from city wells. Extensive pumping has produced a localized reversal of the regional groundwater gradients within Kirtland AFB. The depth to groundwater varies widely within the basin. The depth to water is less than 10 ft in many parts of the Rio Grande Valley. In areas east and west of the valley, the depth to groundwater commonly exceeds 300 ft; in some areas of the West Mesa, the depth to groundwater is almost 900 ft (Anderholm, 1987). Figure 2-6 shows the regional potentiometric surface. Figure 2-7 shows the water table elevations below Kirtland AFB.

The fault system that forms the eastern boundary of the Albuquerque-Belen Basin trisects the area occupied by Kirtland AFB (Figure 2-8). The north-south striking Sandia Fault enters the base from the north, the Hubbell Springs Fault extends colinearly to the south, and the Tijeras Fault cuts the base diagonally from the northeast. The fault complex divides the local groundwater system into three distinct hydrogeologic regions (Figure 2-9): the region west of the fault complex is identified as Hydrogeologic Region I (HR1); the region straddling the fault complex is identified as Hydrogeologic Region II (HR2); and the region east of the fault complex is identified as Hydrogeologic Region III (HR3). HR1 has been divided into two subareas: Subarea 1, in the northwest portion of the base, and Subarea 2, in the southwest portion of the base. HR2 has been designated as Subarea 3 and is in the central portion of the base. HR3, designated Subarea 4, is in the east-southeast portion of the base (SNL, 1994).

The HR1 saturated zone setting is within the Upper Santa Fe Group sediments. Groundwater is generally assumed to be unconfined in the upper portion of the aquifer. Depth to groundwater in this subregion varies from approximately 490 ft belowground surface (bgs) near the southeast edge of the subregion to approximately 350 ft bgs at the west edge (Figure 2-10). The water level in this region ranges from about 4,935 ft amsl along the east boundary of the subregion to 4,880 ft amsl on the west. Over the 5-mi distance that separates these points, the gradient is about 11 ft/mi, or 0.002 ft/ft. This determination of the water table gradient is based on readings from monitor wells installed by SNL that are completed to the local water table. Given the heterogeneity associated with aquifer sediments, flow directions within the aquifer may vary considerably at the local scale.

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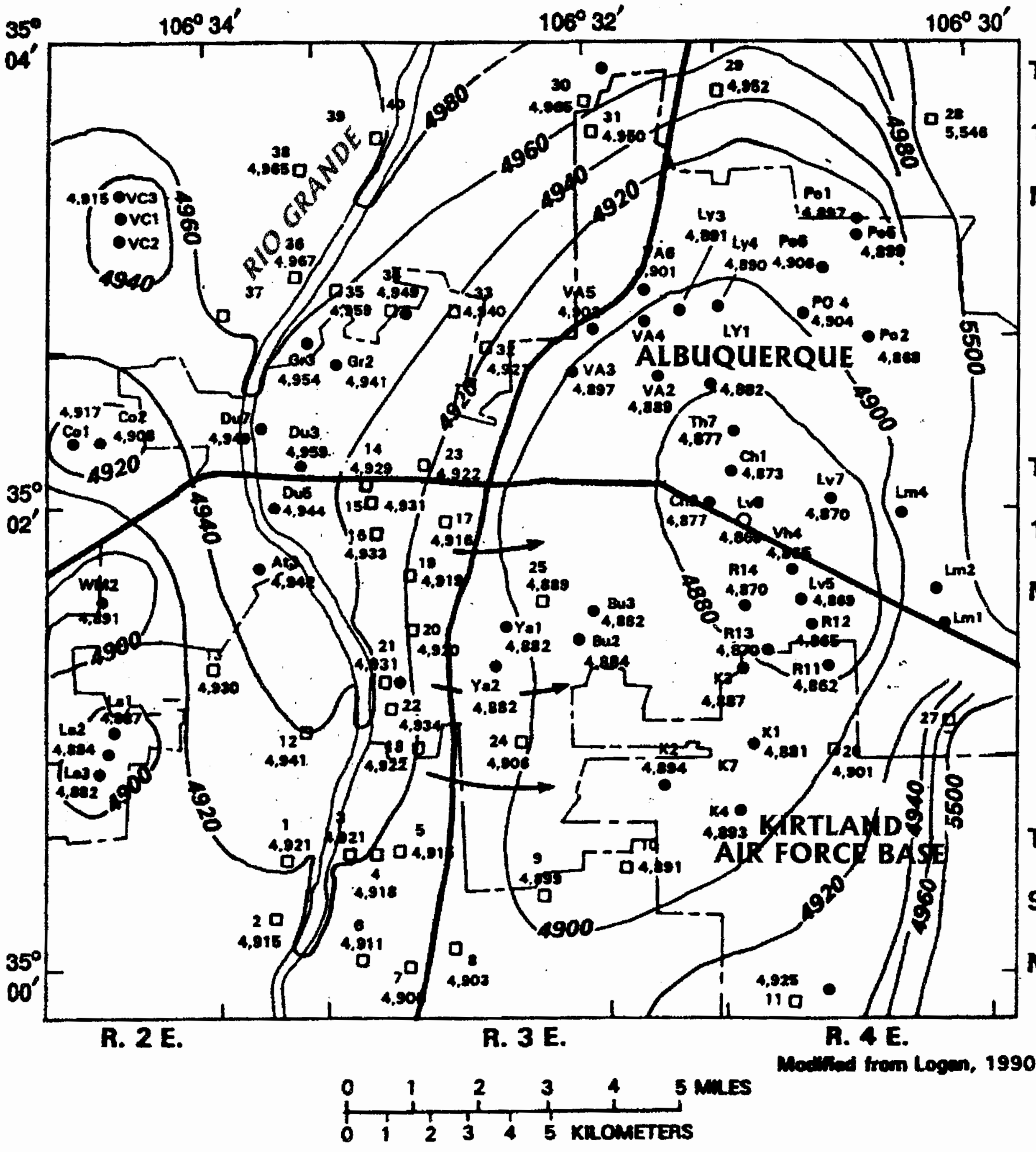

LEGEND

4920 WATER-TABLE CONTOUR--Shows altitude of water table, winter 1988-89. Dashed where approximately located. Contour interval 20 ft and variable above 4960. Datum is sea level.

K4 ● 4,893 DEEP WELL AND IDENTIFICATION CODE--4,893 is altitude of water level. Datum is sea level.

7 □ 4,906 SHALLOW WELL AND IDENTIFICATION CODE--4,906 is altitude of water level.

→ DIRECTION OF GROUNDWATER FLOW

Figure 2-6. Regional Potentiometric Surface Map

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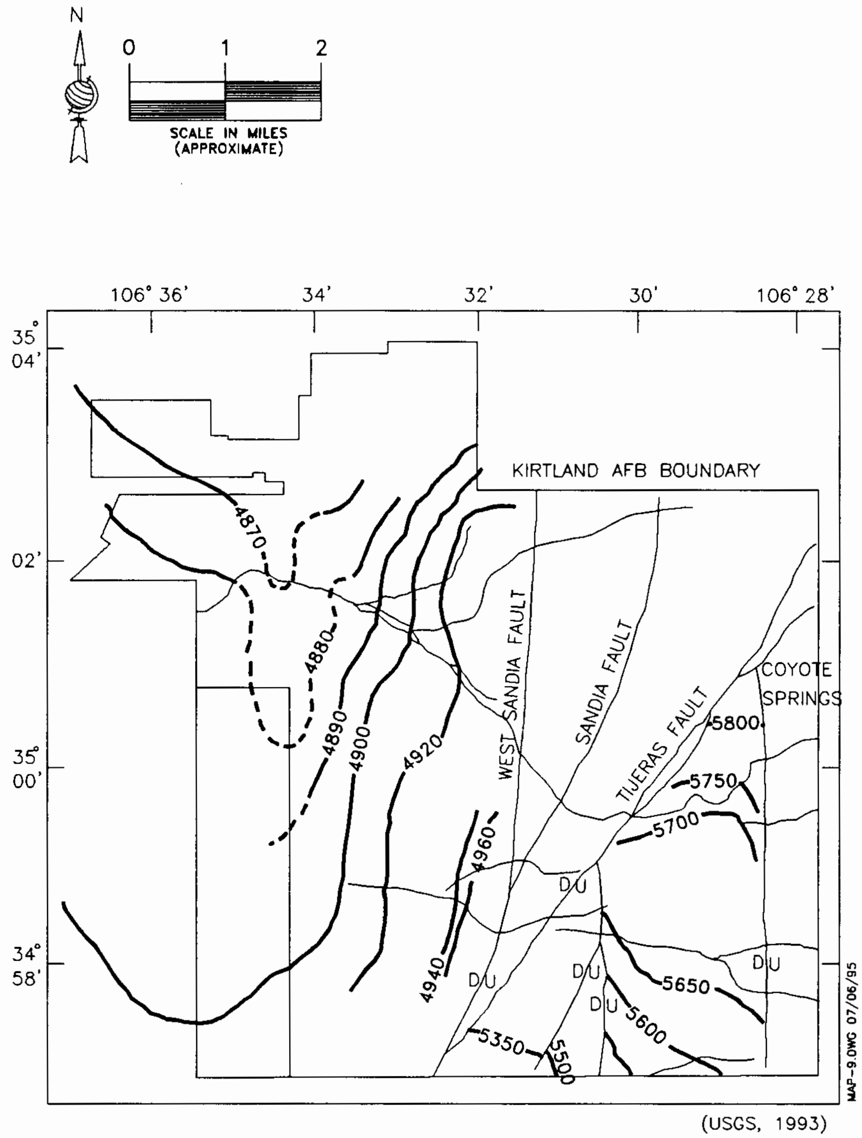

Figure 2-7. Generalized Water Table Elevations (September 1992), Kirtland AFB

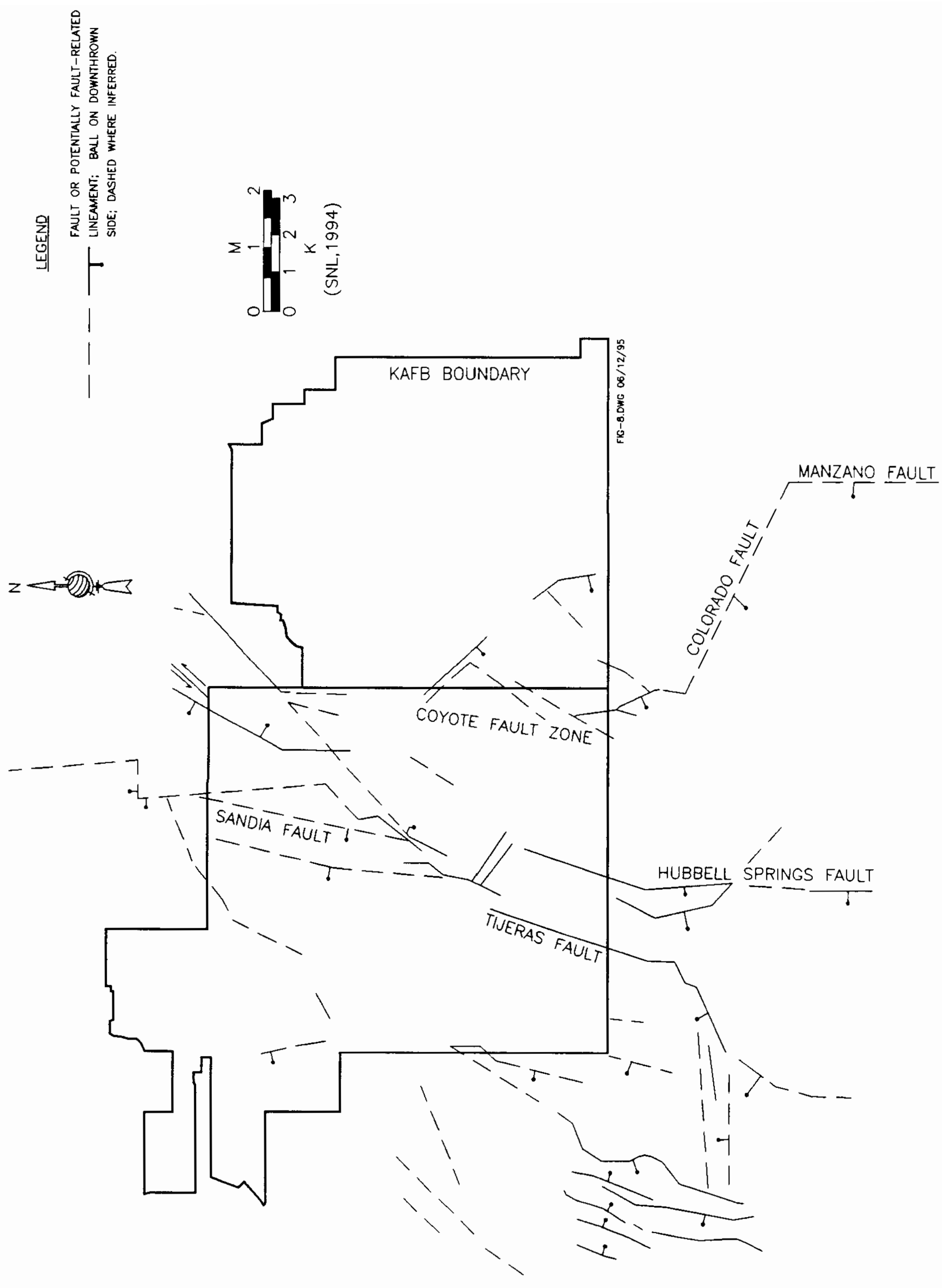

Figure 2-8. Geologic Faults Within Kirtland AFB and Vicinity

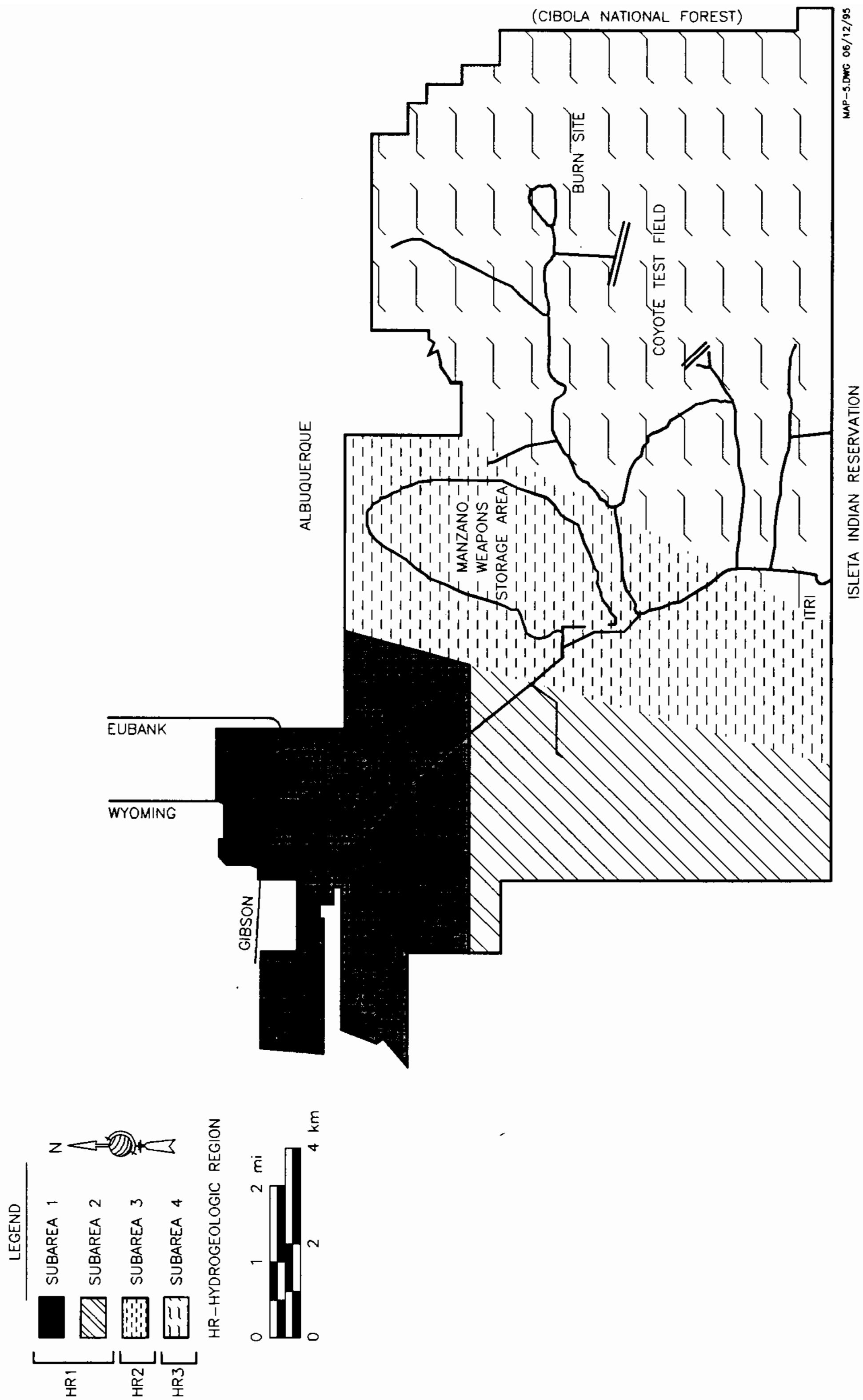

Figure 2-9. Locations of Hydrogeologic Zones at Kirtland AFB

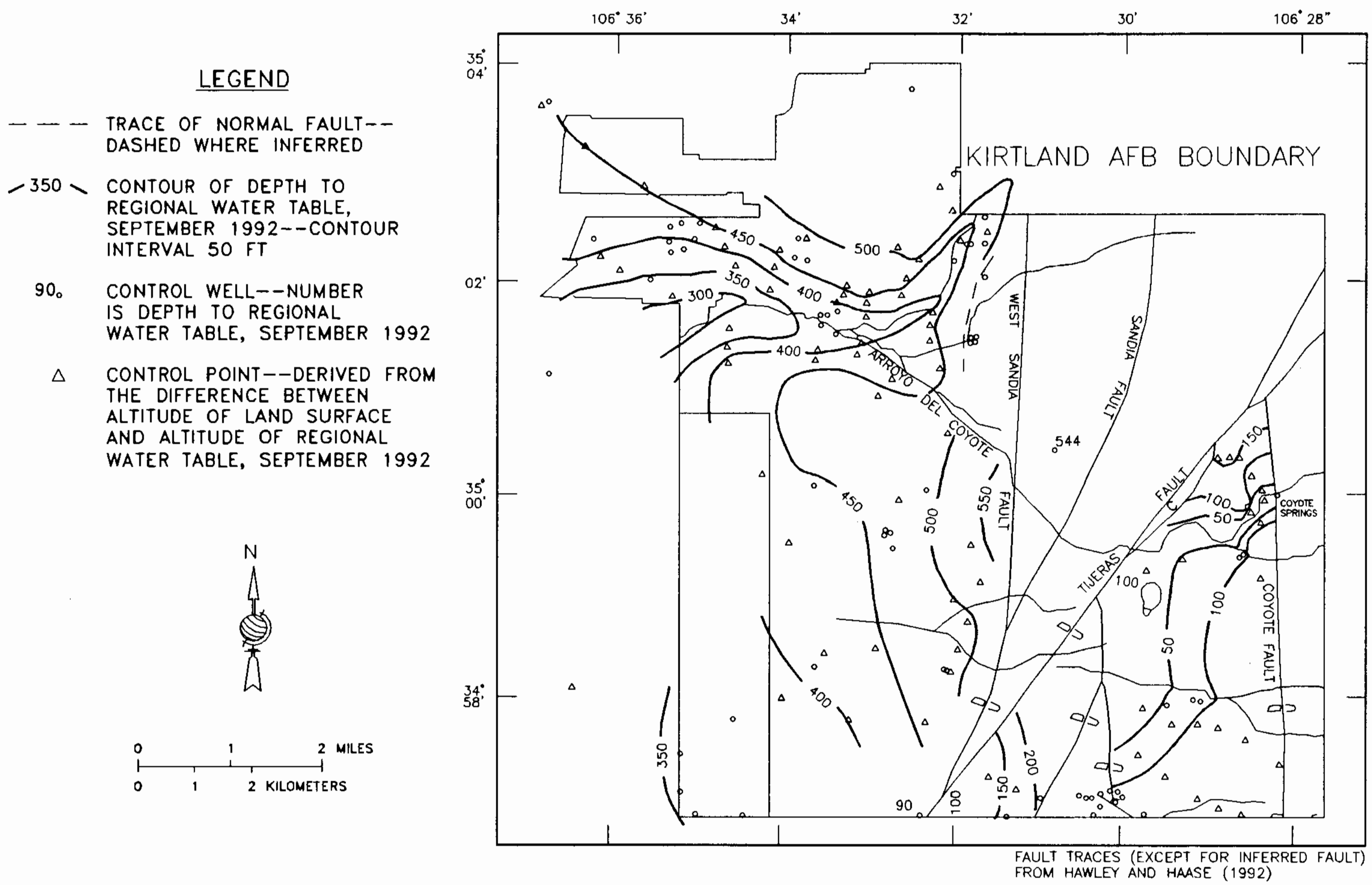

Figure 2-10. Generalized Depth to Regional Groundwater Table (September 1992), Kirtland AFB

HR2 straddles the Tijeras/Hubbell Springs/Sandia Fault complex. The saturated zone hydrology is characterized by the juxtaposition of high- and low-permeability materials as a result of vertical offset due to faulting (Thorn *et al.*, 1993). East of the fault zone, depth to groundwater is relatively shallow and static water-level elevation is about 5,710 ft amsl (Figure 2-7). Immediately to the west of the inferred fault trace, depth to water is considerably greater, with water levels recorded at 485 ft bgs, corresponding to elevations of 4,935 ft amsl and 4,920 ft amsl, respectively. Very little is known about groundwater flow in this subregion.

The influence of the fault complex may suggest two distinct groundwater zones: one is adjacent to the mountains and east of the fault zone with a southwest flow direction; the other zone is west of the faults with a predominant flow west. Recharge to the main basin aquifer would occur as overflow across the faults (SNL, 1994). The resolution of groundwater flow in the vicinity of the faults is essential to the issue of recharge to the basin groundwater system as well as local contaminant migration.

HR3, Subarea 4, is in the eastern portion of the area occupied by Kirtland AFB. The bedrock stratigraphy is inferred from outcrops to the south. Along the piedmont slope, the bedrock is mantled by a thin veneer of alluvial material. Depth to groundwater is approximately 90 to 100 ft bgs as measured by monitor wells installed by the Inhalation Toxicology Research Institute (ITRI) along the southern edge and in the central portion of this subregion. Near the foothills, groundwater probably occurs in shallow alluvial aquifers underlying the drainages emerging from the mountains and multiple confined bedrock aquifer systems. This model is particularly appropriate to the canyons that extend east of the mountains, as evidenced by numerous springs emerging from the mountain slopes. Most of these flow only seasonally, but Coyote Springs near the mouth of Coyote Canyon is a perennial spring. Several wells in the canyons and along the foothills produce water from fracture systems in the granite bedrock. Production is limited and water quality varies. Some of the water is not potable because of high concentrations of naturally occurring uranium associated with the granitic bedrock.

2.5.2 Vadose Zone Hydrogeology

Information pertaining to the vadose zone hydrogeology was obtained from sitewide hydrogeologic characterization reports prepared by SNL during 1992 and 1993.

The vadose (or unsaturated) zone is the region located between the land surface and the groundwater system (the saturated zone). The vadose zone provides the link between surface water hydrology (processes associated with precipitation, snow melt, runoff, infiltration, overland flow, and evapotranspiration) and groundwater hydrogeology (processes associated with the flow and transport processes in aquifer systems) (Gee and Hillel, 1988).

The vadose zone is an important part of the hydrogeologic system in the Kirtland AFB area. The vadose zone thickness in this area is large, ranging from 50 ft to greater than 500 ft. Any contaminants released near the ground surface would have to travel a long distance before reaching the groundwater system. Sorption and degradation in the vadose zone could act to decrease contaminant concentrations or mass prior to the point when, or if, contaminants reach the water table.

The vadose zone at Kirtland AFB generally consists of unconsolidated valley fill deposits, and underlying unconsolidated and semiconsolidated sand, gravel, silt, and clay of the Santa Fe Group. On the west side of the base, the valley fill is composed of highly heterogeneous alluvial fan, fluvial, and aeolian deposits. In the eastern portion of the base in the Manzano Mountains, the vadose zone is, in part, composed of bedrock materials of relatively low permeability, but highly fractured.

Flow and transport processes in the vadose zone are highly dependent on many other facets of the hydrogeologic picture such as climate, geomorphology, vegetation, geology, and the location of the saturated zone. The climate of the Kirtland AFB area is characterized by low precipitation, wide temperature extremes, frequent drying winds, some heavy rain showers (usually of short duration, often with erosive effects), erratic seasonal distribution of precipitation, and high evapotranspiration. These conditions imply a low recharge rate to the groundwater system from areal infiltration. Due to the complexity of the environmental setting of the Kirtland AFB area, detailed base-wide flow and transport processes in the vadose zone are still poorly understood.

2.6 Potable Water Supply

Groundwater is pumped from wells for public, irrigation, industrial, commercial, domestic, and livestock uses. Wells having large yields usually penetrate at least 200 ft into water-bearing materials. The municipal water system of the City of Albuquerque is supplied from wells ranging in depth from 65 to 1,284 ft. In 1985, the average daily pumpage in Albuquerque was 274-acre-ft. Several schools, hotels, hospitals, public buildings, and government installations in and near Albuquerque are supplied with water from privately and institutionally owned wells. Many industries and commercial institutions obtain their water from private wells. Many wells are used to irrigate small farms and gardens. An inventory of large-capacity wells owned by Kirtland AFB and the City of Albuquerque was taken in the Phase I study. At the base, 98 percent of the water used is groundwater pumped by Kirtland AFB production wells from the Upper Santa Fe Group Aquifer. The remainder of the water used on base is purchased from the City of Albuquerque. Locations of Kirtland AFB production wells and monitoring wells are shown in Figure 2-11.

2.7 Population and Land Use

Kirtland AFB is bounded to the north and west by the City of Albuquerque and its suburbs, to the south by the Isleta Indian Pueblo, and to the east by the Cibola National Forest. Land use in the vicinity of Kirtland AFB varies from urban to open rangeland (Figure 2-12). The area immediately north of the base is predominantly urban. Open spaces and forest land are northeast and east. Land west of Kirtland AFB is a mix of urban, industrial, and agricultural areas. The Isleta Pueblo land to the south and southeast is mostly open space and forest.

Population density in the vicinity of Kirtland AFB is shown in Figure 2-13. In 1990, the population of the Albuquerque metropolitan area was about 480,000. The unincorporated Rio Grande Valley to the south of Albuquerque and west of Kirtland AFB had a population of about 36,000. The population is extremely sparse on the Isleta Pueblo to the south, and to the east in the Cibola National Forest and Manzano Mountains. Most of the Isleta Pueblo population is concentrated about 8 to 12 mi southwest of Kirtland AFB.

Kirtland AFB contains over 52,000 acres of land with more than 800 buildings and 5.6 million sq ft of floor space (USAF, 1981). The 377 ABW employs more than 2,500 individuals who support the nearly 21,000 employees in Kirtland's 150 associate units (USAF, 1994a).

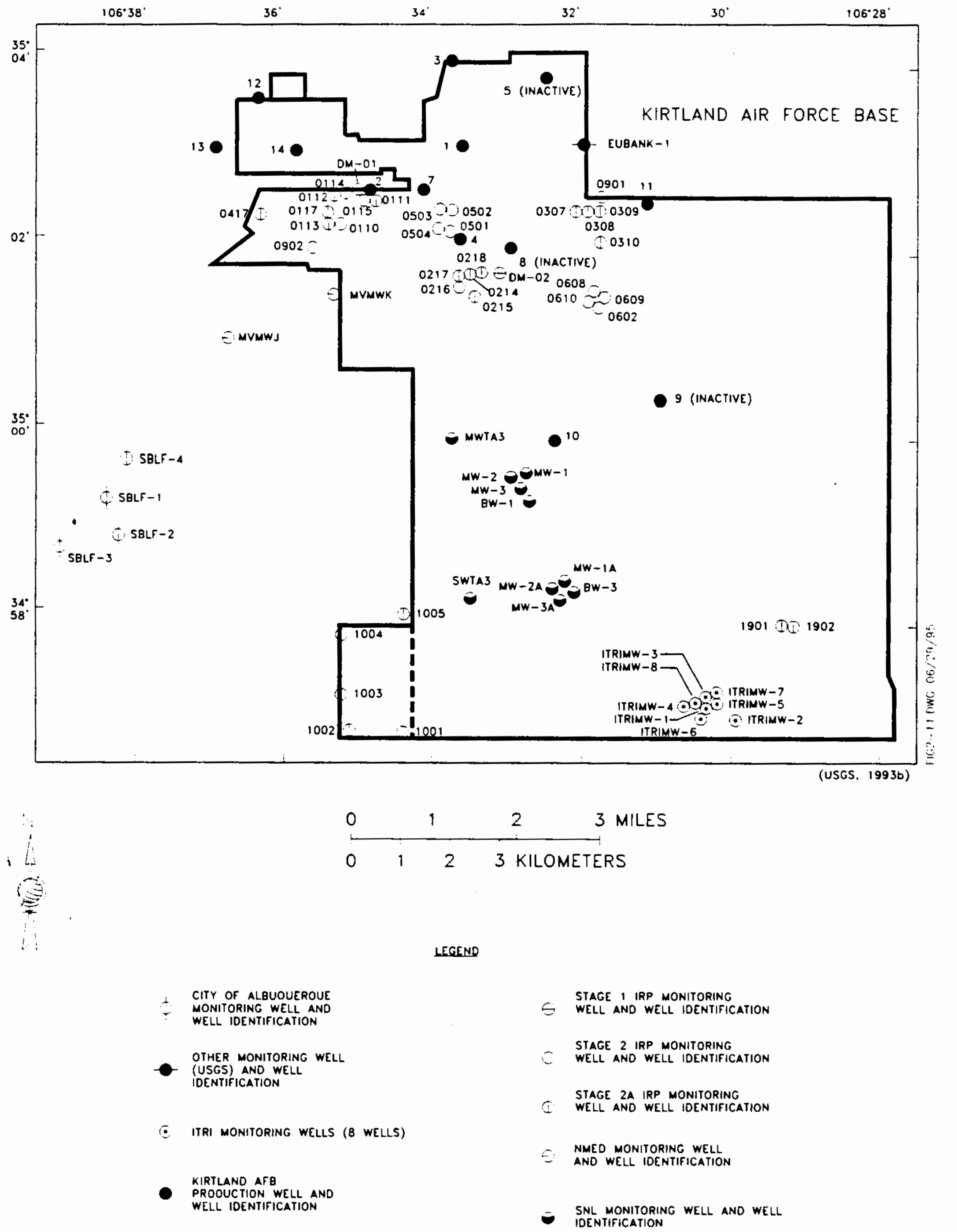

Figure 2-11. Locations of Monitoring Wells and Production Wells at Kirtland AFB

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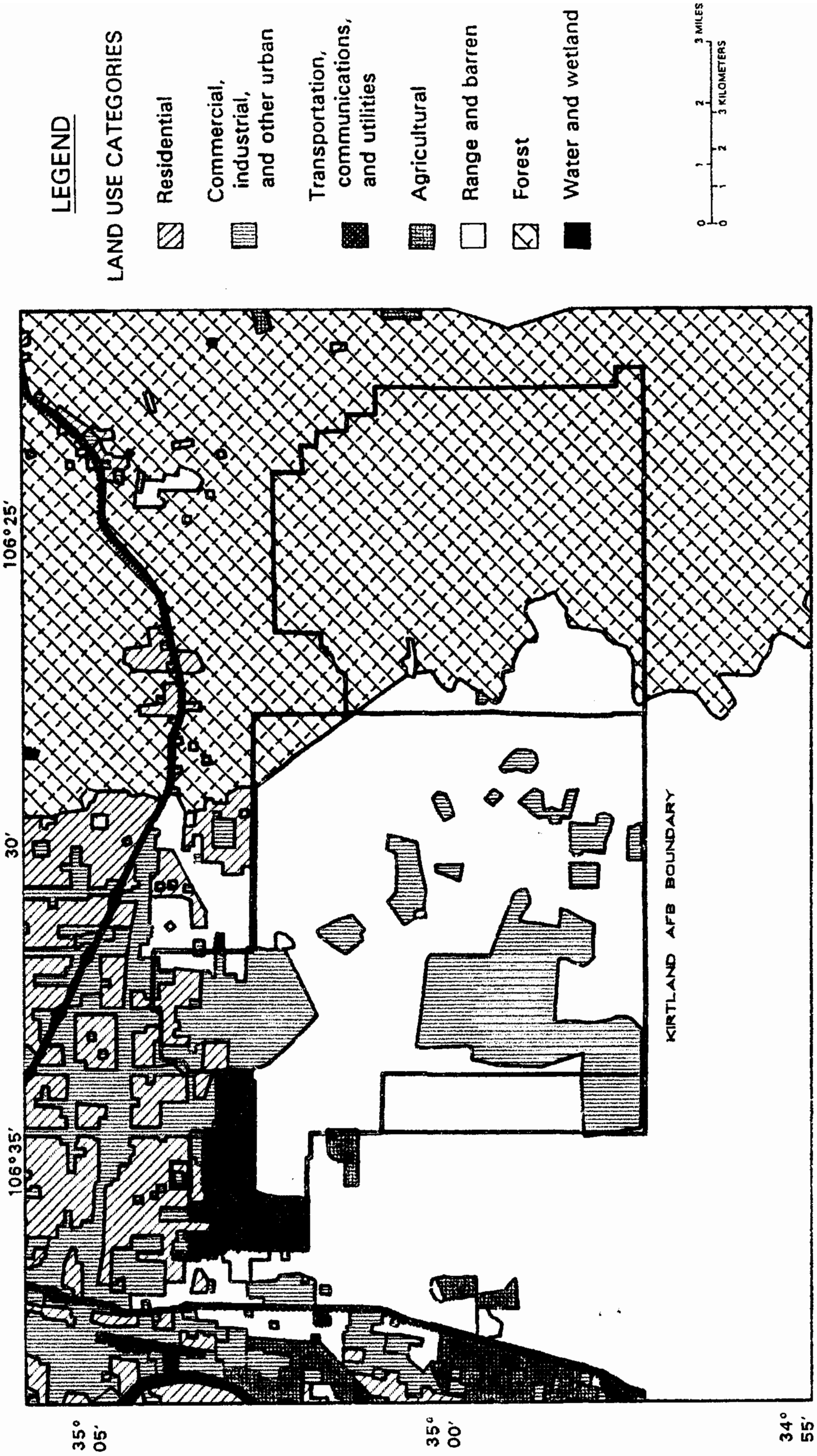

(USGS, 1990)

Figure 2-12. Land Use in the Vicinity of Kirtland AFB

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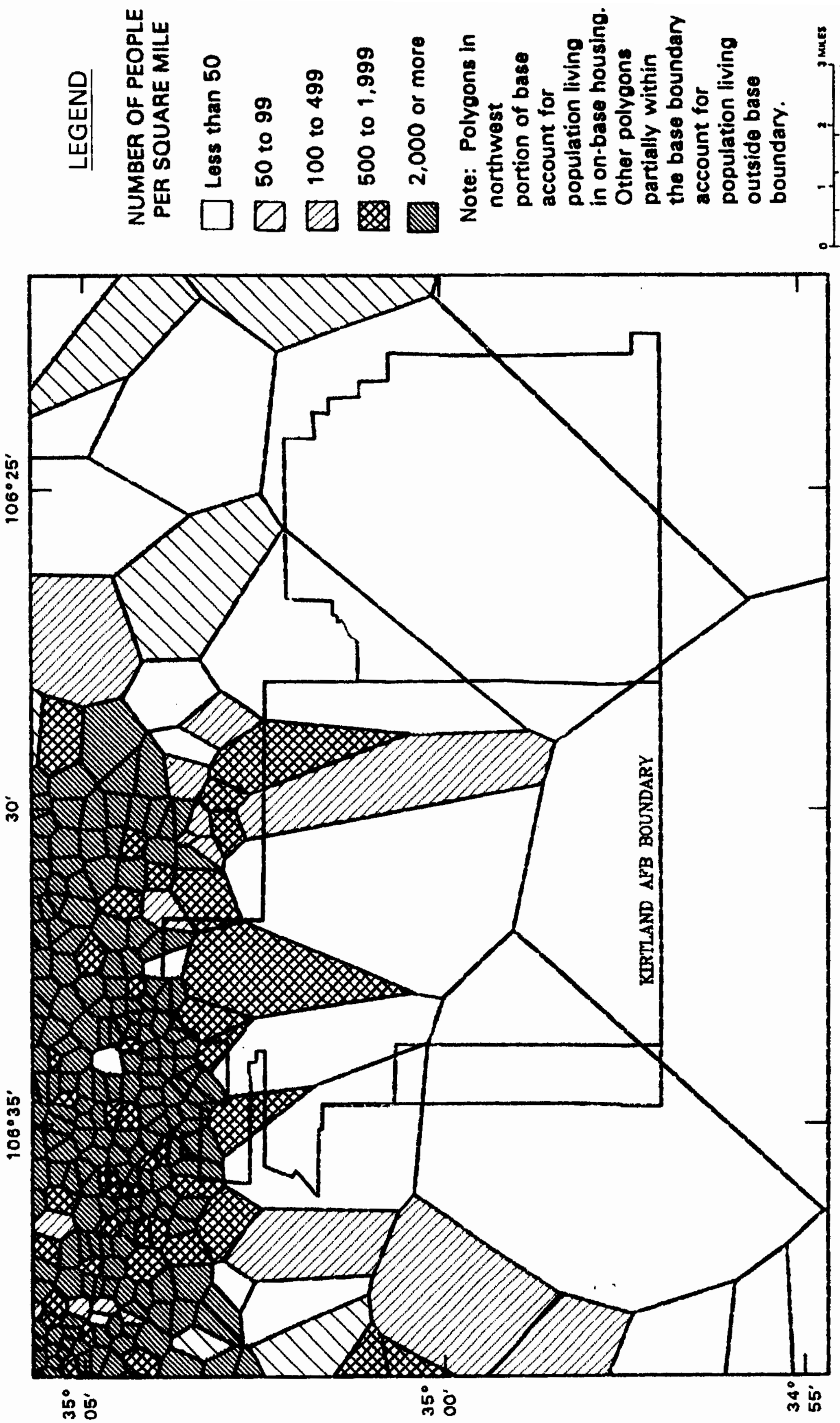

U.S. Bureau of the Census, 1990

Figure 2-13. Population Density in the Vicinity of Kirtland AFB

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2.8 Biological Resources

2.8.1 Vegetation

The vegetation on the upper slopes of Kirtland AFB can be classified into two basic ecological associations: the Piñon-Juniper Association and the Grassland Association. The vegetation on the lower slopes of the Manzano Mountains is primarily the Piñon-Juniper Association. The Piñon-Juniper Association has a lower elevation limit of 5,800 ft; Colorado piñon pine and the one-seed juniper are co-dominants in this association. The understory in this association is dominated by grasses and shrubs. The Grassland Association has an upper elevation limit of 5,800 ft. Within this association are more than 50 species of grasses; however, only a small number of these are abundant. Dominant species include black grama, sand muhly, threeawn, Indian ricegrass, six-weeks grama, fluff grass, and spike dropseed. Several shrubs are also common in the Grassland Association.

2.8.2 Wildlife

Wildlife on and in the vicinity of Kirtland AFB is associated with xeric habitats, which seasonally support a narrow range of species. In light of the lack of competition from livestock, animal populations that feed on grasses and other range plants are abundant. Evidence supporting this contention is apparent in the sightings of numerous rodent burrows and mule deer, which descend in this zone from higher elevations in winter. Below the Manzano Mountains foothills (part of the base), occasional sightings of coyotes occur.

Birds are the most commonly seen wildlife on Kirtland AFB. In the Grassland Association, horned larks, meadowlarks, thrashers, predatory birds (hawks, owls, vultures), several species of sparrows, scaled quail, and mourning doves are the most-often seen species. Scrub jays, plain titmouse, bushtits, woodpeckers of several species, and warblers occur in the Piñon-Juniper Association as year-round residents.

2.8.3 Threatened and Endangered Species

An endangered and threatened species survey was conducted by the Nature Conservancy (UNM, 1995). The potential habitat was surveyed for four plant species of concern; animal species surveys were conducted for the presence of northern goshawk and gray vireo. The peregrine falcon was initially included in the survey, but was removed as an endangered species by the Federal government. Grama grass cactus, a native New Mexican sensitive species, was found in several areas throughout the base. The final report, dated April 1995, is available from the Kirtland AFB Natural Resources Manager. An endangered and threatened species management action plan is in progress.

The plant species survey included potential habitat within undeveloped portions of land on the main base and the western foothills of the Manzano Mountains. Species considered rare included *Pediocactus papyracanthus, Mammillaria wrightii, Neolloydia intertexta,* and *Amsonia fugatei*. These species were surveyed on 2,240 acres.

Rare plant data under consideration for this RFI were extracted from the 1995 UNM report. Most of the Appendix III sites were located within the urban/industrial area of Kirtland AFB; the remaining sites were at the Manzano Weapons Storage Area (MWSA) and the Civil Engineering Research Facility. The

1995 UNM report did not include a survey at the urban/industrial area or at the quadrats (a 320-acre plot) where the nonurban/industrial Appendix III sites are located.

The animal species surveys were conducted in phases. Methods of study used to identify habitat included the examination of aerial photographs and topographic maps, as well as site reconnaissance.

The gray vireo is listed by the State of New Mexico as an endangered species. Its habitat, the arid scrub woodland on foothills and mesas, has a highly localized occurrence in the state. All habitats considered to be potential for breeding gray vireos were surveyed. Male and female gray vireos were sighted on Kirtland AFB and the Forest Service Withdrawn Area. Summering gray vireos were found in ungrazed juniper woodland at the base of the foothills (elevation 5,900 to 6,600 ft) of the Manzano Mountains.

Northern goshawk are uncommon breeders in central New Mexico; generally, they require mature stands of large conifers with a fairly closed canopy and open understory. During 2 days of surveys, no evidence of northern goshawk nesting was found (UNM, 1995). Overall, it appears that no suitable goshawk habitat exists on Kirtland AFB.

2.8.4 Sensitive Habitat

Sensitive habitat includes wetlands, plant communities that are unusual or of limited distribution, and important seasonal use areas for wildlife (such as migration routes, breeding areas, or crucial summer or winter habitats).

No streams or lakes exist on Kirtland AFB, and moist habitat is essentially nonexistent for either breeding or migrating wildlife. Sensitive habitat does not appear to be prevalent at Kirtland AFB.

3.0 Investigation Procedures

3.1 Field Procedures

The field investigation procedures and the analytical results provide a basis for assessing the environmental conditions and the presence or absence of environmental contamination. This section presents the general sampling operations and procedures used during the field portion of the Kirtland AFB Appendix III RFI.

All activities were conducted to meet the data quality objectives (DQOs) and quality assurance/quality control (QA/QC) requirements in the EPA-approved *IRP Appendix III Non-Wasteline Investigation Work Plan* for Kirtland AFB (USAF, 1994c). Specific DQO and QA/QC requirements are detailed in the IRP Appendix III Data Collection Quality Assurance Plan (DCQAP) (USAF, 1994d). All work was performed to ensure worker health and safety as presented in the IRP Appendix III Health and Safety Plan (Halliburton NUS, 1994). Deviations from the approved plans are described in Section 3.2.

3.1.1 Sampling Investigations

Field investigation activities included surface and subsurface soil sample collection and sediment sample collection. Table 3-1 lists number of boreholes and samples collected at each site. Table 3-2 lists the sample preparation and analyses performed on soil and sediment samples collected at each site.

3.1.1.1 Surface and Subsurface Soil Sampling

During the Appendix III RFI, 122 sites were investigated. Surface and/or subsurface soil samples were collected for lithologic description and laboratory analysis at 13 locations. Surface soil samples (0 to 2 ft deep) were collected with stainless steel spatulas. Subsurface soil samples (0 to 50 ft deep) were collected with a Geoprobe; a hand auger was used at selected sites for collecting shallow subsurface samples (0 to 15 ft deep).

Soil samples collected were initially screened for volatile organic compounds (VOCs) using portable organic vapor analyzers (photoionization detector (PID) and/or flame ionization detector [FID]) and monitoring for radiation using gamma and beta-gamma meters, each with a sodium iodide (NaI) detector. Field instrument readings were recorded in the field logbook and on borehole logsheets. Field-screening instruments were calibrated daily.

The following describes equipment and procedures used for collecting soil samples. Sample collection equipment was decontaminated prior to each sample-collection event according to procedures described in Section 3.1.1.4.

Table 3-1. Drilling and Sampling Activity Summary, Appendix III Non-Wasteline Field Investigation

Site Name	Boreholes	Soil Samples[a]
SWMU 6-14 Sewage Effluent Transmission Line (ST-51)	8	9
SWMU 6-16 Jet Engine Burn Area (part of Kirtland Fire Training Area [FT-13])	9	37
SWMU 10-3, Building 20215 Waste Oil Tank 20215 (AAFES East Service Station) (ST-249)	0	0
SWMU 8-49, Building 20677, Fuel Shop Battery Storage Area (ST-275)	5	14
SWMU 9-4, Building 617, Waste Accumulation Area (ST-276)	10	48
SWMU 9-20, Building 909, Inactive Waste Accumulation Area (ST-277)	4	19
SWMU 8-58 Battery Storage Area (ST-321)	9	27
SWMU 8-53, Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)	5	23
SWMU 10-2E Building 702, Jet Engine Test Cell (SS-63) (former ST-336)	5	26
SWMU ST-64, U.S. Army Corps of Engineers Vehicle Maintenance Yard, Building 20212 (ST-64) (former ST-337)	5	15
SWMU SS-65 Horizontal Polarized Dipole Drum Rack (SS-65) (former ST-338)	8	34
WP-339 Contractor Yard West of Building 20423 (WP-339)	10	60
SWMU 8-41, Building 20423, Waste Battery Storage Area (ST-274)	7	22
ST-341, Building 1033, Condensate Holding Tank (ST-341)	8	30

a. Includes replicate samples

Table 3-2. Analytical Method Summary, Appendix III Field Investigation

Parameter	Extraction	Analysis
Volatiles (solid)	SW-5030	SW-8240
Volatiles (aqueous)	SW-5030	SW-8240
Semivolatiles (solid)	SW-3550	SW-8270
Semivolatiles (aqueous)	SW-3510	SW-8270
ICP Metals (solid)	SW-3050	SW-6010
ICP Metals (aqueous-total, dissolved)	SW-3005	SW-6010
Gas furnace atomic absorption (GFAA) metals:		
Antimony	SW-3050	7041(S)
Arsenic	SW-3050	7060(S)
Chromium	SW-3050	7191(S)
Lead	SW-3050	7421(S)
Selenium	SW-3050	7740(S)
Thallium	SW-3050	7841(S)
Mercury	SW-3050	SW-7470
Mercury (soil)	SW-3050	SW-7471
Toxicity characteristic leading procedure (TCLP)	EPA-1311	7421(S)
Total petroleum hydrocarbons (solid)	SW-5030/3550	SW-8015
Total petroleum hydrocarbons (aqueous)	SW-5030/3510	SW-8015
pH (soil)	NA	SW-9045
% Solids	NA	C 2216

Geoprobe Sampling

A Geoprobe was used to collect subsurface soil samples at the sites investigated during Appendix III non-wasteline investigation. These sites included waste accumulation areas and storage yards, battery storage yards, USTs, a jet engine burn area, a jet engine test cell, a paint shop, and a drum rack. Sample points were finalized after considering access restrictions and underground utility locations. Additional deeper sampling was performed when field-screening (PID and/or FID) indicated the presence of VOCs at readings greater than three times background values (no radioactivity above background was detected during field-screening at any of the sites investigated). Sampling continued at 10-ft intervals below the deepest sample planned until field-screening instruments did not indicate the presence of VOCs, or the maximum attainable depth was reached with a Geoprobe.

Geoprobe Description

The Geoprobe is a hydraulically driven, truck-mounted soil sampling system that uses static force and percussion to drive sampling tools into the subsurface to collect soil samples with minimal waste generation. A steel sampling tube (24 in. long, 1.375 in. inside diameter) is the core sample collection device (i.e., large-bore sampler). Hollow probe rods (36 in. long, 1 in. outside diameter) are attached to the large-bore sampler in succession to advance the sampler to the desired depth. While being driven to the desired sampling depth, the sampler is kept closed by a piston tip that is held in place by a reverse threaded stop-pin located at the tail end of the sampler. When the sampler is driven to the desired sample collection depth, the piston stop-pin is removed, allowing the piston tip to ride upward as the sample tube is advanced. The sampler is subsequently driven an additional 24 in. for collection of the desired soil interval.

Prior to collecting a sample, an assembly of four decontaminated brass tubes (each 6 in. long) wrapped in an acetate sheath was placed inside the large-bore sampler. This setup permitted a soil collection interval of 24 in. per advancement. A 24-in. clear acetate sleeve was used in place of the brass tubes when collecting soil for lithologic description at alternate 5 ft intervals.

Samples for lithologic description and laboratory analysis were field-screened with an organic vapor meter (FID and/or PID), NaI gamma meter, and an NaI beta-gamma meter. Instrument readings were recorded in the field log book and on borehole logsheets. If field-screening indicated possible contamination, the brass tube exhibiting the highest FID or PID reading was designated for VOC analysis.

Brass tubes were used for collecting and shipping samples for laboratory analysis for all parameters. Following sample screening, the individual brass tube ends were covered with 2-in. square sheets of 0.003 in.-thick Teflon and sealed with vinyl caps. Samples were then individually placed in sealable plastic bags and stored on ice in a cooler.

Hand-Auger Sampling

Part of the investigation effort during the Appendix III RFI for non-wasteline sites included collecting soil samples near the ground surface (0.2 ft below grade to approximately 15 ft bgs) with a stainless-steel hand auger. Sample jars were filled by directly transferring the auger contents. Samples collected for VOC analysis were shipped to the laboratory in 40-ml glass vials.

3.1.1.3 Decontamination Procedures

In accordance with the DCQAP, which is based on IRP Handbook guidance, all sampling equipment was fully decontaminated prior to use for sample collection. The water used for field decontamination activities was provided on base from potable water sources. A permanent decontamination pad was used for all decontamination activities.

General decontamination activities for a Geoprobe and drilling rods include a high-pressure, hot water (potable) wash with Liquinox detergent for all external surfaces. A high-pressure hot water rinse followed the washing, and subsequent air-drying completed a Geoprobe decontamination process. To minimize the potential for cross-contamination, this decontamination procedure was performed prior to mobilizing a Geoprobe to successive site locations.

Prior to use, decontamination activities for sampling equipment (e.g., large-bore samplers, brass tubes) were conducted as follows:

- Washing with a solution of potable water and Liquinox detergent, followed by a potable water rinse.
- A triple rinse, consisting of an American Society of Testing Materials (ASTM) Type II water rinse, pesticide-grade methanol rinse, and finally a pesticide-grade hexane rinse.
- Air-drying of all sampling equipment, which was subsequently wrapped in aluminum foil for storage.

3.1.1.4 Borehole Abandonment

Following borehole completion, boreholes were backfilled with bentonite pellets to approximately 1 in. below the ground surface and allowed to hydrate. The borehole was completed to the surface using a cement-sand mixture (e.g., quick-setting concreteor Quikrete®), and an approximate 4-in. length of polyvinyl chloride (PVC) pipe (2-in. outside diameter) was placed in the concrete for sample identification. Boreholes drilled at concrete-cored locations on the flightline were similarly backfilled; the exception was that following completion, the Kirtland AFB Civil Engineers Squadron required flightline borehole locations to be recast using a high compressive-strength concrete. All abandoned boreholes were checked 24 to 48 hours after backfilling for settling.

3.1.2 Sample Handling

All samples were obtained in accordance with the requirements of the IRP Handbook. In addition to sample custody responsibilities, sample handling includes the selection of appropriate containers and preservatives, collection of required sample volume, and the management of holding times required of the analyses requested. The DCQAP, Section 1 (Table 1), provides specifications for sample containers (deviations are described in Section 3.2), volume requirements, preservatives, and allowable holding times per analyses requested. Table 3-2 summarizes the analytical methods used for Appendix III RFI samples.

3.1.2.1 Sample Identification System

During the Appendix III RFI, a sample identification system was used to identify each sample submitted for analysis to ensure sample traceability. At the time of sample collection, each sample container was affixed with an adhesive-backed sample label indicating the Air Force Center for Environmental Excellence (AFCEE) sample code (where appropriate), location, date and time of collection, analyses requested, and any preservative (for water samples collected in laboratory containers). This coding nomenclature included specific information pertaining to site number, borehole number, and sample depth. For QC samples (e.g., equipment blanks, ambient condition blanks, trip blanks, and replicates), other unique identifiers were included in the sample code. All replicate samples were sent blind to the laboratory. As samples were received by the laboratory for analysis, each was assigned a unique laboratory identification number through a computerized laboratory information management system (LIMS). Hard copy and electronic data provided by the laboratory included both field and laboratory identification codes.

3.1.2.2 Sample Packaging, Shipping, and Documentation

Samples were packaged and shipped in accordance with EPA and U.S. Department of Transportation (DOT) regulations, and 1993 IRP Handbook standards. Samples were sent to the laboratory in coolers packed with vermiculite and Blue Ice™. A sealed container of distilled water was placed in each cooler shipped to the laboratory to serve as a temperature blank to monitor compliance with EPA sample preservation protocol (i.e., <4°C). The temperature was measured upon receipt at the laboratory and recorded on the chain-of-custody form. Custody seals were affixed to each cooler, and strapping tape was applied to the lid and drainage port. Each sample shipment included a completed chain-of-custody form and the AFCEE sample logsheet.

The Field Team Leader (FTL) was responsible for the completion of the following forms:

- Sample labels
- Chain-of-custody forms
- AFCEE sample log forms
- Shipping labels
- Chain-of-custody seals
- Federal Express™ airbills

Sample custody was maintained and documented according to the Kirtland AFB Appendix III DCQAP Section 1.6. Visual inspection and notation of anomalies, with subsequent documentation on chain-of-custody forms and verbal notification, were found to meet project data quality requirements. Use of the custody seals ensured that any tampering with samples during shipment to the laboratory would be detected; no such occurrences were noted. Copies of the chain-of-custody forms generated during the field investigation are in Appendix E.

3.1.3 Land Surveying

All Appendix III soil sample borehole locations were surveyed following completion. A New Mexico-registered land surveyor was contracted to conduct a third-order survey of all sampling locations. Each soil boring location was surveyed to the nearest 0.10 ft horizontally and vertically. Existing survey monuments within Kirtland AFB were used as reference points. Vertical elevations were referenced to the 1929 National Geodetic Vertical Datum (NGVD29). Horizontal locations were surveyed to the Kirtland AFB coordinates that are tied to the New Mexico State Plane Coordinate System. Appendix D includes the ground survey report for all surveyed locations.

3.1.4 Waste Handling

Waste soil (i.e., soil not used for site analytical characterization) was generated during the Kirtland AFB Appendix III RFI soil sampling activities (e.g., Geoprobe). Liquid waste was also generated when sampling equipment was decontaminated. The following sections describe the management of field investigation-derived waste.

3.1.4.1 *Waste Soil*

Generated waste soil was minimal during Geoprobe sampling. Waste from each Geoprobe borehole, primarily soil-related to lithologic description, was placed in sealable, 1-gallon plastic bags and labeled. All of the 1-gallon bags of waste soil from one site were then placed in one large, sealed plastic bag. The larger plastic bag was labeled with the corresponding site number and placed into a 55-gallon DOT-approved drum. Waste soil from several sites were stored in the same drum. Each 55-gallon drum of waste soil was sealed and clearly labeled with the following information:

- Site numbers corresponding to the bags contained in the drum
- Drum contents (i.e., soil cuttings)
- Dates covering the collection period
- Point of contact (POC) name and telephone number
- The words "pending sample analysis"

All drums were stored in a Kirtland AFB accumulation point pending sampling and analysis prior to final disposition. Final disposition of Geoprobe drilling waste will depend on the analytical results for each borehole or site. Upon review of the waste characterization analytical results, drums or plastic bags containing nonhazardous soil will be disposed of, at the discretion of the POC, either off-base at an approved landfill or on-base in a manner specified by the POC.

3.1.4.2 *Wastewater*

Equipment decontamination wash and water rinsate fluids were collected and containerized in DOT-approved 55-gallon drums. All drums were sealed and clearly labeled with the following information:

- Drum contents and date filled
- Drums of Geoprobe sampling-related decontamination water were sequentially numbered upon collection
- POC name and telephone number
- The words "pending sample analysis"

All drums were stored in a Kirtland AFB accumulation point pending sampling and analysis prior to final disposition. Fluids generated during Geoprobe decontamination activities will be sampled for the analytical parameters required by the City of Albuquerque Sewer Use and Wastewater Control Ordinance, Chapter 8, Article 9. Nonhazardous drum contents will be disposed of by discharge to the sanitary sewer system on-base, which discharges to the City of Albuquerque publicly owned treatment works (POTW).

If samples submitted for waste characterization are determined to contain RCRA hazardous constituents, waste manifestation documents will be prepared and submitted to the Kirtland AFB Environmental Management Compliance Branch, the Contracting Officer's Representative, and the POC.

3.2 Work Plan Deviations

There were no major deviations from the Work Plan (USAF, 1994b) that would compromise data quality regarding decision-making. Deviations were discussed with the EPA regulator through verbal or written communication (Appendix G). Deviations are described below:

- Ten percent of the data was validated instead of 100 percent of the data. This change was instituted to reduce cost and effort associated with data validation. The 10 percent data validation frequency was established by EPA.

- Because of an oversight during field investigations, none of the samples submitted for analysis from the Appendix III RFI, Appendix III non-wasteline sites were designated for pH analysis. Consequently, no analyses for soil pH were performed.

3.3 Data Quality Objectives

DQOs are programmatic sample collection and management activities and sample analysis accuracy and precision requirements applied to environmental sample measurement as the result of the DQO process, (EPA, 1987 and revised EPA, 1993) in a series of planning steps based on scientific method. These steps are designed to ensure the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended application. EPA policy and regulations emphasize that environmental data must be of known quality to achieve that goal. Code of Federal Regulations Title 40, Part 300 (40 CFR 300), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), mandates the development of a Sampling and Analysis Plan (SAP), which specifies acceptable data quality goals, defines responsibility for achieving these goals, and includes as its key elements a field sampling plan and a DCQAP under CERCLA. Aside from 40 CFR 265 Subpart F, which requires a SAP for the investigation of potential groundwater contamination, programmatic QA planning documents are not required under RCRA. However, their development and use are advised in RCRA guidance documents to maximize investigation efficiency and minimize costs.

DQOs for the Appendix III RFI include analytical method precision and accuracy requirements, instrument detection limits, and control limits for matrix spike and matrix spike duplicate recovery (historical) and relative percent difference (method-specific requirements) (USAF, 1993b). Environmental measurement data will be of acceptable quality to enable the following decisions regarding site disposition:

- Recommendation for NFA and removal from the RCRA Part B Permit.

- Initiation of monitoring or further investigation.

- Corrective measure studies and remediation.

The Appendix III RFI was performed in conformance with the Appendix III DCQAP. Exceptions are described in Section 3.2. The quality objectives to meet data uses stated in the Appendix III Work Plan were as follows:

- Data collection and management performed in accordance with EPA and IRP guidance.

- Data generation and reporting that are scientifically and legally defensible.

- Data acceptability as determined by precision, accuracy, representativeness, and completeness that enables decision-making (e.g., further action/no further action).

3.4 Quality Assurance and Quality Control

3.4.1 Quality Assurance

Quality assurance is an integrated system of data management activities used to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting to provide environmental monitoring data of known acceptable quality. The procedures, stipulated in the EPA-approved Appendix III DCQAP, were used to provide acceptable and representative data to satisfy project DQOs and to enable appropriate decision-making regarding subsequent site disposition. During initial stages of the RFI, the QA officer was onsite daily observing all aspects of sample collection activity (e.g., daily calibration of field monitoring instruments, sample collection and packaging for shipment to the laboratory, chain-of-custody record-keeping, decontamination, collection of field QC samples) to ensure appropriate, scientifically sound quality control. No deficiencies were noted. Minor deviations from the DCQAP were verbally communicated to the FTL and immediately rectified.

Quality assurance for laboratory analytical results was achieved by the laboratory Quality Assurance Program (QAP) and applicable Standard Operating Procedures (SOPs). The laboratories used standard RCRA, SW-846, and ASTM analytical methods.

3.4.2 Quality Control

Quality control is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the established requirements.

3.4.2.1 QC Samples

The QC samples are control checks introduced into the process to monitor the performance of the sample data collection system. Several types of internal QC samples were used to evaluate system performance. For the purpose of this report, system quality control checks were classified as field QC samples or laboratory QC samples and included blanks (e.g., trip, equipment, ambient, and laboratory), replicates, spikes, analytical standards, and surrogates that were used to assess different phases of the data collection and analytical processes beginning with sampling and continuing through transportation, storage, and analysis. These QC samples and their frequency of use are described below.

3.4.2.2 Field QC Samples

Field QC samples included equipment blanks, field replicates, trip blanks, and ambient conditions blanks. Each type of field QC sample is defined below.

Equipment (Rinsate) Blanks

Equipment blanks were obtained every day sampling was conducted under representative field conditions by running Type II reagent-grade water through sample collection equipment (e.g., brass tubes used with a Geoprobe) after decontamination and prior to use for field sample collection. The rinsate was collected and analyzed for the same parameters as environmental samples collected that day. Equipment blanks were used to assess the effectiveness of decontamination procedures.

Field Replicate

Ten percent of all soil samples were field replicates. Replicate samples were identified so laboratory personnel were unable to distinguish them from normal field samples but were analyzed for the same laboratory parameters as the normal environmental field sample. Field replicates are normally used to evaluate field sampling and laboratory QA protocol in conjunction with laboratory QC sample results; however, soil nonhomogeneity makes definitive programmatic QA assessment difficult.

Trip Blanks

Trip blanks were included in every shipping or sample collection cooler that contained samples to be analyzed for VOCs regardless of sample matrix. Trip blanks, consisting of two 40-ml VOC vials, were obtained at the beginning of each day and subjected to the same field conditions as field environmental samples. They were used to evaluate possible environmental sample contamination resulting from sample handling and were provided by the laboratory.

Ambient Condition Blanks

Ambient condition blanks were collected when potential VOC sources existed upwind from sample collection or packaging locations. Ambient condition blanks were used to assess possible environmental sample contamination resulting from an external source (e.g., vapors from refueling operations, heavy traffic).

3.4.2.3 Laboratory QC Samples

The laboratory of Halliburton NUS (Pittsburgh, Pennsylvania) provided analytical results for the Kirtland AFB Appendix III RFI. The laboratory, AFCEE-approved, was audited by the EPA and participates in the Contract Laboratory Program and DOD environmental restoration projects. The QA for laboratory analytical results was achieved through strict adherence to the laboratory Quality Assurance Program (QAP) and applicable SOPs. Additional procedures were implemented for laboratory QC control checks, including analytical standards, method blanks, and surrogate recovery checks. The laboratory QC samples are defined as follows:

Analytical Standards

An analytical standard is comprised of constituent(s) at a known concentration. The standard may be a reference material certified by the National Institute of Standards and Technology (NIST). The laboratory stipulated use of certified analytical standards in its QA Program. To evaluate measurement system precision and accuracy control, analytical standards used included:

- ***Calibration standard,*** used to determine instrument response factors and linear range. Used on a method-specific frequency or as system conditions necessitate (e.g., post-maintenance, out-of-control check standards).

- ***Calibration check standard,*** at or near the midpoint of the standard calibration curve, analyzed each day of analysis for appropriate parameters. Results must fall within method-specific acceptance criteria. If not, results are flagged and corrective action is taken to recover system control.

- ***Internal standards,*** usually isotopes of organic compounds of interest used for target compound quantitation.

Method Blanks

The method blank is an analytical control sample that contains either distilled/deionized water or control solid, and other reagents (e.g., surrogates, internal standards). The method blank is carried through the entire analytical procedure (preparation and analysis).

Surrogates

Surrogates are organic compounds similar to analytes of interest in chemical composition and physical behavior, but not normally present in environmental samples. These compounds were added to all blanks, calibration and check standards, samples (including normal environmental samples, replicates, and QC samples), and spiked samples prior to sample processing. By calculating percent recovery, surrogates are used to monitor extraction efficiency. Method-specific percent recoveries are required for obtaining valid results. When surrogate recovery was outside method acceptance criteria, results were flagged by the laboratory. Samples were re-analyzed where appropriate.

Matrix Spike

A matrix spike (MS) is a separate aliquot of a sample spiked with the analyte(s) of interest and analyzed with the environmental sample. The results of MS analyses are used to measure method accuracy (as defined by percent recovery). Spike recovery was compared to laboratory matrix-specific historical statistical recovery criteria. Spike recovery outside laboratory QA acceptance criteria is flagged. Spike recovery may identify interference in complex matrices causing analytical bias. A matrix spike duplicate (MSD) (a second spiked aliquot of the same matrix and spiking solution) is analyzed and percent spike recovery calculated. The relative percent difference between the MS and MSD is calculated to determine matrix-specific, project-specific analytical precision. Analytical methods for organic constituents have specific MS/MSD precision requirements. When results were outside of method criteria, results were flagged and re-analysis performed where appropriate. MS/MSDs were used for both organic and inorganic analyses at a frequency of one set per 20 environmental samples. Laboratory Control Sample (LCS) and LCS duplicate—solid or liquid matrices—may be substituted for MS/MSD samples, per AFCEE IRP guidance.

Field samples and field QC samples were analyzed in conjunction with laboratory QC samples. The combined results of field and laboratory control samples were used to enable an overall quality assessment of measurement data.

3.4.3 Laboratory Analysis Activities

The Halliburton NUS laboratory provided analytical support for the Kirtland AFB Appendix III RFI. The laboratory used standard EPA methodology and QA/QC protocol to ensure the reliability, consistency, and comparability of reported results. Sample analysis was performed for required parameters (e.g., VOCs, semivolatile organic compounds (SVOCs), petroleum hydrocarbons, inorganics) and target compounds identified in the Appendix III Work Plan (USAF, 1994b) by the described EPA analytical methodology. The SW-846/8240 VOC was analyzed by the laboratory using a capillary column (SW-846/8260) (EPA, 1992). Instrument detection limits (IDLs) and QC acceptance criteria for analytes of interest are provided in Appendix K, as required by the EPA and Air Force IRP Guidance (AFCEE, 1994). Laboratory QC sample acceptance criteria are based on either method-specific requirements or on historical laboratory matrix-specific statistical criteria. Analytical results not meeting applicable criteria are flagged by the laboratory and discussed in the case narrative. Historical laboratory acceptance criteria used in the Appendix III environmental sample analysis effort are also available in laboratory QA/QC reports, the Appendix III Work Plan (USAF, 1994b), and Appendix K.

QC acceptance criteria related to field QC replicate samples are identified in Section 3.4.2.2 and shown in Table 3-4.

Table 3-4. Acceptance Criteria for Field Replicate Samples

Method	QC Sample Frequency	Acceptance Criteria
SW-846/8240/8260 (volatile organics)	1 set per 10 samples	RPD <30%
SW-846/8270 (semivolatile organics)	1 set per 10 samples	RPD <30%
SW-846/6010 (inorganics by ICP)	1 set per 10 samples	RPD <40%
SW-846/7471 (mercury by GFAA)	1 set per 10 samples	RPD <40%
SW-846/8015b (TPH)	1 set per 10 samples	RPD <40%
SW-846/8080 (pesticides and polychlorinated biphenyls [PCBs])	1 set per 10 samples	RPD <30%
SW-846/8150 (herbicides)	1 set per 10 samples	RPD <30%
Gross alpha and beta	1 set per 10 samples	RPD <30%

3.5 Data Validation and Evaluation

The following describes practices used for data validation and reporting of the environmental data resulting from the Appendix III RFI.

Data validation was performed on 10 percent of the analytical results of the environmental samples collected during this investigation. Data validation was conducted according to the following EPA national protocols and *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* SW-846 method-specific criteria:

- Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (EPA, 1994a).
- Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (EPA, 1994b).
- SW-846, Method 8240/8260; *Volatile Organic Analysis.*
- SW-846, Method 8270; *Semivolatile Organic Analysis.*
- SW-846, Method 6010; *Inductively Coupled Plasma (ICP) Inorganic Analysis.*
- SW-846, Method 7471; *Manual Cold-Vapor Technique for Mercury Analysis.*
- SW-846, Method 7040; *GFAA Technique for Antimony.*
- SW-846, Method 7060; *GFAA Technique for Arsenic.*
- SW-846, Method 7190; *GFAA Technique for Chromium.*
- SW-846, Method 7421; *GFAA Technique for Lead.*
- SW-846, Method 7740; *GFAA Technique for Selenium.*
- SW-846, Method 7841; *GFAA Technique for Thallium.*

In accordance with EPA national protocols, organic and inorganic data were evaluated based on the following criteria:

- Data completeness.
- Holding times.
- Initial and continuing calibration verification.
- Blank analyses.
- Interference check sample results (inorganic data only).
- Matrix spike/matrix spike duplicate analyses.
- Field replicate results (where appropriate).
- Laboratory control sample results.
- Detection limits.
- Sample quantitation results.

In addition to the organic and inorganic data validation mentioned above, data from total petroleum hydrocarbon (TPH) analyses were also validated. However, this analysis is a screening method and was validated according to QA2 criteria (EPA/450/G-90/004) that requires evaluating the sample documentation, holding time, calibration data, method blank, and blank spike analysis results.

As a result of the validation, qualifiers have been added to the data to alert the user of the limitations associated with the sample results. The following definitions provide brief explanations of the nationally used qualifiers assigned to sample results in the data review process:

U The analyte was analyzed for but not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample.

UJ The analyte was not detected above the sample quantitation limit. However, the reported quantitation limit is approximate, and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected because of major deficiencies in the ability of the laboratory to verify the presence or absence of the analyte.

Results and conclusions of this formal data validation process were submitted to the project manager in the form of data validation memoranda. The data validation memoranda explain the findings of the data evaluation process, include a summary of the qualifiers assigned, and provide justification for actions taken on the data. Data QC concerns are summarized in Section 3.5.1.

3.5.1 Data Quality Assurance/Quality Control

Data validation protocol gives a representative indication of overall analytical control. If a particular problem related to analytical control is identified frequently, the data user will be alerted to the limitations associated with that particular constituent in the data validation memorandum. Ten percent of the data was formally validated; results indicate data to be generally good quality for site assessment. Specific occurrences which resulted in qualification of the associated data are addressed in the following summary.

3.5.1.1 Organic Analyses Data Evaluation Summary

The following paragraphs summarize the limitations of the data based upon the formal data validation review for 10 percent of the data packages. Most data reviewed were acceptable, but qualifiers were assigned to some analyte results in the 10 percent population. Problems identified were not considered significant because the analytes were not detected in the environmental samples. Details of the data validation review are presented in Appendix K. Data use for decision-making purposes is not impacted.

- Initial or continuing calibration Relative Response Factors (RRFs) for 3-nitroaniline tended to be less than the 0.050 minimum quality control criteria. Nondetects for this compound in the affected samples (approximately 34 samples of the 176 validated samples) were unreliable and therefore rejected, R.

- Initial and continuing calibration quality control statistical parameters exceeded 50 percent QC criteria for the volatile compounds carbon disulfide, 2-butanone, bromomethane, 2-chloroethylvinylether, 2-hexanone, acetone, trans-1,2-dichloroethane, vinyl acetate, chloroethane, toluene, and chlorobenzene in several data packages. Positive results and nondetects for affected compounds in affected data packages were estimated, J and UJ, respectively, unless previously rejected.

- Initial and continuing calibration quality control statistical parameters exceeded 50 percent for the semivolatile compounds 4-nitroaniline, 2,4-dinitrophenol, benzyl alcohol, 4-nitrophenol, 3-nitroaniline, benzo(g,h,i)perylene, carbazole, and 3,3'-dichlorobenzidine. Positive results and nondetects for affected compounds in the affected data packages were estimated, J and UJ, respectively.

- Some positive results for benzo(k)fluoranthene were estimated, J, because of initial calibration percent relative standard deviations (%RSDs) greater than the 30 percent QC criteria; and some positive results for acetone, bis(2-ethylhexyl)phthalate and phenol were qualified as estimated, J, because of continuing calibration percent differences (%Ds) greater than the 25 percent QC criteria. These statistics indicate that the laboratory had difficulty in maintaining consistent responses for these compounds, but the problem was not severe enough to cause uncertainty on associated nondetects.

- Acetone, methylene chloride, 2-butanone, benzene, tetrachloroethene, vinyl chloride, ethylbenzene, 2-hexanone, 4-methyl-2-pentanone, styrene, 1,1,2,2-tetrachloroethane, xylene (total), toluene, and di-n-butylphthalate consistently occurred as laboratory method and field quality control blank contaminants during the validation review. Results for these compounds reported at concentrations less than the validation action levels were considered to be false positives and are qualified as undetected, U.

- Pesticide/PCB surrogate percent recoveries (%Rs) for three samples were outside QC limits. Nondetects for the compounds reported in the affected samples were qualified as estimated, UJ. Surrogate recovery noncompliances are indicative of matrix interferences, which cause the instrumental response of the compound to be augmented or suppressed; hence, reanalysis of these samples often fails to yield acceptable recoveries as well. It should be noted that based on overall quality of the data, the validator chooses the best results to be presented in the data.

- Positive results and/or nondetects of the volatile fraction for three samples in data package ST-276, one sample in data package ST339Y, and one sample in data package 32137 and three samples in data package ST341A were qualified as estimated, J and UJ, respectively, because the internal standards used to quantitate these results failed to meet quality control criteria. Because sample results are quantitated based on internal standard responses, the exact level of quantitation/ detectability for these compounds is uncertain.

- Positive results and/or nondetects of the semivolatile fraction for one sample in data package ST339Y, two samples in data package ST276, one sample in data package 32137, two samples in data package ST276A, and one sample in data package ST341A were qualified as estimated, J and UJ, respectively, because the internal standards used to quantitate these results failed to meet quality control criteria. Because sample results are quantitated based on internal standard responses, the exact level of quantitation/detectability for these compounds is uncertain.

- Results for xylenes (total), 1,1,2,2,-tetrachloroethane, and tetrachloroethene of the volatile fraction and pentachlorophenol of the semivolatile fraction were estimated in the associated unspiked samples as a result of MS/MSD results being outside quality control limits. These noncompliances are indicative of matrix interferences resulting in uncertainty of quantitation.

- Laboratory control sample duplicate (LCS/LCSD) results for the volatile organic compounds acetone, 1,1,2-trichloroethane, vinyl acetate, 2-chloroethylvinyl ether, benzene, bromomethane, carbon disulfide, and toluene were outside quality control limits. Positive results and/or nondetects were estimated, J and/or UJ, respectively. Failure to meet LCS/LCSD quality control criteria indicates imprecision/lack of consistency in instrumental responses for the affected compounds.

- Positive results for several compounds in the volatile fraction were estimated because they were reported at concentrations below the reporting limit, which is the limit at and above which sample results are statistically considered to be greater than 99 percent confident. Therefore, results reported at concentrations less than the reporting limit are considered to be approximate values.

3.5.1.2 Inorganic (Metals) Analyses Data Evaluation Summary

The following paragraphs summarize the limitations of the data of inorganic analyses based upon the formal data validation review for 10 percent of the data packages. Most data reviewed were acceptable, but qualifiers were assigned to some analyte results in the 10 percent population. Problems identified were not considered significant because the analytes were not detected in the environmental samples. (Details of the data validation review are presented in Appendix K.) Data use for decision-making purposes is not impacted.

- The continuing calibration verification (CCV) %Rs for arsenic and chromium exceeded quality control limits. Positive results for these compounds were qualified as estimated, J, in the affected validation samples. Additionally, CCV %Rs for antimony, arsenic, chromium, lead, selenium, and thallium were below quality control limits. Positive results and/or nondetects for these analytes were qualified as estimated, J and UJ, respectively.

- Qualifications based on laboratory method and/or field quality control blank contamination were made for the analytes in the packages as indicated in the following table.

Table 3-5. Analytes Requiring Qualification

Analyte	Data Package
Antimony	ST399Y
Arsenic	ST277
Cadmium	32137, ST33Y, ST339U
Chromium	ST277
Copper	33637, ST277, ST339Y, ST339U
Lead	ST339U
Mercury	ST339U
Nickel	ST277, ST339Y
Sodium	32137, 33637, ST339Y, ST339U
Zinc	ST277, ST339Y, ST339U

- Affected positive results reported at concentrations below the associated validation action levels were qualified as undetected, U. These results are considered to be false positives because of blank contamination.

- Several other analytes were also present as blank contaminants in various data packages; however, no data qualifications were necessary since all affected sample results were either nondetect or were reported at concentrations above the validation action levels.

- Negative concentrations for antimony, nickel, potassium, and zinc were reported for the laboratory method blanks at levels which exceeded the absolute value of the IDL. These occurrences in the affected data packages indicated instrumental drift (base-line fluctuations) which caused readings to be inconsistent. Positive results and nondetects for these affected analytes in the affected samples of the validation data packages were qualified as estimated, J and/or UJ, respectively.

- Nondetects for molybdenum in several samples were estimated, UJ, because instrumental responses for this analyte was suppressed based on evidence associated with the interference check sample (ICS) results. Interferences were also noted for copper, chromium, nickel, sodium, vanadium, zinc in the validated data packages as a result of high calcium concentrations within the sample matrix. These results were qualified as estimated, J.

- Positive results of copper and nickel for samples in data package ST339Y and barium and copper for samples in data package ST339U were qualified as estimated, J, due to laboratory duplicate imprecision.

- LCS results for barium, cadmium, copper, nickel, and potassium were noncompliant. Positive results for these analytes were qualified as estimated, J. Failure to meet LCS QC criteria indicates imprecision/lack of consistency in instrumental responses for the affected analytes.

- MS %RS for barium, mercury, potassium, lead, and zinc exceeded quality control limits. Positive results were qualified as estimated, J. These noncompliances are a result of interferences associated with the matrix of the sample.

- MS %RS for antimony, arsenic, lead, nickel, selenium, silver, thallium, and zinc were below QC limits. Positive results and nondetects for arsenic, lead, nickel and zinc were qualified as estimated, J and UJ, respectively. Nondetects for antimony, selenium, silver, and thallium were qualified as estimated, UJ. These noncompliances are a result of interferences associated with the matrix of the sample.

- Matrix interferences which cause the MS %R for a particular analyte to be less than 30 percent are considered to be severe. Severe matrix interferences were noted for antimony in data packages ST339U and ST339Y. Nondetects for antimony in these data packages were rejected, R.

- GFAA post digestion spikes (PDSs) %Rs for arsenic, selenium, and/or thallium were below QC limits in data packages 33637 and ST277. Positive results for arsenic were qualified as estimated, J. Nondetects for selenium and thallium were qualified as estimated, UJ.

- GFAA PDS %Rs for chromium exceeded quality control limits in data package ST277. Positive results for chromium were qualified as estimated, J.

3.5.2 Decision Criteria for Proposing a Course of Action Based on Organic Contaminants

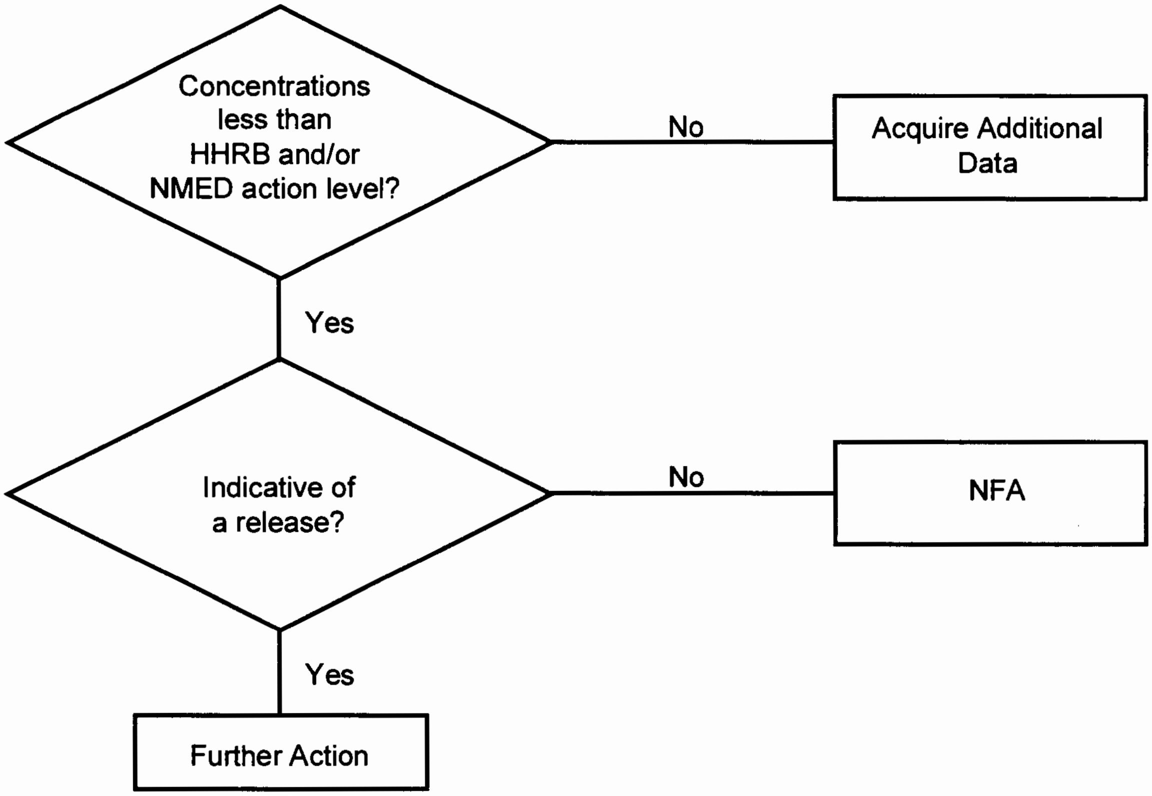
The primary objective of the Appendix III RFI at Kirtland AFB was to characterize the nature and extent of contamination in site media, and to determine the overall environmental impact from any contaminant release to either soil or groundwater. Because of the shallow depth of soil borings (< 50 ft), this RFI was limited to soil investigation only. The soil was primarily analyzed for VOCs, SVOCs, diesel range organics (DRO), gasoline range organics (GRO), polynuclear aromatic hydrocarbons (PAH), and metals (discussed in the following section). After characterizing the specific site media, specific actions were proposed through the assessment of current site conditions. Their specific actions typically associated with an RFI include a NFA, resampling of environmental media to better define the extent of any contamination, or a Corrective Measures Study (CMS).

Figure 3-1 presents the decision criteria used to select a recommended course of action for the Appendix III RFI sites. This decision criteria is based on the comparison between analytical soil results for a specific site and human health risk-based (HHRB) action levels. The standard approach to evaluate a site and propose a further course of action is to use HHRB action levels for selected chemicals. If the specific site analytical results exceed the HHRB action levels, a CMS would be recommended. A NFA would be proposed for sites where analytical data are below the HHRB action levels and are not indicative of a release. Further investigation would be proposed if analytical results (indicative of a release) are below the HHRB action levels.

The HHRB action levels used for evaluation during this assessment are risk-based concentrations calculated for a residential scenario. These concentrations were obtained from the widely accepted EPA Region III Risk-Based Concentration Table (EPA, 1995). Action levels for DRO and GRO were taken from the NMED UST regulations (NMED, 1991).

3.5.3 Decision Criteria for Proposing a Course of Action Based on Metal Contamination

The decision criteria for metals is more complex than that previously described for organic contamination because of the natural occurrence of metals in soil; it is difficult to distinguish between naturally occurring (background) concentrations and contamination. Metal results in excess of the HHRB action levels, with the exception of arsenic, beryllium, and manganese discussed in Section 4.2.2, result in proposing further investigation for a site. Metal concentrations greater than two times the upper tolerance limit (UTL) and associated with organic concentrations not attributable to laboratory contamination also resulted in proposing further investigation or CMS at a site. Metal concentrations greater than two times the UTL but not associated with organic contamination were considered to be anomalous occurrences due to the nonhomogeneous nature of alluvial soil underlying Kirtland AFB.



* No HHRB action level is applicable to GRO and DRO; NMED action level is the criteria to evaluate GRO and DRO concentrations.

Figure 3-1. Decision Criteria for Proposing a Course of Action Based on Organic Contaminants

4.0 Facility-Wide Results Summary

4.1 Overview of Contaminants Detected

A total of 364 environmental samples were collected in the investigation of 14 non-wasteline sites during the Appendix III RFI. Table 4-1 lists the organic constituents, metals, and radiological isotopes detected in these samples. Table 4-1 also includes the range of measured concentrations and the location of the maximum detected concentrations.

A variety of organic compounds was detected in samples collected during the RFI, most at concentrations less than 1 mg/kg. Based on a review of QC sample results, some organic compounds detected were attributed to field and laboratory contamination (Section 3.5.1.1). Hazardous organic constituents, detected at higher concentrations, were found at four sites: SWMU ST-64, a vehicle maintenance yard; SWMU WP-339, a contractor yard used to park vehicles and store equipment; SWMU ST-341, a condensate holding tank used for collection of a water/fuel mixture from a pump house; and SWMU 9-20, a waste storage accumulation area. Details of specific contaminants detected and the concentrations are discussed in site-specific investigation sections (Sections 5.0 through 18.0).

A summary of metals detected in environmental samples and the ranges of concentrations is presented in Table 4-1. Metals are discussed relative to Kirtland AFB sitewide background levels in Section 4.2, and are subsequently addressed in site-specific sections, 5.0 through 18.0.

4.2 Statistical Analysis of Background Data

During the wasteline and non-wasteline portions of the Appendix III RFI, 78 background soil samples were collected at Kirtland AFB in areas away from any known or suspected contamination near the sites investigated. For the most part, metal concentrations in these samples are well below the calculated HHRB action levels (Table 4-2); however, beryllium, manganese, and arsenic are present in some samples at concentrations exceeding HHRB action levels. These results are consistent with background levels detected during the Stage 2B RFI (USAF, 1995). This section outlines the methodology used to determine background metal concentrations for the Appendix III RFI sites.

Background concentrations were calculated to distinguish naturally occurring metal concentrations from concentrations that may indicate contamination. Statistical analysis results are used to support the conclusion that concentrations of beryllium, manganese, and arsenic exceeding HHRB action levels are naturally occurring.

Table 4-1. Summary of Concentration Data for Constituents Detected in Soil, Appendix III Non-Wasteline RFI (all Concentrations in mg/kg)

Constituent	Number of Detections	Range	Mean	Median	Location of Maximum Value
Volatiles					
Acetone[a]	65	0.0018–0.18	0.016	0.009	ST-337C-03
Carbon disulfide	1	0.0018–0.0018	0.0018	0.0018	ST-338C-03
Chlorobenzene	7	0.002–0.72	0.22	0.008	ST-341C-04
Ethylbenzene	11	0.002–45	8.2	0.88	ST-341C-03
2-Hexanone	1	0.003–0.003	0.003	0.003	ST-339C-05
Methyl ethyl ketone[a]	13	0.002–0.023	0.007	0.006	ST-337C-03
Methyl isobutyl ketone	2	0.0016–0.0086	0.0051	0.0051	ST-337C-03
Methylene chloride[a]	95	0.0013–0.019	0.0053	0.0048	ST-339C-07
Tetrachloroethylene	3	0.002–0.0031	0.0025	0.0025	ST-276C-03
Toluene	28	0.001–18	1.1	0.00305	ST-341C-08
Xylenes, total	7	0.013–3.1	0.49	0.019	ST-337C-03
m,p-Xylene (sum of isomers)	22	0.002–150	14.6	0.695	ST-341C-03
o-Xylene	17	0.003–60	8.3	1.4	ST-341C-03
Semivolatiles					
Acenapthene	4	0.22–1.8	0.8	0.595	ST-341C-03
Anthracene	6	0.036–2.1	0.71	0.48	ST-341C-03
Benzo(a)anthracene	9	0.065–4.9	1.3	0.51	ST-341C-03
Benzo(a)pyrene	8	0.055–1.8	0.76	0.59	ST-337C-02
Benzo(b)fluoranthene	9	0.067–3.5	1	0.48	ST-337C-02
Benzo(g,h,i)perylene	5	0.066–1.2	0.5	0.4	ST-337C-02
Benzo(k)fluoranthene	8	0.05–2.6	0.88	0.575	ST-341C-03
Bis(2-ethylhexyl)phthalate[a]	50	0.049–5.4	0.49	0.26	ST-339C-04
Chrysene	10	0.063–3.5	1.1	0.455	ST-341C-03
Di-n-butylphthalate[a]	35	0.23–0.71	0.47	0.46	ST-321C-02
Dibenz(a,h)anthracene	1	0.57–0.57	0.57	0.57	ST-337C-02
Dibenzofuran	3	0.3–1.1	0.69	0.66	ST-341C-03
1,2-Dichlorobenzene	5	0.003–1.1	0.26	0.004	ST-341C-06
1,3-Dichlorobenzene	11	0.0044–0.375	0.068	0.016	ST-341C-05
1,4-Dichlorobenzene	2	0.31–0.48	0.4	0.395	ST-341C-06
Fluoranthane	15	0.17–10	2.1	0.82	ST-341C-03
Fluorene	3	0.54–1.2	0.83	0.76	ST-341C-03
Indeno(1,2,3-c,d)pyrene	6	0.052–1.2	0.51	0.43	ST-337C-02
2-Methylnaphthalene	14	0.37–59	12.6	6.25	ST-337C-03
Naphthalene	13	0.36–13	3.9	3	ST-337C-03
Phenanthrene	16	0.12–9	1.7	0.735	ST-341C-03
Phenol	67	0.088–2.5	0.68	0.61	ST-341C-04
Pyrene	15	0.04–9.9	1.9	0.64	ST-341C-03

Table 4-1. Summary of Concentration Data for Constituents Detected in Soil, Appendix III Non-Wasteline RFI (all Concentrations in mg/kg) (Continued)

Constituent	Number of Detections	Range	Mean	Median	Location of Maximum Value
Petroleum Hydrocarbons					
Diesel fraction	42	4.7–10000	980	75	ST-341C-07
Gasoline fraction	29	0.22–360000	14800	25	ST-341C-03
Metals					
Aluminum	161	2420–17900	7370	6860	ST-277C-04
Antimony	17	3.2–8.4	5.6	5.1	ST-339C-02
Arsenic	161	0.93–88.2	3.7	2.8	ST-339C-10
Barium	161	17.8–1340	155	117	ST-339C-08
Beryllium	156	0.13–1.1	0.47	0.42	ST-277C-04
Cadmium	68	0.34–1.2	0.64	0.595	ST-51C-06
Calcium	161	4680–281000	41900	31500	ST-339C-08
Chromium, total	161	1.1–25.4	7.6	6.9	ST-277C-03
Cobalt	161	2.3–11.5	5.2	4.9	ST-51C-01
Copper	161	6.1–207	36.7	25.1	ST-339C-06
Iron	161	2870–22800	11000	10400	ST-51C-01
Lead	231	1.8–91.2	7.2	5.5	ST-339C-09
Magnesium	161	1840–9060	4230	3910	ST-335C-04
Manganese	161	26.5–579	217	206	ST-51C-01
Mercury	26	0.05–0.35	0.1	0.08	ST-335C-05
Nickel	161	2.6–659	22.5	9.3	ST-277C-01
Potassium	161	372–4720	1530	1390	ST-51C-01
Sodium	161	46.2–925	249	194	ST-339C-04
Thallium	4	0.23–0.42	0.32	0.31	ST-339C-01
Vanadium	161	10.1–58.8	23.8	22.1	ST-275C-01
Zinc	161	11–312	43.6	39	ST-335C-04

Table 4-1. Summary of Concentration Data for Constituents Detected in Soil, Appendix III Non-Wasteline RFI (all Concentrations in mg/kg) (Concluded)

Constituent	Number of Detections	Range	Mean	Median	Location of Maximum Value
Radioactive Isotopes (Concentrations in pCi/g)					
Actinium 208	1	0.7–0.7	0.7	0.7	ST-276C-08
Actinium 228	34	0.5–1.2	0.79	0.75	ST-276C-03
Gross alpha	46	4.8–40	14.9	13	ST-276C-09
Gross beta	47	11–27	18.6	18	ST-276C-05
Bismuth-214	47	0.3–0.8	0.51	0.5	ST-276C-03
Lead-212	47	0.3–1	0.59	0.6	ST-276C-02
Lead-214	47	0.3–0.9	0.55	0.6	ST-276C-04
Potassium-40	47	12–24	17.2	17	ST-276C-02
Radium-224	32	0.7–12	6.2	6.7	ST-276C-03
Radium-226	47	0.2–7.9	1.7	1.7	ST-276C-05
Radium-228	42	0.2–3.4	0.4	0.3	ST-276C-05
Thallium-208	47	0.2–0.5	0.24	0.2	ST-276C-03
Thorium-227	29	1.2–3	1.8	1.7	ST-276C-03
Thorium-234	16	0.7–1.4	1	1	ST-276C-02
Uranium-235	30	0.09–0.2	0.12	0.1	ST-276C-02
Miscellaneous Inorganics					
Nitrate	8	2.8–28	13.3	14.5	ST-51C-07
Sulfate	17	31–180	82.5	75	ST-277C-03
Sulfur	2	240–280	260	260	ST-338C-08
Pesticides					
DDD	1	0.0084–0.0084	0.0084	0.0084	ST-277C-03
DDE	3	0.0064–0.052	0.022	0.008	ST-337C-05
DDT	1	0.022–0.022	0.022	0.022	ST-337C-04

a. Common laboratory contaminant

Table 4-2. Summary of Appendix III RFI Wasteline and Non-Wasteline Background Concentrations for Metals in Soil (all Concentrations in mg/kg)

Metal	Number of Samples	Number of Detections	Range	Mean	Median	UTL	Proposed HHRB Action Level
Aluminum	70	70	1410–20200	7950	7780	14700	78000
Antimony	70	0	<0.255	N/A	N/A	N/A	31
Arsenic	70	68	0.31–12.5	3	2.65	6.5	0.37
Barium	70	70	23.2–1610	217	152	735	5500
Beryllium	70	59	0.155–1.4	0.47	0.42	0.84	0.15
Cadmium	70	25	<0.51–1.6	0.84	0.73	N/A[a]	39
Calcium	70	70	842–154000	48600	37550	121000	N/A
Chromium, Total	70	70	1.8–35.4	9.4	7.3	21.6	390
Cobalt	70	70	1.5–20.7	7	5.95	15.4	4700
Copper	70	70	10.6–600	61	38.15	223	2900
Iron	70	70	3700–28200	12600	12100	23800	N/A
Lead	72	72	1.8–30.6	6.1	5.45	17.5	400
Magnesium	70	70	683–12500	5460	5210	10400	N/A
Manganese	70	70	53.5–675	249	210	549	390
Mercury	70	4	<0.04–0.24	0.16	0.13	N/A[a]	23
Molybdenum	66	2	<5.1–66	35.7	35.7	N/A[a]	390
Nickel	70	69	<2.1–659	26.2	8.3	188	1600
Potassium	70	70	269–4740	1710	1565	3590	N/A
Selenium	70	0	<0.205	N/A	N/A	N/A	390
Silver	70	0	<0.51	N/A	N/A	N/A	390
Sodium	70	70	49.6–1880	263	176.5	787	N/A
Thallium	70	27	<0.1–0.42	0.16	0.14	N/A[a]	N/A
Vanadium	70	70	7–63.8	30.3	29.4	55.3	550
Zinc	70	70	15.3–265	48.3	39.65	114	23000

a. Value not considered valid because of low number of detections.

4.2.1 Methodology for Determining Background Concentrations

The UTL method of calculating an upper level of background concentrations (Lieberman, 1958) provides a useful benchmark for comparison purposes. Using this method, a concentration is calculated to separate expected background concentrations for a particular metal from those that indicate potential contamination. The UTLs were calculated using all 70 background soil samples collected basewide for which metals analysis was performed rather than limiting the calculation to the site-specific or stage-specific background sample(s). The basewide background approach was chosen because of the need for at least three samples to calculate a UTL, and at least eight samples to calculate a meaningful UTL

(EPA, 1989). The disadvantage of combining all background samples is that spatial variability in the natural concentrations of metals may obscure site-specific elevated concentrations because of contamination. For example, if natural concentrations of a particular metal are high at the north end of the base but low at the south end, the calculated UTL could be too high to recognize potential contamination in southern sites. Conversely, some northern sites with concentrations above the UTL could be falsely identified as contaminated. Despite this disadvantage, the calculation of the UTL using all background values is the best approach because of the following:

- Vertical stratigraphic variability (including that resulting from excavation and fill activities during installation of the investigated units) can make direct comparison between site-specific background samples and other boreholes at the site inconclusive.

- No consistent horizontal variability in background concentrations of metals has been identified.

- In general, characteristics of Appendix III RFI sites suggest that metal contamination would be accompanied by organic contamination. This reduces the likelihood that significant metal contamination would go undetected.

It must be recognized that in comparison with the UTL, which is approximately the 95th percentile of the background concentration, about 5 percent of values can be expected to exceed the UTL within the background or other noncontaminated samples. With more than 364 environmental samples and 4,800 individual analyses for metals, comparison with the UTL yields a significant number of false positives.

4.2.2 Beryllium, Manganese, and Arsenic Concentrations

Beryllium, manganese, and arsenic were detected in numerous soil samples collected at Appendix III RFI sites across Kirtland AFB at levels approaching or exceeding the calculated HHRB action levels. Because of the presence of these three metals in elevated concentrations, several statistical analyses were performed during the Stage 2B RFI to determine whether these were possibly the result of contamination (USAF, 1995):

- T-test comparison between background metals values and those from individual sites.

- Correlation between metals concentrations and depth.

- Correlation between metals concentrations and TPH concentrations.

These tests strongly indicated that concentrations of beryllium, manganese, and arsenic above HHRB action levels were naturally occurring. Appendix III RFI background sampling results are similar to those from Stage 2B (Table 4-3) lending further support to this argument. Because of the similarity between Stage 2B RFI and Appendix III RFI results, these statistical analyses were not performed on Appendix III RFI data.

Table 4-3. Comparison of Appendix II (Stage 2B) and Appendix III RFI Background Concentrations for Arsenic, Beryllium, and Manganese (all Concentrations in mg/kg)

Metal	Investigation	Range	Mean	Median	UTL
Arsenic	Appendix II	<3–11.9	3.7	3	7.7
	Appendix III	0.58–12.5	2.9	2.6	6.5
Beryllium	Appendix II	<0.01–0.92	0.47	0.44	0.82
	Appendix III	0.22–1.4	0.43	0.41	0.84
Manganese	Appendix II	3.2–528	237	229	435
	Appendix III	53.5–675	252	216	551

4.2.3 Organic Constituents

Kirtland AFB personnel sampled background soil for organic constituents. Diesel fraction hydrocarbons were detected in 32 percent of these background samples at a median concentration of 8.5 mg/kg. While the source of these concentrations has not been specifically identified, it is probably unrelated to possible releases from SWMUs given the placement of background borings 50 ft or more from the SWMUs and the high incidence of detection in background samples. These results point to a ubiquitous TPH presence (probably from naturally occurring organics in the soil), or laboratory-related contamination or artifacts of analysis. In general, TPH concentrations up to 10 mg/kg range were not considered, by themselves, as evidence of a release from the SWMU and are well below the 100 mg/kg NMED TPH action level.

4.3 Nature of Contamination

Potential contaminants at Appendix III sites consist primarily of petroleum hydrocarbon fuels, VOCs, SVOCs (including PAHs and phthalates, which are fuel combustion residuals), and metals. Details of the nature of contamination are presented on a site-specific basis in Sections 5.0 through 18.0. Each of these sections contains an analytical result summary of the organic and inorganic compounds detected in environmental samples for the 1994 investigation at that site. Full analytical results for all Appendix III non-wasteline RFI environmental samples collected at Kirtland AFB are provided as Appendix F.

4.3.1 Fate and Transport

The fate and transport of site contaminants are determined on the basis of various chemical and physical properties. Literature or calculated values for such properties as specific gravity, vapor pressure, and solubility can indicate a contaminant's potential interaction with other environmental media (e.g., soil, water, and air), particularly if site-specific lithology and soil properties are known.

Table 4-4. Environmental Fate and Transport Parameters for Organic Compounds

CAS Number	Chemical	Molecular Weight[a,b,d,e] (g/mole)	Specific Gravity[b,d] (20/4°C)	Vapor Pressure[a,d,e] (mm Hg @ 20°C)	Water Solubility[a,d,e] (mg/l @ 20°C)	Octanol/Water Partition Coefficient[e] (K_{ow})	Organic Carbon Partition Coefficient[e] (K_{oc})	Henry's Law Constant[e] (atm-m^3/mole)	BCF[a] (L/kg)
Halogenated Aliphatic Hydrocarbons									
75-09-2	Methylene chloride	84.93	1.327	362	20,000	20	8.8	2.03×10^{-3}	5
127-18-4	Tetrachloroethylene	165.83	1.626	18	150	398	364	2.59×10^{-2}	30.6
Ketones									
67-64-1	Acetone	58.08	0.7899	270	1.0×10^{-6}	0.57	2.2	2.06×10^{-5}	N/A
78-93-3	Methyl ethyl ketone	72.11	0.8054	77	268,000	1.95	1.8	2.74×10^{-5}	0
591-78-6	2-Hexanone	100.16	0.8113	2	35,000	24	75	1.75×10^{-3} [b]	N/A
108-10-1	Methyl isobutyl ketone	100.16	0.7978	10	19,100	15.4	113	1.49×10^{-5} [b]	N/A
Monocyclic Aromatics									
108-90-7	Chlorobenzene	112.56	1.1058	11.7	466 (25°C)	690	330	3.72×10^{-3}	10.3
100-41-4	Ethylbenzene	106.16	0.8670	7	152	1,412	1,100	6.43×10^{-3}	37.5
95-50-1	1,2-Dichlorobenzene	147	1.3048	1.0	100	3.6×10^{3}	1.7×10^{3}	1.93×10^{-3}	N/A
541-73-1	1,3-Dichlorobenzene	147	1.2884	2.28 (25°C)	123 (25°C)	3.6×10^{3}	1.7×10^{3}	3.61×10^{-3}	N/A
106-46-7	1,4-Dichlorobenzene	147	1.2475	1.18 (25°C)	79 (25°C)	3.6×10^{3}	1.7×10^{3}	3.1×10^{-3}	N/A
108-88-3	Toluene	92.13	0.8669	28	534.8 (25°C)	537	300	6.66×10^{-3}	10.7
108-95-2	Phenol	94.11	1.070	0.341 (25°C)	93,000(25°C)	29	14.2	4.54×10^{-7}	1.4
1330-20-7	Xylenes	106.16	0.870	10	998	1,820	240	7.04×10^{-3}	N/A
Phthalate Esters									
84-74-2	Di-n-butylphthalate	278.3	1.0465	1.0×10^{-5} (25°C)	13 (25°C)	398,000	170,000	2.82×10^{-7}	89
117-84-0	Di-n-octylphthalate	390.57	0.978	1.4×10^{-4}	3.0 (25°C)	7.4×10^{9}	3.6×10^{9}	1.7×10^{-5}	N/A
117-81-7	Bis(2-ethylhexyl) phthalate	391	0.99 (20/20°C)	2×10^{-7}	0.4 (25°C)	4.1×10^{9}	2.0×10^{9}	3×10^{-7}	130

Table 4-4. Environmental Fate and Transport Parameters for Organic Compounds (Continued)

CAS Number	Chemical	Molecular Weight[a,b,d,e] (g/mole)	Specific Gravity[b,d] (20/4°C)	Vapor Pressure[a,d,e] (mm Hg @ 20°C)	Water Solubility[a,d,e] (mg/l @ 20°C)	Octanol/Water Partition Coefficient[e] (K_{ow})	Organic Carbon Partition Coefficient[e] (K_{oc})	Henry's Law Constant[e] (atm-m^3/mole)	BCF[a] (L/kg)
Polynuclear Aromatic Hydrocarbons (PAHs)									
83-32-9	Acenaphthene	154.2	N/A	1.55×10^{-3} (25°C)	3.42 (25°C)	9.6×10^{3}	4.6×10^{3}	9.1×10^{-5}	N/A
120-12-7	Anthracene	178.23	1.283 (25/4°C)	1.95×10^{-4} (25°C)	1.3 (25°C)	2.8×10^{4}	1.4×10^{4}	8.6×10^{-5}	N/A
191-24-2	Benzo(g,h,i)perylene	276	N/A	1.03×10^{-10} (25°C)	2.6×10^{-4} (25°C)	3.2×10^{6}	1.6×10^{6}	1.44×10^{-7}	N/A
207-08-9	Benzo(k)fluoranthene	252.32	N/A	9.6×10^{-11}	5.5×10^{-4} (25°C)	1.15×10^{6}	5.5×10^{5}	3.87×10^{-5}	N/A
53-70-3	Dibenzo(a,h)anthracene	278.35	1.282	1.0×10^{-10} (25°C)	5.0×10^{-4} (25°C)	6.9×10^{6}	3.3×10^{6}	7.3×10^{-8}	N/A
193-39-5	Indeno(1,2,3-cd)pyrene	276.34	N/A	1.0×10^{-10} (25°C)	6.2×10^{-2}	3.2×10^{6}	1.6×10^{6}	6.95×10^{-8}	N/A
56-55-3	Benzo(a)anthracene	228.3	1.274	2.2×10^{-8}	5.7×10^{-3}	3.98×10^{7}	1.36×10^{6}	1×10^{-6}	30
50-32-8	Benzo(a)pyrene	252	1.351	5.6×10^{-9} (25°C)	3.8×10^{-3} (25°C)	1.15×10^{6}	5.5×10^{6}	4.9×10^{-7}	30
205-99-2	Benzo(b)fluoranthene	252.3	N/A	5×10^{-7}	0.014 (25°C)	1.15×10^{6}	550,000	1.22×10^{-5}	30[c]
218-01-09	Chrysene	228.3	1.274	6.3×10^{-9} (25°C)	1.8×10^{-3} (25°C)	410,000	200,000	1.05×10^{-6}	30[c]
206-44-0	Fluoranthene	202.3	1.252	5×10^{-6}	0.26 (25°C)	79,000	38,000	6.5×10^{-6}	1,150
86-73-7	Florene	116.2	1.202	7.1×10^{-4}	1.69 (25°C)	15,800	7,300	6.4×10^{-5}	1,500
91-57-6	2-Methylnaphthalene	142.2	1.0058	10 (105°C)	26 (25°C)	0.46	2.2/3.82	4.99×10^{-4}	N/A
91-20-3	Naphthalene	128.2	1.162	0.087 (25°C)	31.7 (25°C)	1,950	940	4.6×10^{-4}	10.5
85-01-08	Phenanthrene	178.2	0.9800	6.8×10^{-4}	1.00 (25°C)	28,800	14,000	1.59×10^{-4}	2630
129-00-0	Pyrene	202.3	1.271 (23/4°C)	2.5×10^{-6} (25°C)	0.13 (25°C)	75,900	38,000	5.04×10^{-6}	30[c]

Table 4-4. Environmental Fate and Transport Parameters for Organic Compounds (Concluded)

CAS Number	Chemical	Molecular Weight[a,b,d,e] (g/mole)	Specific Gravity[b,d] (20/4°C)	Vapor Pressure[a,d,e] (mm Hg @ 20°C)	Water Solubility[a,d,e] (mg/l @ 20°C)	Octanol/Water Partition Coefficient[e] (K_{ow})	Organic Carbon Partition Coefficient[e] (K_{oc})	Henry's Law Constant[e] (atm-m³/mole)	BCF[a] (L/kg)
Pesticide Organic Compounds									
72-54-8	4,4'-DDD	320	1.476	1.0×10^{-6}(30°C)	1.6×10^{-1} (24°C)	1.6×10^{6}	7.7×10^{5}	2.2×10^{-5}	N/A
72-55-9	4,4'-DDE	318	N/A	6.5×10^{-6}	0.04	9.1×10^{6}	4.4×10^{6}	2.3×10^{-5}	N/A
50-29-3	4,4'-DDT	354.5	1.56 (15/4°C)	1.9×10^{-7}(25°C)	1.0×10^{-3}(25°C)	8.1×10^{6}	3.9×10^{6}	3.89×10^{-5}	N/A
Miscellaneous Organic Compounds									
132-64-9	Dibenzofuran	168.1	1.09	N/A	<1	4,000	11,000	N/A	1,350
75-15-0	Carbon disulfide	76.14	1.263	360	2,940	100	54	1.23×10^{-2}	0

N/A Not Available
a Superfund Public Health Evaluation Manual, 1986.
b Handbook of Chemistry and Physics, 1995.
c The Bioconcentration Factor (BCF) for this PAH is assumed to be the same as the BCF for benzo(a)pyrene.
d Handbook of RCRA Ground-Water Monitoring Constituents: Chemical & Physical Properties (Appendix IX to 40 CFR 264), EPA, 1992.
e Aquatic Fate Process Data for Organic Priority Pollutants (EPA, 1982).

Table 4-5. Environmental Fate and Transport Parameters for Inorganic Compounds

Analyte	Molecular Weight (g/mole)	Soil/Water Distribution Coefficient (K^d)[a] (ml/g)	Bioconcentration Factor (BCF)[b] (L/kg)
Antimony	121.75	N/A	N/A
Arsenic	74.92	1.0–8.3	44
Barium	137.34	N/A	N/A
Beryllium	9.01	N/A	19
Cadmium	112.4	1.3–27	64
Chromium (total)	52	470–150,000	16
Cobalt	58.93	0.2–3,800	N/A
Copper	63.54	1.4–333	36
Lead	207.19	4.5–7,640	N/A
Manganese	54.94	0.2–10,000	N/A
Mercury	200.59	10	N/A
Nickel	58.71	N/A	N/A
Thallium	204.37	N/A	116
Vanadium	50.94	N/A	N/A
Zinc	65.38	0.1–8,000	47

N/A Not Available.

a Distribution ranges are presented (Dragun, 1988).

b The BCF for each chemical reported as "N/A" is assumed to be 1.0 (EPA, 1991).

This section contains general discussions about physical properties of contaminants detected during site investigations at Kirtland AFB, and the fate and transport for related classes of chemicals detected. Site-specific discussions of contaminants detected and release mechanisms are provided in the appropriate site investigation sections.

4.3.1.1 Chemical and Physical Properties of Detected Contaminants

Chemical and physical properties for all organic constituents detected at Kirtland AFB are provided in Table 4-4. Properties for the inorganic constituents detected are summarized in Table 4-5. A brief summary of each property (e.g., specific gravity, solubility, etc.) and its significance to the fate and transport of the identified compounds or compound class is given below. Many properties are water-related and may not impact the current investigation; however, they are presented for information as they may be considered during a CMS in reference to site-specific constituents.

Specific Gravity

Specific gravity is temperature dependent and is the ratio of the weight of a given volume of chemical (in its pure state) to the weight of distilled water at the same volume. Constituents having specific gravities less than one will float, while compounds with specific gravities >1 will sink. This property can be used to help predict the interaction of compounds in groundwater and soil moisture. Soil was the medium investigated during the Stage 2B RFI.

Of all the organic compounds detected in the soil at the 16 Kirtland AFB sites recommended for further investigation or a CMS in this study, those having specific gravities <1 include acetone, toluene, ethylbenzene, xylenes, and bis(2-ethylhexyl)phthalate. These compounds will have a greater tendency to volatilize and impact air quality; however, worst-case soil concentrations should result in negligible air quality impact.

Vapor Pressure

Vapor pressure is temperature dependent and is the amount of pressure exerted on the atmosphere by a compound in its gaseous state. This property is a measure of a compound's ability to volatilize. A compound with a higher vapor pressure is more volatile than a compound with a lower vapor pressure. Vapor pressure is important when evaluating the migration of contaminants from environmental interfaces (e.g., soil/air). Inorganics are not considered volatile.

Halogenated aliphatic hydrocarbons, ketones, and monocyclic aromatics are more volatile than PAHs.

Solubility

Solubility is the maximum amount of mass of an organic compound or element that will dissolve into a given volume of solvent or water. The rate at which a constituent is leached by infiltrating precipitation is directly proportional to its water solubility. More soluble compounds/elements are more readily leached than less soluble chemicals.

Most of the volatile organics detected at Kirtland AFB, especially methyl ethyl ketone, 2-hexanone, and methyl isobutyl ketone, are highly soluble compared to PAH compounds.

Octanol/Water Partition Coefficient

The octanol/water partition coefficient (K_{ow}) is a measure of the extent of partitioning between octanol and water at equilibrium. The K_{ow} can be used to predict the bioconcentration of a chemical in aquatic organisms since a linear relationship exists between the K_{ow} and the uptake of chemicals by fatty tissues of animals and human (Lyman *et al.,* 1990). The K_{ow} is also useful in characterizing the sorption of compounds by organic soil where experimental values are not available. Generally, chemicals with higher K_{ow} values prefer the sorbed phase rather that the dissolved phase.

Of all the organic compounds detected in environmental media at Kirtland AFB, benzene-related compounds and PAHs have the highest octanol/water partitioning coefficients.

Organic Carbon Partition Coefficient

The organic carbon partition coefficient (K_{oc}) defines the extent of partitioning between organic carbon and water at equilibrium. The K_{oc} can be used to predict the rate of mobility of a contaminant in groundwater. Those chemicals with higher K_{oc} values are more inclined to bind to organic soil and sediment.

Several PAHs and monocyclic aromatics were detected in the soil at Kirtland AFB. The K_{oc} values for these chemicals are relatively high; therefore, these contaminants are expected to be less mobile in the environment.

Henry's Law Constant

The Henry's Law constant, which is the ratio of the vapor pressure and water solubility, is a measure of the extent of partitioning between air and water at equilibrium. This property characterizes the volatility of a particular chemical and can be used to determine the likelihood of migration of groundwater and surface water contaminants to the surrounding atmosphere. Chemicals with higher Henry's Law constants are more volatile; chemicals with Henry's Law constants greater than 5×10^{-3} are expected to be found in the atmosphere or the soil gas.

Ethylbenzene, toluene, benzene, tetrachloroethylene, and trichloroethylene are soil contaminants at Kirtland AFB which have relatively high vapor pressures and Henry's Law constants greater than 5×10^{-3}. These compounds are expected to migrate through the soil as soil gas.

Bioconcentration Factor

The bioconcentration factor (BCF) is the ratio of aquatic-animal-tissue concentration to water concentration and is both chemical- and species-specific. BCFs indicate the ability of a chemical to accumulate in living tissue. The higher the BCF the greater the accumulation. When site-specific values are not measured, literature values are used or the BCF is estimated from the K_{ow}.

Distribution Coefficient

The distribution coefficient (K_d) is a measure of the equilibrium partitioning between soil and water of a chemical or ion. The distribution of organic chemicals is a function of both the K_{oc} and the amount of organic carbon in soil. The K_d for an inorganic constituent present in its ionic state is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. Coulomb's Law predicts that the ion with the smallest hydrated radius and the largest charge will be preferentially accumulated over ions with larger radii and smaller charges. Consequently, the K_d values for metals can vary greatly depending on ionic states and the amount of organic carbon in the soil. Elements with higher K_d values are more likely to bind to soil rather than disperse or dissolve in water.

4.3.1.2 Persistence of Detected Contaminants

The persistence of various classes of organic compounds identified above and in site-specific discussions (Sections 5.0 through 18.0) are included in this section. Several transformation and release mechanisms affect contaminant persistence (e.g., hydrolysis, photolysis, biodegradation, volatilization, oxidation/ reduction). The following general classes of organic compounds and elements are discussed:

- Halogenated aliphatic hydrocarbons.
- Ketones.
- Monocyclic aromatics.
- Phenols.
- Phthalate esters.

- Polynuclear aromatic hydrocarbons.
- Inorganics.

Halogenated Aliphatic Hydrocarbons

The presence of halogenated solvents including trichloroethylene and tetrachloroethylene is apparently related to their former use on the base in vehicle and fuel system cleaning and maintenance. Volatilization is an important mechanism of contaminant release when discussing this class of chemicals. The life of trichloroethylene and tetrachloroethylene is 3 to 5 months in a reducing atmosphere, under anaerobic bacterial activity, where they degrade to isomers of dichloroethylene, trichloroethane, tetrachloroethane, dichloroethane, and finally vinyl chloride, which is the most persistent (approximately 10 years). However, in arid, basic soil at Kirtland AFB, the degradation process is significantly impeded (Lyman *et al.,* 1990), accounting for the limited detection of degradation products.

Ketones

Ketones are highly soluble in water. Volatilization of ketones is significant. The volatilization from soil depends on vapor pressure, while the volatilization from water depends on Henry's Law constant. Biodegradation is an important fate process for acetone in soil. It should be noted that most ketones detected in environmental samples were at very low concentrations and were probably the result of laboratory contamination (e.g., acetone and related impurities and breakdown products from sample preparation, methyl ethyl ketone, methyl isobutyl ketone, 2-hexanone).

Monocyclic Aromatics

Monocyclic aromatics such as benzene, toluene, ethylbenzene, and xylenes are not considered to be persistent compounds in the environment compared to PAHs and metals. In general, the most significant fate process for these compounds is volatilization or microbial degradation. The biodegradation of these compounds in the soil matrix is dependent on the abundance of microflora, macronutrient availability, soil pH, and temperature. While these compounds are amenable to microbial degradation, it is not anticipated that degradation will occur naturally at an appreciable rate as the arid soil characteristics at Kirtland AFB do not readily support natural degradation.

Phenols

Nonhalogenated phenolic compounds are relatively susceptible to biodegradation in unsaturated soil. The presence of phenols in the environment is relatively uncommon because their use is limited, they have a high solubility in water, and they demonstrate high susceptibility to microbial degradation. Phenols may have been used at Kirtland AFB in the past for various aircraft maintenance activities, predominantly as a paint remover.

Phthalate Esters

Phthalate esters are considered to be relatively persistent environmental contaminants. Phthalate esters are usually detected at very high concentrations associated with industrial landfills; however, they are also common laboratory contaminants, which is the more probable cause for the low levels detected in

Stage 2B RFI samples. Although numerous studies have demonstrated that phthalate esters undergo biodegradation, the process is slow. Certain microorganisms have been shown to excrete products that increase the solubility of phthalates and enhance their biodegradation (Gibbons and Alexander, 1989). Biodegradation is an important fate mechanism, as is bioaccumulation. Hydrolysis of phthalate esters is slow, with calculated half-lives of 3 to 2,000 years (bis-2-(ethylhexyl)phthalate) (EPA, 1979). Similarly, photolysis is considered to be an insignificant degradation mechanism (EPA, 1982).

Polynuclear Aromatic Hydrocarbons

PAHs are common constituents of oil and grease. Solubilities of PAHs are generally low. Volatilization from a given media is a more significant fate process for PAHs with low molecular weights (e.g., fluorene, fluoranthene, phenanthrene) than for higher molecular weight PAHs (such as benzo(a)anthracene). Once PAHs have become entrained in organic matter in soil, they become less mobile in the environment. PAHs do not contain functional groups susceptible to hydrolytic interaction, making hydrolysis an insignificant mechanism. While susceptible to photolytic degradation, subsurface contamination precludes natural photolysis. Studies have demonstrated that PAHs are amenable to microbial degradation in soil matrices (EPA, 1979). PAH concentration levels are low and were detected at a limited number of sites investigated. Since it is probable that nutrient availability at contaminated sites is low, microbial populations may be small.

Inorganics

Metals are considered to be persistent contaminants in soil and sediment matrices. Adsorption to organic matter in soil is indicated by K_d values. Lead is the most strongly adsorbed inorganic. The relative retention of several metals in soil is, from most to least, lead, antimony, copper, chromium, zinc, nickel, cobalt, cadmium.

Inorganics can become soluble and may leach into groundwater under certain conditions (i.e., low pH of the leaching solution and low organic matter content of soil). Specific conditions increasing the possibility of the leaching of inorganic analytes include high contaminant concentrations, the presence of soluble chelating agents, and acid rain. High soil pH and predominantly low or absent organic contaminants at a site would seem to preclude leaching of any inorganic contaminants. The geology at Kirtland AFB is variable and naturally enriched with heavy metals including arsenic, beryllium, and uranium (New Mexico Bureau of Mines and Mineral Resources, 1994).

5.0 SWMU 6-14, Sewage Effluent Transmission Line (ST-51)

5.1 Site Background and Environmental Setting

The sewage effluent transmission line (SWMU 6-14), in the northwest portion of Kirtland AFB, is an inactive pipeline that carried effluent via gravity southeast from the sewage lagoons to the main pond at the golf course (Figure 5-1). As sewage moved through the lagoons, it underwent a two-stage settling and natural biodegradation process. The lagoon levels were manually monitored and adjusted by discharges either to the City of Albuquerque sewer system or through the pipeline to the main pond. The effluent was estimated to consist of 30 percent domestic and 70 percent industrial sewage. Discharges to the main pond typically took place from spring to fall (March to December) where the pond water was used for irrigation (USAF, 1993b).

The effluent transmission line trends southeast from the sewage lagoons and crosses the Tijeras Arroyo south of the Landfill 2 area. Near the INWS Radioactive Training Site 8, the pipeline crosses part of Arroyo del Coyote and turns east to the main pond (Figure 5-1). The pipeline is about 12,000 ft and was constructed of 15-in. diameter reinforced concrete, with one 14-in. diameter PVC pipe section. The pipeline was used from 1965 until 1987 when the sewage lagoons were deactivated. There were no visible indications of releases observed during the RCRA Facility Assessment (RFA) Visual Site Inspection (VSI) performed in 1988 (Kearney/Centaur, 1988). However, in 1983 erosion undercut a portion of the pipe and caused a failure that resulted in a localized release. The rupture occurred at a valve near the INWS Radioactive Training Site 8 (Figure 5-2). The volume released was estimated at 110,000 gallons (USAF, 1993b). This release area was investigated on June 21, 1994.

SWMU 6-14 is in the urban industrial zone, which is discussed in Section 2.0. There are three production wells near this site: KAFB-4 is 1,000 ft southeast of the sewage lagoon, KAFB-8 is 5,100 ft southeast, and KAFB-7 is 4,100 ft northeast.

5.2 Study Area Investigation

The area of investigation was limited to soil in the vicinity of SWMU 6-14 from the ground surface to 11 ft below grade.

5.2.1 Previous Investigations

No previous investigations have been performed to determine the presence or absence of soil contamination at SWMU 6-14. Analytical results of sewage lagoon wastewater testing indicated the presence of Appendix VIII and RCRA-regulated constituents (i.e., VOCs at concentrations of less than 60 μg/L and SVOCs ranging in concentration from 0.4 μg/L to 57 μg/L at the Lagoon 1 inlet [USAF, 1981]). Because the pipeline had ruptured, the permeable subsurface material potentially received contaminated wastewater.

5.2.2 Data Gaps

No data were available to confirm the presence or absence of contaminants in soil at this site.

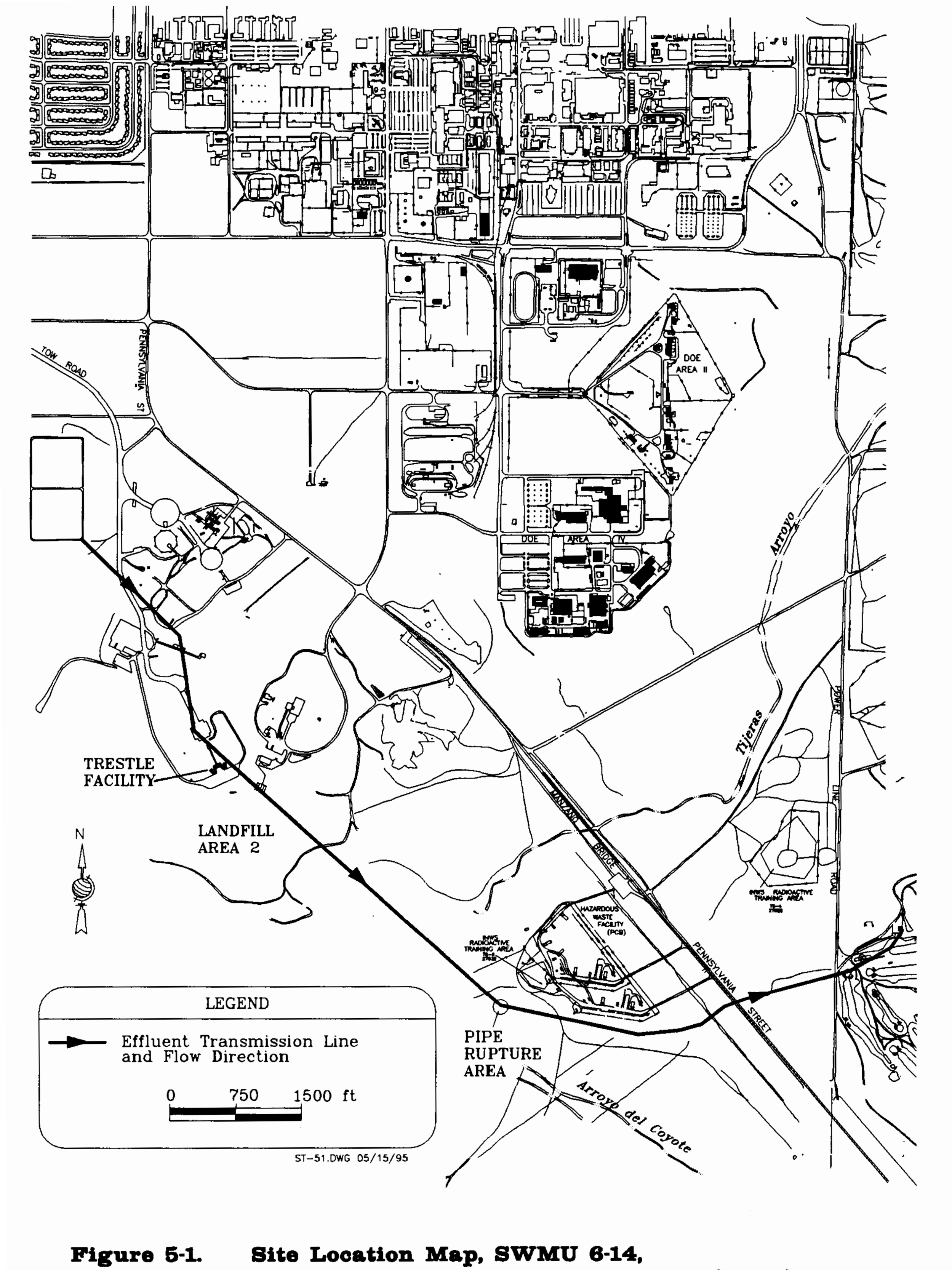


Figure 5-1. Site Location Map, SWMU 6-14, Sewage Effluent Transmission Line (ST-51)

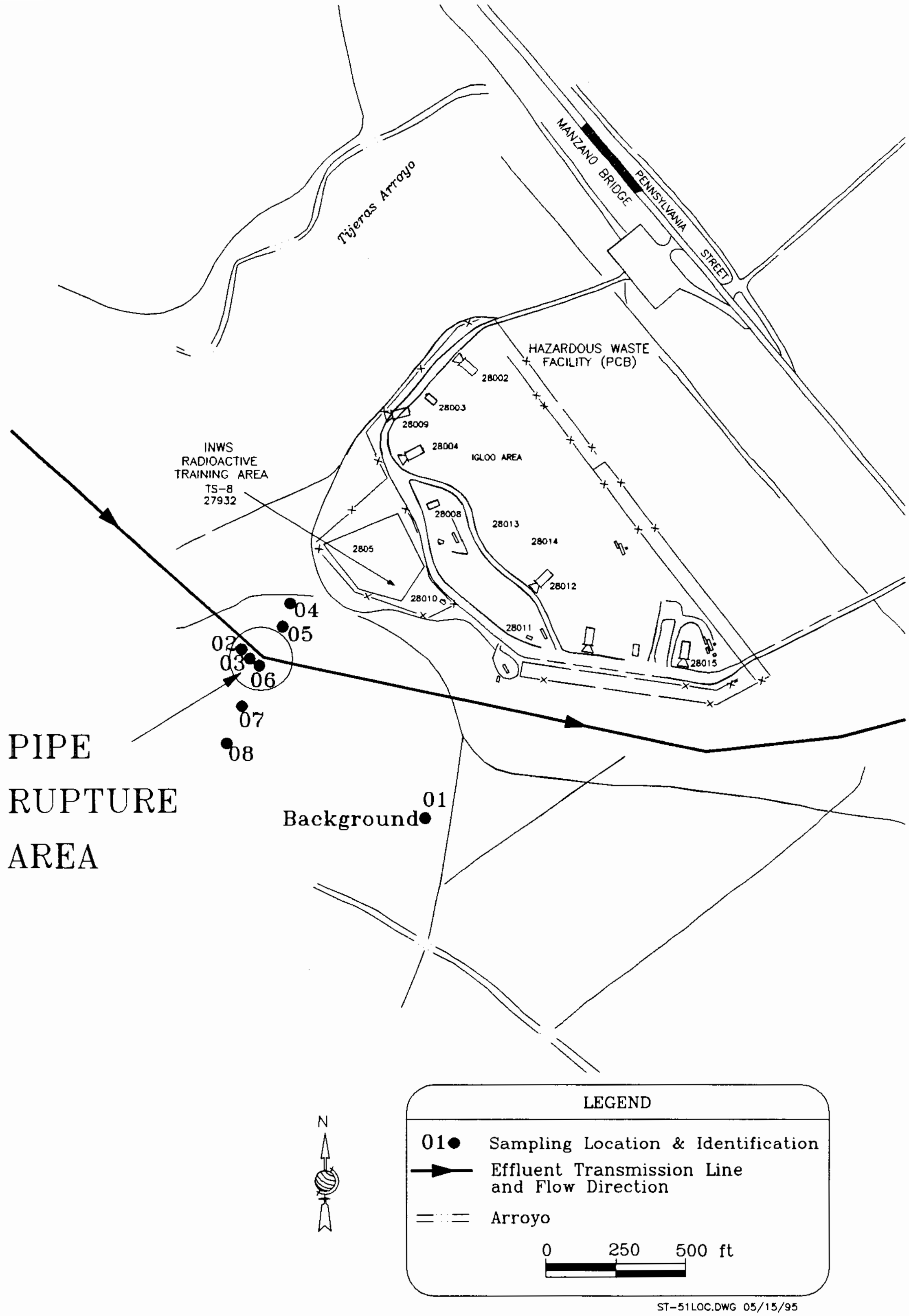


Figure 5-2. Soil Sampling Locations at SWMU 6-14, Sewage Effluent Transmission Line (ST-51)

5.2.3 RFI Field Investigation

The objective of this investigation was to determine the presence or absence of contaminants in soil in the area of the pipeline rupture. Prior to the collection of soil samples, the effluent transmission line was surveyed and staked in the field. On June 21, 1994, eight boreholes, ST-51C-01 through ST-51C-08, were hand-augered in the vicinity of the pipeline rupture area (Figure 5-2). ST-51C-06 was located adjacent to the pipeline rupture point. Four boreholes, ST-51C-02 through ST-51C-05, were located on both sides of the pipeline at approximately 10 ft and 25 ft laterally away from the rupture point. ST-51C-07 and ST-51C-08 were hand-augered on the south side of the pipeline, approximately 10 and 50 ft downgradient from the rupture. To determine site-specific background concentrations, ST-51C-01 was hand-augered in an area away from any known or suspected contamination. One soil sample was collected from each borehole at a depth of 10 ft based on the buried depth of the pipeline at 6 ft to 8 ft below grade (USAF, 1993c). Samples were collected by filling glass jars with recovered material.

Sampling operations and sample handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples collected at this site are listed in Table 5-1. Borehole logs are in Appendix C.

5.2.4 Laboratory Analysis

Nine soil samples were analyzed for VOCs, SVOCs, metals, TPH, nitrate, and soil moisture. All samples were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. All field-screening instrument readings remained at background levels throughout drilling and sampling activities at SWMU 6-14.

Table 5-1. Boreholes and Samples Collected at SWMU 6-14, Sewage Effluent Transmission Line (ST-51)

Borehole	Borehole Location	Depth (ft)
01	Background sampling borehole	10-11
02	25 ft NW of pipe rupture	10-11
03	10 ft NW of pipe rupture	10-11
04	25 ft N of pipe rupture	10-11[a]
05	10 ft N of pipe rupture	10-11
06	At pipe rupture site	10-12
07	10 ft S of pipe rupture	10-11
08	50 ft S of pipe rupture	10-11

a. Replicate sample also collected at this depth interval.

5.3 Site Characteristics

5.3.1 Geology

The SWMU 6-14 area is underlain by unconsolidated alluvial sediment that is predominantly very fine-grained to fine-grained silty sand. A 2-ft thick layer of silty clay was encountered in ST-51C-04 at a depth of 7.5 ft below grade. A 0.5-ft thick layer of sandy gravel (including granitic rock fragments, limestone, mica, and chert) was encountered in ST-51C-05 at a depth of 9 ft below grade. A maximum depth of 12 ft below grade was attained in boreholes at this site. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this site are in Appendix C.

5.3.2 Hydrogeology

Groundwater beneath SWMU 6-14 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably northeast at this site. Three production wells are in this area: KAFB-4 is upgradient 1,000 ft southeast, KAFB-8 is upgradient 5,100 ft southeast, and KAFB-7 is cross-gradient 4,100 ft northeast. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

5.4 Nature and Extent of Contamination

The following subsections describe the nature and extent of contamination based on analytical results for soil samples collected and submitted for analysis from SWMU 6-14. Analytical results are summarized in Table 5-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Organic Compounds

The VOCs detected in soil samples collected at SWMU 6-14 were acetone, methylene chloride, tetrachloroethylene, and toluene. Acetone (0.008 mg/kg) was only detected in borehole ST-51C-02. Tetrachlorethylene (0.003 mg/kg) was only detected in the background sampling borehole, ST-51C-01. Toluene (0.001 to 0.003 mg/kg) was detected in boreholes ST-51C-01, ST-51C-04, and ST-51C-05. Methylene chloride (0.004 to 0.008 mg/kg) was detected in all samples. All VOC concentrations were below HHRB action levels.

Table 5-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 6-14, Sewage Effluent Transmission Line (ST-51)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)								
				ST-51C-01	*ST-51C-02*	*ST-51C-03*	*ST-51C-04*		*ST-51C-05*	*ST-51C-06*	*ST-51C-07*	*ST-51C-08*
				10–11	10–11	10–11	10–11 FR1	10–11	10–11	10–12	10–11	10–11
VOC	Acetone	7,800	0.10	ND	0.008	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	0.008	0.005	0.006	0.006	0.004	0.006	0.004	0.004	0.004
	Tetrachloroethylene	12.0	0.005	0.003	ND	ND	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	0.001	ND	ND	0.003	ND	0.002	ND	ND	ND
SVOC	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	0.38	0.41	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	13,800	7,780	9,050	9,790	10,200	9,900	10,000	8,890	9,120
	Arsenic	0.37	6.5	3.0	2.5	2.3	2.6	2.1	5.5	2.9	1.8	2.8
	Barium	5,500	735	238	181	194	214	179	191	179	168	180
	Beryllium	0.15	0.84	1.1	0.84	0.75	0.88	0.68	0.93	0.89	0.77	0.75
	Cadmium	39.0	N/A	0.97	0.84	0.86	0.66	1.1	ND	1.2	ND	0.85
	Calcium	N/A	121,000	45,200	35,200	32,100	38,000	36,200	35,300	34,000	33,000	32,500
	Chromium, total	390	21.6	17.0	12.8	11.5	11.5	10.0	11.9	16.5	10.2	13.8
	Cobalt	4,700	15.4	11.5	8.5	8.8	9.4	8.4	8.7	9.6	9.4	10.8
	Copper	2,900	223	19.1	13.1	16.9	14.6	11.8	14.6	15.0	13.2	17.9
	Iron	N/A	23,800	22,800	17,800	18,100	19,400	17,200	19,600	19,300	18,100	19,100
	Lead	400	17.5	12.4	8.0	7.4	9.7	6.9	7.7	10.7	7.3	8.7
	Magnesium	N/A	10,400	7,580	5,470	5,310	6,030	5,060	6,140	6,240	5,690	6,050
	Manganese	390	549	579	388	383	432	362	431	439	404	444
	Nickel	1,600	188	19.8	14.0	17.8	14.3	14.2	18.0	16.5	13.3	14.5
	Potassium	N/A	3,590	4,720	2,910	3,270	3,420	2,300	2,960	3,410	2,850	2,850
	Sodium	N/A	787	135	131	146	147	121	133	134	134	168
	Thallium	N/A	N/A	ND	ND	ND	ND	ND	ND	0.29	ND	0.23
	Vanadium	550	55.3	42.7	33.1	34.8	36.6	32.0	36.2	36.9	34.2	35.8
	Zinc	23,000	114	61.9	45.1	45.2	56.3	42.9	52.1	47.6	45.4	58.0
OTHER	Nitrate	130,000	N/A	18.0	16.0	13.0	13.0	4.5	2.8	5.4	28.0	19.0
	Moisture (%)			7.2	5.2	7.1	9.6	11.2	13.8	10.5	9.6	6.2

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Di-n-butylphthalate (0.41 and 0.38 mg/kg) was the only SVOC detected at this site. It was only detected in the sample and replicate from borehole ST-51C-04; the concentrations were below the HHRB action level of 7,800 mg/kg.

Petroleum Hydrocarbons

No diesel or gasoline range hydrocarbons were detected in these samples.

Metals

Table 5-2 lists all reportable metal concentrations detected at SWMU 6-14 and the respective UTL and HHRB action level concentrations. Arsenic, beryllium, and manganese were the only metals detected at concentrations above HHRB action levels. Arsenic (1.8 to 5.5 mg/kg) was detected in all samples and one replicate; the concentrations were above the 0.37 mg/kg HHRB action level, but below the 6.5 mg/kg UTL concentration. Except for the 5.5 mg/kg detection, the arsenic concentrations were similar to the 3 mg/kg detection in the background sampling borehole ST-51C-01. Beryllium (0.68 to 1.1 mg/kg) was detected in all samples and one replicate; the concentrations were above the 0.15 mg/kg HHRB action level and, except in two samples and one replicate, were also below the 0.84 mg/kg UTL concentration. The highest beryllium detection (1.1 mg/kg) was measured in the background sampling borehole ST-51C-01. Manganese (362 to 579 mg/kg) was detected in six of the eight samples and one replicate at concentrations above the HHRB action level. Except for the background borehole sample, all manganese concentrations were below the 549 mg/kg UTL concentration. The concentrations of arsenic, beryllium, and manganese appear to be naturally occurring throughout Kirtland AFB as discussed in Section 4.2.2

Nitrate and Soil Moisture

Nitrate was detected in all samples at concentrations ranging from 2.8 mg/kg to 28.0 mg/kg (Table 5-2). The concentrations are below the nitrate HHRB action level of 130,000 mg/kg. Soil moisture values ranged from 5.2 to 13.8 percent.

5.5 Conclusions and Recommendations

Conclusions

- Four VOCs and one SVOC were detected in the soil samples collected from this site; all concentrations were below HHRB action levels.

- Arsenic, beryllium, and manganese were the only metals detected at concentrations exceeding HHRB action levels; these concentrations appear to be naturally occurring throughout Kirtland AFB.

- The analytical results at SWMU 6-14 are not indicative of a contaminant release at this site.

Recommendations

- Based on the findings of the RFI, no further action is necessary; therefore, SWMU 6-14 does not require further investigation. A NFA proposal should be prepared.

6.0 SWMU 6-16, Jet Engine Burn Area (Part of Kirtland Fire Training Area [FT-13]) (FT-52)

SWMU 6-16 is comprised of three areas that previously had three distinct SWMU numbers. SWMU 6-17 (FT-39) and SWMU 6-18 (FT-52) were combined into SWMU 6-16 (FT-13) for management of these collocated sites. For this RFI Report, the Jet Engine Burn Area is referred to as FT-52.

6.1 Site Background and Environmental Setting

The jet engine burn area (SWMU 6-16) is in the northwest portion of Kirtland AFB, south of the Albuquerque International Airport east-west runway. SWMU 6-16 is 1,100 ft southwest of the old air traffic control tower and 100 ft west-southwest of the Fire Control Training Area (Figure 6-1). The site consists of a decommissioned jet airplane that was used by Kirtland AFB personnel for fire control training from 1987 to 1990. The aircraft is 50 ft x 45 ft, and rests flat on bare ground. During fire training exercises, noncontaminated JP-4 was piped from a nearby aboveground storage tank into the engine area and set on fire. Aqueous film-forming foam (AFFF) was used to extinguish the fires. In 1989, a shallow metal pan, 3 ft x 4 ft x 3 in., was placed under the engine area to catch fuel and AFFF residues. No indications of releases were observed during the RFA VSI conducted in 1988 (Kearney/Centaur, 1988). SWMU 6-16 was investigated May 26 through June 3, 1994.

SWMU 6-16 is in the urban/industrial zone, which is discussed in Section 2.0. The nearest production wells to this site are KAFB-13, 6,200 ft northwest; KAFB-14, 5,300 ft northeast; and KAFB-2, 6,500 ft northeast.

6.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU 6-16 from ground surface to 27 ft below grade.

6.2.1 Previous Investigations

Potential soil contamination at the jet engine burn area has not been investigated. However, there is a release potential to the soil based on approximately 2 years of training exercises prior to the installation of the metal pan and the lack of secondary containment during use of this facility. During a recent site visit, an area of stressed vegetation approximately 25 sq ft was observed around the tail of the aircraft.

6.2.2 Data Gaps

No data were available to confirm the presence or absence of contaminants at this site.

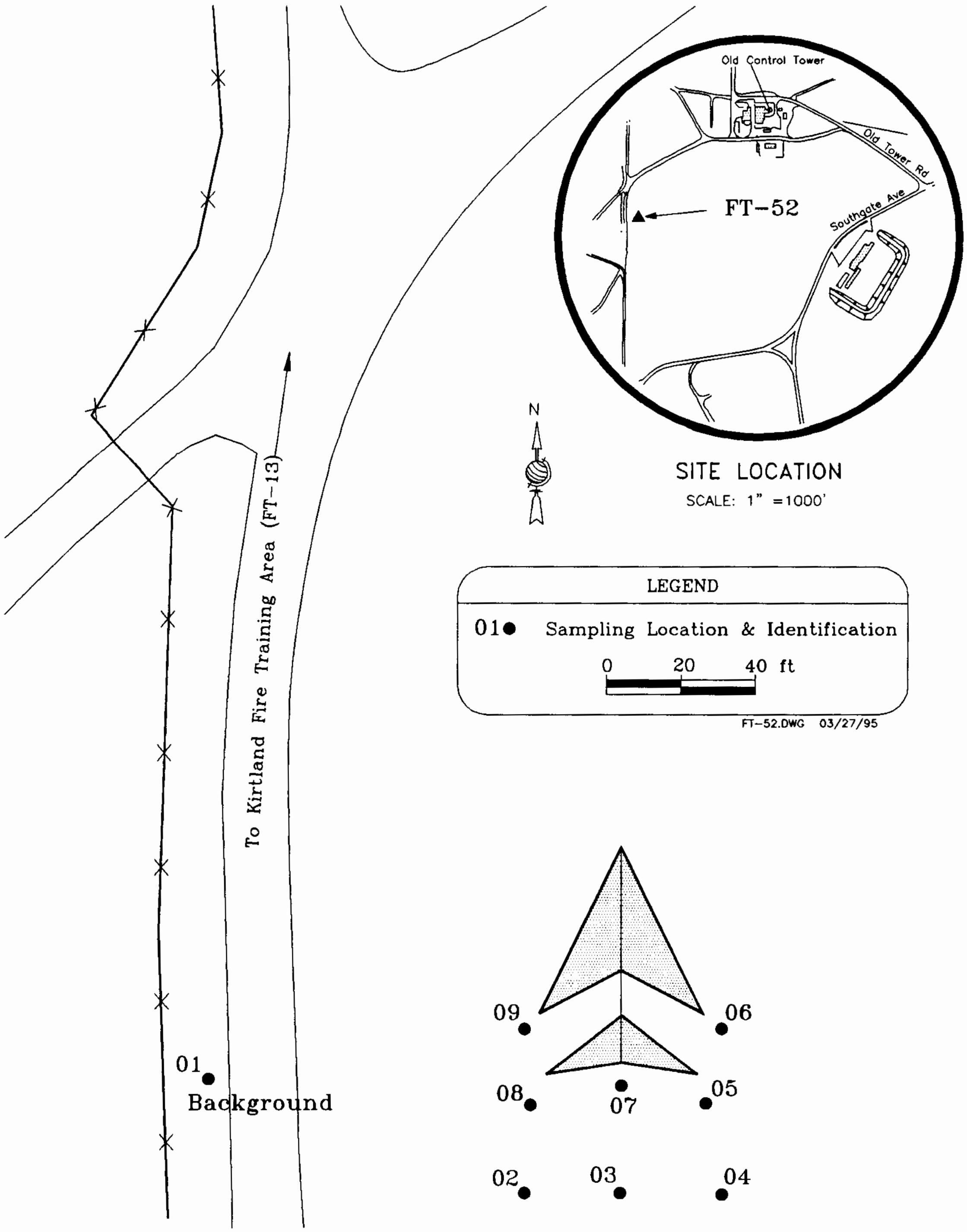


Figure 6-1. **Soil Sampling Locations at SWMU 6-16, Jet Engine Burn Area (part of Kirtland Fire Training Area [FT-13]) (FT-52)**

6.2.3 RFI Field Investigation

The objective of the investigation was to determine if contamination is present in the soil adjacent to the rear of the aircraft.

On May 26 through June 3, 1994, eight boreholes, FT-52C-02 to FT-52C-09, were drilled with a Geoprobe to 27 ft below grade within the jet engine burn area. Four soil samples were collected from each borehole: one at the surface, and the other at depths of 5, 10, and 25 ft below grade. To collect site-specific background concentration data, FT-52C-01 was drilled 95 ft west of the aircraft. This area was assumed to be away from any known or suspected contamination. Two soil samples were collected from FT-52C-01 at depths of 10 and 15 ft below grade (Figure 6-1).

Sampling operations and sampling handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples collected at this site are listed in Table 6-1. Borehole logs are in Appendix C.

Table 6-1. Boreholes and Samples Collected at SWMU 6-16, Jet Engine Burn Area (part of Kirtland Fire Training Area [FT-13]) (FT-52)

Borehole	Borehole Location	Depth (ft)				
01	Background sampling borehole, ~ 95 ft W of site	NS	NS	10-12	14-16	NS
02	45 ft SW of aircraft tail	0-2	5-8	10-12	NS	25-27
03	35 ft S of aircraft tail	0-2	5-7	10-12	NS	23-27[a]
04	45 ft SE of aircraft tail	0-2	5-7	10-12	NS	24-26
05	25 ft E-SE of aircraft tail	0-2	5-8	10-12	NS	24-26
06	25 ft NE of aircraft tail	0-2	4-8[a]	10-12	NS	24-26
07	5 ft S of aircraft tail	0-2	5-7	10-12	NS	24-26
08	25 ft SW of aircraft tail	0-2	5-7	10-12	NS	24-26
09	25 ft NW of aircraft tail	0-2	4-8[a]	10-12	NS	24-26

NS No sample collected at this depth

a. Replicate sample also collected at this depth interval.

6.2.4 Laboratory Analysis

Thirty-six samples were analyzed for VOCs, PAHs, TPH, metals, and soil moisture. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters and/or a PID or FID. No readings above background values were measured with these instruments.

6.3 Site Characteristics

6.3.1 Geology

The jet engine burn area is underlain by unconsolidated alluvial sediment that is predominantly very fine-grained to fine-grained silty sand and sand. Caliche was present in the top 10 ft in all boreholes as granule-sized concretions with occasional feldspar granules and granitic and volcanic rock fragments. Below 10 ft, the caliche was cemented and disseminated (light- to heavily stained zones and patches). No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this area are presented in Appendix C.

6.3.2 Hydrogeology

Groundwater beneath SWMU 6-16 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The groundwater gradient is probably northeast at this site. There are three production wells near the site: KAFB-13 is cross-gradient 6,200 ft northwest, KAFB-14 is downgradient 5,300 ft northeast, and KAFB-2 is cross-gradient 6,500 ft northeast.

Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

6.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples collected at SWMU 6-16. Analytical results are presented in Table 6-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Table 6-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 6-16, Jet Engine Burn Area (part of Kirtland Fire Training Area [FT-13]) (FT-52)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)									
				FT-52C-01		FT-52C-02				FT-52C-03			
				10–12	14–16	0–2	5–8	10–12	25–27	0–2	5–7	10–12	23–27
VOC	Acetone	7,800	0.10	0.011	0.005	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	0.007	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND
	total Xylenes	160,000	0.005	ND	0.015	ND	ND	ND	ND	ND	ND	ND	ND
	m,p-Xylene (sum of isomers)	160,000	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOC	1,2-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1,3-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	0.005	ND	ND	ND
METALS	Aluminum	78,000	14,700	8,170	5,480	6,690	6,110	11,000	7,840	5,300	9,340	8,730	7,120
	Arsenic	0.37	6.5	3.1	3.2	1.9	1.5	1.9	1.9	1.8	2.4	2.5	2.0
	Barium	5,500	735	378	63.8	104	404	179	57.7	86.1	488	278	136
	Beryllium	0.15	0.84	0.75	0.42	0.32	0.32	0.97	0.53	0.32	0.54	0.64	0.41
	Cadmium	39.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.52
	Calcium	N/A	121,000	33,600	73,100	27,900	63,500	28,700	25,800	17,800	110,000	29,100	16,300
	Chromium, total	390	21.6	8.9	8.7	2.8	3.4	6.9	5.7	3.6	7.3	6.1	8.9
	Cobalt	4,700	15.4	6.4	4.2	3.9	3.9	5.2	5.8	3.5	4.4	6.0	4.9
	Copper	2,900	223	42.1	170	6.3	26.4	56.7	41.6	6.1	19.2	21.7	34.3
	Iron	N/A	23,800	11,800	7,900	9,010	7,560	13,400	13,800	7,660	10,300	13,400	11,500
	Lead	400	17.5	7.6	4.5	3.2	2.5	7.2	4.7	4.2	5.3	5.5	5.1
	Magnesium	N/A	10,400	5,070	3,740	2,420	3,350	5,260	4,440	2,160	5,940	4,320	3,280
	Manganese	390	549	282	134	112	87.6	232	248	107	166	230	174
	Nickel	1,600	188	28.0	76.9	5.6	20.0	22.2	24.0	4.3	274	26.5	551
	Potassium	N/A	3,590	1,680	1,150	1,010	987	2,030	1,880	967	1,500	1,690	1,590
	Sodium	N/A	787	466	256	74.2	292	419	163	46.4	469	298	154
	Vanadium	550	55.3	31.6	21.7	22.7	19.1	30.2	28.6	17.2	23.7	31.5	24.8
	Zinc	23,000	114	46.6	85.3	18.7	24.8	50.8	45.2	17.6	29.8	33.5	34.5
OTHER	Moisture (%)			6.5	4.9	6.9	5.7	7.0	5.0	5.6	6.9	6.7	3.5

Table 6-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 6-16, Jet Engine Burn Area (part of Kirtland Fire Training Area [FT-13]) (FT-52)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	FT-52C-04 0–2	FT-52C-04 5–7	FT-52C-04 10–12	FT-52C-04 24–26	FT-52C-05 0–2	FT-52C-05 5–8	FT-52C-05 10–12	FT-52C-05 24–26
VOC	Acetone	7,800	0.10	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND
	total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND	ND	ND
	m,p-Xylene (sum of isomers)	160,000	N/A	ND	ND	ND	ND	ND	ND	ND	ND
SVOC	1,2-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	ND	ND
	1,3-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	0.004	ND	ND
METALS	Aluminum	78,000	14,700	7,490	7,160	12,700	6,380	7,570	8,110	13,700	6,660
	Arsenic	0.37	6.5	1.5	2.4	4.3	1.8	1.8	2.5	3.8	2.7
	Barium	5,500	735	71.0	223	680	36.7	116	424	87.0	70.9
	Beryllium	0.15	0.84	0.42	0.32	0.87	0.41	0.42	0.33	0.85	0.42
	Cadmium	39.0	N/A	ND	ND	ND	ND	ND	0.66	ND	ND
	Calcium	N/A	121,000	9,330	158,000	38,700	7,840	26,300	181,000	47,800	15,200
	Chromium, total	390	21.6	5.2	5.1	6.6	5.7	4.2	4.8	7.7	6.0
	Cobalt	4,700	15.4	4.3	3.1	6.4	2.9	3.4	2.3	7.3	5.7
	Copper	2,900	223	12.1	67.7	51.7	13.0	10.9	37.6	45.0	27.7
	Iron	N/A	23,800	10,100	6,780	15,400	9,330	9,360	7,740	15,900	11,100
	Lead	400	17.5	5.0	3.3	8.2	3.7	4.1	3.2	7.3	5.3
	Magnesium	N/A	10,400	2,370	5,300	5,630	2,770	2,750	5,750	5,920	3,930
	Manganese	390	549	136	69.7	271	124	121	101	281	249
	Nickel	1,600	188	5.9	13.7	11.9	18.4	6.1	15.0	98.2	20.5
	Potassium	N/A	3,590	1,910	934	2,750	1,300	1,200	1,190	2,500	1,570
	Sodium	N/A	787	52.4	358	359	117	66.8	381	355	143
	Vanadium	550	55.3	20.0	18.3	36.1	19.3	21.5	19.6	37.9	23.3
	Zinc	23,000	114	23.9	40.5	56.8	23.8	21.9	29.7	49.6	36.5
OTHER	Moisture (%)			5.5	5.5	7.6	3.2	5.0	9.2	6.1	4.6

Table 6-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 6-16, Jet Engine Burn Area (part of Kirtland Fire Training Area [FT-13]) (FT-52)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)								
				FT-52C-06					FT-52C-07			
				0–2	4–8 FR	4–8	10–12	24–26	0–2	5–7	10–12	24–26
VOC	Acetone	7,800	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	m,p-Xylene (sum of isomers)	160,000	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOC	1,2-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1,3-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	7,550	6,920	5,390	9,050	6,710	5,370	8,240	9,240	8,920
	Arsenic	0.37	6.5	1.8	2.1	1.5	3.4	2.1	1.7	2.8	2.6	3.8
	Barium	5,500	735	118	532	201	90.1	65.6	94.0	392	63.0	484
	Beryllium	0.15	0.84	0.32	0.33	0.32	0.75	0.42	0.32	0.45	0.56	0.63
	Cadmium	39.0	N/A	ND	ND	ND	ND	ND	ND	0.78	0.67	ND
	Calcium	N/A	121,000	19,600	110,000	56,500	43,700	17,300	26,600	125,000	22,500	33,000
	Chromium, total	390	21.6	3.8	4.5	3.3	8.3	5.8	3.5	6.0	7.4	6.5
	Cobalt	4,700	15.4	4.0	2.5	2.9	6.9	5.9	3.5	3.8	7.4	5.7
	Copper	2,900	223	6.3	42.8	26.5	58.9	57.8	6.3	24.9	24.5	12.9
	Iron	N/A	23,800	9,630	7,120	6,520	12,300	10,500	6,730	8,150	14,600	11,200
	Lead	400	17.5	3.9	2.9	2.6	7.2	5.9	3.3	4.2	8.2	5.8
	Magnesium	N/A	10,400	2,630	4,250	2,870	5,100	4,050	2,180	5,270	5,380	4,320
	Manganese	390	549	120	80.6	83.7	334	348	100	107	353	202
	Nickel	1,600	188	6.8	6.5	6.4	17.3	21.1	6.7	15.5	14.7	18.7
	Potassium	N/A	3,590	1,160	1,020	889	1,910	1,760	855	1,110	2,160	1,730
	Sodium	N/A	787	68.2	388	276	342	148	62.0	352	203	352
	Vanadium	550	55.3	23.4	18.5	14.7	30.5	23.8	18.5	21.9	35.8	29.4
	Zinc	23,000	114	21.0	39.7	26.4	57.3	55.1	18.1	29.8	51.8	30.3
OTHER	Moisture (%)			5.8	8.2	6.3	6.3	3.8	5.9	10.7	10.5	4.7

Table 6-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 6-16, Jet Engine Burn Area (part of Kirtland Fire Training Area [FT-13]) (FT-52)[1] (Concentrations mg/kg) (Concluded)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	FT-52C-08 0–2	FT-52C-08 5–7	FT-52C-08 10–12	FT-52C-08 24–26	FT-52C-09 0–2	FT-52C-09 4–8 FR	FT-52C-09 4–8	FT-52C-09 10–12	FT-52C-09 24–26
VOC	Acetone	7,800	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	m,p-Xylene (sum of isomers)	160,000	N/A	0.002	ND	ND	ND	ND	ND	ND	ND	ND
SVOC	1,2-Dichlorobenzene	7,000	0.70	ND	0.004	0.003	ND	ND	ND	ND	ND	ND
	1,3-Dichlorobenzene	7,000	0.70	0.016	0.018	0.032	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	5,180	8,760	10,500	5,800	6,120	4,530	4,350	5,950	5,390
	Arsenic	0.37	6.5	1.3	3.3	2.7	2.0	2.4	1.8	2.3	2.2	1.9
	Barium	5,500	735	92.9	320	464	69.3	96.0	131	167	87.9	34.4
	Beryllium	0.15	0.84	0.32	0.53	0.85	0.41	0.32	0.31	ND	0.32	0.41
	Cadmium	39.0	N/A	ND	ND	ND	ND	0.53	ND	ND	ND	ND
	Calcium	N/A	121,000	12,700	55,900	52,000	14,000	23,300	42,200	67,800	41,900	5,800
	Chromium, total	390	21.6	3.9	5.3	6.3	7.0	4.8	4.3	4.0	7.4	5.6
	Cobalt	4,700	15.4	3.1	5.2	6.7	5.7	3.4	2.8	2.9	3.4	4.5
	Copper	2,900	223	11.1	11.6	14.0	35.4	6.3	22.9	12.4	27.6	82.8
	Iron	N/A	23,800	6,380	10,300	12,100	10,600	8,030	5,540	4,650	7,550	9,500
	Lead	400	17.5	3.0	4.6	5.7	3.9	3.6	2.9	2.7	3.8	2.6
	Magnesium	N/A	10,400	2,140	4,820	5,130	3,490	2,360	1,940	2,350	2,820	2,720
	Manganese	390	549	131	152	271	245	118	76.3	66.7	95.0	206
	Nickel	1,600	188	6.1	11.1	9.9	103	6.7	11.9	6.3	62.9	88.2
	Potassium	N/A	3,590	901	1,450	1,760	1,550	1,030	748	660	989	1,170
	Sodium	N/A	787	54.2	289	403	144	53.6	101	139	163	147
	Vanadium	550	55.3	12.8	26.0	30.7	23.0	18.5	14.6	11.8	18.2	21.9
	Zinc	23,000	114	22.1	29.0	39.0	38.7	18.9	20.0	16.5	32.7	52.7
OTHER	Moisture (%)			5.5	5.8	5.4	2.6	6.4	4.2	5.0	6.9	3.0

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Organic Compounds

Five VOCs were detected in soil samples collected at SWMU 6-16: acetone, methyl ethyl ketone, methylene chloride, xylenes (total), and m,p-xylenes (sum of isomers). These VOCs were only detected in samples from boreholes FT-52C-01 and FT-52C-08 (Table 6-2). At the background sampling borehole, FT-52C-01, acetone (0.011 and 0.005 mg/kg) was detected in the 10- to 12-ft and 14- to 16-ft samples. Methyl ethyl ketone (0.007 mg/kg) was only detected in the 10- to 12-ft sample. Xylenes (total) (0.015 mg/kg) were only detected in the 14- to 16-ft sample. All of these concentrations were below the respective HHRB action levels. Methylene chloride (0.003 mg/kg) was only detected in the 14- to 16-ft sample from borehole FT-52C-01. Methylene chloride was also detected in associated QC samples and is believed to be the result of laboratory contamination as discussed in Section 3.5.1. At FT-52C-08, m,p-xylene (0.002 mg/kg) was the only VOC detected; the concentration measured in the 0- to 2-ft sample was below the 160,000 mg/kg HHRB action level.

1,2-Dichlorobenzene and 1,3-dichlorobenzene were the only SVOCs detected at this site. 1,2-Dichlorobenzene (0.004 and 0.003 mg/kg) was only detected in two samples from borehole FT-52C-08. 1,3-Dichlorobenzene (0.004 to 0.032 mg/kg) was detected in five samples. The highest concentrations (0.016 to 0.032 mg/kg) were detected in borehole FT-52C-08. The concentrations of 1,2-dichlorobenzene and 1,3-dichlorobenzene did not exceed the HHRB action levels.

Petroleum Hydrocarbons

No diesel or gasoline range hydrocarbons were detected in soil samples collected at SWMU 6-16.

Metals

Table 6-2 lists all reportable metal concentrations detected at SWMU 6-16 and the respective UTL and HHRB action level concentrations. Nickel concentrations (4.3 to 551 mg/kg) exceeded the 188 mg/kg UTL in the 5- to 7-ft and 23- to 27-ft samples from FT-52C-03. The concentrations are below the 1,600 mg/kg HHRB action level. Arsenic and beryllium were the only metals detected in samples at concentrations greater than the HHRB action levels. Arsenic (1.3 to 4.3 mg/kg) was detected in all samples; the concentrations exceed the HHRB action level of 0.37 mg/kg, but are below the 6.5 mg/kg UTL, and are similar to the 3.1 and 3.2 mg/kg concentrations measured in the samples from the background sampling borehole FT-52C-01. Beryllium (0.32 to 0.97 mg/kg) was detected in all but one sample collected at the site. Beryllium concentrations in three samples, FT-52C-02 (10 to 12 ft), FT-52C-04 (10 to 12 ft), FT-52C-05 (10 to 12 ft), exceed the UTL of 0.84 mg/kg. The range of beryllium concentrations detected in all FT-52 samples exceed the HHRB action level of 0.15 mg/kg and, except for three samples used above, is below the 0.84 mg/kg UTL, and is similar to the concentrations measured in samples from the background sampling borehole FT-52C-01. The concentrations of arsenic and beryllium appear to be naturally occurring throughout Kirtland AFB as discussed in Section 4.2.2.

Soil Moisture

Soil moisture values ranged from 2.6 to 10.7 percent.

6.5 Conclusions and Recommendations

Conclusions

- Five VOCs and two SVOCs were detected in soil samples collected at SWMU 6-16; all concentrations were below HHRB action levels.

- Arsenic and beryllium were the only metals detected at concentrations exceeding HHRB action levels. Beryllium was detected in three samples at concentrations above the 0.84 mg/kg UTL value. The arsenic and beryllium concentrations appear to be naturally occurring throughout Kirtland AFB.

- The analytical results at SWMU 6-16 are not indicative of a release at this site.

Recommendations

- Based on the findings of the RFI, no further action is necessary at SWMU 6-16; therefore, this site does not require further investigation. A NFA proposal should be prepared.

7

7.0 SWMU 10-3, Building 20205, Waste Oil Tank 20215 (AAFES East Service Station) (ST-249)

Currently, Kirtland AFB is modifying the RCRA Part B Permit to transfer this site from Appendix III Sites to Appendix II. This RFI Report was prepared to meet the requirements of the permit and the USAF Statement of Work dated March 7, 1994.

7.1 Site Background and Environmental Setting

Waste oil tank 20215 (SWMU 10-3) was located below an asphalt parking lot on the east side of Building 20205, the Army Air Force Exchange Service (AAFES) Service Station at the intersection of Second Avenue and F Street. In October 1994, the 500-gallon tank was removed under the Kirtland AFB Underground Storage Tank (UST) Program.

SWMU 10-13 was also listed as ST-249 in the Kirtland AFB RCRA Part B Permit, Stage 2B Appendix II Sites. It was investigated June 3, 6, and 7, 1994, under the Appendix II (Stage 2B) RFI. Results of the investigation are contained in the Final RFI Report, Appendix II (Stage 2B) (USAF, 1995). This investigation concluded that no release had occurred at the site and recommended that a NFA proposal be prepared.

Recommendations

- Based on the results of the Stage 2B RFI and the tank removal effort from Kirtland AFB, no further investigation is required at the site. It is recommended that a NFA proposal be prepared for SWMU 10-3.

8.0 SWMU 8-49, Building 20677, Fuel Shop Waste Battery Storage Area (ST-275)

8.1 Site Background and Environmental Setting

The fuel shop battery storage area (SWMU 8-49) is southwest of Building 20677 in the northwest portion of the base. It is on the north side of Building 20723 and is 15 ft x 13 ft (Figure 8-1). The storage area is a small asphalt pad formerly used by the adjacent fuel shop for storing used vehicle batteries. In 1984 or 1985, used automotive batteries were stored on a wood pallet at SWMU 8-49 (Kearney/Centaur, 1988). The pad was used as a battery storage area for about 3 years, after which the batteries were moved by Defense Reutilization and Marketing Office (DRMO) to a fenced storage area near Building 20423 (ST-274) for consolidation (USAF, 1993b). In 1988, six batteries were observed on the wood pallet; some were noted as being in poor or cracked condition (Kearney/Centaur, 1988). The asphalt pad is currently used to store two aboveground tanks containing spent diesel fuel. SWMU 8-49 was investigated on June 14, 1994.

Building 20677 is in the urban/industrial zone. The nearest production wells to this site are KAFB-1, 3,000 ft west-northwest; KAFB-4, 6,000 ft southwest; and KAFB-7, 6,700 ft west-southwest.

8.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU 8-49 from ground surface to 7 ft below grade.

8.2.1 Previous Investigations

No previous investigations have been performed to determine the presence or absence of soil contamination at this site.

8.2.2 Data Gaps

No data were available to confirm the presence or absence of contaminants in the subsurface soil at this site prior to the Appendix III RFI field investigation.

8.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contaminants in soil adjacent to SWMU 8-49.

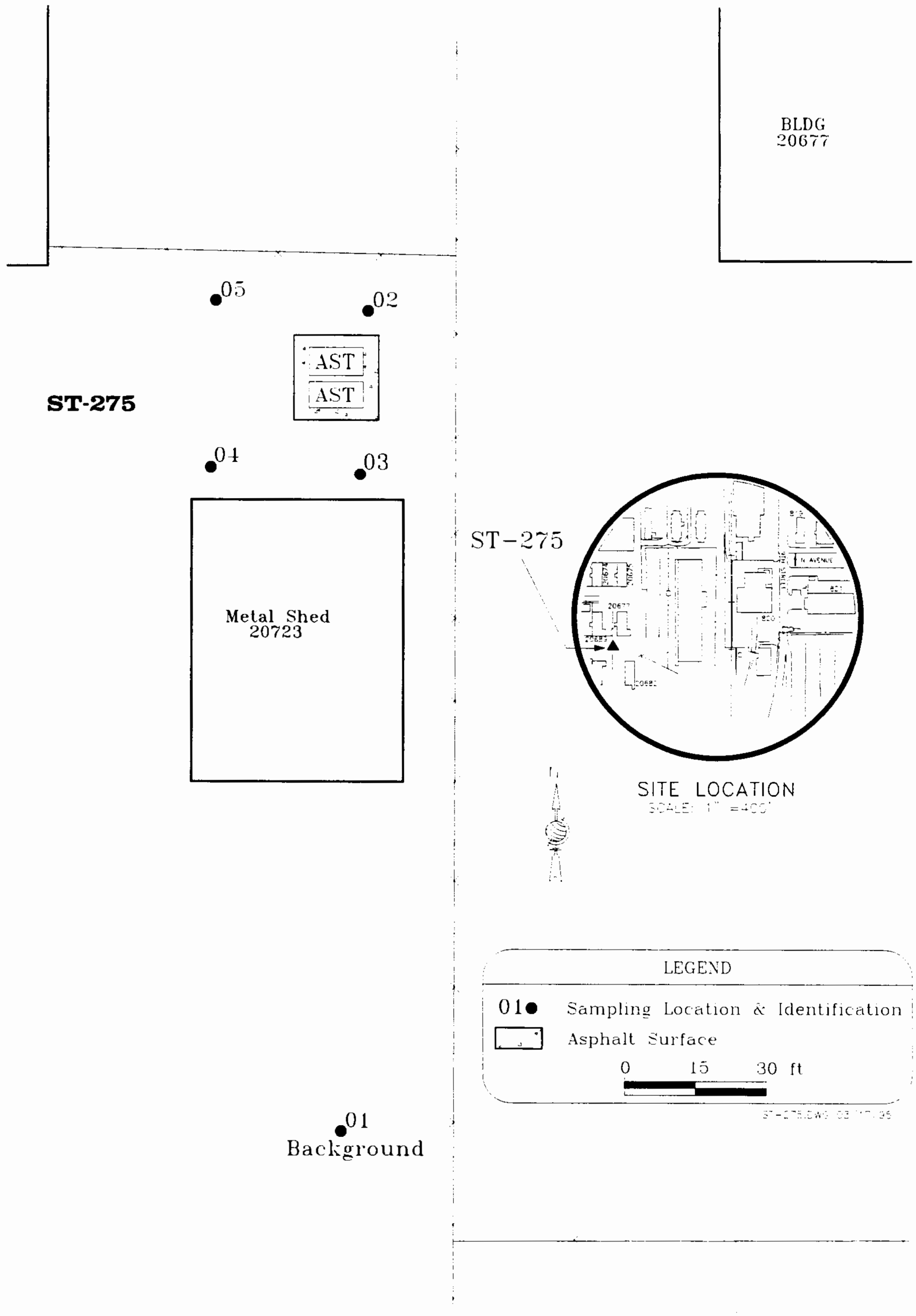


Figure 8-1. **Soil Sampling Locations at SWMU 8-49, Building 20677, Fuel Shop Waste Battery Storage Area (ST-275)**

On June 14, 1994, 15 soil samples were collected and submitted for analysis from five boreholes at SWMU 8-49. For the purpose of collecting site-specific background concentration information, one borehole, ST-275C-01, was drilled and sampled south of the pad in an area away from any known or suspected contamination. Four boreholes (ST-275C-01, ST-275C-03, ST-275C-04, and ST-275C-05) were drilled with a Geoprobe; ST-275C-02 was drilled with a hand auger. Except for ST-27C-01, three soil samples per borehole were collected. One sample was collected immediately below the asphalt surface; the other two were collected from depths of 2 and 5 ft below grade, respectively. The background soil sample was collected at a depth of 4 ft below grade. Sampling locations are presented on Figure 8-1.

Sampling operations and sample handling procedures are described in Section 3.0 of this report. Sample depths, sample locations, and replicate samples collected and submitted for analysis from SWMU 8-49 are listed in Table 8-1. Borehole logs are included in Appendix C.

Table 8-1. Boreholes and Samples Collected at SWMU 8-49, Building 20677, Fuel Shop Waste Battery Storage Area (ST-275)

Borehole	Borehole Location	Sample Depth (ft)	PID/FID (ppm_V) [a,b]
01	S of Building 20723	4-6	0/0
02	NE corner of SWMU 8-49	0-1	0/1
		2-3	0/1
		4-5	0/1
03	SE corner of SWMU 8-49	0-2	0/1
		2-5	2/20
		5-7	0/0
04	SW corner of SWMU 8-49	0-2[a]	0/10.5
		2-4[a]	0/0
		5-7	0/0
05	NW corner of SWMU 8-49	0-2	1.7/150
		2-4	1/0
		5-7	0/0

a. ppmv = parts-per-million volume (ml/L) as isobutylene for the PID and as methane for the FID.

b. PID and FID readings are values above background. Only the highest value for the interval is listed.

c. Replicate sample also collected in this depth interval.

8.2.4 Laboratory Analysis

Eleven soil samples and two replicates were collected at SWMU 8-49 and analyzed for lead, mercury, TPH (the expected contaminants associated with normal operations at this site), and soil moisture. Two samples, ST-275C-03-0002 and background sample ST-275C-01-0406, were analyzed for metals, toxicity characteristic leaching procedure (TCLP) lead, TPH, and soil moisture. The purpose of the metals analysis was to determine the potential for any other metal contamination. The TCLP analysis was performed to determine the leachate concentration of potential lead contamination. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. The brass tube with the highest reading was submitted for TPH analysis. Elevated PID and FID readings (ranging from 1 to 150 ppm above background) were measured in soil samples collected from boreholes ST-275C-02, ST-275C-03, ST-275C-04, and ST-275C-05.

8.3 Site Characteristics

8.3.1 Geology

The area surrounding SWMU 8-49 is underlain by unconsolidated alluvial sediment that is predominantly fine-grained sand and very fine-grained to fine-grained silty sand. Caliche was present in samples collected just below the asphalt-soil interface for lithologic classifications as light- to heavily stained patches. A maximum depth of 7 ft below grade was attained in three of the five boreholes sampled at SWMU 8-49. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this site are included in Appendix C.

8.3.2 Hydrogeology

Groundwater beneath SWMU 8-49 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably west-northwest at this site. Three production wells are located near SWMU 8-49: KAFB-1 is possibly downgradient or cross-gradient 3,000 ft west-northwest, KAFB-4 is upgradient 6,000 ft southwest, and KAFB-7 is cross-gradient 6,700 ft west-southwest. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

8.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples collected at SWMU 8-49. Analytical results are presented in Table 8-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Organic Compounds

Total xylenes (0.015 and 0.019 mg/kg) were detected in the 2- to 5-ft and 5- to 7-ft samples from ST-275C-03; the concentrations of this VOC were below the HHRB action level of 160,000 mg/kg.

Table 8-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-49, Building 20677, Fuel Shop Waste Battery Storage Area (ST-275)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)												
				ST-275C-01	ST-275C-02			ST-275C-03			ST-275C-04				
				4–6	0–1	2–3	4–5	0–2	2–5	5–7	0–2 FR	0–2	2–4 FR	2–4	5–7
VOC	total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	0.015	0.019	ND	ND	ND	ND	ND
TPH	Gasoline fraction	100	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	6,400	NA	NA	NA	7,610	NA	NA	NA	NA	NA	NA	NA
	Arsenic	0.37	6.5	4.1	NA	NA	NA	3.4	NA	NA	NA	NA	NA	NA	NA
	Barium	5,500	735	109	NA	NA	NA	130	NA	NA	NA	NA	NA	NA	NA
	Beryllium	0.15	0.84	0.33	NA	NA	NA	0.33	NA	NA	NA	NA	NA	NA	NA
	Calcium	N/A	121,000	46,300	NA	NA	NA	47,100	NA	NA	NA	NA	NA	NA	NA
	Chromium, total	390	21.6	13.1	NA	NA	NA	7.8	NA	NA	NA	NA	NA	NA	NA
	Cobalt	4,700	15.4	5.1	NA	NA	NA	4.3	NA	NA	NA	NA	NA	NA	NA
	Copper	2,900	223	28.0	NA	NA	NA	10.7	NA	NA	NA	NA	NA	NA	NA
	Iron	N/A	23,800	9,340	NA	NA	NA	10,700	NA	NA	NA	NA	NA	NA	NA
	Lead	400	17.5	6.5 / *ND	5.4	2.9	2.9	5 / *ND	4.6	4.1	3.2	4.8	4.3	4.8	3.5
	Magnesium	N/A	10,400	5,440	NA	NA	NA	3,780	NA	NA	NA	NA	NA	NA	NA
	Manganese	390	549	169	NA	NA	NA	158	NA	NA	NA	NA	NA	NA	NA
	Mercury	23.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Nickel	1,600	188	7.0	NA	NA	NA	6.6	NA	NA	NA	NA	NA	NA	NA
	Potassium	N/A	3,590	1,270	NA	NA	NA	1,930	NA	NA	NA	NA	NA	NA	NA
	Sodium	N/A	787	110	NA	NA	NA	80.0	NA	NA	NA	NA	NA	NA	NA
	Vanadium	550	55.3	58.8	NA	NA	NA	23.7	NA	NA	NA	NA	NA	NA	NA
	Zinc	23,000	114	28.9	NA	NA	NA	22.9	NA	NA	NA	NA	NA	NA	NA
OTHER	Moisture (%)			8.2	7.9	11.7	12.4	8.4	9.7	10.4	13.5	10.7	9.0	9.5	6.8

Table 8-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-49, Building 20677, Fuel Shop Waste Battery Storage Area (ST-275)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)				
				ST-275C-05			*ST-275C-04*	*ST-275C-04*
				0–2	2–4	5–7	0–2 FR	2–4 FR
VOC	total Xylenes	160,000	0.005	ND	ND	ND	ND	ND
TPH	Gasoline fraction	100	1.0	0.61	ND	ND	ND	ND
METALS	Aluminum	78,000	NA	NA	NA	NA	NA	NA
	Arsenic	0.37	NA	NA	NA	NA	NA	NA
	Barium	5,500	NA	NA	NA	NA	NA	NA
	Beryllium	0.15	NA	NA	NA	NA	NA	NA
	Calcium	N/A	NA	NA	NA	NA	NA	NA
	Chromium, total	390	NA	NA	NA	NA	NA	NA
	Cobalt	4,700	NA	NA	NA	NA	NA	NA
	Copper	2,900	NA	NA	NA	NA	NA	NA
	Iron	N/A	NA	NA	NA	NA	NA	NA
	Lead	400	2.0	2.0	5.1	5.3	NA	NA
	Magnesium	N/A	NA	NA	NA	NA	NA	NA
	Manganese	390	NA	NA	NA	NA	NA	NA
	Mercury	23.0	N/A	ND	ND	ND	ND	ND
	Nickel	1,600	NA	NA	NA	NA	NA	NA
	Potassium	N/A	NA	NA	NA	NA	NA	NA
	Sodium	N/A	NA	NA	NA	NA	NA	NA
	Vanadium	550	NA	NA	NA	NA	NA	NA
	Zinc	23,000	NA	NA	NA	NA	NA	NA
OTHER	Moisture (%)			16.2	11.4	6.8	8.7	8.0

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Petroleum Hydrocarbons

No diesel range hydrocarbons were detected in samples submitted for analysis from this site.

Gasoline range hydrocarbons (0.61 mg/kg) were detected in one sample submitted for analysis; this concentration was below the NMED action level for TPH of 100 mg/kg.

Metals

Table 8-2 lists all reportable metal concentrations detected at SWMU 8-49 and the respective UTL and HHRB action level concentrations. Only two samples, ST-275C-03 and background sample ST-275C-01, were analyzed for all metals. Arsenic and beryllium were the only metals detected in samples at concentrations greater than the respective HHRB action levels. Vanadium (58.8 mg/kg) was detected in ST-275C-01, above the UTL of 55.3 mg/kg, but below the respective HHRB action level 550 mg/kg. Arsenic (3.4 to 4.1 mg/kg) was detected in both samples; the detections exceed the HHRB action level of 0.37 mg/kg, but are below the UTL of 6.5 mg/kg. Beryllium (0.33 mg/kg) was detected in the two samples identified above, which exceeds the HHRB action level of 0.15 mg/kg, but is below the UTL of 0.84 mg/kg. The concentrations of arsenic and beryllium appear to be naturally occurring throughout Kirtland AFB as discussed in Section 4.2.2.

Soil Moisture

Soil moisture values ranged from 6.8 to 16.2 percent.

8.5 Conclusions and Recommendations

Conclusions

- Total xylenes and gasoline range hydrocarbons were the only organic compounds detected in the soil samples collected from this site. Total xylenes detections did not exceed HHRB action levels. The gasoline range hydrocarbon detection (0.61 mg/kg in one sample) at this site was similar to those measured in background samples collected during the Appendix III Wasteline RFI. The gasoline range hydrocarbon detection alone is not conclusive evidence of a release occurring at this site. Since the VOC detection and the GRO detection were associated with different boreholes, it is assumed that they are not correlated. Because no other release indicators are present, it is probable that a release has not occurred.

- Arsenic and beryllium were the only metals detected at concentrations exceeding HHRB action levels; the concentrations appear to be naturally occurring throughout Kirtland AFB.

- The analytical results at SWMU 8-49 are not indicative of a contaminant release from this site.

Recommendations

- Based on the findings of the RFI, no further action is necessary; therefore, SWMU 8-49 does not require further investigation. A no further action proposal should be prepared.

9.0 SWMU 9-4, Building 617, Waste Accumulation Area (ST-276)

9.1 Site Background and Environmental Setting

The waste accumulation area at Building 617 (SWMU 9-4) is located in the Phillips Laboratory Chemical Laser Facility in the southwest portion of Kirtland AFB. The site is a 60 ft x 30 ft concrete pad at ground level, east of Building 620 (Figure 9-1). The area is used for the temporary storage of 30-gallon, double-containment, vented drums generated from the chemical laser research operations in the building. The site was investigated June 27–29 and July 25, 1994.

In previous years, the waste generated from the facility consisted of oil and sodium hydroxide that were contained in 55-gallon, closed-top waste drums and stored at the waste accumulation area. During the 1988 VSI (Kearney/Centaur, 1988), the waste accumulation area was observed to be diked by 2-ft high concrete walls on the west and north sides; however, by 1991 the entire perimeter was bermed. The drums are typically removed by a contractor at 1-month intervals for disposal at the DRMO. During a Phase I Records Search conducted in 1981, it was discovered that an estimated monthly 400 gallons of hydrogen fluoride/deuterium fluoride scrubber solutions were first drained to a limestone pit and then to a drainfield at the site.

SWMU 9-4 is located in the urban/industrial zone, which is discussed in Section 2.0. The nearest production wells to this site are KAFB-2, 3,200 ft east, and KAFB-14, 3,700 ft north.

9.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU 9-4 from ground surface to 30 ft below grade.

9.2.1 Previous Investigations

Potential soil contamination has not been investigated at this site. During the RFA VSI, more than 2 dozen 55-gallon drums were observed on the soil, south and east of the concrete pad. Additionally, evidence of cracks and stains were observed on the concrete pad along with stained soil around the unit indicating the possibility of one or more releases at the site (Kearney/Centaur, 1988).

9.2.2 Data Gaps

No data were available to confirm the presence or absence of contamination at this site.

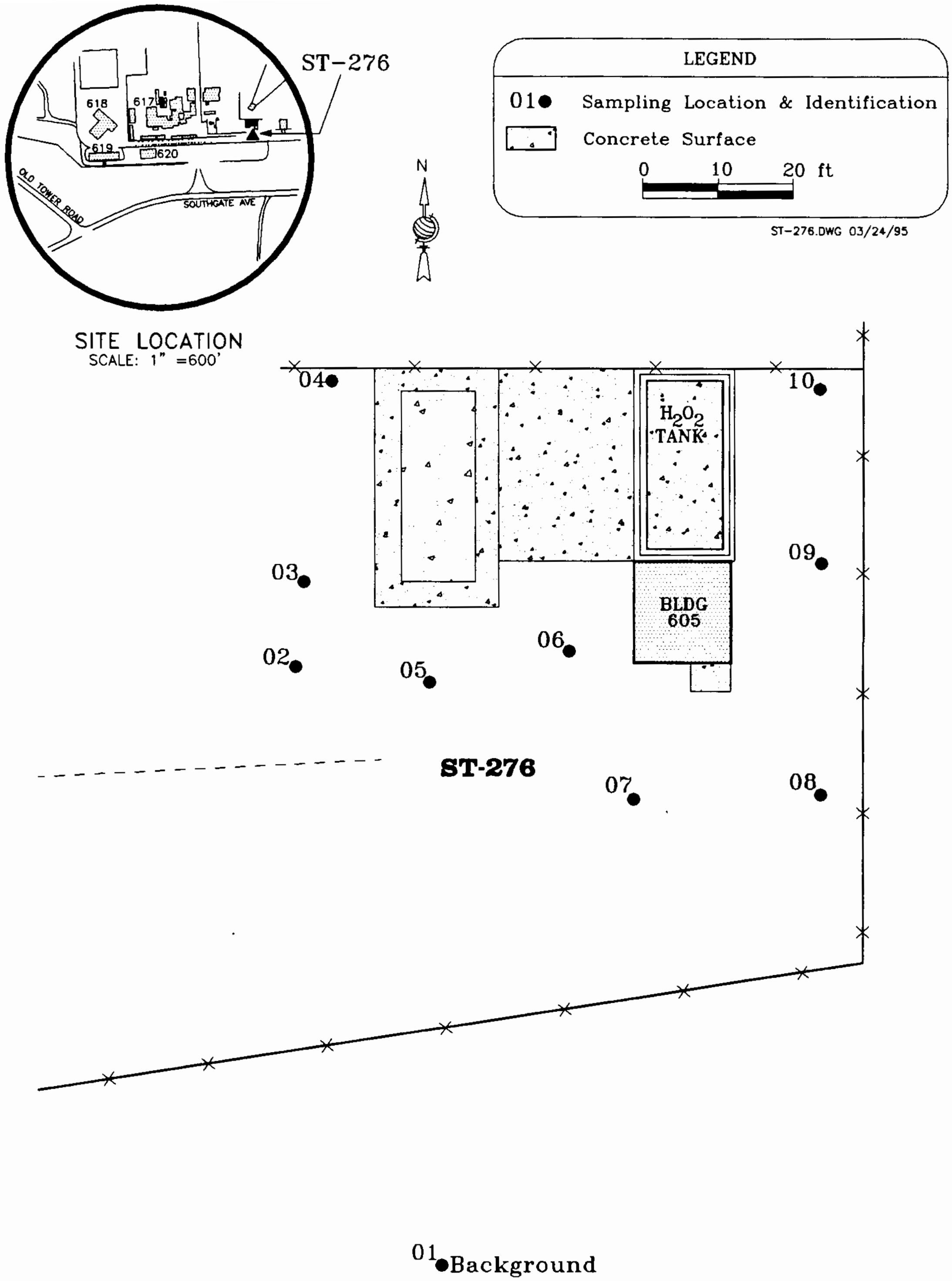


Figure 9-1. Soil Sampling Locations at SWMU 9-4, Building 617, Waste Accumulation Area (ST-276)

9.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contamination in soil adjacent to SWMU 9-4. On June 22 to 29 and July 25, 1994, nine boreholes (ST-276C-02 to ST-276C-10) were drilled with a Geoprobe, east, west, and south of the concrete pad. Five soil samples were collected and submitted for analyses from each borehole: one at the surface and the other four at depths of 5, 10, 15, and 25 ft below grade. To collect background concentration information, one additional soil boring (ST-276C-01) was drilled south of the facility fence, away from known or suspected areas of contamination. Samples from ST-276C-01 were collected and submitted for analyses from 5 ft and 22 ft below grade. Borehole locations for this site are shown on Figure 9-1.

Sampling operations and sample handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples collected at SWMU 9-4 are listed in Table 9-1. Boreholes logs are included in Appendix C.

9.2.4 Laboratory Analysis

Forty-seven soil samples and one replicate sample were analyzed for VOCs, SVOCs, gross alpha, gross beta, and gamma spectrometry, alpha-emitting radium isotopes, radium-228, TPH, and soil moisture. Radiochemistry analyses were performed because of the reported storage and disposal of deuterium fluoride scrubber solutions at the site. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. All field-screening instrument readings remained at background levels throughout drilling and sampling activities at SWMU 9-4.

9.3 Site Characteristics

9.3.1 Geology

The area surrounding SWMU 9-4 is underlain by unconsolidated alluvial sediment that is predominantly fine-grained sand and very fine-grained to fine-grained silty sand. A maximum depth of 30 ft below grade was attained in borehole ST-276C-02. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this site are presented in Appendix C.

9.3.2 Hydrogeology

Groundwater beneath SWMU 9-4 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

Table 9-1. Boreholes and Samples Collected at SWMU 9-4, Building 617, Waste Accumulation Area (ST-276)

Borehole	Borehole Location	Depth (ft)				
01	S of Building 605 and fence	NS	5-9	NS	NS	22-26
02	SW corner of bermed concrete pad	0-2	5-8	10-13	15-19	22-30
03	Approximately 10 ft N of ST-276C-02	0-4	4-8	8-12	14-17	23-27
04	NW corner of bermed concrete pad	0-3	4-8	8-12	15-19	22-26
05	Approximately 10 ft E of ST-276C-02	0-4	5-9	9-13	15-19	22-26
06	Approximately 10 ft NE of ST-276C-05	0-5	5-8	9-12	15-19	22-26
07	Approximately 15 ft SW of Building 605	0-5	5-8	9-12	15-19	22-26
08	18 ft S and 25 ft E of SE corner of Building 605	0-4	4-8	8-12	13-17	21-25
09	20 ft N and 20 ft E of SE corner of Building 605	0-1[a]	3-7	8-12	13-17	21-25
10	13 ft E of NE corner of bermed concrete pad	0-2	4-8	9-13	14-18	23-27

NS No sample collected at this depth

a. Replicate sample also collected at this depth interval.

The gradient is probably northeast at this site. Two production wells are located near SWMU 9-4: KAFB-2 is downgradient 3,200 ft east and KAFB-14 is downgradient 3,700 ft north. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

9.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples submitted for analysis from SWMU 9-4. Analytical results are presented in Table 9-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Organic Compounds

Four VOCs, acetone, methylene chloride, tetrachloroethylene, and toluene, were detected in one or more soil samples collected and submitted for analysis from SWMU 9-4. Acetone (0.005 to 0.01 mg/kg) was detected in eight samples at concentrations below the HHRB action level of 7,800 mg/kg. Methylene chloride (0.001 to 0.01 mg/kg) was detected in 25 samples at concentrations below the HHRB action level of 85 mg/kg. Tetrachloroethylene (0.003 mg/kg) was detected in one sample at a concentration that did not exceed the HHRB action level of 12.0 mg/kg. Toluene (0.002 to 0.007 mg/kg) was detected in seven samples at concentrations below the HHRB action level of 16,000 mg/kg.

Seven SVOCs were detected in soil samples collected for analyses from SWMU 9-4. Bis(2-ethylhexyl)phthalate (0.80 and 1.4 mg/kg) was detected in two samples at concentrations below the HHRB action level of 46 mg/kg. Chrysene (0.35 and 0.37 mg/kg) was detected in two samples at concentrations below the HHRB action level of 88 mg/kg. Di-n-butylphthalate (0.36 to 0.60 mg/kg) was detected in 13 samples at concentrations below the HHRB action level of 7,800 mg/kg. Fluoranthane (0.56 to 0.99 mg/kg) was detected in four samples. There is no established HHRB action level for phenanthrene. Phenol (0.36 to 1.1 mg/kg) was detected in 38 samples, including both background samples from ST-276C-01, at concentrations below the HHRB action level of 47,000 mg/kg. Pyrene (0.43 to 0.64 mg/kg) was detected in four samples at concentrations below the HHRB action level of 2,300 mg/kg. No SVOCs were detected at concentrations that exceed HHRB action levels.

Petroleum Hydrocarbons

No gasoline range hydrocarbons were detected in samples submitted for analysis from this site.

Diesel range hydrocarbons were detected in 10 samples at concentrations ranging from 4.8 mg/kg to 16.8 mg/kg. Diesel range hydrocarbons were not detected in the background samples. The diesel range hydrocarbon concentrations detected in the site samples did not exceed the NMED action level for TPH of 100 mg/kg. Diesel hydrocarbon concentrations correlated with multiple SVOC detections in bore-holes ST-276C-04, ST-276C-08, and ST-276C-09 and may indicate limited releases at these locations.

Radiological Parameters

A screening level analysis was performed on the radiological data generated from soil samples collected at SWMU 9-4 to determine if radiological materials had been released to subsurface soil. A comparison of sample and background population arithmetic means was performed to determine if the sample and background populations were equal. Background data for this comparison included the single background sampling borehole ST-276C-01 collected during the Appendix III RFI, data collected at

Table 9-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 9-4, Building 617, Waste Accumulation Area (ST-276)[1]
(Radionuclide concentrations pCi/g; all other concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL	Borehole Number and Sample Depth Interval (ft)											
				ST-276C-01		ST-276C-02					ST-276C-03				
				5–9	22–26	0–2	5–8	10–13	15–19	22–30	0–4	4–8	8–12	14–17	23–27
VOC	Acetone	7,800	0.10	0.008	ND	ND	ND	0.017	0.01	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	0.001	ND	0.005	0.006	0.007	0.006	0.006
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.003	ND	ND
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOC	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Di-n-butylphthalate	7,800	0.70	ND	ND	0.41	0.36	ND	ND	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	0.76	0.43	0.44	1.1	1.1	ND	0.62	0.59	0.76	0.64	0.55	0.43
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RAD	Actinium 208	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Actinium 228	N/A	N/A	0.80	0.70	0.90	ND	ND	1.0	0.80	0.80	0.70	0.60	1.2	0.80
	Gross alpha	N/A	N/A	16.0	4.8	10.0	11.0	15.0	20.0	24.0	14.0	11.0	12.0	28.0	12.0
	Gross beta	N/A	N/A	19.0	18.0	18.0	11.0	16.0	23.0	25.0	17.0	15.0	14.0	25.0	20.0
	Bismuth-214	N/A	N/A	0.60	0.50	0.60	0.40	0.60	0.70	0.60	0.60	0.40	0.60	0.80	0.50
	Lead-212	N/A	N/A	0.50	0.60	0.60	0.30	0.50	1.0	0.70	0.50	0.40	0.50	1.0	0.60
	Lead-214	N/A	N/A	0.60	0.40	0.60	0.30	0.60	0.70	0.70	0.60	0.40	0.40	0.80	0.50
	Potassium-40	N/A	N/A	16.0	21.0	17.0	12.0	15.0	18.0	24.0	17.0	15.0	16.0	22.0	21.0
	Radium-224	N/A	N/A	ND	6.8	ND	4.2	ND	0.90	ND	6.5	ND	5.8	12.0	7.5
	Radium-226	N/A	N/A	2.5	0.20	2.4	0.30	2.6	1.5	2.5	3.1	1.9	0.40	4.0	1.5
	Radium-228	N/A	N/A	0.30	0.40	0.50	0.20	0.30	0.50	0.50	ND	0.30	0.30	0.80	0.50
	Thallium-208	N/A	N/A	0.20	0.20	0.30	0.20	0.20	0.40	0.30	0.20	0.20	0.20	0.50	0.30
	Thorium-227	N/A	N/A	1.6	ND	1.8	ND	1.4	ND	2.1	1.6	1.3	ND	3.0	ND
	Thorium-234	N/A	N/A	0.80	ND	ND	ND	1.4	1.1	1.0	0.90	ND	ND	ND	1.0
	Uranium-235	N/A	N/A	0.10	ND	0.10	ND	0.20	0.09	0.10	0.20	0.10	ND	0.20	0.09
OTHER	Moisture (%)			8.2	7.5	3.8	6.3	9.3	8.3	9.6	8.5	10.7	9.2	7.3	5.6

Table 9-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 9-4, Building 617, Waste Accumulation Area (ST-276)[1]
(Radionuclide concentrations pCi/g; all other concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL	Borehole Number and Sample Depth Interval (ft)									
				ST-276C-04					ST-276C-05				
				0–3	4–8	8–12	15–19	22–26	0–4	5–9	9–13	15–19	22–26
VOC	Acetone	7,800	0.10	ND	ND	ND	0.002	ND	ND	ND	ND	0.011	0.006
	Methylene chloride	85.0	0.005	0.006	0.007	0.006	0.007	0.006	0.006	0.006	0.004	ND	0.005
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	0.007	ND	ND	ND	ND	ND	ND	0.003	ND
SVOC	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Chrysene	88.0	0.70	0.37	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	0.99	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	0.79	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	0.69	0.80	0.67	0.63	0.63	0.77	0.53	ND	ND	ND
	Pyrene	2,300	0.70	0.64	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	16.8	ND	4.8	ND	ND	ND	ND	13.0	8.1	12.0
RAD	Actinium 208	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Actinium 228	N/A	N/A	0.60	ND	0.70	1.1	0.90	0.70	ND	ND	0.80	0.70
	Gross alpha	N/A	N/A	9.3	5.2	7.2	19.0	9.4	7.4	7.0	ND	21.0	18.0
	Gross beta	N/A	N/A	17.0	16.0	18.0	18.0	21.0	18.0	17.0	18.0	16.0	27.0
	Bismuth-214	N/A	N/A	0.50	0.40	0.50	0.80	0.70	0.60	0.50	0.60	0.60	0.40
	Lead-212	N/A	N/A	0.50	0.40	0.40	0.80	0.80	0.60	0.40	0.60	0.70	0.60
	Lead-214	N/A	N/A	0.50	0.50	0.40	0.90	0.60	0.60	0.50	0.60	0.60	0.70
	Potassium-40	N/A	N/A	15.0	16.0	16.0	17.0	19.0	18.0	14.0	18.0	19.0	20.0
	Radium-224	N/A	N/A	ND	ND	4.6	ND	1.5	1.5	ND	ND	8.9	7.2
	Radium-226	N/A	N/A	2.4	0.30	1.6	3.7	1.4	0.20	2.7	0.30	0.60	7.9
	Radium-228	N/A	N/A	0.30	0.40	0.20	0.40	0.30	0.20	0.20	0.30	0.20	3.4
	Thallium-208	N/A	N/A	0.20	0.20	0.20	0.30	0.30	0.20	0.20	0.20	0.30	0.20
	Thorium-227	N/A	N/A	1.5	1.2	ND	2.4	ND	ND	1.3	1.8	2.2	ND
	Thorium-234	N/A	N/A	ND	ND	ND	ND	1.0	ND	0.90	ND	ND	0.70
	Uranium-235	N/A	N/A	0.10	ND	0.10	0.20	0.09	ND	0.20	ND	ND	ND
OTHER	Moisture (%)			1.6	10.8	9.0	7.9	5.1	9.9	10.4	8.2	10.3	3.3

Table 9-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 9-4, Building 617, Waste Accumulation Area (ST-276)[1] (Radionuclide concentrations pCi/g; all other concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL	Borehole Number and Sample Depth Interval (ft)									
				ST-276C-06					ST-276C-07				
				0–5	5–8	9–12	15–19	22–26	0–5	5–8	9–12	15–19	22–26
VOC	Acetone	7,800	0.10	ND	0.009	0.005	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	0.004	0.004	0.003	0.003	0.011	0.008	0.009	0.009	0.008	0.009
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	0.002	0.002	ND	0.004	0.002	ND	ND	0.002	ND
SVOC	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND	ND	0.38	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	0.59	0.41	ND	ND	ND	0.51	0.62	0.42	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	6.4	4.7	ND	ND	ND	ND	ND	ND	ND	ND
RAD	Actinium 208	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Actinium 228	N/A	N/A	0.80	0.70	ND	ND	0.80	0.90	ND	ND	1.1	0.90
	Gross alpha	N/A	N/A	4.9	13.0	13.0	7.4	12.0	8.4	9.2	7.6	12.0	15.0
	Gross beta	N/A	N/A	11.0	21.0	19.0	19.0	21.0	21.0	14.0	19.0	19.0	18.0
	Bismuth-214	N/A	N/A	0.50	0.30	0.50	0.50	0.60	0.50	0.30	0.40	0.40	0.50
	Lead-212	N/A	N/A	0.50	0.50	0.70	0.60	0.60	0.60	0.50	0.60	0.70	0.80
	Lead-214	N/A	N/A	0.50	0.40	0.60	0.60	0.70	0.70	0.40	0.60	0.70	0.60
	Potassium-40	N/A	N/A	15.0	15.0	16.0	16.0	23.0	17.0	15.0	17.0	19.0	19.0
	Radium-224	N/A	N/A	6.7	0.70	8.7	7.9	7.9	ND	0.90	7.2	8.9	9.2
	Radium-226	N/A	N/A	0.20	1.7	0.50	0.30	1.7	0.40	0.40	0.70	1.8	1.7
	Radium-228	N/A	N/A	0.20	0.30	0.30	ND	0.40	0.30	0.20	0.40	0.40	0.50
	Thallium-208	N/A	N/A	0.30	0.20	0.20	0.30	0.30	0.30	0.20	0.20	0.30	0.30
	Thorium-227	N/A	N/A	1.6	ND	2.1	2.0	ND	1.8	ND	1.8	ND	ND
	Thorium-234	N/A	N/A	ND	0.80	ND	ND	1.4	1.2	ND	ND	1.4	1.0
	Uranium-235	N/A	N/A	ND	0.10	ND	ND	0.10	ND	ND	ND	0.10	0.10
OTHER	Moisture (%)			6.9	7.3	8.2	5.7	5.3	9.7	11.4	9.1	11.2	6.6

Table 9-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 9-4, Building 617, Waste Accumulation Area (ST-276)[1]
(Radionuclide concentrations pCi/g; all other concentrations mg/kg) (Concluded)

Chemical Class	Analyte	HHRB Action Level	PQL	Borehole Number and Sample Depth Interval (ft)															
				ST-276C-08					*ST-276C-09*						*ST-276C-10*				
				0–4	4–8	8–12	13–17	21–25	0–1 FR	0–1	3–7	8–12	13–17	21–25	0–2	4–8	9–13	14–18	23–27
VOC	Acetone	7,800	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOC	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND	0.80
	Chrysene	88.0	0.70	ND	0.35	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Di-n-butylphthalate	7,800	0.70	0.46	0.51	0.60	0.39	ND	0.45	0.39	0.48	0.41	ND	ND	ND	ND	0.42	0.43	ND
	Fluoranthane	3,100	0.70	ND	0.80	ND	ND	ND	0.56	ND	ND	ND	ND	0.57	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	0.70	ND	ND	ND	0.44	ND	ND	ND	ND	0.42	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	0.61	0.85	1.0	0.54	0.41	0.98	0.91	ND	0.99	1.0	1.1	0.76	0.58	0.36	0.44	0.41
	Pyrene	2,300	0.70	ND	0.60	ND	ND	ND	0.43	ND	ND	ND	ND	0.43	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	ND	5.5	ND	ND	ND	7.1	ND	ND	ND	ND	5.2	ND	ND	ND	ND	ND
RAD	Actinium 208	N/A	N/A	ND	ND	ND	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Actinium 228	N/A	N/A	ND	0.60	0.60	ND	0.60	0.60	ND	0.70	0.70	1.2	0.70	0.50	ND	0.70	1.0	0.70
	Gross alpha	N/A	N/A	18.0	13.0	27.0	14.0	17.0	15.0	23.0	23.0	7.2	40.0	16.0	9.4	14.0	17.0	36.0	25.0
	Gross beta	N/A	N/A	20.0	15.0	19.0	25.0	23.0	22.0	25.0	13.0	13.0	24.0	20.0	18.0	16.0	18.0	20.0	18.0
	Bismuth-214	N/A	N/A	0.50	0.50	0.30	0.40	0.40	0.40	0.60	0.50	0.50	0.60	0.40	0.40	0.50	0.40	0.40	0.50
	Lead-212	N/A	N/A	0.50	0.50	0.40	0.60	0.50	0.50	0.60	0.60	0.50	0.90	0.50	0.60	0.50	0.50	0.80	0.70
	Lead-214	N/A	N/A	0.50	0.50	0.30	0.50	0.40	0.40	0.60	0.60	0.50	0.60	0.50	0.50	0.50	0.50	0.60	0.50
	Potassium-40	N/A	N/A	14.0	17.0	13.0	14.0	21.0	14.0	16.0	14.0	13.0	21.0	22.0	18.0	14.0	15.0	19.0	20.0
	Radium-224	N/A	N/A	ND	ND	5.3	6.7	6.4	0.60	ND	6.8	6.3	ND	5.8	6.8	5.6	5.9	9.0	8.3
	Radium-226	N/A	N/A	2.4	2.2	1.1	1.7	1.8	0.40	2.0	1.8	2.6	2.9	0.40	0.30	2.2	0.40	1.4	1.9
	Radium-228	N/A	N/A	0.20	0.30	0.30	0.30	0.20	0.30	ND	ND	ND	0.30	0.50	0.30	0.20	0.20	0.40	0.30
	Thallium-208	N/A	N/A	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.20	0.20	0.20	0.20	0.30	0.30
	Thorium-227	N/A	N/A	1.6	1.5	ND	1.7	1.6	ND	1.8	1.7	1.6	2.5	ND	ND	1.4	ND	1.3	2.0
	Thorium-234	N/A	N/A	ND	0.80	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	ND	ND
	Uranium-235	N/A	N/A	0.10	0.10	0.10	0.10	0.10	ND	0.10	0.10	0.20	0.20	ND	ND	0.10	ND	0.10	0.10
OTHER	Moisture (%)			7.9	2.0	10.8	5.2	6.0	1.2	0.80	6.3	8.6	3.3	11.4	5.3	8.2	7.6	9.2	5.1

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

radioactive burial site RB-11 during the Stage 2D-1 RFI, and data collected by SNL. The analysis determined with 95 percent confidence that the background and site datasets are from the same population. Therefore, it is concluded that there have not been any releases of radionuclides to subsurface soil at this site.

Soil Moisture

Soil moisture values ranged from 0.80 to 11.4 percent.

9.5 Conclusions and Recommendations

Conclusions

- Four VOCs was detected in soil samples collected at SWMU 9-4 at concentrations below HHRB action levels. The methylene chloride detections are probably the result of laboratory contamination, as discussed in Section 3.0.
- Seven SVOCs was detected in soil samples collected at SWMU 9-4 at concentrations below respective HHRB action levels.
- No gasoline range hydrocarbons were detected in soil samples collected at SWMU 9-4. Diesel range hydrocarbons (4.7 to 16.8 mg/kg) were detected in 10 samples; the concentrations did not exceed the NMED action level of 100 mg/kg. The detections were similar to concentrations detected in background samples analyzed during the Appendix III RFI; however, because other release indicators, SVOCs, were detected, the concentrations may indicate limited releases at the site.
- A screening review performed on soil samples collected for radiological parameters concluded with 95 percent confidence that no difference between the background samples and the borehole samples existed at SWMU 9-4.

Recommendations

- Based on the findings of the RFI, SWMU 9-4 requires further investigation. Additional soil sampling should be performed in the vicinity of SWMU 9-4 to confirm the release of diesel range hydrocarbons. If a release is confirmed, additional soil sampling will be necessary to define the extent of contamination at the site.

10.0 SWMU 9-20, Building 909, Inactive Waste Accumulation Area (ST-277)

10.1 Site Background and Environmental Setting

The inactive waste accumulation area (SWMU 9-20) is adjacent to the southeast side of Building 909 (Figure 10-1) in the western portion of Kirtland AFB. From the mid-1950s until 1990, SWMU 9-20 was used for the management of waste oil and hydraulic fluid. The former waste accumulation area consists of a barren strip of soil (approximately 15 ft x 60 ft) and is surrounded by an asphalt parking area. Containers (5 to 55 gallon) for the waste fluids were stored on wood pallets at SWMU 9-20. The hydraulic fluid was disposed via the DRMO and the waste oil was removed by a contractor (Kearney/Centaur, 1988). The Kearney RFA report noted that at the time of the 1988 VSI, the soil at the unit had been recently worked over and it was difficult to determine the extent of any potential soil contamination. However, approximately 12 sq ft soil at or in the vicinity of the unit was observed to be visibly stained. The area was investigated on June 16 and 20, 1994.

Building 909 is located in the urban/industrial zone, which is discussed in Section 2.0. The nearest production wells to this site are KAFB-14, 3,000 ft west-southwest; KAFB-2, 4,500 ft southeast; and KAFB-12, 4,900 ft west-northwest.

10.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU 9-20 from ground surface to 27 ft below grade.

10.2.1 Previous Investigations

No previous investigations have been performed to determine the presence or absence of soil contamination at this site.

10.2.2 Data Gaps

No data were available to confirm the presence or absence of contaminants in the soil at this site.

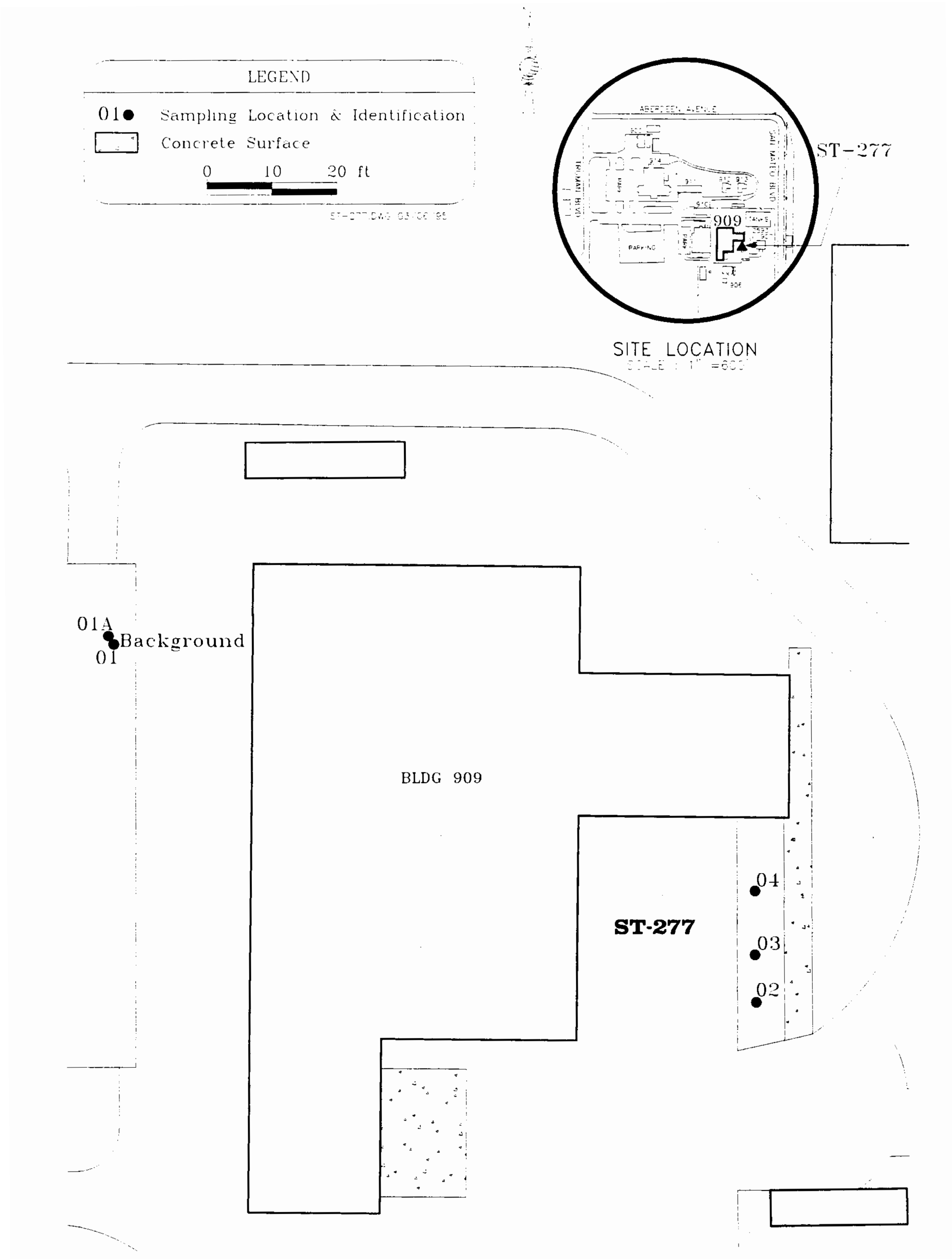


Figure 10-1. Soil Sampling Locations at SWMU 9-20, Building 909, Inactive Waste Accumulation Area (ST-277)

10.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contaminants in soil adjacent to SWMU 9-20. On June 16, 1994, three boreholes, ST-277C-02 to ST-277C-04, were drilled and sampled using a Geoprobe. The boreholes were equally spaced along the center of the soil strip where the barrels and drums were reportedly stored (Figure 10-1). Five soil samples were collected per borehole: one from the surface soil, and at depths of 5, 10, 15, and 25 ft below grade. On June 20, 1994, to determine site-specific background concentrations, a fourth borehole, ST-277C-01, was located on the west side of Building 909, in an area away from any known or suspected contamination. ST-277C-01 was drilled and sampled on June 20, 1994. Samples were collected at depths of 5 ft and 20 ft below grade.

Sampling operations and sample handling procedures are described in Section 3.0 of this report. Sample depths, sample locations, and replicate samples collected at SWMU 9-20 are listed in Table 10-1. Borehole logs are included in Appendix C.

Table 10-1. Boreholes and Samples Collected at SWMU 9-20, Building 909, Inactive Waste Accumulation Area (ST-277)

Borehole	Borehole Location	Sample Depth (ft)	PID/FID (ppm_v) [a,b]
01	Background borehole 20 ft W of Building 909	5-7	0/0
		20-22	0/0
02	S borehole	0-4[c]	0/3
		5-7	0/0
		10-13	0/0
		15-18	0/0
		24-27	0/0
03	Middle borehole	0-2	0/0
		5-7	0/0
		10-12	0/0
		14-20	0/0
		24-26	0/0
04	N borehole	0-4[c]	0/1.5
		5-7	0/0
		10-13	0/0
		15-18	0/0
		24-27	0/0

a. ppm_v = parts-per-million volume (ml/L) as isobutylene for the PID and as methane for the FID.

b. PID and FID readings are values above background. Only the highest value for the interval is listed.

c. Replicate sample also collected in this depth interval.

10.2.4 Laboratory Analysis

Seventeen soil samples and two replicates were collected at SWMU 9-20 and analyzed for SVOCs, metals, TPH, pesticides/PCBs, sulfate (the expected contaminants associated with normal operations at this site), and soil moisture. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. The brass tube with the highest PID or FID measurements was submitted for SVOC and TPH analysis. Elevated readings (ranging from 1.5 to 3 ppm_V above background) were measured in soil samples collected from boreholes ST-277C-02 and ST-277C-04 (Table 10-1).

10.3 Site Characteristics

10.3.1 Geology

The area surrounding SWMU 9-20 is underlain by unconsolidated alluvial sediment that is predominantly fine-grained sand and very fine-grained to fine-grained silty sand. A maximum depth of 27 ft below grade was attained at two of the four boreholes sampled at SWMU 9-20. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this site are included in Appendix C.

10.3.2 Hydrogeology

Groundwater beneath SWMU 9-20 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably north at this site. Three production wells are located near SWMU 9-20: KAFB-14 is cross-gradient 3,000 ft west-southwest, KAFB-2 is upgradient 4,500 ft southeast, and KAFB-12 is cross-gradient 4,900 ft west-northwest. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

10.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples collected and submitted for analysis at ST-275. Analytical results are presented in Table 10-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Table 10-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 9-20, Building 909, Inactive Waste Accumulation Area (ST-277)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)							
				ST-277C-01		ST-277C-02					
				5–7	20–22	0–4 FR	0–4	5–7	10–13	15–18	24–27
SVOC	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	0.53	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND	ND	ND	ND
	Gasoline fraction	100	1.0	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	3,840	4,490	4,820	4,870	6,910	6,260	8,800	10,300
	Arsenic	0.37	6.5	3.0	2.4	2.6	3.2	2.9	2.3	2.7	3.6
	Barium	5,500	735	106	111	447	149	138	23.9	166	84.7
	Beryllium	0.15	0.84	0.41	0.41	0.32	ND	0.42	0.31	0.55	0.67
	Cadmium	39.0	N/A	0.72	1.0	ND	ND	ND	ND	ND	ND
	Calcium	N/A	121,000	15,400	32,200	113,000	38,800	14,700	4,680	32,400	15,900
	Chromium, total	390	21.6	5.2	14.1	6.8	5.4	6.8	6.8	12.5	13.7
	Cobalt	4,700	15.4	5.2	4.5	5.5	4.1	5.2	3.2	6.7	6.9
	Copper	2,900	223	26.6	17.1	14.2	12.1	18.4	9.3	53.1	51.0
	Iron	N/A	23,800	11,900	11,800	7,730	9,180	11,800	8,830	14,000	13,700
	Lead	400	17.5	4.0	5.3	9.1	3.8	5.6	5.0	6.3	8.0
	Magnesium	N/A	10,400	3,210	3,570	5,650	3,720	4,150	2,850	4,790	4,880
	Manganese	390	549	151	174	91.9	106	187	124	266	276
	Nickel	1,600	188	5.9	659	8.0	3.9	24.8	5.0	9.7	12.0
	Potassium	N/A	3,590	1,270	1,560	794	870	1,370	1,190	1,610	1,960
	Sodium	N/A	787	119	141	173	135	136	246	273	285
	Vanadium	550	55.3	31.8	27.1	26.1	27.7	33.2	18.3	25.4	26.2
	Zinc	23,000	114	27.3	27.5	19.6	16.3	29.9	22.0	51.4	53.5
OTHER	Moisture (%)			2.3	3.0	7.6	5.0	5.1	4.6	9.0	11.0
	Sulfate			45.0	75.0	48.0	45.0	50.0	67.0	31.0	76.0
PESTICIDES	DDD			ND	ND	0.08	ND	ND	ND	ND	ND

Table 10-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 9-20, Building 909, Inactive Waste Accumulation Area (ST-277)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)				
				ST-277C-03				
				0–2	5–7	10–12	14–20	24–26
SVOC	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	9.2	ND	ND	ND	ND
	Gasoline fraction	100	1.0	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	4,920	7,150	6,420	9,660	12,600
	Arsenic	0.37	6.5	4.7	3.3	2.2	3.6	4.6
	Barium	5,500	735	358	64.3	42.1	92.1	69.7
	Beryllium	0.15	0.84	0.32	0.43	0.42	0.54	0.80
	Cadmium	39.0	N/A	ND	ND	ND	ND	0.91
	Calcium	N/A	121,000	50,700	13,100	10,000	24,900	17,500
	Chromium, total	390	21.6	25.4	7.6	11.8	13.0	14.4
	Cobalt	4,700	15.4	3.7	4.4	4.1	8.0	8.5
	Copper	2,900	223	14.0	26.9	17.4	13.6	35.5
	Iron	N/A	23,800	6,880	9,990	8,490	11,700	15,900
	Lead	400	17.5	4.1	5.2	3.5	8.0	8.8
	Magnesium	N/A	10,400	4,260	3,600	2,810	3,910	5,680
	Manganese	390	549	80.7	191	159	192	333
	Nickel	1,600	188	5.2	9.4	7.9	29.3	13.3
	Potassium	N/A	3,590	672	1,150	1,150	1,480	2,140
	Sodium	N/A	787	132	202	239	365	380
	Vanadium	550	55.3	28.6	30.4	15.7	23.3	30.3
	Zinc	23,000	114	21.9	32.1	26.1	31.7	49.1
OTHER	Moisture (%)			5.3	6.4	5.8	7.9	12.0
	Sulfate			60.0	56.0	65.0	180	130
PESTICIDES	DDD			0.008	ND	ND	ND	ND

Table 10-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 9-20, Building 909, Inactive Waste Accumulation Area (ST-277)[1] (Concentrations mg/kg) (Concluded)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)					
				ST-277C-04					
				0–4 FR	0–4	5–7	10–13	15–18	24–27
SVOC	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	484	720	6.4	ND	ND	ND
	Gasoline fraction	100	1.0	ND	ND	ND	ND	ND	0.35
METALS	Aluminum	78,000	14,700	9,160	6,710	9,800	7,850	10,200	17,900
	Arsenic	0.37	6.5	4.0	3.4	3.2	2.9	3.6	5.0
	Barium	5,500	735	255	135	63.4	126	131	81.7
	Beryllium	0.15	0.84	0.55	0.43	0.64	0.57	0.65	1.1
	Cadmium	39.0	N/A	ND	ND	0.74	ND	0.75	ND
	Calcium	N/A	121,000	78,500	84,800	17,900	12,700	30,000	25,100
	Chromium, total	390	21.6	7.3	6.7	9.6	10.6	12.7	19.1
	Cobalt	4,700	15.4	6.4	4.6	6.6	5.3	7.9	9.0
	Copper	2,900	223	15.8	13.3	12.0	35.7	33.6	49.0
	Iron	N/A	23,800	10,600	9,180	12,800	10,900	17,200	20,200
	Lead	400	17.5	4.5	4.2	6.1	6.1	7.3	12.9
	Magnesium	N/A	10,400	6,280	4,410	4,550	3,630	5,650	7,270
	Manganese	390	549	189	140	246	190	291	445
	Nickel	1,600	188	9.7	23.7	10.3	9.2	13.1	17.6
	Potassium	N/A	3,590	1,440	1,040	1,520	1,310	1,880	3,120
	Sodium	N/A	787	351	289	381	321	334	483
	Vanadium	550	55.3	38.5	27.7	31.6	20.6	31.6	39.1
	Zinc	23,000	114	28.6	22.8	33.6	41.9	48.1	67.0
OTHER	Moisture (%)			9.0	7.7	5.9	12.0	7.2	16.4
	Sulfate			110	110	99.0	110	83.0	120
PESTICIDES	DDD			ND	ND	ND	ND	ND	ND

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Organic Compounds

The only SVOC detected in soil samples collected at SWMU 9-20 was di-n-butylphthalate (0.53 mg/kg) in ST-277C-02 (0 to 4 ft). This concentration is below the HHRB action level for di-n-butylphthalate of 7,800 mg/kg.

Petroleum Hydrocarbons

Diesel range hydrocarbons (6.4 to 720 mg/kg) were detected in three samples and a field replicate. The diesel range hydrocarbon concentrations detected in ST-277C-04 (0-4 ft) and the field replicate of this sample exceed the NMED action level of 100 mg/kg. Gasoline range hydrocarbons (0.35 mg/kg) were detected in sample ST-277C-04 (24 to 27 ft).

Metals

Table 10-2 lists all reportable metal concentrations detected at SWMU 9-20 and the respective UTL and HHRB action level concentrations. Arsenic, beryllium, and manganese were the only metals detected in samples at concentrations greater than the respective HHRB action levels. Arsenic (2.2 to 4.7 mg/kg) was detected in all samples; concentrations exceeded the HHRB action level of 0.37 mg/kg. Beryllium (0.31 to 3.6 mg/kg) was detected in all samples but ST-277C-02 (0 to 4 ft); concentrations exceeded the HHRB action level of 0.15 mg/kg. Manganese was detected in ST-277C-04 (24 to 27 ft) at a concentration of 483 mg/kg, exceeding the HHRB action level of 390 mg/kg. All concentrations were below the respective UTLs. The concentrations of arsenic, beryllium, and manganese appear to be naturally occurring throughout Kirtland AFB as discussed in Section 4.2.

Pesticides/PCBs

DDD (1,1-bis(chlorophenyl)-2,2-dichloroethane) was detected in ST-277C-03 (0 to 2 ft) and the field replicate of ST-277C-02 (0 to 4 ft) at concentrations of 0.008 and 0.08 mg/kg, respectively. Although DDD was not detected in the background sample, the concentrations detected in the two samples are below the HHRB action level of 2.7 mg/kg.

Sulfate and Soil Moisture

Sulfate was detected in all samples at concentrations ranging from 31 to 180 mg/kg. Soil moisture values ranged from 2.3 to 16.4 percent.

10.5 Conclusions and Recommendations

Conclusions

- Di-n-butylphthalate was the only SVOC detected in a soil sample collected at this site; the concentration detected was below the HHRB action level.

- Diesel range hydrocarbons were detected in one soil sample (ST-277C-04) and its associated field replicate at concentrations exceeding the NMED action level of 100 mg/kg. Additional investigation is recommended to confirm that a release occurred.

- Gasoline range hydrocarbons were detected in the 24- to 27-ft sample from ST-277C-04 soil sample at a concentration below the NMED action level of 100 mg/kg.

- Arsenic, beryllium, and manganese were the only metals detected at concentrations exceeding HHRB action levels; the concentrations appear to be naturally occurring throughout Kirtland AFB.

- DDD was detected in two samples at concentrations below the HHRB action level.

- The analytical results at SWMU 9-20 are indicative of a release from this site.

Recommendations

- Because of the presence of TPH above the NMED action level, further investigation should be performed to confirm the extent of the diesel hydrocarbon release. Additional soil samples should be collected in the vicinity of borehole ST-277C-04.

11.0 SWMU 8-58, Building 57007, Battery Storage Area (ST-321)

11.1 Site Description and History

SWMU 8-58, a former battery storage area, was adjacent to the east side of Building 57007 in the southern portion of Kirtland AFB (Figure 11-1). SWMU 8-58 was used for used battery storage resulting from the New Mexico Engineering Research Institute vehicle maintenance activities. According to the Kearney RFA, this unit consisted of two side-by-side pallets, stacked with lead-acid vehicle batteries. The pallets were placed on a gravel/dirt parking area on the east side of Building 57007 and were stacked two-high. The batteries were disposed of via DRMO. During the VSI in 1988, 25 batteries containing an estimated 10 gallons of sulfuric acid were noted (Kearney/Centaur, 1988). Several cracked batteries were also noted. Following a site reconnaissance in September 1993, it was determined that used batteries are no longer stored in this manner. Used batteries are presently stored in a locked battery room, 8 ft x 5 ft, added to the northwest end of Building 57007. The site was investigated on June 6, 1994.

Building 57007 is located on the Hubbell Bench, on the east boundary of the Albuquerque-Belen Basin (USAF, 1993b). The nearest production well to the site is KAFB-10, 4 mi northwest; it is controlled and operated by DOE and SNL.

11.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU 8-58 from ground surface to 6 ft below grade.

11.2.1 Previous Investigations

No previous investigations have been performed at this site to investigate potential soil contamination.

11.2.2 Data Gaps

No data were available to confirm the presence or absence of contaminants in the soil at this site.

11.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contaminants in soil at this site. Nine boreholes were drilled and sampled with a Geoprobe at SWMU 8-58. Boreholes ST-321C-03 through ST-321C-09 were located along the east side of Building 57007, in the former battery storage area. ST-321C-02 was drilled and sampled on the west side of Building 57007 in an attempt to determine if that area had also been used as a battery storage area. Three soil samples per borehole were collected: one at the surface and the other two at depths of 2 ft and 5 ft below grade. To obtain site-specific background concentration data, the background sampling borehole, ST-321C-01,

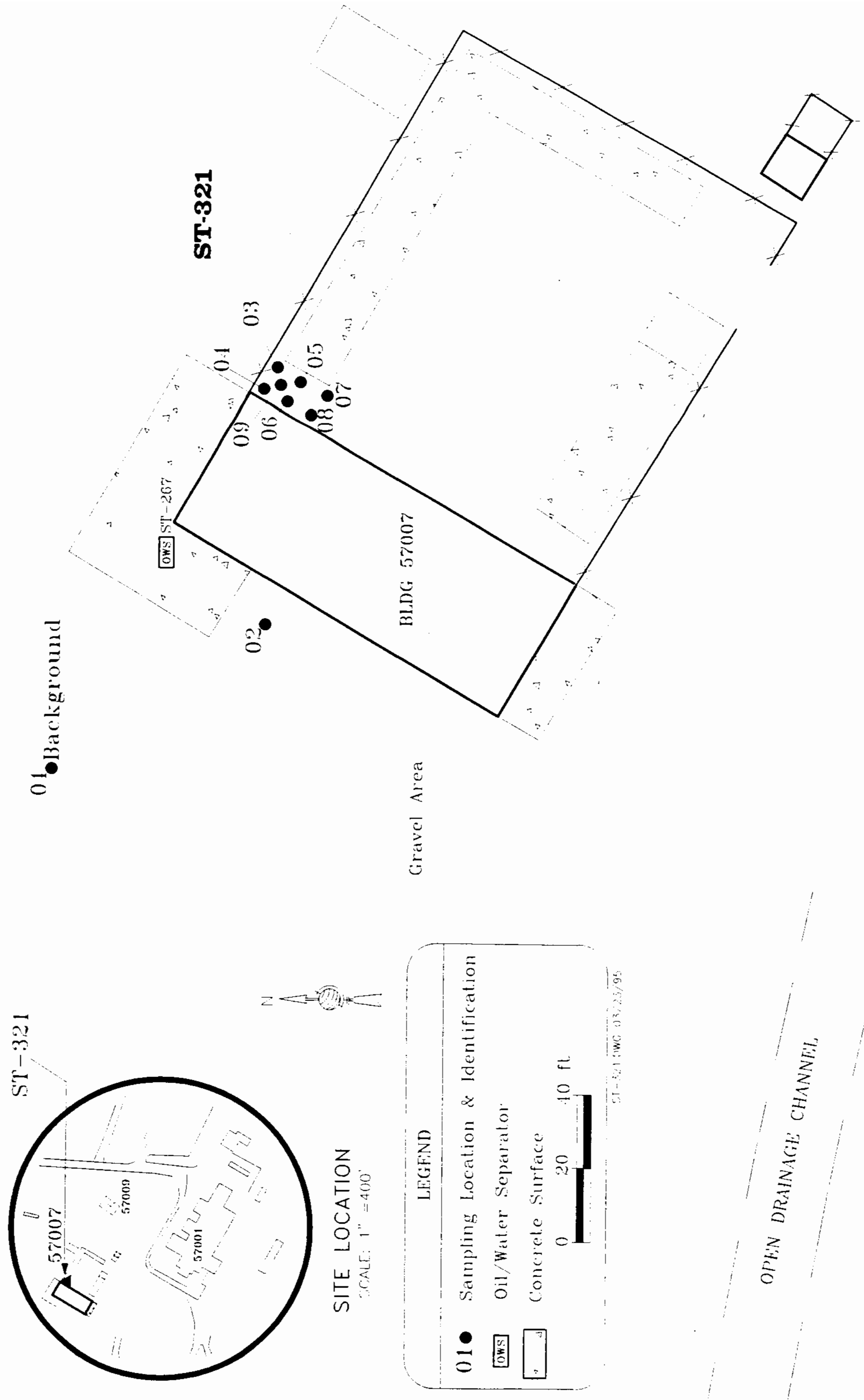


Figure 11-1. Soil Sampling Locations at SWMU 8-58, Battery Storage Area (ST-321)

was drilled northwest of the site, away from any known or suspected waste areas. The background soil sample was collected at a depth of 5 ft below grade. Sample locations are shown in Figure 11-1.

Sampling operations and sample handling procedures are described in Section 3.0. Sample depths, sample locations, and replicate samples collected and submitted for analysis at SWMU 8-58 are listed in Table 11-1. Borehole logs are included in Appendix C.

Table 11-1. Boreholes and Samples Collected at SWMU 8-58, Building 57007, Battery Storage Area (ST-321)

Borehole	Borehole Location	Sample Depth (ft)
01	120 ft NW of SWMU 8-58	4-6
02	30 ft SW of NW corner of Building 57007	0-1 2-3 5-6
03	NE corner of SWMU 8-58	0-1 1-2 5-6
04	NW corner of SWMU 8-58	0-1 2-4 4-6[a]
05	Middle of the E side of SWMU 8-58	0-1 1-2[a] 4-6
06	Middle of the W side of SWMU 8-58	0-1 1-2 4-6
07	SE corner of SWMU 8-58	0-1 1-2[a] 4-6
08	SW corner of SWMU 8-58	0-1 1-2 4-6
09	Center of the N half of SWMU 8-58	0-1 1-2[a] 4-6

a. Replicate sample also collected at this depth interval.

11.2.4 Laboratory Analysis

Twenty-five soil samples and four replicates were analyzed for SVOCs, lead, and mercury (the expected contaminants associated with the site), and soil moisture. Three samples were analyzed for metals to determine if any other metal contamination is present and TCLP lead to determine the potential leachate concentration of any lead contamination. The background sample was analyzed for SVOCs, metals, TCLP lead, and soil moisture. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. All field-screening instrument readings remained at background levels throughout drilling and sampling activities at SWMU 8-58.

11.3 Site Characteristics

11.3.1 Geology

The Building 57007 area is underlain by unconsolidated alluvial sediment and weathered granite. The sediment is predominantly fine-grained sand and very fine-grained to fine-grained silty sand. Caliche was present in samples collected for lithologic classifications as light- to heavily stained patches at depths ranging from below the asphalt-soil interface to 6 ft below grade. A maximum depth of 6 ft below grade was attained with a Geoprobe at SWMU 8-58. No borehole penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this site are included in Appendix C.

11.3.2 Hydrogeology

This site is on the western edge of the HR3 saturated zone setting as defined by SNL studies (Figure 2-9). Bedrock in this area is inferred to be Permian- and Pennsylvanian-aged sedimentary rock. Near the mountains, bedrock is inferred to be Precambrian granite and metamorphic rock. Bedrock is covered by alluvial material, and the thickness of this cover presumably increases west away from the mountains. Depth to groundwater is estimated at 90 to 100 ft below grade (Figure 2-10) (SNL, 1994). Groundwater flow is west-northwest. The nearest production well is KAFB-10, 4 mi downgradient northwest. Hydraulic conductivity values based on testing range from 6.52 to 114.5 ft/day. A more detailed discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

11.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on soil sampling results. Analytical results for soil samples submitted for analysis at SWMU 8-58 are summarized Table 11-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

The SVOCs di-n-butylphthalate and phenol were detected in soil samples collected at SWMU 8-58. Di-n-butylphthalate (0.38 to 0.71 mg/kg) was detected in 13 samples and the four field replicates. Phenol (0.35 to 0.49 mg/kg) was detected in three samples and a field replicate. None of the detected concentrations were above HHRB action levels.

Table 11-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-58, Building 57007, Battery Storage Area (ST-321)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	*ST-321C-01*	*ST-321C-02*			*ST-321C-03*			*ST-321C-04*			
				4–6	0–1	2–3	5–6	0–1	1–2	5–6	0–1	2–4	4–6 FR	4–6
SVOC	Di-n-butylphthalate	7,800	0.70	ND	0.61	0.39	0.71	0.55	ND	0.45	0.58	0.54	0.59	0.71
	Phenol	47,000	0.30	0.46	ND	ND	ND	NA	0.49	0.45	NA	NA	0.35	NA
METALS	Aluminum	78,000	14,700	4,310	4,270	6,140	5,910	NA	4,370	NA	NA	NA	NA	NA
	Arsenic	0.37	6.5	3.8	4.7	3.2	3.3	NA	3.7	NA	NA	NA	NA	NA
	Barium	5,500	735	175	87.6	154	141	NA	212	NA	NA	NA	NA	NA
	Beryllium	0.15	0.84	0.34	0.41	0.33	0.45	NA	0.34	NA	NA	NA	NA	NA
	Cadmium	39.0	N/A	ND	0.92	ND	0.78	NA	ND	NA	NA	NA	NA	NA
	Calcium	N/A	121,000	137,000	19,800	74,300	59,700	NA	130,000	NA	NA	NA	NA	NA
	Chromium, total	390	21.6	6.9	9.2	5.6	8.1	NA	5.0	NA	NA	NA	NA	NA
	Cobalt	4,700	15.4	3.1	3.0	4.4	3.7	NA	3.1	NA	NA	NA	NA	NA
	Copper	2,900	223	14.7	14.8	14.3	14.5	NA	11.5	NA	NA	NA	NA	NA
	Iron	N/A	23,800	4,800	5,760	7,400	7,750	NA	5,150	NA	NA	NA	NA	NA
	Lead	400	17.5	6.6	17.7	10.5	9.3	7.8	6.3	8.6	19.1	9.1	7.8	21.1
	Magnesium	N/A	10,400	3,600	1,840	2,750	3,960	NA	3,030	NA	NA	NA	NA	NA
	Manganese	390	549	90.1	118	133	170	NA	74.5	NA	NA	NA	NA	NA
	Mercury	23.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Nickel	1,600	188	6.8	6.6	75.2	51.3	NA	7.7	NA	NA	NA	NA	NA
	Potassium	N/A	3,590	758	1,210	1,520	1,180	NA	818	NA	NA	NA	NA	NA
	Sodium	N/A	787	284	141	90.3	101	NA	84.7	NA	NA	NA	NA	NA
	Vanadium	550	55.3	10.1	11.4	16.5	16.1	NA	11.9	NA	NA	NA	NA	NA
	Zinc	23,000	114	20.8	40.1	28.6	30.0	NA	21.6	NA	NA	NA	NA	NA
OTHER	Moisture (%)			11.5	2.4	9.3	10.3	13.4	12.5	8.4	5.4	8.6	5.6	5.1

Table 11-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-58, Building 57007, Battery Storage Area (ST-321) [1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)													
				ST-321C-05				ST-321C-06			ST-321C-07				ST-321C-08		
				0–1	1–2 FR	1–2	4–6	0–1	1–2	4–6	0–1	1–2 FR	1–2	4–6	0–1	1–2	4–6
SVOC	Di-n-butylphthalate	7,800	0.70	0.46	0.44	NA	NA	NA	0.40	NA	NA	0.38	0.50	NA	0.52	NA	NA
	Phenol	47,000	0.30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS	Aluminum	78,000	14,700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Arsenic	0.37	6.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Barium	5,500	735	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Beryllium	0.15	0.84	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Cadmium	39.0	N/A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Calcium	N/A	121,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Chromium, total	390	21.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Cobalt	4,700	15.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Copper	2,900	223	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Iron	N/A	23,800	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Lead	400	17.5	21.2	10.0	6.9	6.6	13.8	9.0	9.2	5.1	15.1	6.2	9.5	10.8	8.4	9.9
	Magnesium	N/A	10,400	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	390	549	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Mercury	23.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Nickel	1,600	188	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	N/A	3,590	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	N/A	787	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Vanadium	550	55.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Zinc	23,000	114	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OTHER	Moisture (%)			7.7	12.4	11.2	3.7	14.5	11.8	3.3	8.6	11.1	15.2	7.8	7.5	13.2	10.0

Table 11-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-58, Building 57007, Battery Storage Area (ST-321)[1] (Concentrations mg/kg) (Concluded)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)			
				ST-321C-09			
				0–1	1–2 FR	1–2	4–6
SVOC	Di-n-butylphthalate	7,800	0.70	NA	0.61	NA	0.47
	Phenol	47,000	0.30	NA	NA	NA	NA
METALS	Aluminum	78,000	14,700	NA	NA	NA	NA
	Arsenic	0.37	6.5	NA	NA	NA	NA
	Barium	5,500	735	NA	NA	NA	NA
	Beryllium	0.15	0.84	NA	NA	NA	NA
	Cadmium	39.0	N/A	NA	NA	NA	NA
	Calcium	N/A	121,000	NA	NA	NA	NA
	Chromium, total	390	21.6	NA	NA	NA	NA
	Cobalt	4,700	15.4	NA	NA	NA	NA
	Copper	2,900	223	NA	NA	NA	NA
	Iron	N/A	23,800	NA	NA	NA	NA
	Lead	400	17.5	12.3	7.9	6.3	8.6
	Magnesium	N/A	10,400	NA	NA	NA	NA
	Manganese	390	549	NA	NA	NA	NA
	Mercury	23.0	0.00	ND	ND	ND	ND
	Nickel	1,600	188	NA	NA	NA	NA
	Potassium	N/A	3,590	NA	NA	NA	NA
	Sodium	N/A	787	NA	NA	NA	NA
	Vanadium	550	55.3	NA	NA	NA	NA
	Zinc	23,000	114	NA	NA	NA	NA
OTHER	Moisture (%)			16.0	13.3	13.7	4.2

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Metals

Table 11-2 lists all reportable metal concentrations detected at SWMU 8-58 and the respective UTL and HHRB action level concentrations. Arsenic and beryllium were the only metals detected in samples at concentrations greater than HHRB action levels. Arsenic (3.2 to 4.7 mg/kg) was detected in five samples; all concentrations exceeded the HHRB action level of 0.37 mg/kg, but were below the 6.5 mg/kg UTL. Beryllium (0.33 to 0.45 mg/kg) was detected in five samples; all concentrations were above the HHRB action level of 0.15 mg/kg, but below the 0.84 mg/kg UTL. These concentrations of arsenic and beryllium appear to be naturally occurring throughout Kirtland AFB as discussed in Section 4.2.2.

Lead was detected in four of 29 samples at concentrations above the UTL, but below the HHRB action level. Lead was not detected in TCLP analyses performed for samples ST-321C-01 (4 to 6 ft) and ST-321C-03 (1 to 2 ft).

Soil Moisture

Soil moisture values ranged from 2.4 to 16 percent.

11.5 Conclusions and Recommendations

Conclusions

- Di-n-butylphthalate and phenol were the only SVOCs detected in the soil samples from this site; all concentrations were below HHRB action levels.
- Arsenic and beryllium were the only metals detected at concentrations exceeding HHRB action levels; these concentrations appear to be naturally occurring throughout Kirtland AFB.
- Lead was detected in four samples at levels above the UTL, but below action levels.
- The analytical results at SWMU 8-58 are not indicative of a release from this site.

Recommendations

- Based on the findings of the RFI, no further action is necessary; therefore, SWMU 8-58 does not require further investigation. A no further action proposal should be prepared.

12.0 SWMU 8-53, Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)

12.1 Site Background and Environmental Setting

The paint shop floor drain and rockbed are in the northwest portion of the base near Building 20681, the paint shop waste accumulation area (Figure 12-1). SWMU 8-53 is also considered a part of Building 20681 and is described as the paint shop drain and north accumulation area. The site consists of a gravel-covered soil area 30 ft x 45 ft on the north side of the building. During the RFA VSI, the area was reported to be 40 ft x 10 ft (Kearney/Centaur, 1988). According to the Phase I Records Search (USAF, 1981), the generated waste material consisted of used paint thinners and paint-booth wastewater. An estimated 10 gallons per month of thinners was discharged onto the gravel-surface bed. Large objects were also reportedly spray-painted on the gravel area. The discharging of small quantities of paint thinners to the gravel area appears to have been a long-standing practice. There were no release controls at the unit prior to 1991. During the RFA VSI, paint stains were observed on the gravel bed (Kearney/Centaur, 1988). Prior to 1986, approximately 50 gallons per month of paint-booth wastewater was discharged to the sanitary sewer via the floor drain and a sink in the paint booth.

The paint shop is currently active; however, the gravel bed is no longer used as a painting area or for the disposal of paint and thinner. Painting is now accomplished in a dry, double air-filtered booth instead of a water booth. In 1986, the new painting method was initiated and the paint shop floor drain was capped.

SWMU 8-53 is in the urban/industrial zone, which is discussed in Section 2.0. The nearest production wells to this site are Eubank-1, 4,500 ft northeast; Sandia-6, 2,200 ft southeast; and KAFB-1, 3,300 ft northwest.

12.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU 8-53 from the ground surface to 26 ft below grade.

12.2.1 Previous Investigations

No previous investigations have been performed to determine the presence or absence of soil contamination at this site.

12.2.2 Data Gaps

No data were available to confirm the presence or absence of soil contamination at this site.

12.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contaminants in soil adjacent to SWMU 8-53. On June 13–15, 1994, soil samples were collected from five boreholes with a

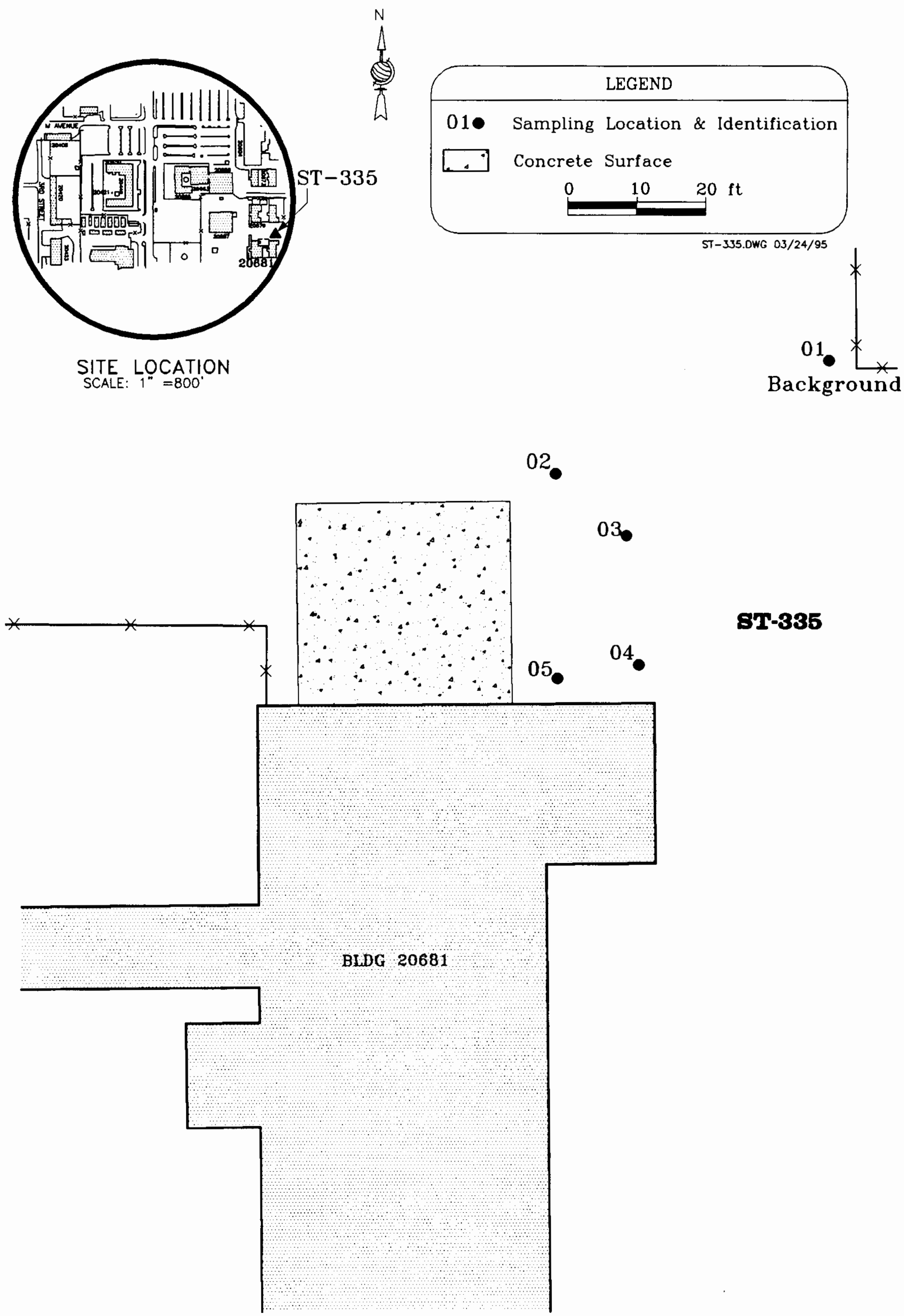


Figure 12-1. Soil Sampling Locations at SWMU 8-53, Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)

Geoprobe. Four boreholes, ST-335C-02 to ST-335C-05, were drilled 26 ft below grade in the gravel bed north of Building 20681. Five soil samples were submitted for analysis from each borehole: one at the surface, and at depths of 5, 10, 15, and 25 ft below grade. To determine site-specific background concentrations, ST-335C-01 was drilled in an area away from any known or suspected contamination. Two soil samples were collected from ST-335C-01 at depths of 5 and 24 ft below grade. Figure 12-1 presents the borehole locations.

Sampling operations and sampling handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples collected at this site are shown in Table 12-1. Borehole logs are in Appendix C.

12.2.4 Laboratory Analysis

Twenty-two soil samples and one replicate were submitted for analysis at SWMU 8-53 and analyzed for VOCs, SVOCs, TPH, metals, and soil moisture. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. No readings above background were measured with these instruments.

12.3 Site Characteristics

12.3.1 Geology

The SWMU 8-53 area is underlain by unconsolidated alluvial sediment that is predominantly fine-grained silty sand to fine-grained sand. Caliche was present as granule-sized concretions, or cemented and disseminated. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this site are presented in Appendix C.

12.3.2 Hydrogeology

Groundwater beneath SWMU 8-53 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably west-northwest at this site. Three production wells are located near SWMU 8-53: Eubank-1 and Sandia-6 are upgradient 4,500 ft northeast and 2,200 ft southeast, respectively, and KAFB-1 is downgradient 3,300 ft northwest. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

Table 12-1. Boreholes and Samples Submitted for Analysis at SWMU 8-53, Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)

Borehole	Borehole Location	Sample Depth (ft)
01	Background borehole	5-11 24-26
02	8 ft NE of Building 20681	0-3[a] 5-7 10-12 15-17 24-26
03	17 ft E of Building 20681	0-2 5-9 10-12 15-21 24-26
04	18 ft E of Building 20681	0-2 5-8 10-12 15-17 24-26
05	7 ft E of Building 20681	0-3 5-9 10-12 15-19 24-26

a. Replicate sample also collected at this depth interval.

12.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples submitted for analysis at SWMU 8-53. Analytical results are presented in Table 12-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Organic Compounds

Two VOCs, acetone and methylene chloride, were detected in soil samples submitted for analysis at this site. Acetone (0.003 mg/kg) was detected in ST-335C-05 (5 to 9 ft). Methylene chloride (0.004 to 0.005 mg/kg) was detected in all five samples at borehole ST-335C-05. The detected concentrations of both acetone and methylene chloride do not exceed the HHRB action level of 7,800 mg/kg for acetone and 85 mg/kg for methylene chloride.

Table 12-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-53, Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)							
				ST-335C-01		ST-335C-02					
				5–11	24–26	0–3 FR	0–3	5–7	10–12	15–17	24–26
VOC	Acetone	7,800	0.10	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND
SVOC	Di-n-butylphthalate	7,800	0.70	ND	540	ND	580	ND	420	ND	ND
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	9,290	8,660	6,650	4,140	9,740	8,960	3,560	10,300
	Arsenic	0.37	6.5	3.7	2.4	8.9	6.8	2.6	2.1	1.9	2.6
	Barium	5,500	735	178	205	285	142	150	88.4	48.3	112
	Beryllium	0.15	0.84	0.54	0.54	0.42	ND	0.54	0.54	ND	0.54
	Cadmium	39.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND
	Calcium	N/A	121,000	46,000	24,800	59,800	16,500	35,400	25,400	12,400	23,200
	Chromium, total	390	21.6	7.0	7.9	19.0	6.5	8.8	9.6	7.6	9.7
	Cobalt	4,700	15.4	7.4	6.6	4.1	3.5	7.7	6.8	4.9	8.1
	Copper	2,900	223	10.6	25.9	18.1	9.4	39.4	28.9	70.7	15.0
	Iron	N/A	23,800	13,900	15,100	9,920	7,140	14,400	14,600	7,760	17,700
	Lead	400	17.5	4.7	5.7	22.1	6.7	7.1	5.4	4.6	7.4
	Magnesium	N/A	10,400	5,720	4,380	4,790	2,200	6,850	5,440	2,730	4,990
	Manganese	390	549	251	247	176	153	269	297	192	286
	Mercury	23.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND
	Nickel	1,600	188	10.0	9.4	80.6	4.6	9.3	10.1	8.7	10.5
	Potassium	N/A	3,590	1,780	1,820	1,390	955	2,120	2,070	686	1,950
	Sodium	N/A	787	175	378	151	94.5	232	352	175	517
	Vanadium	550	55.3	30.7	28.7	23.0	13.7	43.2	26.4	15.2	34.7
	Zinc	23,000	114	29.3	36.2	29.9	19.9	46.4	40.2	38.8	34.7
OTHER	Moisture (%)			7.3	7.2	4.1	9.5	7.9	7.8	2.4	7.9

Table 12-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-53, Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)				
				ST-335C-03				
				0–2	5–9	10–12	15–21	24–26
VOC	Acetone	7,800	0.10	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND
SVOC	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	8,150	9,880	5,930	6,150	12,000
	Arsenic	0.37	6.5	11.1	3.9	1.1	1.7	2.8
	Barium	5,500	735	411	183	68.5	89.2	141
	Beryllium	0.15	0.84	0.45	0.54	0.31	0.31	0.55
	Cadmium	39.0	N/A	ND	ND	ND	0.52	ND
	Calcium	N/A	121,000	113,000	36,100	26,800	22,500	26,100
	Chromium, total	390	21.6	13.8	10.1	5.4	5.0	9.2
	Cobalt	4,700	15.4	5.5	6.7	5.2	5.1	7.7
	Copper	2,900	223	9.6	24.2	42.9	39.9	45.4
	Iron	N/A	23,800	9,100	14,100	14,600	11,000	16,300
	Lead	400	17.5	9.3	8.3	3.8	5.2	7.3
	Magnesium	N/A	10,400	6,500	6,280	3,830	3,600	5,450
	Manganese	390	549	113	246	229	199	277
	Mercury	23.0	N/A	ND	ND	ND	ND	ND
	Nickel	1,600	188	8.2	8.3	5.8	8.4	10.0
	Potassium	N/A	3,590	1,440	2,060	1,390	1,560	2,220
	Sodium	N/A	787	145	292	255	223	557
	Vanadium	550	55.3	31.7	43.0	28.4	21.3	34.4
	Zinc	23,000	114	29.0	37.9	39.0	33.4	44.5
OTHER	Moisture (%)			10.7	8.1	3.4	4.3	9.9

Table 12-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-53, Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)				
				ST-335C-04				
				0–2	5–8	10–12	15–17	24–26
VOC	Acetone	7,800	0.10	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND
SVOC	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	9.2	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	7,380	10,100	10,900	9,780	10,300
	Arsenic	0.37	6.5	5.9	3.4	2.2	2.8	2.8
	Barium	5,500	735	666	290	188	156	68.4
	Beryllium	0.15	0.84	ND	0.46	0.58	0.58	0.58
	Cadmium	39.0	N/A	ND	ND	0.58	ND	ND
	Calcium	N/A	121,000	139,000	57,200	28,900	32,000	34,400
	Chromium, total	390	21.6	10.5	7.2	8.4	10.8	11.6
	Cobalt	4,700	15.4	3.9	6.5	7.6	7.3	7.3
	Copper	2,900	223	144	15.2	21.1	17.9	35.5
	Iron	N/A	23,800	7,500	13,400	16,400	15,300	16,500
	Lead	400	17.5	26.7	5.3	29.6	6.1	6.7
	Magnesium	N/A	10,400	9,060	6,760	6,070	6,120	5,090
	Manganese	390	549	86.3	240	304	280	254
	Mercury	23.0	N/A	ND	ND	ND	ND	ND
	Nickel	1,600	188	5.9	6.9	10.4	12.2	8.4
	Potassium	N/A	3,590	1,320	2,230	2,600	1,960	2,270
	Sodium	N/A	787	174	144	144	130	128
	Vanadium	550	55.3	23.5	40.8	35.0	28.6	33.6
	Zinc	23,000	114	312	33.4	40.4	41.1	42.9
OTHER	Moisture (%)			13.2	13.4	14.5	13.6	13.2

Table 12-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-53, Building 20681, Paint Shop Floor Drain to Rock Bed (ST-335)[1] (Concentrations mg/kg) (Concluded)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)				
				ST-335C-05				
				0–3	5–9	10–12	15–19	24–26
VOC	Acetone	7,800	0.10	ND	0.003	ND	ND	ND
	Methylene chloride	85.0	0.005	0.004	0.005	0.004	0.004	0.005
SVOC	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	9,180	11,500	7,740	6,440	10,000
	Arsenic	0.37	6.5	6.4	6.0	1.9	2.1	2.9
	Barium	5,500	735	237	211	82.7	150	59.7
	Beryllium	0.15	0.84	0.57	0.56	0.45	0.32	0.45
	Cadmium	39.0	N/A	ND	0.56	ND	ND	ND
	Calcium	N/A	121,000	69,700	42,300	21,400	19,000	23,900
	Chromium, total	390	21.6	10.4	12.2	7.9	10.0	9.1
	Cobalt	4,700	15.4	6.1	9.3	7.4	6.1	8.4
	Copper	2,900	223	25.5	18.9	48.4	48.9	37.1
	Iron	N/A	23,800	13,700	16,800	14,400	14,300	17,000
	Lead	400	17.5	7.2	8.6	6.2	9.7	6.0
	Magnesium	N/A	10,400	7,110	7,530	4,920	4,770	5,360
	Manganese	390	549	245	261	261	262	321
	Mercury	23.0	N/A	ND	0.35	ND	ND	ND
	Nickel	1,600	188	6.8	12.8	7.5	12.8	9.4
	Potassium	N/A	3,590	1,970	2,700	1,730	1,360	2,240
	Sodium	N/A	787	109	878	96.4	196	127
	Vanadium	550	55.3	53.3	58.6	28.9	24.4	34.3
	Zinc	23,000	114	40.3	47.4	43.3	41.7	47.9
OTHER	Moisture (%)			11.7	10.5	11.7	7.0	11.1

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

One SVOC, di-n-butylphthalate (0.42 to 0.58 mg/kg), was detected in three soil samples; concentrations detected were below the HHRB action level for di-n-butylphthalate of 7,800 mg/kg.

Petroleum Hydrocarbons

Diesel range hydrocarbons (9.2 mg/kg) were detected in one sample, ST-335C-04 (0 to 2 ft); this concentration is less than the NMED action level of 100 mg/kg.

Metals

Table 12-2 lists all reportable metal concentrations detected at SWMU 8-53 and the respective UTL and HHRB action level concentrations. Arsenic and beryllium were the only metals detected in samples at concentrations greater than the respective HHRB action levels. Arsenic (1.1 to 11.1 mg/kg) was detected in all samples; the concentrations exceeded the HHRB action level of 0.37 mg/kg. In addition, the arsenic concentration detected in two samples and a field replicate exceeded the UTL of 6.5 mg/kg. Beryllium (0.31 to 0.58 mg/kg) was detected in 20 samples; the concentrations exceeded the HHRB action level of 0.15 mg/kg, but did not exceed the 0.84 mg/kg UTL. The concentrations of arsenic and beryllium appear to be naturally occurring throughout Kirtland AFB as discussed in Section 4.2.2.

Moisture

Soil moisture values ranged from 2.4 to 14.5 percent.

12.5 Conclusions and Recommendations

Conclusions

- Acetone, methylene chloride, and di-n-butylphthalate were the only organic compounds detected in the soil samples collected from this site; all concentrations were below HHRB action levels. Methylene chloride was also detected in associated QC samples and is believed to be the result of laboratory contamination as discussed in Section 3.5.1.
- Gasoline range hydrocarbons were not detected in samples collected from this site.
- Diesel range hydrocarbons detected in samples at this site were similar to those measured in background samples collected during the Appendix III RFI. The diesel range hydrocarbon detection alone is not conclusive evidence of a release at this unit. Because no other release indicators are present, it is probable that a release has not occurred.
- Arsenic and beryllium were the only metals detected at concentrations exceeding HHRB action levels; the concentrations appear to be naturally occurring throughout Kirtland AFB.
- The analytical results at SWMU 8-53 are not indicative of a contaminant release from this site.

Recommendations

- Based on the findings of the RFI, no further action is necessary; therefore, SWMU 8-53 does not require further investigation. A No Futher Action proposal should be prepared.

13.0 SWMU 10-2E, Building 704, Jet Engine Test Cell (SS-63) (former ST-336)

13.1 Site Background and Environmental Setting

The SWMU 10-2E is an active jet engine test cell in Building 704 in the western portion of Kirtland AFB, on Cell Drive south of the east-west runway. The facility is the site where all jet engine fuel and hydraulic fluids are drained and replaced, and where jet engine performance is tested. Currently, waste materials at this unit consist of waste fuel and engine oil that are disposed of at a rate of 4 gallons per month and 10 gallons per month, respectively. JP-4 is used exclusively at the facility and 10,000 gallons of fuel is trucked in each year. In the late 1960s, waste fuel was drained down a sloping concrete ramp that extends from the south wall of the facility to a built-up fill area. The fill is estimated to be a maximum of 6 ft thick. As a result, the SWMU 10-2E area of investigation included the built-up fill area (Figure 13-1). SWMU 10-2E was investigated from June 8–10, 1994.

Building 704 is located in the urban/industrial zone, which is discussed in Section 2.0. The nearest production wells to this site are KAFB-2, 1,000 ft northeast, and KAFB-14, 6,000 ft northwest.

13.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU 10-2E from the ground surface to 26 ft below grade.

13.2.1 Previous Investigations

No previous investigations have been performed to determine the presence or absence of soil contamination at this site.

13.2.2 Data Gaps

No data were available to confirm the presence or absence of soil contamination at this site.

13.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contaminants in soil adjacent to SWMU 10-2E. On June 8–10, 1994, five boreholes, ST-336C-01 to ST-336C-05, were drilled and sampled using a Geoprobe. To determine site-specific background concentrations of analytes in the soil, ST-336C-01 was drilled and sampled in an area away from any known or suspected contamination. Two soil samples were submitted for analysis from ST-336C-01 at depths of 5 and 26 ft below grade. On June 9–10, 1994, ST-336C-02 through ST-336C-05 were drilled and sampled. Five soil samples were submitted for analysis from the boreholes: one at the surface, and 5, 10, 15, and 26 ft below grade. These boreholes were located in a built-up fill area from 10 to 20 ft south of the fence, adjacent to the concrete ramp extending from Building 704. Drainage from the site runs down the sloping concrete ramp to the fill area.

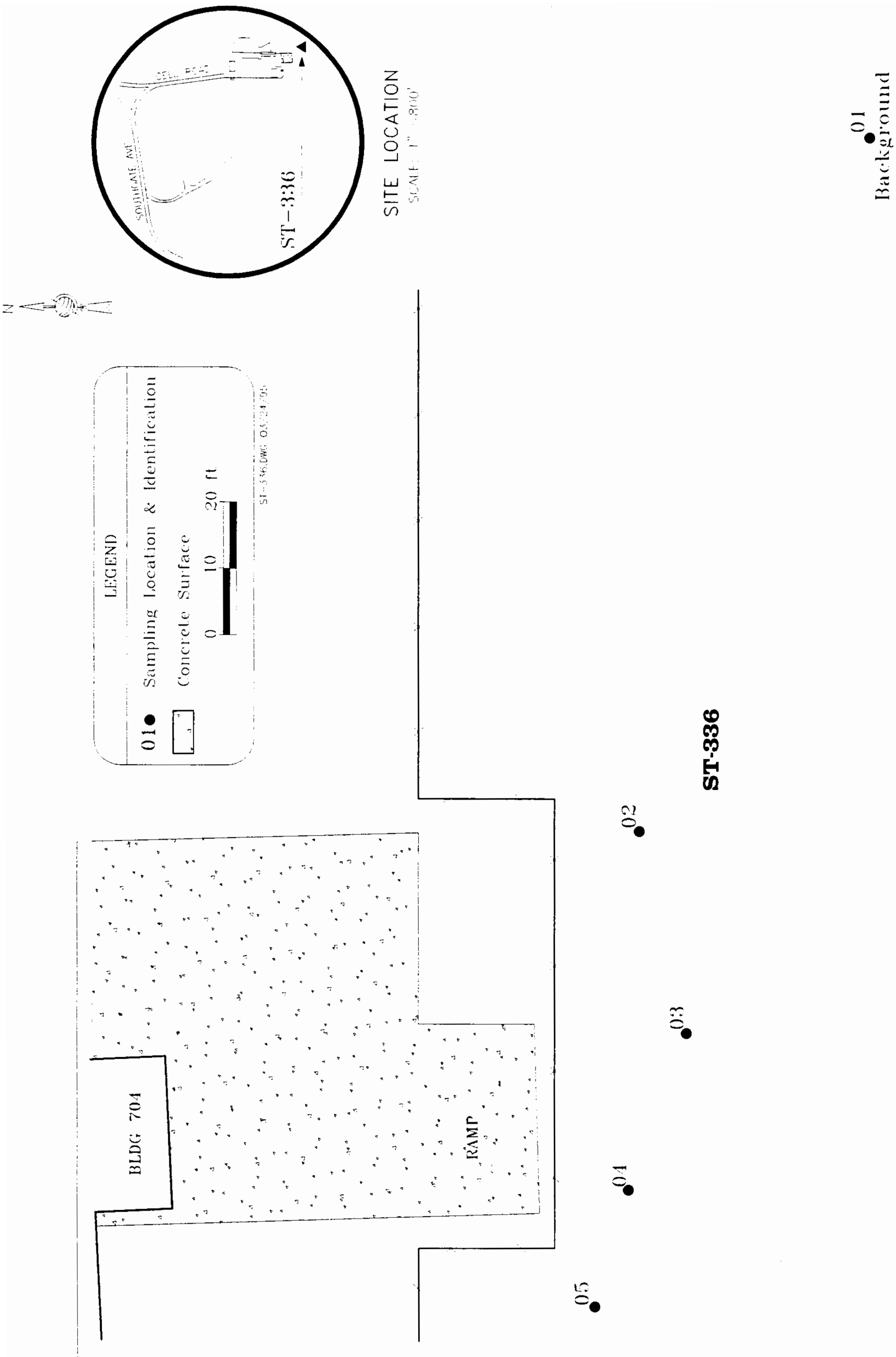


Figure 13-1. Soil Sampling Locations at SWMU 10-2E, Building 702, Jet Engine Test Cell (SS-63) (former ST-336)

Sampling operations and sample handling procedures are described in Section 3.0 of this report. Sample depths, sample locations, and replicate samples collected at SWMU 10-2E are listed in Table 13-1. Borehole logs are in Appendix C.

Table 13-1. Boreholes and Samples Collected at SWMU 10-2E, Building 704, Jet Engine Test Cell (SS-63) (former ST-336)

Borehole	Borehole Location	Sample Depth (ft)	PID (ppm_v) [a,b]
01	~130 ft SE of SWMU 10-2E	5-9[c]	0
		24-26	20
02	~12 ft S and 25 ft W of the SE corner of the concrete ramp	0-5	0
		5-8	0
		10-12	2
		15-17	10
		24-26	140
03	21 ft S and 4 ft W of SE corner of the concrete ramp	0-4[c]	0
		5-7	0
		10-12	0
		15-17	0
		24-26	0
04	12 ft S and 14 ft W of SE corner of the concrete ramp	0-2[c]	0
		5-7	0
		10-12	0
		15-17	0
		23-25	0
05	10 ft S and 11 ft W of the SW corner of the concrete ramp	0-4[c]	0
		5-7	0
		10-12	0
		15-17	0
		24-26	6

a. ppm_v = parts-per-million volume (ml/L) as isobutylene for the PID and as methane for the FID.

b. PID and FID readings are values above background. Only the highest value for the interval is listed.

c. Replicate sample also collected in this depth interval.

13.2.4 Laboratory Analysis

Twenty-two soil samples and four replicates were collected at SWMU 10-2E and analyzed for TPH, lead, (the expected contaminants associated with normal operations at this site), and soil moisture. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. The brass tube with the highest reading was submitted for TPH analysis. Elevated FID readings (ranging from 2 to 140 ppm_V above background) were measured in soil samples collected from boreholes ST-336C-01, ST-336C-02, and ST-336C-05 (Table 13-1).

13.3 Site Characteristics

13.3.1 Geology

The area surrounding SWMU 10-2E is underlain by unconsolidated alluvial sediment that is predominantly fine-grained sand and very fine-grained to fine-grained silty sand. Caliche was present in samples collected for lithologic classification as light- to heavily stained patches just below the surface. A maximum depth of 26 ft below grade was attained in three boreholes at SWMU 10-2E. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this area are presented in Appendix C.

13.3.2 Hydrogeology

Groundwater beneath SWMU 10-2E is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably northeast at this site. Two production wells are located near SWMU 10-2E: KAFB-2 is downgradient 1,000 ft northeast and KAFB-14 is downgradient 6,000 ft northwest. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

13.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples submitted for analysis at SWMU 10-2E. Analytical results are presented in Table 13-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Organic Compounds

Diesel range hydrocarbons (8.3 mg/kg) were detected in only one sample, ST-336C-01 (24 to 26 ft); this concentration does not exceed the NMED action level for TPH of 100 mg/kg.

Table 13-2. Summary of Reportable Concentrations for Soil Analyses at SWMU 10-2E, Jet Engine Test Cell, Building 704 (SS-63) (former ST-336)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)															
				ST-336C-01			ST-336C-02					ST-336C-03					
				5–9 FR	5–9	24–26	0–5	5–8	10–12	15–17	24–26	0–4 FR	0–4	5–7	10–12	15–17	24–26
TPH	Diesel fraction	100	10.0	ND	ND	8.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Lead	400	13.6	3.6	2.6	3.2	4.8	3.4	2.9	3.3	2.4	5.3	5.6	2.2	3.0	3.2	6.1
OTHER	Moisture (%)			1.8	3.5	6.8	8.1	7.5	2.4	15.5	11.0	6.9	7.6	3.9	4.2	2.7	8.7

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)											
				ST-336C-04						ST-336C-05					
				0–2 FR	0–2	5–7	10–12	15–17	23–25	0–4 FR	0–4	5–7	10–12	15–17	24–26
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Lead	400	13.6	4.5	10.6	3.3	2.5	2.8	2.7	6.0	12.5	8.2	2.8	2.7	2.5
OTHER	Moisture (%)			7.4	6.6	5.3	4.7	3.9	5.5	1.7	4.2	4.4	4.0	5.6	3.9

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Metals (Lead)

Lead (2.2 to 12.5 mg/kg) was detected in all samples; the concentrations do not exceed the HHRB action level of 400 mg/kg.

Soil Moisture

Soil moisture values ranged from 1.7 to 15.5 percent.

13.5 Conclusions and Recommendations

Conclusions

- Gasoline range hydrocarbons were not detected in samples collected from this site. Diesel range hydrocarbons detected in one sample at this site were similar to those measured in background samples collected during the Appendix III RFI. The diesel hydrocarbon detection alone is not conclusive evidence of a release at this unit. Because no other release indicators are present, it is probable that a release has not occurred.

- Lead (2.2 to 12.5 mg/kg) was detected in all samples; the concentrations do not exceed the HHRB action level of 400 mg/kg.

- The analytical results at SWMU 10-2E are not indicative of a contaminant release from this site.

Recommendations

- Based on the findings of the RFI, no further action is necessary; therefore, SWMU 10-2E does not require further investigation. A NFA proposal should be prepared.

14.0 SWMU ST-64, Building 20212, U.S. Army Corps of Engineers Vehicle Maintenance Yard (ST-64) (former ST-337)

14.1 Site Background and Environmental Setting

The U.S. Army Corps of Engineers vehicle maintenance yard is at 4th Street and G Avenue in the northwest portion of Kirtland AFB at Building 20212 (recently demolished). SWMU ST-64 is in the southeast corner of the fenced maintenance yard (Figure 14-1). It is comprised of a soil/gravel area 30 ft x 35 ft between the former location of Building 20211 to the east and two small metal buildings to the west. The soil/gravel area is directly over emptied and abandoned fuel-oil tanks once used by Building 20211, a demolished steam boiler plant. Vent pipes from the USTs are still visible at the surface. This site was investigated on June 7 and 8, 1994.

SWMU ST-64 is inactive, but it was previously used for the storage of liquid waste barrels generated by the vehicle maintenance facility. The liquid waste consisted of used automotive fluids such as motor oil, brake fluid, and antifreeze. The waste fluids were stored in six 55-gallon drums and placed on wood pallets.

The cause of concern at SWMU ST-64 was stained soil in a 10 ft x 50 ft area. The stained soil is believed to be the result of careless pouring of waste fluids into the barrels; the duration of storage is unknown.

SWMU ST-64 is in the urban/industrial zone, which is discussed in Section 2.0. The nearest production wells to this site are KAFB-3, 5,000 ft northwest; Eubank-1, 5,500 ft east-southeast; Sandia-6, 4,200 ft southeast; and KAFB-1, 2,700 ft southwest.

14.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU ST-64 from ground surface to 32 ft below grade.

14.2.1 Previous Investigations

No previous investigations have been performed to determine the presence or absence of soil contamination at this site.

14.2.2 Data Gaps

No data were available to confirm the presence or absence of contaminants in the soil at this site.

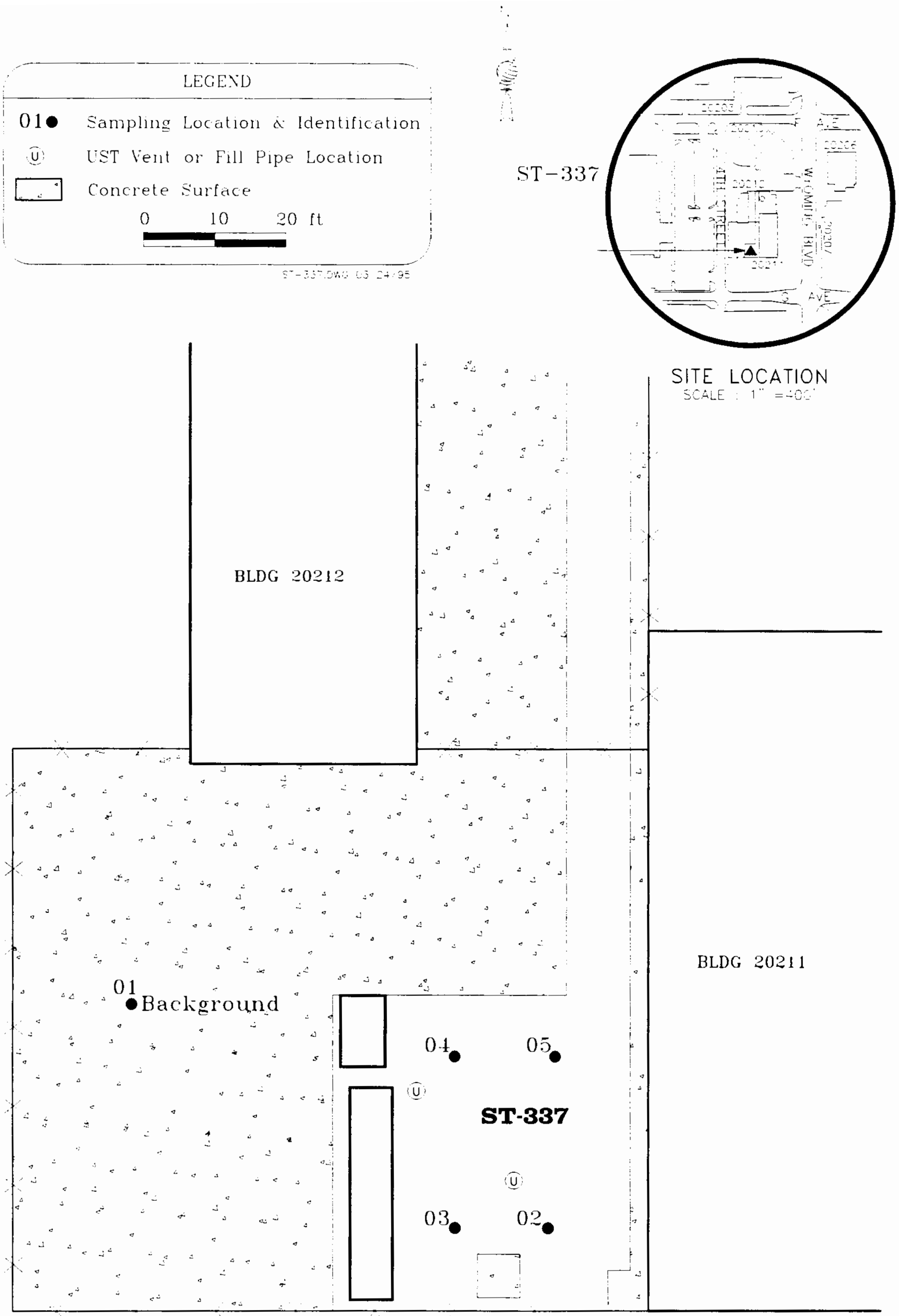


Figure 14-1. **Soil Sampling Locations at SWMU ST-64, Building 20212, U.S. Army Corps of Engineers Vehicle Maintenance Yard (ST-64) (former ST-337)**

14.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contaminants in soil adjacent to SWMU ST-64. On June 7 and 8, 1994, five boreholes, ST-337C-01 to ST-337C-05, were drilled and sampled with a Geoprobe. To collect background concentration data, ST-337C-01 was northwest of the site in an area away from any known or suspected contamination. Four boreholes were in the area where the stained soil had previously been observed. Except for borehole ST-337C-01, three soil samples were collected from each boring: one at the surface, one at 5 ft below grade, and one at 10 ft below grade. No surface sample was collected from boring ST-337C-01.

Sampling operations and sampling handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples collected and submitted for analysis for this site are shown in Table 14-1. Borehole logs are in Appendix C.

Table 14-1. Boreholes and Samples Submitted for Analysis for SWMU ST-64, Building 20212, U.S. Army Corps of Engineers Vehicle Maintenance Yard (ST-64) (former ST-337)

Borehole	Borehole Location	Sample Depths (ft)	PID/FID [a,b] (ppm_v)
01	Background sampling borehole	5-7	NA[c]/0
		10-12	NA/0
02	Previously stained soil area	0-2	NA/0
		5-8	NA/0
		10-13	NA/4
03	Previously stained soil area	0-2	NA/0
		5-8	95/0
		10-13	54/NA
04	Previously stained soil area	0-2	5/NA
		5-7	10/NA
		10-12	4/NA
		30-32	0/NA
05	Previously stained soil area	0-2	12/NA
		5-8	11/NA
		10-13	3/NA

a. ppm_v = parts-per-million volume (ml/L) as isobutylene for the PID and as methane for the FID.

b. PID and FID readings are values above background. Only the highest value for the interval is listed.

c. NA = Not analyzed for with this instrument.

14.2.4 Laboratory Analysis

Fifteen soil samples were collected at this site and analyzed for VOCs, SVOCs, PCBs/pesticides, metals, TPH, and soil moisture. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters, and a PID and/or FID. The brass tube with the highest PID or FID measurements was dedicated for VOC and SVOC analysis. Elevated PID/FID readings (ranging from 3 to 95 ppm_V above background) were measured in soil samples from ST-337C-03, ST-337C-04, and ST-337C-05.

14.3 Site Characteristics

14.3.1 Geology

The SWMU ST-64 area is underlain by unconsolidated alluvial sediment that is predominantly fine-grained silty sand to very fine-grained silty sand. Three 13-ft boreholes, one 12-ft, and one 32-ft borehole were drilled at SWMU ST-64. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4.

As a result of UST installation, it is probable that backfill material is present. Borehole logs for this area are presented in Appendix C.

14.3.2 Hydrogeology

Groundwater beneath SWMU ST-64 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably west-northwest at this site. Four production wells are located in this area: KAFB-3 is downgradient 5,000 ft northwest, Eubank-1 is downgradient 5,500 ft east-southeast, Sandia-6 is upgradient 4,200 ft southeast, and KAFB-1 is cross-gradient 2,700 ft northwest. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

14.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on soil sampling results. Analytical results for soil samples submitted for analysis at SWMU ST-64 are summarized in Table 14-2, where only the reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Table 14-2. Summary of Reportable Concentrations for Soil Analyses at SWMU ST-64, U.S. Army Corps of Engineers Vehicle Maintenance Yard, Building 20212, (ST-64) (former ST-337)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)							
				ST-337C-01		*ST-337C-02*			*ST-337C-03*		
				5–7	10–12	0–2	5–8	10–13	0–2	5–8	10–13
VOC	Acetone	7,800	0.10	ND	0.006	0.004	0.003	ND	ND	0.18	0.087
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND	3.2	1.8
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND	0.023	0.009
	Methyl isobutyl ketone	6,300	0.05	ND	ND	ND	ND	ND	ND	0.009	ND
	Methylene chloride	85.0	0.005	0.003	0.003	0.004	0.014	0.013	0.01	0.006	0.008
	Toluene	16,000	0.005	ND	0.003	ND	ND	ND	ND	0.003	0.003
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND	3.1	0.26
SVOC	Acenapthene	4,700	0.70	ND	ND	0.44	ND	ND	ND	ND	ND
	Anthracene	23,000	N/A	ND	ND	0.60	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	2.6	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	1.8	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	3.5	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	1.2	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	1.5	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND
	Chrysene	88.0	0.70	ND	ND	3.2	ND	ND	ND	ND	ND
	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND	ND	ND	ND
	Dibenz(a,h)anthracene	0.088	0.70	ND	ND	0.57	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	6.3	ND	0.55	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	1.2	ND	ND	ND	ND	ND
	2-Methylnaphthalene	N/A	0.70	ND	ND	ND	ND	ND	ND	50.0	59.0
	Naphthalene	3,100	0.70	ND	ND	ND	ND	ND	ND	11.0	13.0
	Phenanthrene	N/A	0.70	ND	ND	3.2	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	ND	ND	ND	ND	ND	ND
	Pyrene	2,300	0.70	ND	ND	5.0	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	ND	9.9	46.0	93.0	140	3,300	5,600	4,400
	Gasoline fraction	100	1.0	ND	ND	ND	0.37000	0.45000	ND	150	86.0
METALS	Aluminum	78,000	14,700	5,450	3,750	6,860	8,090	9,580	10,800	9,750	6,660
	Arsenic	0.37	6.5	3.1	2.7	9.5	3.7	3.8	10.6	3.6	2.3
	Barium	5,500	735	153	100	160	236	221	176	200	168
	Beryllium	0.15	0.84	0.45	0.33	0.43	0.58	0.55	0.56	0.56	0.33
	Cadmium	39.0	N/A	ND	ND	0.54	ND	ND	ND	ND	ND
	Calcium	N/A	121,000	36,900	48,200	44,600	48,500	46,600	41,700	47,300	71,800
	Chromium, total	390	21.6	8.6	5.5	11.6	11.0	6.9	7.6	10.2	6.5
	Cobalt	4,700	15.4	5.0	2.4	5.7	7.5	5.8	6.6	5.6	4.1
	Copper	2,900	223	16.0	25.1	20.8	22.8	14.3	13.7	31.3	17.6
	Iron	N/A	23,800	8,690	5,110	10,100	12,100	14,100	14,500	14,200	9,850
	Lead	400	17.5	6.5	3.4	37.5	8.0	10.6	8.9	5.5	3.4
	Magnesium	N/A	10,400	3,820	2,190	3,870	5,430	4,250	4,600	4,250	3,490
	Manganese	390	549	194	81.0	219	274	211	197	177	120
	Nickel	1,600	188	8.3	6.4	9.3	13.0	18.3	10.2	7.9	5.9
	Potassium	N/A	3,590	971	645	1,630	1,380	1,770	2,250	1,660	1,070
	Sodium	N/A	787	83.2	62.9	89.1	117	198	106	138	151
	Vanadium	550	55.3	18.8	11.9	20.8	25.4	31.6	31.0	33.0	23.5
	Zinc	23,000	114	30.3	36.8	67.2	41.7	30.7	37.1	30.4	22.2
OTHER	Moisture (%)			10.5	8.9	7.7	14.4	9.2	10.2	11.4	9.6
PESTICIDES	DDE	1.9	N/A	ND	ND	ND	ND	ND	ND	ND	0.006
	DDT	1.9	N/A	ND	ND	ND	ND	ND	ND	ND	ND

Table 14-2. Summary of Reportable Concentrations for Soil Analyses at SWMU ST-64, U.S. Army Corps of Engineers Vehicle Maintenance Yard, Building 20212, (ST-64) (former ST-337)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)						
				ST-337C-04				*ST-337C-05*		
				0–2	5–7	10–12	30–32	0–2	5–8	10–13
VOC	Acetone	7,800	0.10	ND	ND	0.007	ND	ND	0.014	0.005
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	0.004	ND
	Methyl isobutyl ketone	6,300	0.05	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	0.005	0.004	0.004	0.003	0.005	0.005	0.004
	Toluene	16,000	0.005	0.018	ND	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	0.026	ND	ND	ND	ND	ND	ND
SVOC	Acenapthene	4,700	0.70	ND	ND	ND	ND	ND	ND	ND
	Anthracene	23,000	N/A	ND	ND	ND	ND	0.36	ND	ND
	Benzo(a)anthracene	0.88	0.70	0.37	ND	ND	ND	0.87	ND	ND
	Benzo(a)pyrene	0.088	0.70	0.41	ND	ND	ND	0.77	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	0.48	ND	ND	ND	0.69	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	0.40	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	0.38	ND	ND	ND	0.77	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	0.45	ND	ND	ND
	Chrysene	88.0	0.70	0.47	ND	ND	ND	0.95	ND	ND
	Di-n-butylphthalate	7,800	0.70	ND	0.47	ND	0.49	ND	ND	ND
	Dibenz(a,h)anthracene	0.088	0.70	ND	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	0.82	ND	ND	ND	2.1	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	0.41	ND	ND
	2-Methylnaphthalene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND
	Naphthalene	3,100	0.70	ND	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	1.5	ND	ND
	Phenol	47,000	0.30	ND	0.54	0.58	ND	ND	ND	ND
	Pyrene	2,300	0.70	0.66	ND	ND	ND	1.7	ND	ND
TPH	Diesel fraction	100	10.0	7.9	ND	ND	ND	31.4	ND	ND
	Gasoline fraction	100	1.0	0.29000	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	11,300	9,490	5,990	4,340	10,600	7,210	8,980
	Arsenic	0.37	6.5	17.1	3.4	3.3	1.1	10.9	2.1	2.8
	Barium	5,500	735	125	224	94.8	67.7	191	179	137
	Beryllium	0.15	0.84	0.54	0.54	0.42	0.31	0.54	0.43	0.43
	Cadmium	39.0	N/A	ND	ND	ND	ND	ND	ND	ND
	Calcium	N/A	121,000	27,500	31,100	33,000	17,600	33,700	31,500	49,400
	Chromium, total	390	21.6	9.5	1.1	5.5	5.2	8.2	10.6	6.7
	Cobalt	4,700	15.4	6.4	6.1	4.2	6.5	6.4	5.2	5.3
	Copper	2,900	223	14.2	29.9	76.2	76.3	13.5	58.6	11.2
	Iron	N/A	23,800	14,700	13,500	8,820	13,000	14,400	10,400	10,900
	Lead	400	17.5	20.4	4.2	3.9	3.8	14.9	4.1	5.0
	Magnesium	N/A	10,400	4,090	4,450	2,450	2,870	4,200	3,700	3,400
	Manganese	390	549	215	205	105	189	221	169	119
	Nickel	1,600	188	9.2	8.6	5.5	11.3	8.2	6.7	7.7
	Potassium	N/A	3,590	2,460	1,750	974	1,000	2,230	1,240	1,400
	Sodium	N/A	787	107	286	263	148	161	196	200
	Vanadium	550	55.3	31.7	29.0	21.0	24.4	31.5	21.7	26.4
	Zinc	23,000	114	37.2	37.3	44.5	46.3	34.2	42.6	21.4
OTHER	Moisture (%)			7.7	8.0	5.8	3.3	7.6	6.0	7.9
PESTICIDES	DDE	1.9	N/A	0.008	ND	ND	ND	0.052	ND	ND
	DDT	1.9	N/A	0.022	ND	ND	ND	ND	ND	ND

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Organic Compounds

Seven VOCs were detected in samples submitted for analysis from this site: acetone, ethylbenzene, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, toluene, and total xylenes. The greatest number of detections were found in borehole ST-337C-03, where all of the compounds listed above were detected in the 5- to 8-ft sample. Three VOCs, acetone, methylene chloride, and toluene, were detected in the background borehole, ST-337C-01. Acetone (0.003 to 0.087 mg/kg) was detected in eight samples; concentrations were similar to those detected in background sample ST-337C-01 (10 to 12 ft). Ethylbenzene (3.2 and 1.8 mg/kg) was detected in two samples, ST-337C-03 (5 to 8 ft and 10 to 13 ft). Methyl ethyl ketone (0.0041 to 0.023 mg/kg) was detected in three samples. Methyl isobutyl ketone (0.009 mg/kg) was detected in one sample, ST-337C-03 (5 to 8 ft). Methylene chloride (0.003 to 0.014 mg/kg) was detected in all samples. Toluene (0.003 to 0.018 mg/kg) was detected in four samples. Total xylenes (0.026 to 3.1 mg/kg) were detected in three samples. None of the detected VOC concentrations exceeded HHRB action levels.

Eighteen SVOCs were detected in samples submitted for analysis from this site; 13 of the 18 SVOCs were PAHs. No SVOCs were detected in the background samples. These compounds were detected in samples ST-337C-02 (0 to 2 ft), ST-337C-02 (10 to 13 ft), ST-337C-04 (0 to 2 ft), and ST-337C-05 (0 to 2 ft) and detected concentrations ranged from 0.36 to 6.3 mg/kg. Compounds detected above HHRB action levels include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h) anthracene, and indeno(1,2,3-c,d)pyrene. Benzo(a)anthracene (2.6 mg/kg) was detected in ST-337C-02 (0 to 2 ft), exceeding the HHRB action level for this compound of 0.88 mg/kg. Benzo(a)pyrene was detected above the HHRB action level of 0.088 mg/kg in ST-337C-02 (0 to 2 ft), ST-337C-04 (0 to 2 ft), and ST-337C-05 (0 to 2 ft). Benzo(b)fluoranthene (3.5 mg/kg) was detected in ST-337C-02 (0 to 2 ft), exceeding the HHRB action level of 0.88 mg/kg. Dibenz(a,h)anthracene (0.57 mg/kg) was detected in ST-337C-02 (0 to 2 ft), exceeding the HHRB action level of 0.088 mg/kg. Indeno(1,2,3-c,d)pyrene (1.2 mg/kg) was detected in ST-337C-02 (0 to 2 ft) exceeding the HHRB action level of 0.88 mg/kg.

Other SVOC compounds detected in samples submitted from this site include two phthalates (bis(2-ethylhexyl)phthalate and di-n-butylphthalate), 2-methylnaphthalene, naphthalene, and phenol. None of these compounds were above HHRB action levels.

Petroleum Hydrocarbons

Gasoline range hydrocarbons (0.29 to 150 mg/kg) were detected in five samples. The highest concentrations were detected in samples from borehole ST-337C-03. The 150 mg/kg concentration in the 5- to 8-ft sample exceeds the 100 mg/kg NMED action level (Table 14-2).

Diesel range hydrocarbons (7.9 to 5,600 mg/kg) were detected in nine samples. The concentrations detected in four samples exceeded the NMED action level of 100 mg/kg. The highest concentrations were detected in samples from borehole ST-337C-03.

Metals

Table 14-2 lists all reportable metal concentrations detected at SWMU ST-64 and the respective UTL and HHRB action level concentrations. Arsenic and beryllium were the only metals detected in samples at concentrations greater than HHRB action levels. Arsenic (1.1 to 17.1 mg/kg) was detected in all samples; the concentrations in all samples and background samples exceed the HHRB action level of

0.37 mg/kg. The arsenic concentration detected in four samples exceed the UTL of 6.5 mg/kg. Beryllium (0.31 to 0.58 mg/kg) was detected in all samples; the concentrations detected in all samples and background samples exceed the HHRB action level of 0.15 mg/kg. The concentrations of arsenic and beryllium appear to be naturally occurring throughout Kirtland AFB as discussed in Section 4.2.2.

Soil Moisture

Soil moisture values ranged from 3.3 to 14.4 percent.

Pesticides

Two pesticides were detected in samples submitted for analysis from SWMU ST-64: DDE (1,1-bis(chlorophenyl)-2,2-dichloroethene) and DDT (1,1-bis(chlorophenyl)-2,2,2-trichloroethane). DDE (0.006, 0.008, and 0.052 mg/kg) was detected in three samples: ST-337C-03 (10 to 13 ft); ST-337C-04 (0 to 2 ft); and ST-337C-05 (0 to 2 ft). DDT (0.022 mg/kg) was detected in one sample: ST-337C-04 (0 to 2 ft). Detected concentrations of DDE and DDT were below the HHRB action level for both compounds of 1.9 mg/kg.

14.5 Conclusions and Recommendations

Conclusions

- Seven VOCs were detected in samples collected at this site; all concentrations were below HHRB action levels.

- Eighteen SVOCs were detected in samples collected at this site; 13 were PAHs. Compounds detected above HHRB action levels include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. Other SVOC compounds detected in samples collected at this site include two phthalates (bis(2-ethylhexyl)phthalate and di-n-butylphthalate), 2-methylnaphthalene, naphthalene, and phenol. None of these compounds were above HHRB action levels.

- Gasoline range hydrocarbons were detected in five samples at concentrations ranging from 0.29 to 150 mg/kg. One sample contained a concentration in excess of the NMED action level of 100 mg/kg, indicating a release occurred at this site.

- Diesel range hydrocarbons were detected in nine samples at concentrations ranging from 7.9 to 5,600 mg/kg; four samples contained concentrations in excess of the NMED action level of 100 mg/kg. The concentrations indicate that a release occurred at this site.

- Arsenic and beryllium were the only metals detected at concentrations exceeding HHRB action levels of 0.37 and 0.15 mg/kg, respectively. Arsenic was detected in four samples at concentrations above the 6.5 mg/kg UTL value; the concentrations appear to be naturally occurring throughout Kirtland AFB.

- Two pesticides, DDE and DDT, were detected in samples collected from SWMU ST-64 at concentrations below HHRB action levels.

- The analytical results at SWMU ST-64 indicate a contaminant release at this site.

Recommendations

- Because of the presence of PAHs and TPH concentrations above HHRB/NMED action levels, further investigation is required to define the nature and extent of contamination.

15.0 SWMU SS-65, Horizontal Polarized Dipole (HPD) Drum Rack (SS-65) (former ST-338)

15.1 Site Background and Environmental Setting

The HPD drum rack (SWMU SS-65) is an inactive site in the west portion of Kirtland AFB at the HPD Facility (Figure 15-1). The drum rack is located on the southwest side of Pennsylvania Avenue, 1 mi south of Hardin Boulevard. The drum rack is a concrete pad approximately 6 ft x 25 ft with a shallow trough running the length of the southwest side. The trough has a horizontal drain hole in the north edge that empties to the ground surface; 10 55-gallon drums were stored horizontally on the pad with the spigots facing southwest over the trough. The trough was intended to catch any drippings from the spigots; the drums contained solvents, lubricants, and diesel fuel. In the past, rainwater caused the trough to overflow carrying any spilled chemicals to the ground surface.

In August 1991, facility personnel discovered a spill at the north end of the drum rack. Contaminated soil was excavated from the spill area and placed in a pile. The excavation is a trench 8 ft wide, with a maximum depth of about 10 ft at the northwest edge of the pad. The excavated soil was placed in a spoils pile 75 ft northwest of the drum rack; the pile is 30 ft x 40 ft x 5 ft. Soil samples were collected from the spoils pile during the Appendix III RFI to characterize the soil for disposal to comply with applicable local, State, and Federal requirements. The HPD drum rack was investigated on June 22-24, 1994.

The HPD Facility is located in the urban/industrial zone, as discussed in Section 2.0. The nearest production wells to this site are KAFB-4, 1,500 ft southwest; KAFB-8, 3,000 ft upgradient southeast; and KAFB-7, 4,500 ft downgradient northwest.

15.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU SS-65 from ground surface to 26 ft below grade.

15.2.1 Previous Investigations

On August 7, 1991, two soil samples were collected near the spill area excavation. One was collected from the bottom of the excavation, estimated to be 10 ft deep, and the second sample was collected from the excavated material in the spoils pile. Samples were analyzed for total volatile organic aromatics (VOAs) according to EPA Method 8240.

Analytical results showed that the sample collected from the bottom of the excavation contained five chemicals: methylene chloride at 12.78 mg/kg; acetone at 22.46 mg/kg; 1,1,1-trichloroethane at 12.54 mg/kg; carbon tetrachloride at 31.340 mg/kg; and benzene at 9.70 mg/kg. The sample collected from the excavated material contained four of those five chemicals: methylene chloride at 171.27 mg/kg; 1,1,1-trichloroethane at 22.04 mg/kg; trichloroethene at 45.86 mg/kg; and benzene at 19.46 mg/kg.

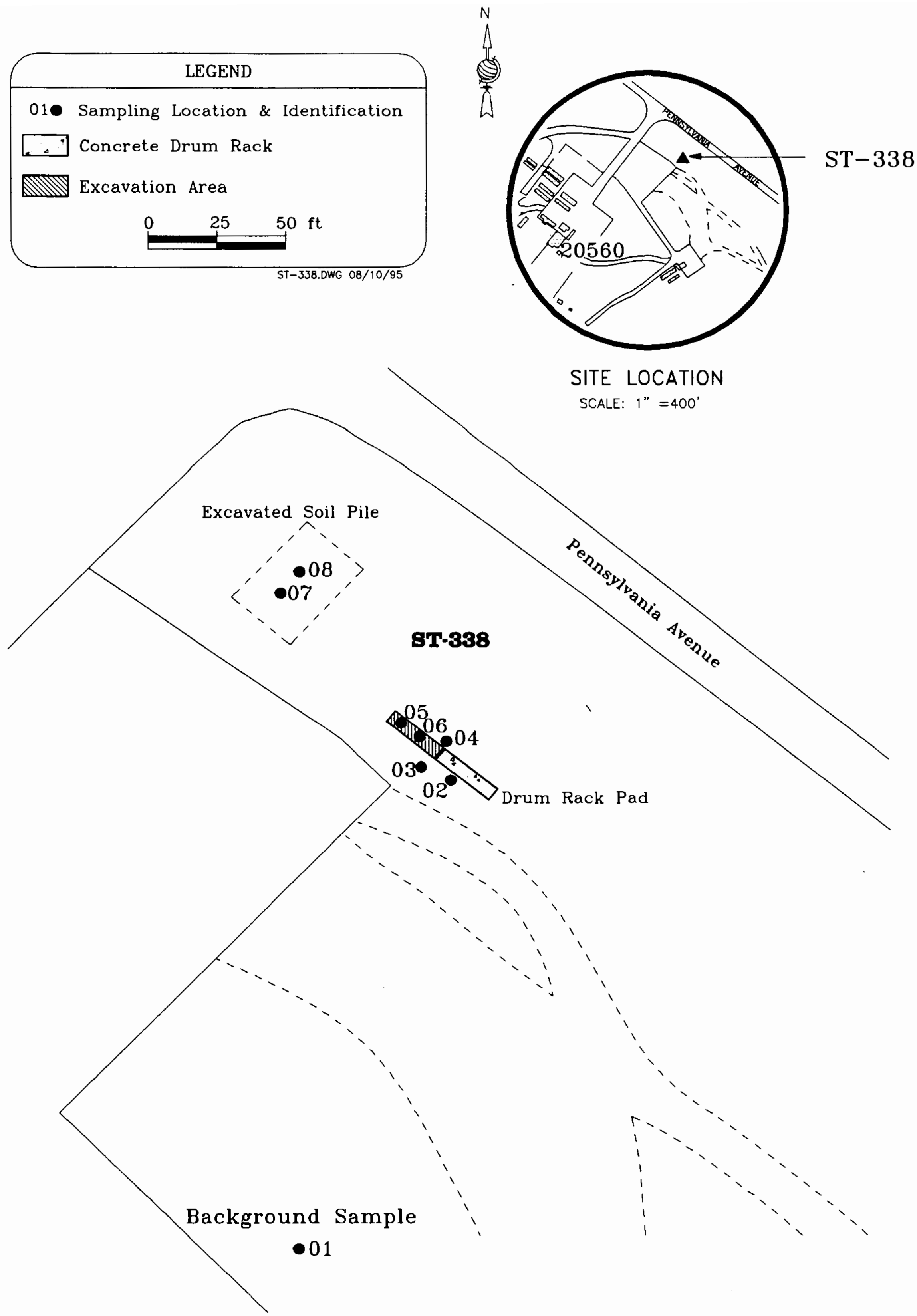


Figure 15-1. Soil Sampling Locations at SWMU SS-65, HPD Drum Rack (SS-65) (former ST-338)

Additional sampling was performed on April 1, 1993. Three soil samples were collected and analyzed for VOCs by EPA Method 8240. Two of the samples were collected near the drain hole location. One sample was collected at 8.5 to 9 ft below the ground surface and the other was collected at 2 ft below the surface. The third sample was collected from the western edge of the excavated soil pile at a depth of 2 ft. Acetone (6.0 to 23.0 mg/kg) and methylene chloride (0.017 to 0.019 mg/kg) was detected in all three samples. The trip blank, however, also contained methylene chloride (0.002 mg/kg) and acetone (0.001 mg/kg), suggesting possible laboratory contamination. No other VOAs were detected in the soil samples collected during this sampling event (Kirtland AFB Waste Sampling, Task Request/Analysis Report Form for samples collected on August 7, 1991 and April 1, 1993).

15.2.2 Data Gaps

Data from previous investigation activities indicate contamination in the subsurface soil at SWMU SS-65. The collection of additional soil samples during the Appendix III RFI was necessary to further characterize soil contamination at this site.

15.2.3 RFI Field Investigation

The objective of the investigation was to further characterize the extent of contaminants in the soil adjacent to SWMU SS-65C. On June 22–24, 1994, five boreholes, ST-338C-02 to ST-338C-06, were drilled in the vicinity of the drum rack pad to a depth of 26 ft below grade using a Geoprobe. Boreholes ST-338C-05 and ST-338C-06 were inside the excavation area, near the northwest end of the concrete drum rack pad; ST-338C-03 and ST-338C-04 were at the northwest and northeast ends of the pad, respectively. Borehole ST-338C-02 was along the southwest side of the pad. Five soil samples were collected from each borehole at the surface and at depths of 5, 10, 15, and 25 ft below grade. Sample locations are presented in Figure 15-1.

Borehole ST-338C-01 was drilled in an area away from any known or suspected contamination to obtain samples for characterization of site-specific background conditions. Samples were collected from this borehole at depths of 5 ft and 25 ft below grade.

On June 23, 1994, two soil samples (ST-338C-07 and ST-338C-08) were collected from the excavated soil pile. These samples were collected for waste characterization analysis for disposal purposes. The samples were collected using stainless steel spoons and bowls at two locations in the center of the spoils pile at a depth of approximately 1 ft below the pile surface.

Sampling operations and sampling handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples submitted for analysis at this site are shown in Table 15-1. Borehole logs are in Appendix C.

15.2.4 Laboratory Analysis

The soil samples collected in the vicinity of the drum rack pad and the background soil samples were analyzed for VOCs, SVOCs, TPH, and soil moisture. Soil samples collected from the excavated soil pile were analyzed for RCRA hazardous waste characteristics, including corrosivity, ignitability, reactivity, toxicity (TCLP extraction for metals and nonvolatiles), and zero headspace analysis for volatiles.

Table 15-1. Boreholes and Samples Submitted for Analysis from SWMU SS-65, HPD Drum Rack (SS-65) (former ST-338)

Borehole	Borehole Location	Sample Depth (ft)				
01	150 ft S of the drum rack pad	NS	5-9[a]	NS	NS	24-26
02	Central SW side of drum rack pad	0-2	5-7	10-13	15-17	24-26
03	SW corner of drum rack pad	0-5	5-7	10-12	15-17	24-26
04	NW corner of drum rack pad	0-4[a]	5-7	10-13	15-17	24-26
05	Inside excavated area N of drum rack pad	0-4	5-9[a]	10-14[a,b]	15-17	24-26
06	Inside excavated area N of drum rack pad	0-5	5-9[a,b]	10-13[a,b]	14-18[a,b]	24-26
07	Excavated soil pile	0-1	NS	NS	NS	NS
08	Excavated soil pile	0-1	NS	NS	NS	NS

NS No sample collected

a. Replicate sample also collected at this depth interval.

b. Second replicate sample also collected at this depth interval.

The brass tubes in each 2-ft. sample interval were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. No readings above background values were measured with these instruments.

15.3 Site Characteristics

15.3.1 Geology

The area surrounding SWMU SS-65 is underlain by unconsolidated alluvial sediment that is predominantly fine-grained sand and very fine-grained to fine-grained silty sand. Caliche was present in samples collected for lithologic classification as light- to heavily stained patches. A maximum depth of 26 ft below grade was attained in several boreholes at SWMU SS-65. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this area are presented in Appendix C.

15.3.2 Hydrogeology

Groundwater beneath SWMU SS-65 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably northwest at this site. Three production wells are located near SWMU SS-65: KAFB-4 is cross-gradient 1,500 ft southwest, KAFB-8 is upgradient 3,000 ft southeast, and KAFB-7 is downgradient 4,500 ft to the northwest. Depth to groundwater is estimated to be 350 ft below grade or less (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

15.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples collected at SWMU SS-65. Analytical results are presented in Table 15-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Organic Compounds

Six VOC analytes were detected in samples submitted for analysis at SWMU SS-65. Acetone (0.004 to 0.049 mg/kg) was detected in eight samples and two field replicates. Carbon disulfide (0.002 mg/kg) was detected in one sample, ST-338C-03 (5 to 7 ft). Methyl ethyl ketone (0.006 mg/kg) and methyl isobutyl ketone (0.002 mg/kg) were only detected in one sample, ST-338C-05 (0 to 4 ft). Methylene chloride (0.003 to 0.008 mg/kg) was detected in 27 samples and 6 field replicates. Toluene (0.001 to 0.003 mg/kg) was detected in three samples and two field replicates. All VOC concentrations were below HHRB action levels.

SVOC analytes were not detected in soil samples collected at SWMU SS-65.

Petroleum Hydrocarbons

Diesel range hydrocarbons (10.7 mg/kg) were only detected in ST-338C-06 (0 to 5 ft) at a concentration below the HHRB action level of 100 mg/kg.

Soil Moisture

Soil moisture values ranged from 0.8 to 9.8 percent.

Table 15-2. Summary of Reportable Concentrations for Soil Analyses at SWMU SS-65, HPD Drum Rack (SS-65) (former ST-338)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)												
				ST-338C-01			*ST-338C-02*					*ST-338C-03*				
				5–9 FR	5–9	24–26	0–2	5–7	10–13	15–17	24–26	0–5	5–7	10–12	15–17	24–26
VOC	Acetone	7,800	0.10	0.007	ND	0.006	ND	0.014	0.012	0.049	0.012	ND	0.005	ND	ND	ND
	Carbon disulfide	7,800	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl isobutyl ketone	6,300	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	0.009	0.004	0.008	0.003	0.009	0.011	0.009	0.009	0.003	0.009	0.003	0.004	0.003
	Toluene	16,000	0.005	ND	0.001	ND	ND	ND	ND	0.003	ND	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Barium	5,500	735	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OTHER	Flashpoint (°F)			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Moisture (%)			0.90	1.0	0.80	5.0	8.4	8.1	2.2	6.0	2.0	9.6	9.8	1.7	2.3
	Sulfur			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 15-2. Summary of Reportable Concentrations for Soil Analyses at SWMU SS-65, HPD Drum Rack (SS-65) (former ST-338)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)													
				ST-338C-04						ST-338C-05							
				0–4 FR	0–4	5–7	10–13	15–17	24–26	0–4	5–9 FR	5–9	10–14 FR	10–14 FR2	10–14	15–17	24–26
VOC	Acetone	7,800	0.10	ND	ND	0.004	ND	ND	ND	0.009	ND	ND	ND	ND	ND	ND	ND
	Carbon disulfide	7,800	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND	0.006	ND	ND	ND	ND	ND	ND	ND
	Methyl isobutyl ketone	6,300	0.05	ND	ND	ND	ND	ND	ND	0.002	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	0.0003	0.003	0.003	0.006	0.008	0.007	0.005	0.005	0.004	0.004	ND	0.005	0.004	0.004
	Toluene	16,000	0.005	0.001	ND	ND	ND	ND	ND	0.002	ND	ND	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Barium	5,500	735	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OTHER	Flashpoint (°F)			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Moisture (%)			1.6	4.2	4.7	2.9	4.1	2.4	5.0	2.4	4.8	ND	5.4	5.9	2.1	0.80
	Sulfur			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 15-2. Summary of Reportable Concentrations for Soil Analyses at SWMU SS-65, HPD Drum Rack (SS-65) (former ST-338)[1] (Concentrations mg/kg) (Concluded)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)												
				ST-338C-06											ST-338C-07	ST-338C-08
				0–5	5–9 FR1	5–9 FR2	5–9	10–13 FR1	10–13 FR2	10–13	14–18 FR1	14–18 FR4	14–18	24–26	0–1	0–1
VOC	Acetone	7,800	0.10	ND	ND	ND	ND	0.006	ND	ND	ND	ND	ND	ND	ND	ND
	Carbon disulfide	7,800	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl isobutyl ketone	6,300	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	0.004	0.004	ND	0.006	0.005	ND	0.005	0.003	ND	0.004	0.003	ND	ND
	Toluene	16,000	0.005	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TPH	Diesel fraction	100	10.0	10.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS	Barium	5,500	736	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.54	1.42
OTHER	Flashpoint (°F)			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	200	200
	Moisture (%)			3.4	ND	7.7	11.5	ND	10.6	11.6	ND	2.7	3.5	7.0	N/A	N/A
	Sulfur			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	240	280

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Soil Pile Samples

Samples collected from the excavated soil pile (ST-338C-07 and ST-338C-08) were analyzed for RCRA hazardous waste characteristics, including corrosivity, ignitability, reactivity, toxicity (TCLP extraction for metals and nonvolatiles), and zero headspace analysis for volatiles. Barium was detected in ST-338C-07 and ST-338C-08 at concentrations of 1.54 mg/l and 1.42 mg/l, respectively; the concentrations are below the toxicity characteristic waste maximum contaminant concentration value of 100 mg/l. Sulfur was detected in ST-338C-07 and ST-338C-08 at concentrations of 240 mg/kg and 280 mg/kg, respectively. Flashpoint values for both samples were 200^0 F.

15.5 Conclusions and Recommendations

Conclusions

- Six VOC analytes were detected in the soil samples collected from this site; all concentrations were below HHRB action levels.
- No SVOC analytes were detected in soil samples collected from this site.
- Diesel range hydrocarbons were detected in one sample at a concentration below the HHRB action level of 100 mg/kg.
- Sulfur and barium were detected in the samples collected from the excavated soil pile. The barium concentrations were below the toxicity characteristic waste maximum contaminant concentration value.
- There has been a release at the drum rack site and the contaminated soil has been excavated. VOCs were only detected at one of the sampling locations in the excavation. All VOC concentrations were below HHRB action levels.

Recommendations

- Additional sampling of the excavated soil pile, and the subsurface beneath the pile, are planned to fully characterize this material for proper disposal.
- Based on the findings of the RFI, no further action is necessary at the drum rack; therefore, SWMU SS-65 does not require further investigation. A NFA proposal should be prepared.

16.0 WP-339, Contractor Yard West of Building 20423 (WP-339)

16.1 Site Background and Environmental Setting

The contractor yard is in the northwest portion of the base near the intersection of Third Street and Hardin Boulevard (Figure 16-1). This site is an area 90 ft x 100 ft, west of Building 20423. The area is now the northeast section of a larger contractor yard that measures 277 ft x 322 ft. During its use as a contractor yard, the area was fenced into three sections, one of which was the area 90 ft x 100 ft. The yard is covered with gravel and dirt and is underlain with what appears to be continuous asphalt pavement. For about 25 years, base contractors parked vehilcles and stored equipment at the yard. According to the Phase I Records Search, an estimated 500 gallons of engine oil per month was drummed and sent to DRMO (USAF, 1981).

A concern for this site developed following the investigation of an adjacent acid neutralization pit located at the northwest corner of the battery shop in Building 20423 (ST-274). During the acid pit investigation, a soil boring was drilled 50 ft west of the acid pit toward the yard fence on the east side of Hardin Boulevard. Seven soil samples were collected from this boring. Methylene chloride was detected at concentrations of 7 μg/kg and 6 μg/kg in samples from 20 ft and 40 ft below grade, respectively. No contaminants were detected in the other five samples.

The yard is presently used for Kirtland AFB Civil Engineers for vehicle parking; the fences have been removed from the 90-ft x 100-ft area. This site was investigated on July 28-31, 1994.

The contractor yard is located in the urban/industrial zone, which is discussed in Section 2.0. The nearest production wells to this site are Sandia-6, 3,600 ft east; KAFB-4, 4,800 ft southwest; KAFB-7, 5,000 ft southwest; and KAFB-1, 1,500 ft northwest.

16.2 Study Area Investigation

The area of investigation was limited to the soil in the contractor yard from ground surface to 52 ft below grade.

16.2.1 Previous Investigations

No previous investigations have been performed at this site.

16.2.2 Data Gaps

No data were available to confirm the presence or absence of contaminants in the soil at this site.

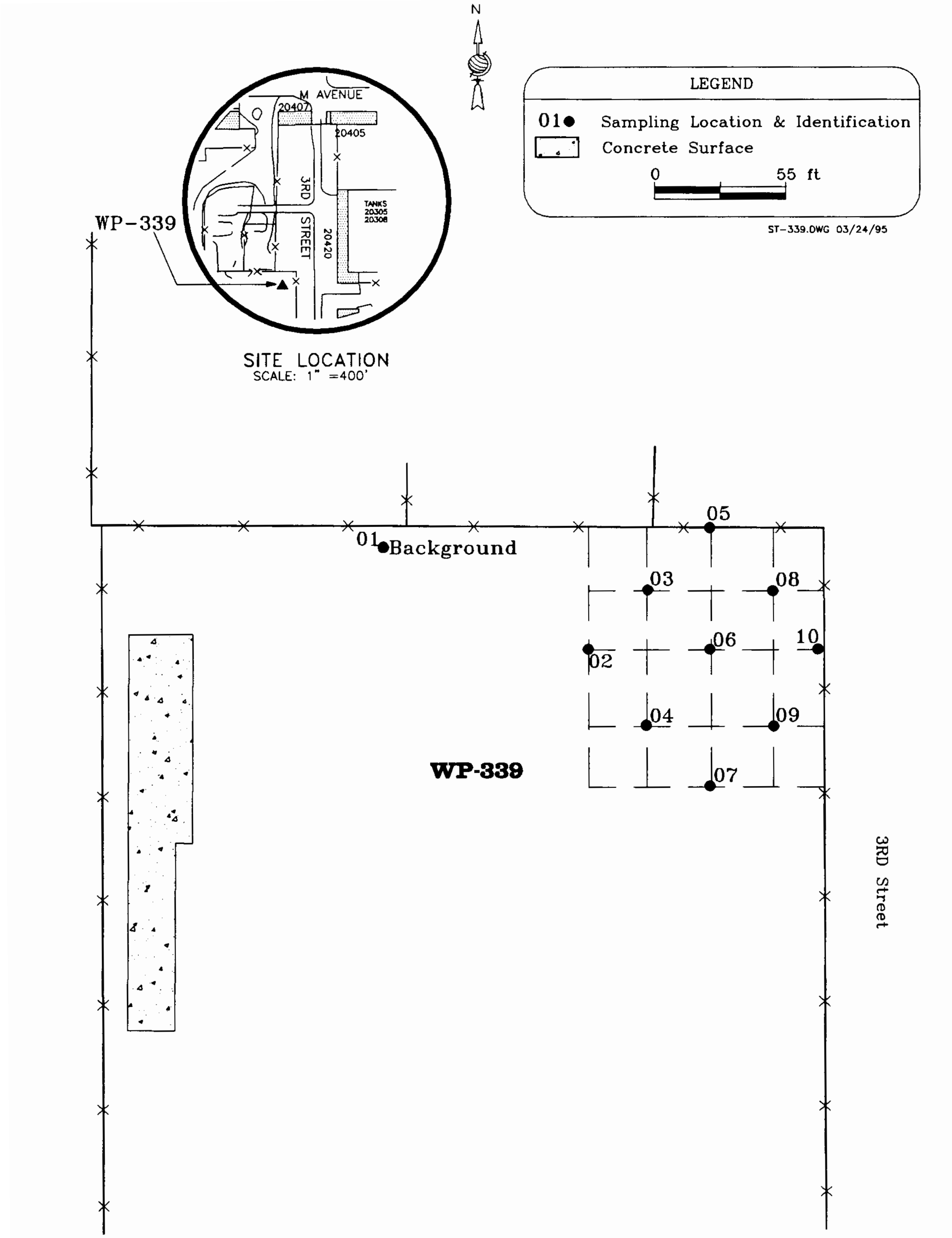


Figure 16-1. Soil Sampling Locations at WP-339, Contractor Yard West of Building 20423 (WP-339)

16.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contaminants in soil at WP-339. A sampling grid with nine boreholes on 50-ft centers was planned across the site. The boreholes, WP-339C-02 to WP-339C-10, were drilled to a depth of approximately 50 ft below grade using a Geoprobe. Soil samples were collected from each borehole at the surface and at depths of 10, 20, 30, 40, and 50 ft below grade for laboratory analyses. To determine site-specific background concentrations, borehole WP-339C-01 was drilled in an area away from any known or suspected areas of contamination. The background borehole was drilled to a depth of 25 ft and samples were collected at 5 ft and 25 ft below grade (Figure 16-1).

Sampling operations and sampling handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples submitted for analysis at this site are shown in Table 16-1. Borehole logs are in Appendix C.

Table 16-1. Boreholes and Samples Submitted for Analysis at WP-339, Contractor Yard West of Building 20423 (WP-339)

Borehole	Borehole Location	Sample Depth (ft)					
01	Background sample, 150 ft W of site	NS	5-7	25-27	NS	NS	NS
02	W sample	0-2	10-12	20-22[a]	30-32	40-42	44-46
03	NW sample	0-2	10-12	20-22	30-32	40-42	50-52
04	SW sample	0-2	10-12	20-22	30-32	40-42	50-52
05	N sample	0-2	10-12	20-22	30-32	40-42	50-52
06	Center of sampling grid	0-2	10-12	20-22	30-32	40-42	48-50
07	S sample	0-2	10-12	20-22	30-32	40-42	50-52
08	NE sample	0-2	10-12	20-22	30-32	40-42	50-52
09	SE sample	0-2	10-12	20-22	30-32	40-42	49-51
10	E sample	0-2	10-12	20-22[a]	30-32	40-42	50-52

NS No sample collected at this depth

a. Replicate sample also collected at this depth interval.

16.2.4 Laboratory Analysis

The soil samples were analyzed for VOCs, SVOCs, metals, and soil moisture. The brass tubes in each 2-ft sample interval were field-screened for possible contamination using gamma and beta-gamma meters and a PID and/or FID. No readings above background values were measured with these instruments throughout drilling and sampling activities at WP-339.

16.3 Site Characteristics

16.3.1 Geology

Ten boreholes were drilled at the contractor yard using a Geoprobe. The background borehole, WP-339C-01, was drilled to a depth of 27 ft below grade; the boreholes onsite ranged from depths of 46 to 52 ft below grade. The site is underlain by unconsolidated alluvial sediment that is predominantly very fine-grained to fine-grained silty sand and sand. Well-graded gravel and gravelly sand were encountered approximately between 10 and 32 ft below grade. Below a depth of 40 ft, silty clay, clayey silt, and sandy silt were encountered. In most boreholes, drilling became difficult between approximately 46 and 50 ft below grade. Caliche cementation was present in borehole WP-339C-02 at a depth of 45 ft below grade. Well-graded gravelly sand was encountered below 50 ft. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this area are presented in Appendix C.

16.3.2 Hydrogeology

Groundwater beneath WP-339 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably north-northwest at this site. Four production wells are near this site: KAFB-1 is downgradient 1,500 ft northwest, Sandia-6 is cross-gradient 3,600 ft southeast, KAFB-4 is cross-gradient 4,800 ft southwest, and KAFB-7 is cross-gradient 5,000 ft southwest. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

16.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples collected at WP-339. Analytical results are presented in Table 16-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1]

(Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)								
				WP-339C-01		WP-339C-02						
				5–7	25–27	0–2	10–12	20–22 FR	20–22	30–32	40–42	44–46
VOC	Acetone	7,800	0.10	0.011	ND	ND	ND	0.015	ND	ND	ND	ND
	Chlorobenzene	1,600	0.005	ND	ND	ND	0.002	ND	ND	ND	ND	0.002
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
SVOC	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	0.065	ND	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	0.055	ND	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	0.067	ND	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	0.066	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	0.43	0.14	0.19	ND	ND	1.3	0.34	0.43	0.31
	Chrysene	88.0	0.70	ND	ND	0.063	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	0.17	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	0.052	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	0.12	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	ND	ND	ND	0.092	ND	0.15	ND
	Pyrene	2,300	0.70	ND	ND	0.29	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	7,850	3,850	7,700	3,920	7,750	6,320	6,490	16,900	3,270
	Antimony	31.0	N/A	ND	ND	5.6	ND	ND	ND	ND	6.5	8.4
	Arsenic	0.37	6.5	4.4	1.6	3.9	1.3	2.8	2.9	2.2	3.8	1.5
	Barium	5,500	735	169	75.5	153	27.6	172	131	106	82.5	179
	Beryllium	0.15	0.84	0.44	0.22	0.40	0.22	0.47	0.43	0.39	0.85	0.23
	Cadmium	39.0	N/A	0.60	0.88	0.60	1.1	0.91	0.58	0.60	1.1	0.49
	Calcium	N/A	121,000	55,700	36,800	146,000	28,400	19,700	25,100	15,200	20,900	23,200
	Chromium, total	390	21.6	6.6	4.9	6.6	4.5	7.4	6.3	5.7	13.0	5.1
	Cobalt	4,700	15.4	4.7	3.8	4.2	3.4	5.2	4.4	4.4	6.7	4.3
	Copper	2,900	223	20.7	46.1	17.8	22.5	70.7	55.3	23.4	26.3	204
	Iron	N/A	23,800	9,590	9,800	7,450	8,370	11,100	9,420	10,400	16,200	7,090
	Lead	400	17.5	5.7	3.5	4.3	3.6	6.1	5.5	4.8	9.8	3.1
	Magnesium	N/A	10,400	6,000	2,930	3,120	3,130	3,740	3,750	3,740	6,370	2,020
	Manganese	390	549	232	194	86.9	200	215	198	222	351	168
	Mercury	23.0	N/A	0.24	ND	ND	ND	ND	ND	ND	ND	0.05
	Nickel	1,600	188	8.1	6.2	6.1	4.9	9.0	7.3	7.4	12.9	16.6
	Potassium	N/A	3,590	1,570	1,310	1,060	965	1,530	1,180	1,820	3,120	717
	Sodium	N/A	787	197	176	76.1	224	492	436	402	660	126
	Thallium	N/A	N/A	0.42	ND	ND	ND	ND	ND	ND	ND	ND
	Vanadium	550	55.3	33.5	19.5	18.1	14.7	19.1	16.6	18.7	22.6	13.5
	Zinc	23,000	114	39.6	38.1	24.2	30.4	77.9	51.6	43.6	57.9	84.4
OTHER	Moisture (%)			9.9	2.8	11.6	2.1	6.5	8.0	6.3	10.8	1.0

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)					
				WP-339C-03					
				0–2	10–12	20–22	30–32	40–42	50–52
VOC	Acetone	7,800	0.10	0.006	0.016	0.013	ND	ND	ND
	Chlorobenzene	1,600	0.005	ND	ND	0.002	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	0.001	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND
SVOC	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	0.15	ND	0.076	0.38	0.17	0.27
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	ND	ND	0.11	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	4,610	4,610	6,850	4,300	6,360	6,550
	Antimony	31.0	N/A	ND	3.2	ND	ND	ND	ND
	Arsenic	0.37	6.5	3.0	1.9	3.0	1.4	2.6	3.1
	Barium	5,500	735	141	73.9	91.2	22.2	130	84.6
	Beryllium	0.15	0.84	0.28	0.26	0.41	0.25	0.42	0.47
	Cadmium	39.0	N/A	ND	0.62	0.42	0.39	0.47	0.40
	Calcium	N/A	121,000	161,000	31,000	29,100	12,800	12,900	29,300
	Chromium, total	390	21.6	3.7	3.7	6.9	7.4	6.1	6.7
	Cobalt	4,700	15.4	2.8	4.0	4.3	3.4	4.0	4.4
	Copper	2,900	223	12.4	32.7	74.8	120	28.9	72.4
	Iron	N/A	23,800	4,470	8,740	9,850	8,230	8,560	8,750
	Lead	400	17.5	3.5	3.7	5.3	3.5	5.2	6.0
	Magnesium	N/A	10,400	2,760	3,310	3,600	2,480	3,320	3,810
	Manganese	390	549	64.3	302	189	149	183	221
	Mercury	23.0	N/A	ND	ND	ND	ND	ND	ND
	Nickel	1,600	188	4.0	5.8	11.7	7.2	9.4	10.2
	Potassium	N/A	3,590	603	1,440	1,340	829	1,290	1,270
	Sodium	N/A	787	86.9	224	476	285	355	393
	Thallium	N/A	N/A	ND	ND	ND	ND	ND	ND
	Vanadium	550	55.3	11.8	14.7	17.4	14.4	14.9	14.6
	Zinc	23,000	114	16.4	35.8	82.3	65.6	40.5	81.8
OTHER	Moisture (%)			12.6	2.5	8.2	3.9	6.3	7.7

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft) WP-339C-04 0–2	10–12	20–22	30–32	40–42	50–52
VOC	Acetone	7,800	0.10	0.024	0.008	0.009	ND	0.017	0.011
	Chlorobenzene	1,600	0.005	ND	ND	ND	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	0.007	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND
SVOC	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	0.40	5.4	0.11	0.13	0.38	0.049
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	0.49	0.24	ND	ND	ND	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	6,010	4,220	3,190	3,520	10,800	5,940
	Antimony	31.0	N/A	ND	6.3	7.2	ND	ND	7.2
	Arsenic	0.37	6.5	3.7	1.2	1.9	1.6	4.7	2.7
	Barium	5,500	735	165	53.7	117	63.6	105	81.6
	Beryllium	0.15	0.84	0.31	0.18	0.20	0.15	0.94	0.56
	Cadmium	39.0	N/A	0.70	0.46	ND	0.56	0.60	ND
	Calcium	N/A	121,000	161,000	19,100	27,400	27,600	58,200	24,900
	Chromium, total	390	21.6	4.9	5.2	3.8	4.5	10.8	5.3
	Cobalt	4,700	15.4	3.5	4.0	3.2	2.9	8.0	6.2
	Copper	2,900	223	14.8	66.0	72.9	49.3	88.2	30.5
	Iron	N/A	23,800	6,660	9,090	7,360	7,220	14,500	8,820
	Lead	400	17.5	6.2	3.3	3.3	3.8	11.7	7.7
	Magnesium	N/A	10,400	3,280	3,320	2,460	2,440	6,810	3,870
	Manganese	390	549	97.9	246	182	157	500	438
	Mercury	23.0	N/A	ND	ND	ND	0.05	ND	ND
	Nickel	1,600	188	6.6	9.4	4.3	6.6	30.2	8.7
	Potassium	N/A	3,590	907	925	880	870	1,940	1,290
	Sodium	N/A	787	241	259	177	194	925	467
	Thallium	N/A	N/A	ND	ND	ND	ND	ND	ND
	Vanadium	550	55.3	16.2	16.2	14.0	12.6	26.0	16.7
	Zinc	23,000	114	20.9	53.4	54.1	41.0	108	66.6
OTHER	Moisture (%)			11.7	3.4	1.4	1.6	15.9	10.3

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft) WP-339C-05 0–2	10–12	20–22	30–32	40–42	50–52
VOC	Acetone	7,800	0.10	ND	0.008	0.009	0.009	0.007	0.005
	Chlorobenzene	1,600	0.005	ND	ND	ND	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	0.003	ND	ND
	Methyl ethyl ketone	47,000	0.10	0.006	0.006	ND	0.003	ND	ND
	Methylene chloride	85.0	0.005	0.004	0.003	ND	0.002	0.002	0.002
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND
SVOC	Anthracene	23,000	N/A	0.036	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	0.11	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	0.12	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	0.16	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	0.099	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	0.05	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	0.39	0.12	1.2	0.26	0.15	0.076
	Chrysene	88.0	0.70	0.13	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	0.32	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	0.081	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	0.27	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	ND	ND	ND	ND
	Pyrene	2,300	0.70	0.47	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	4,520	4,370	9,310	3,190	7,420	3,010
	Antimony	31.0	N/A	7.9	ND	6.2	ND	ND	ND
	Arsenic	0.37	6.5	8.9	1.4	4.0	1.3	3.4	1.6
	Barium	5,500	735	161	79.7	111	26.8	55.4	205
	Beryllium	0.15	0.84	0.26	0.24	0.60	0.19	0.56	0.19
	Cadmium	39.0	N/A	0.34	0.35	0.81	0.47	0.74	0.38
	Calcium	N/A	121,000	69,400	24,500	30,700	16,300	45,900	33,700
	Chromium, total	390	21.6	5.1	5.2	9.3	4.0	7.7	4.1
	Cobalt	4,700	15.4	3.1	4.0	6.4	4.6	5.4	3.2
	Copper	2,900	223	28.4	40.0	79.0	123	85.9	43.6
	Iron	N/A	23,800	6,570	9,620	14,300	7,330	11,700	6,110
	Lead	400	17.5	13.8	4.0	8.5	5.7	7.5	3.3
	Magnesium	N/A	10,400	3,380	3,490	6,340	2,340	4,650	2,240
	Manganese	390	549	143	230	320	189	263	272
	Mercury	23.0	N/A	ND	ND	ND	ND	0.06	ND
	Nickel	1,600	188	6.2	6.2	24.3	9.9	10.8	6.0
	Potassium	N/A	3,590	1,150	1,400	1,580	874	1,400	704
	Sodium	N/A	787	53.3	78.2	595	179	515	165
	Thallium	N/A	N/A	ND	ND	ND	ND	ND	ND
	Vanadium	550	55.3	14.8	15.9	22.1	12.6	20.7	10.3
	Zinc	23,000	114	60.6	42.1	73.0	77.9	112	31.8
OTHER	Moisture (%)			3.2	3.4	10.9	2.4	12.6	2.3

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)					
				WP-339C-06					
				0–2	10–12	20–22	30–32	40–42	48–50
VOC	Acetone	7,800	0.10	0.005	0.009	0.009	0.072	0.009	0.006
	Chlorobenzene	1,600	0.005	ND	ND	ND	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	0.002	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	0.002	ND	ND	ND	ND	ND
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND
SVOC	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	0.10	2.0	0.42	0.26	0.32	0.17
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	ND	ND	ND	ND
	Pyrene	2,300	0.70	0.04	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	4,750	6,140	5,690	2,420	9,390	3,080
	Antimony	31.0	N/A	4.4	4.5	4.3	ND	4.7	ND
	Arsenic	0.37	6.5	3.2	3.0	2.7	0.93	3.8	1.6
	Barium	5,500	735	97.6	92.9	52.3	30.2	53.0	42.0
	Beryllium	0.15	0.84	0.29	0.34	0.35	0.13	0.68	0.19
	Cadmium	39.0	N/A	0.52	0.49	0.58	0.45	0.70	0.42
	Calcium	N/A	121,000	70,700	25,700	23,600	15,400	34,500	34,900
	Chromium, total	390	21.6	4.0	6.6	6.3	2.9	8.5	5.7
	Cobalt	4,700	15.4	2.9	4.5	4.1	2.6	5.8	3.5
	Copper	2,900	223	14.9	34.9	64.6	207	64.5	159
	Iron	N/A	23,800	6,480	10,900	10,100	5,780	11,700	6,620
	Lead	400	17.5	6.4	6.0	5.4	2.7	9.1	3.1
	Magnesium	N/A	10,400	2,310	4,190	3,450	1,920	5,210	3,550
	Manganese	390	549	81.2	232	204	124	338	358
	Mercury	23.0	N/A	0.06	ND	ND	ND	0.05	ND
	Nickel	1,600	188	4.4	8.7	7.8	5.4	11.5	6.5
	Potassium	N/A	3,590	747	1,340	1,140	671	1,950	918
	Sodium	N/A	787	52.1	440	352	162	667	179
	Thallium	N/A	N/A	ND	ND	ND	ND	ND	ND
	Vanadium	550	55.3	14.8	25.5	16.6	10.3	19.7	11.1
	Zinc	23,000	114	21.9	42.9	54.6	98.3	90.6	83.2
OTHER	Moisture (%)			9.4	8.6	6.5	2.4	13.0	3.4

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft) WP-339C-07					
				0–2	10–12	20–22	30–32	40–42	50–52
VOC	Acetone	7,800	0.10	0.008	0.009	0.022	0.023	0.021	0.03
	Chlorobenzene	1,600	0.005	ND	ND	ND	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	0.003	0.003	0.002	0.005	0.019
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND
SVOC	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	0.084	0.21	1.2	0.21
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	0.088	ND	ND	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	5,460	5,020	5,390	3,460	10,800	3,660
	Antimony	31.0	N/A	5.0	4.3	5.1	4.9	ND	ND
	Arsenic	0.37	6.5	3.0	2.1	2.7	1.3	4.0	1.6
	Barium	5,500	735	114	55.0	62.9	82.9	89.4	73.7
	Beryllium	0.15	0.84	0.34	0.20	0.34	0.18	0.71	0.25
	Cadmium	39.0	N/A	0.54	0.40	0.47	ND	0.69	0.45
	Calcium	N/A	121,000	79,200	18,700	11,400	18,300	43,300	53,800
	Chromium, total	390	21.6	4.9	6.0	5.9	3.4	9.9	4.4
	Cobalt	4,700	15.4	3.0	3.8	3.9	3.6	7.1	3.1
	Copper	2,900	223	12.2	44.6	80.6	56.1	55.1	38.2
	Iron	N/A	23,800	6,170	9,450	9,400	7,890	14,200	7,870
	Lead	400	17.5	5.5	5.0	5.8	2.9	9.7	3.9
	Magnesium	N/A	10,400	2,640	3,220	3,530	2,540	6,180	2,540
	Manganese	390	549	91.6	279	181	181	383	235
	Mercury	23.0	N/A	0.06	ND	ND	ND	ND	ND
	Nickel	1,600	188	4.9	6.5	8.0	4.6	14.4	7.8
	Potassium	N/A	3,590	939	940	1,160	1,080	1,900	908
	Sodium	N/A	787	46.2	290	352	139	632	193
	Thallium	N/A	N/A	ND	ND	ND	ND	ND	ND
	Vanadium	550	55.3	14.6	13.8	15.2	14.3	23.6	13.8
	Zinc	23,000	114	17.9	38.5	91.3	41.4	116	35.3
OTHER	Moisture (%)			9.1	5.1	6.2	2.9	13.5	5.0

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)					
				WP-339C-08					
				0–2	10–12	20–22	30–32	40–42	50–52
VOC	Acetone	7,800	0.10	0.012	0.013	ND	ND	0.013	ND
	Chlorobenzene	1,600	0.005	ND	ND	ND	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	0.007	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	0.003	0.003	ND	0.002
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	0.002	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND
SVOC	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	1.1	0.077	ND	0.059
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	0.19	ND	0.12	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	3,620	5,760	9,070	7,860	16,000	5,340
	Antimony	31.0	N/A	ND	ND	ND	ND	ND	ND
	Arsenic	0.37	6.5	5.5	2.7	3.4	2.5	4.9	2.7
	Barium	5,500	735	1,340	135	73.7	91.1	60.6	173
	Beryllium	0.15	0.84	0.15	0.35	0.54	0.42	0.88	0.31
	Cadmium	39.0	N/A	ND	0.58	0.60	0.47	0.75	ND
	Calcium	N/A	121,000	281,000	18,500	18,800	18,500	21,200	41,600
	Chromium, total	390	21.6	3.0	5.8	8.6	7.3	12.3	5.7
	Cobalt	4,700	15.4	2.4	4.5	4.9	4.6	7.4	4.8
	Copper	2,900	223	12.7	15.5	45.9	13.8	13.3	73.0
	Iron	N/A	23,800	2,870	10,000	11,900	11,000	17,300	11,200
	Lead	400	17.5	1.8	6.0	7.0	5.6	10.7	5.4
	Magnesium	N/A	10,400	7,060	3,990	4,610	4,070	6,910	3,700
	Manganese	390	549	26.5	238	237	226	380	298
	Mercury	23.0	N/A	0.09	0.07	0.09	0.07	0.19	0.09
	Nickel	1,600	188	2.6	7.2	9.7	7.3	13.4	7.3
	Potassium	N/A	3,590	372	1,390	1,540	1,860	2,940	1,460
	Sodium	N/A	787	137	302	612	430	726	230
	Thallium	N/A	N/A	0.33	ND	ND	ND	ND	ND
	Vanadium	550	55.3	15.4	16.4	18.6	17.1	25.0	19.2
	Zinc	23,000	114	11.0	32.1	56.9	40.4	45.7	57.2
OTHER	Moisture (%)			12.1	7.0	7.0	2.1	17.4	16.6

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)					
				WP-339C-09					
				0–2	10–12	20–22	30–32	40–42	49–51
VOC	Acetone	7,800	0.10	0.021	ND	0.008	0.012	ND	ND
	Chlorobenzene	1,600	0.005	ND	ND	0.008	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	0.007	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	0.006	ND	ND	ND	ND	ND
	Methylene chloride	85.0	0.005	ND	0.005	ND	ND	ND	ND
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	ND	ND	ND
	Toluene	16,000	0.005	ND	ND	0.001	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	0.013	ND	ND	ND
SVOC	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	0.12	0.27	0.18	0.13
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	0.13	0.11	ND	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	5,090	4,110	6,290	3,360	13,600	3,540
	Antimony	31.0	N/A	ND	ND	ND	ND	ND	ND
	Arsenic	0.37	6.5	2.6	1.4	3.0	1.2	4.4	2.2
	Barium	5,500	735	93.2	37.7	97.4	17.8	272	51.4
	Beryllium	0.15	0.84	0.28	0.20	0.42	0.19	0.80	0.21
	Cadmium	39.0	N/A	0.50	0.66	0.44	0.43	0.95	ND
	Calcium	N/A	121,000	70,600	17,800	11,700	10,300	44,800	43,300
	Chromium, total	390	21.6	4.7	4.4	5.9	3.6	11.0	4.4
	Cobalt	4,700	15.4	2.9	4.0	4.8	3.3	7.6	3.2
	Copper	2,900	223	8.3	15.1	18.9	65.7	17.4	42.6
	Iron	N/A	23,800	5,810	9,410	10,600	7,810	15,700	7,090
	Lead	400	17.5	91.2	3.9	5.9	2.7	9.7	3.3
	Magnesium	N/A	10,400	2,620	3,100	3,740	2,030	6,860	2,420
	Manganese	390	549	85.1	215	215	138	378	282
	Mercury	23.0	N/A	0.13	0.10	0.17	0.07	0.08	0.09
	Nickel	1,600	188	4.0	4.0	8.2	3.4	13.8	4.3
	Potassium	N/A	3,590	978	1,300	1,260	804	2,130	785
	Sodium	N/A	787	74.4	197	368	167	745	152
	Thallium	N/A	N/A	ND	ND	ND	ND	ND	ND
	Vanadium	550	55.3	13.0	15.4	15.1	13.3	23.4	13.0
	Zinc	23,000	114	16.1	29.4	39.6	43.5	57.0	36.8
OTHER	Moisture (%)			10.8	3.4	6.3	2.6	12.0	1.9

Table 16-2. Summary of Reportable Concentrations for Soil Analyses at WP-339, Contractor Yard West of Building 20423 (WP-339)[1] (Concentrations mg/kg) (Concluded)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)						
				WP-339C-10						
				0–2	10–12	20–22 FR	20–22	30–32	40–42	50–52
VOC	Acetone	7,800	0.10	ND	ND	0.019	ND	0.015	0.013	0.022
	Chlorobenzene	1,600	0.005	ND	ND	ND	ND	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND	ND
	2-Hexanone	N/A	0.05	ND	ND	ND	ND	ND	ND	ND
	Methyl ethyl ketone	47,000	0.10	ND	ND	ND	ND	0.005	ND	ND
	Methylene chloride	85.0	0.005	ND	ND	ND	ND	ND	ND	ND
	Tetrachloroethylene	12.0	0.005	ND	ND	ND	0.002	ND	ND	ND
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND	ND
	Total Xylenes	160,000	0.005	ND	ND	ND	ND	ND	ND	ND
SVOC	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	0.21	0.17	ND	0.60	0.43	ND	0.20
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND
	Phenol	47,000	0.30	ND	ND	0.21	0.12	ND	ND	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND	ND
METALS	Aluminum	78,000	14,700	6,460	5,940	7,490	6,360	6,520	9,080	8,300
	Antimony	31.0	N/A	ND	ND	ND	ND	ND	ND	ND
	Arsenic	0.37	6.5	88.2	3.0	3.0	3.0	2.7	3.8	3.4
	Barium	5,500	735	366	86.1	283	151	114	56.6	136
	Beryllium	0.15	0.84	0.37	0.40	0.40	0.38	0.37	0.62	0.57
	Cadmium	39.0	N/A	ND	ND	0.72	ND	0.59	0.75	0.59
	Calcium	N/A	121,000	33,900	12,500	30,800	30,000	17,600	44,300	22,000
	Chromium, total	390	21.6	5.5	6.3	7.2	9.2	11.9	8.0	8.0
	Cobalt	4,700	15.4	3.6	4.9	4.6	4.2	5.1	6.0	5.3
	Copper	2,900	223	14.5	25.1	154	15.1	155	14.7	9.7
	Iron	N/A	23,800	7,070	10,500	10,700	10,200	11,600	11,700	12,700
	Lead	400	17.5	4.2	5.8	5.6	5.5	6.3	7.9	7.3
	Magnesium	N/A	10,400	3,220	3,910	3,860	3,210	3,750	5,120	4,410
	Manganese	390	549	147	221	212	182	227	299	262
	Mercury	23.0	N/A	0.06	0.07	ND	0.08	0.08	0.10	0.12
	Nickel	1,600	188	5.4	9.1	11.4	12.5	20.7	10.8	8.6
	Potassium	N/A	3,590	1,360	1,240	1,480	1,310	1,520	1,640	1,620
	Sodium	N/A	787	50.4	194	494	422	460	750	454
	Thallium	N/A	N/A	ND	ND	ND	ND	ND	ND	ND
	Vanadium	550	55.3	14.7	17.2	17.3	17.2	19.4	18.5	20.5
	Zinc	23,000	114	22.6	33.4	124	28.3	83.8	44.1	31.8
OTHER	Moisture (%)			6.2	6.2	5.7	8.0	2.5	11.1	11.6

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Organic Compounds

Nine VOCs were detected in samples collected at this site. Acetone (0.005 to 0.072 mg/kg) was detected in 36 samples. Chlorobenzene (0.002 to 0.008 mg/kg) was detected in four samples. Ethylbenzene (0.007 mg/kg) was detected in one sample, WP-339C-09 (20 to 22 ft). The compound 2-hexanone (0.003 mg/kg) was detected in one sample, WP-339C-05 (30 to 32 ft). Methyl ethyl ketone (0.002 to 0.007 mg/kg) was detected in eight samples. Methylene chloride (0.002 to 0.019 mg/kg) was detected in 15 samples. Tetrachloroethylene (0.002 mg/kg) was detected in one sample, WP-339C-10 (20 to 22 ft). Toluene (0.001 to 0.002 mg/kg) was detected in three samples. Total xylenes (0.013 mg/kg) were detected in one sample, WP-339C-09 (20 to 22 ft). All concentrations of VOCs detected at this site were below HHRB action levels.

Thirteen SVOCs were detected in samples collected at this site. The only SVOC detected in the background samples was bis(2-ethylhexyl)phthalate (0.43 to 0.41 mg/kg) at depths of 5 to 7 ft bgs and 25 to 27 ft bgs, respectively. Eleven of the 13 SVOCs were PAHs (0.036 to 0.47 mg/kg) and were detected in samples WP-339C-02 (0 to 2 ft) and WP-339C-05 (0 to 2 ft). Benzo(a)pyrene (0.12 mg/kg) was detected in WP-339C-02 (0 to 2 ft), exceeding the HHRB action level of 0.088 mg/kg.

Other SVOC compounds detected in samples collected at this site include bis(2-ethylhexyl)phthalate and phenol. These compounds were detected at concentrations below HHRB action levels.

Metals

Table 16-2 lists all reportable metal concentrations detected at WP-339 and the respective UTL and HHRB action level concentrations. Arsenic, beryllium, and manganese were detected at concentrations above the HHRB action level. Aluminum, arsenic, beryllium, calcium, iron, lead, and zinc were detected at concentrations above the UTL in one or more samples collected at WP-339. The concentrations of aluminum, calcium, iron, and zinc in these samples were below the respective HHRB action level. Lead (1.8 to 91.2 mg/kg) was detected at a concentration over five times the UTL in the 0- to 2-ft sample from WP-339C-09. This concentration is below the 400 mg/kg HHRB action level. Arsenic (0.93 to 88.2 mg/kg) was detected in all samples; the concentrations exceed the HHRB action level of 0.37 mg/kg. In addition, the arsenic concentration detected in two samples exceeds the UTL of 6.5 mg/kg. Beryllium (0.13 to 0.88 mg/kg) was detected in all samples. The beryllium concentrations detected in all samples (except WP-339C-06 (30 to 32 ft) exceed the HHRB action level of 0.15 mg/kg. Manganese (64.3 to 500 mg/kg) was detected in all samples. The manganese concentration in two samples, WP-339C-04 (40 to 42 ft) and WP-339C-04 (50 to 52 ft) 500 and 438 mg/kg, respectively, exceeds the HHRB action level for manganese of 390 mg/kg. The concentrations of arsenic, beryllium, and manganese appear to be naturally occurring throughout Kirtland AFB as discussed in Section 4.2.2.

Soil Moisture

Soil moisture values ranged from 1.0 to 17.4 percent.

16.5 Conclusions and Recommendations

Conclusions

- Nine VOCs were detected in samples collected from this site; all VOC concentrations were below HHRB action levels.
- Thirteen SVOCs were detected in samples collected at this site; 11 were PAHs. One compound, benzo(a)pyrene, was detected above its HHRB action level. Other SVOC compounds detected in samples collected at this site include bis(2-ethylhexyl)phthalate and phenol; these compounds were detected below HHRB action levels.
- Arsenic, beryllium, and manganese were the only metals detected at concentrations exceeding HHRB action levels; the concentrations appear to be naturally occurring throughout Kirtland AFB.
- The analytical results at WP-339 indicate a contaminant release at this site. The detections of PAHs in the shallow samples at locations WP-339C-02 and WP-339C-05 probably indicate surface releases.

Recommendations

- Because of the presence of a PAH above the HHRB action level, additional investigation is recommended to confirm that surface releases have occurred at two locations and to determine the full extent of contamination.

17.0 SWMU 8-41, Building 20423, Waste Battery Storage Area (ST-274)

17.1 Site Background and Environmental Setting

The waste battery storage area (SWMU 8-41), Building 20423, is in the northwest portion of the base (Figure 17-1); it is southeast of the Contractor's Yard (WP-339). The unit is currently used for waste battery storage from other base facilities. This site is an uncovered, fenced, dirt, and gravel area approximately 50 ft x 20 ft. Used batteries of various types and sizes are stored on wood pallets or in 55-gallon drums. Historically, the loaded pallets were double-stacked and were typically stored for 6 months prior to collection by an off-site contractor. Cracked or broken batteries are drained prior to shipment to the yard; however, the storage area typically receives whole batteries. During the RFA VSI, broken, uncovered batteries were observed resting on the ground (Kearney/Centaur, 1988). However, there has been no history of releases at the unit. The waste battery storage area was investigated on June 3, 1994.

SWMU 8-41 is in the urban/industrial zone, which is discussed in Section 2.0. The nearest production wells to this site are Sandia-6, 3,700 ft east; KAFB-7, 4,900 ft southwest; KAFB-4, 4,400 ft southwest; and KAFB-1, 1,900 ft northwest.

17.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of SWMU 8-41 from ground surface to 6 ft below grade.

17.2.1 Previous Investigations

Surface soil sampling was conducted by the Kirtland AFB Environmental Management/Compliance Branch (EMC) in March 1993 (background samples from around the storage area boundary only) and July 1994 because EMC was unaware that the waste battery storage area was an IRP site. Results from the July 1994 sampling indicated the presence of lead contamination with concentrations up to 3,500 mg/kg (Table 17-1). On October 7, 1994, approximately 6 in. of surface soil was removed from the storage area, containerized in three 55-gallon drums, and transported from the site. Analytical results from five surface soil samples collected from the waste battery storage area immediately after the soil removal showed lead concentrations below the 17.5 mg/kg UTL in two samples, and slightly exceeding the UTL in the other three (Table 17-2).

17.2.2 Data Gaps

No data were available to confirm the presence or absence of contaminants at depth in soil beneath this site.

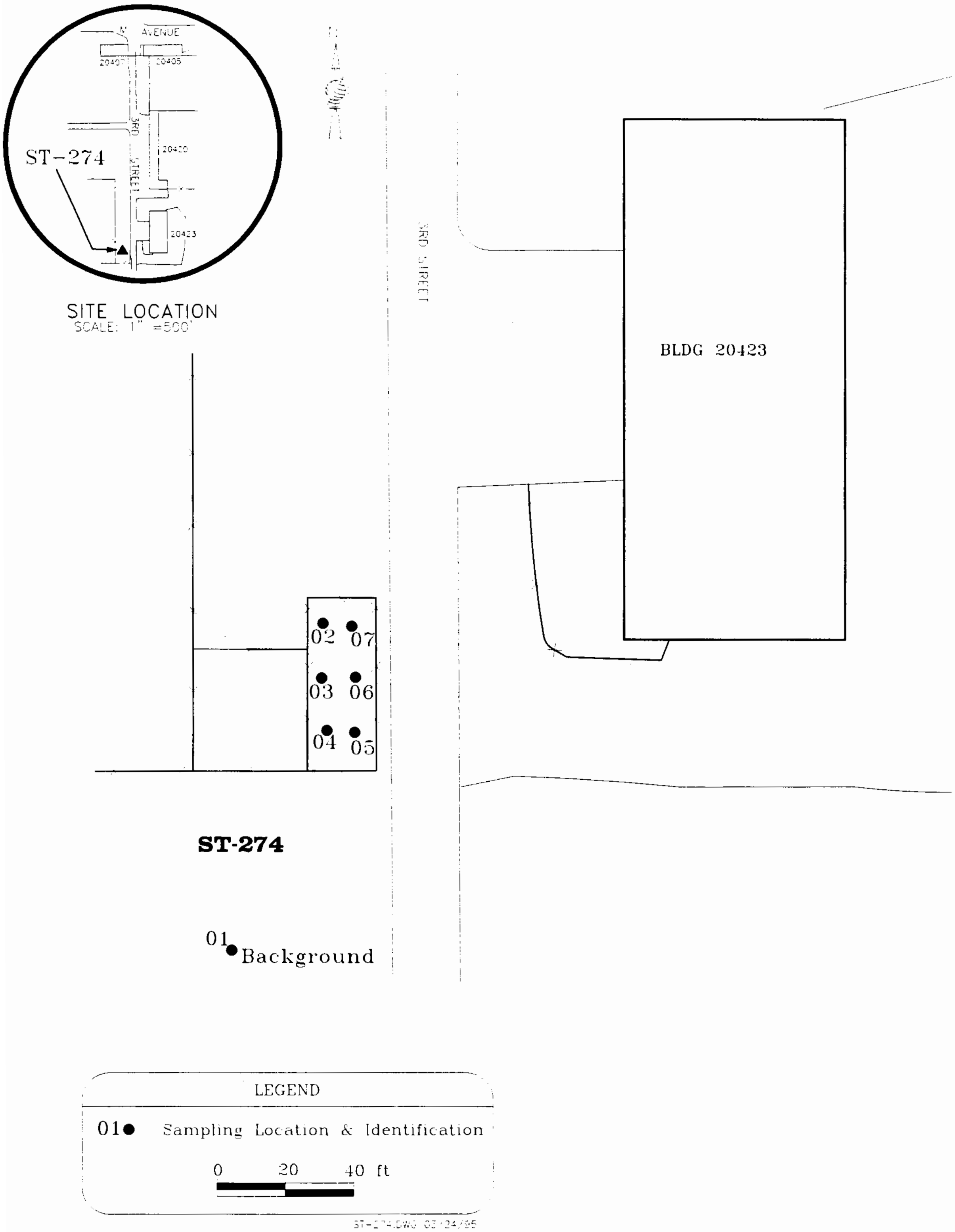


Figure 17-1. Soil Sampling Locations at SWMU 8-41, Building 20423, Waste Battery Storage Area (ST-274)

Table 17-1. Analytical Results for Lead in Surface Soil Samples at SWMU 8-41, Building 20423, Waste Battery Storage Area (ST-274)

Date Collected	Sample Number	Sample Location	Lead Concentration (mg/kg)
March 16, 1993	K120423B #1[1]	Not recorded	2.5[2]
March 16, 1993	K120423B #2[1]	Not recorded	2.4[2]
March 16, 1993	K120423B #3[1]	Not recorded	2.15[2]
July 12, 1994	9407121420	NW corner; surface sample	53.5[3]
July 12, 1994	9407121440	NW corner; 6 in. below surface	7.5[3]
July 12, 1994	9407121445	W corner; surface sample	29.0[3]
July 12, 1994	9407121500	W central; 6 in. below surface	19.0[3]
July 12, 1994	9407121515	E central; surface sample	85.0[3]
July 12, 1994	9407121520	E central; 6 in. below surface	15.5[3]
July 12, 1994	9407121530	S; surface sample	3,500[3]
July 12, 1994	9407121545	S; 6 in. below surface	136.0[3]

1. Background sample
2. Analysis by Graphite Furnace/Atomic Adsorption (GFAA) Method 7421
3. Analysis by Flame/Atomic Adsorption (FAA) Method 7420

Table 17-2. Analytical Results for Lead Following Surface Soil Removal at SWMU 8-41, Building 20423, Waste Battery Storage Area (ST-274)

Date Collected	Sample Location	Lead Concentration (mg/kg)[1]
October 7, 1994	Center of pit	16.04
October 7, 1994	NE Corner	18.52
October 7, 1994	SW Corner	24.6
October 7, 1994	NW Corner	23.4
October 7, 1994	SE Corner	14.80

1. Analysis by Flame Atomic Adsorption (FAA) Method 7420

17.2.3 RFI Field Investigation

The objective of the investigation was to determine the presence or absence of contaminants in soil adjacent to SWMU 8-41. Seven boreholes were drilled with a Geoprobe to a depth of 5 ft. Boreholes, ST-274C-02 to ST-274C-07 were drilled on an equally spaced grid over the area. Three soil samples per borehole were collected for laboratory analysis. Samples were collected at the surface and at depths of 2 and 5 ft below grade. Borehole ST-274C-01 was drilled approximately 60 ft southwest of the site to collect site-specific background soil concentrations. This borehole was assumed to be in an area away from known or suspected contamination. The background soil sample was collected at a depth of 5 ft below grade. Borehole locations are shown in Figure 17-1.

Sampling operations and sampling handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples collected and submitted for analysis are listed in Table 17-3. Borehole logs are in Appendix C.

17.2.4 Laboratory Analysis

Soil samples collected within the waste battery storage area were analyzed for lead, mercury, and soil moisture. One sample, ST-274C-03 (5 to 6 ft), was also analyzed for metals to determine if any other metal contamination is present and for TCLP lead to determine the leachate concentration of any potential lead contamination. The sample from the background sampling borehole was analyzed for metals, TCLP lead, and soil moisture. The brass tubes in each sample interval were field-screened for possible contamination using gamma and beta-gamma meters and/or a PID or FID. No readings above background values were measured with these instruments.

Table 17-3. Boreholes and Samples Submitted for Analysis at SWMU 8-41, Building 20423, Waste Battery Storage Area (ST-274)

Borehole	Borehole Location	Depth (ft)		
01	Background sampling location, ~ 60 ft S of site	NS	5-6	NS
02	In NW corner of site	0-1	2-3	4-6
03	Between boreholes 02 and 04	0-1	1-2[a]	5-6
04	In SW corner of site	0-1	1-2[a]	5-6
05	In SE corner of site	0-1	1-2	5-6
06	Between boreholes 05 and 07	0-1	1-2	5-6[a]
07	In NE corner of site	0-1	1-2	4-6

NS No sample collected at this depth
a. Replicate sample also collected at this depth interval.

17.3 Site Characteristics

17.3.1 Geology

The site is underlain by unconsolidated alluvial sediment that is predominantly very fine-grained sand to fine-grained silty sand. Disseminated and nodule caliche was present in all boreholes drilled in the waste battery storage area, at depths between 2 and 4 ft below grade. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this site are presented in Appendix C.

17.3.2 Hydrogeology

Groundwater beneath SWMU 8-41 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

The gradient is probably northwest at this site. Three production wells are near this site: KAFB-1 is downgradient 1,900 ft northwest, Sandia-6 is upgradient 3,700 ft east, KAFB-7 is cross-gradient 4,900 ft southwest, and KAFB-4 is cross-gradient 4,400 ft southwest. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

17.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples collected at SWMU 8-41. Analytical results are presented in Table 17-4, where only the reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Metals

Table 17-4 lists all reportable metals concentrations and the respective UTL and HHRB action level concentrations. Only two samples (the 5- to 6-ft intervals from boreholes ST-274C-01 and ST-274C-03) were analyzed for the full Method 6010 suite of metals and TCLP lead. In these samples, arsenic and beryllium were the only metals detected at concentrations exceeding HHRB action levels. Arsenic (3.0 and 6.4 mg/kg) was detected above the 0.37 mg/kg HHRB action level, but below the 6.5 mg/kg UTL concentration. Beryllium (0.56 and 0.46 mg/kg) was detected above the 0.15 mg/kg HHRB action level, but below the 0.84 mg/kg UTL concentration. These concentrations appear to be naturally occurring at Kirtland AFB as discussed in Section 4.2.2.

Mercury was not detected in any of the samples collected at this site. Lead (30.2 and 54.4 mg/kg) was detected in the 0- to 1-ft samples from boreholes ST-274C-04 and ST-274C-05. These concentrations exceed the 17.5 mg/kg UTL, but are below the 400 mg/kg HHRB action level. Lead was not detected in the TCLP analysis of the 5- to 6-ft samples from boreholes ST-274C-01 and ST-274C-03.

Soil Moisture

Soil moisture values ranged from 8.3 to 19.0 percent.

17.5 Conclusions and Recommendations

Conclusions

- Arsenic and beryllium were the only metals detected at concentrations exceeding HHRB action levels; the concentrations appear to be naturally occurring throughout Kirtland AFB.
- The analytical results at SWMU 8-41 are not indicative of a contaminant release from this site.

Recommendations

- Based on the findings of the RFI, no further action is necessary at SWMU 8-41; therefore, this site does not require further investigation. A No Further Action proposal should be prepared.

Table 17-4. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-41, Building 20423, Waste Battery Storage Area (ST-274)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)											
				ST-274C-01	ST-274C-02			ST-274C-03				ST-274C-04			
				5–6	0–1	2–3	4–6	0–1	1–2 FR	1–2	5–6	0–1	1–2 FR	1–2	5–6
METALS	Aluminum	78,000	14,700	9,520	N/A	N/A	N/A	N/A	N/A	N/A	7,310	N/A	N/A	N/A	N/A
	Arsenic	0.37	6.5	3.0	N/A	N/A	N/A	N/A	N/A	N/A	6.4	N/A	N/A	N/A	N/A
	Barium	5,500	735	184	N/A	N/A	N/A	N/A	N/A	N/A	411	N/A	N/A	N/A	N/A
	Beryllium	0.15	0.84	0.56	N/A	N/A	N/A	N/A	N/A	N/A	0.46	N/A	N/A	N/A	N/A
	Calcium	N/A	121,000	45,400	N/A	N/A	N/A	N/A	N/A	N/A	96,700	N/A	N/A	N/A	N/A
	Chromium, total	390	21.6	8.0	N/A	N/A	N/A	N/A	N/A	N/A	7.0	N/A	N/A	N/A	N/A
	Cobalt	4,700	15.4	7.6	N/A	N/A	N/A	N/A	N/A	N/A	4.2	N/A	N/A	N/A	N/A
	Copper	2,900	223	12.7	N/A	N/A	N/A	N/A	N/A	N/A	12.1	N/A	N/A	N/A	N/A
	Iron	N/A	23,800	13,800	N/A	N/A	N/A	N/A	N/A	N/A	8,730	N/A	N/A	N/A	N/A
	Lead	400	17.5	4.6	4.0	3.2	6.6	11.3	3.9	4.0	5.2	30.2	6.3	6.7	5.5
	Magnesium	N/A	10,400	6,570	N/A	N/A	N/A	N/A	N/A	N/A	8,530	N/A	N/A	N/A	N/A
	Manganese	390	549	267	N/A	N/A	N/A	N/A	N/A	N/A	182	N/A	N/A	N/A	N/A
	Mercury	23.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Nickel	1,600	188	12.7	N/A	N/A	N/A	N/A	N/A	N/A	11.5	N/A	N/A	N/A	N/A
	Potassium	N/A	3,590	1,880	N/A	N/A	N/A	N/A	N/A	N/A	1,220	N/A	N/A	N/A	N/A
	Sodium	N/A	787	131	N/A	N/A	N/A	N/A	N/A	N/A	122	N/A	N/A	N/A	N/A
	Vanadium	550	55.3	39.2	N/A	N/A	N/A	N/A	N/A	N/A	42.3	N/A	N/A	N/A	N/A
	Zinc	23,000	114	36.0	N/A	N/A	N/A	N/A	N/A	N/A	28.2	N/A	N/A	N/A	N/A
OTHER	Moisture (%)			10.0	11.6	17.9	9.5	9.1	10.4	10.5	12.1	11.2	17.5	18.2	8.3

Table 17-4. Summary of Reportable Concentrations for Soil Analyses at SWMU 8-41, Building 20423, Waste Battery Storage Area (ST-274)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)									
				ST-274C-05			*ST-274C-06*				*ST-274C-07*		
				0–1	1–2	5–6	0–1	1–2	5–6 FR	5–6	0–1	1–2	4–6
METALS	Aluminum	78,000	14,700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Arsenic	0.37	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Barium	5,500	735	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Beryllium	0.15	0.84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Calcium	N/A	121,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Chromium, total	390	21.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Cobalt	4,700	15.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Copper	2,900	223	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Iron	N/A	23,800	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Lead	400	17.5	54.4	3.9	5.9	4.6	2.7	5.0	5.4	10.9	5.8	6.2
	Magnesium	N/A	10,400	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Manganese	390	549	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mercury	23.0	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Nickel	1,600	188	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Potassium	N/A	3,590	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Sodium	N/A	787	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Vanadium	550	55.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Zinc	23,000	114	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OTHER	Moisture (%)			11.8	19.0	11.4	13.3	15.6	9.9	10.7	8.9	15.7	10.7

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

18.0 ST-341, Building 1033, Condensate Holding Tank (ST-341)

18.1 Site Background and Environmental Setting

The condensate holding tank (ST-341) is at Building 1033 in the fuel management section west of the New Mexico Air National Guard Complex in the western portion of Kirtland AFB (Figure 18-1). ST-341 is a 300-gallon steel UST used to collect a fuel/water mixture from fuel pump water condensers. The bottom of the UST is 4 ft below grade. Since weekly monitoring began 4 years ago, fluid levels in the tank have not decreased. Every 30 to 40 days the fuel/water mixture is removed and the fuel is recycled. A buried steel overflow pipe extends about 240 ft southwest from the UST to an unlined evaporation pond (Figure 18-1). During a December 1993 site inspection, there were no visible soil stains, but the surface soil under the pipe outfall indicated disturbance by previous fluid discharge. ST-341 was investigated on July 26-27, 1994.

During a previous base environmental compliance and monitoring program inspection, a spill was observed near the UST standpipe. In December 1992, Kirtland AFB Compliance and Assessment personnel collected a soil sample near the spill area. The sample was analyzed according to EPA Methods 8020 and 418.1; it contained petroleum hydrocarbons, ethylbenzene, toluene, and xylenes. Shallow soil samples (6 to 7 in. below grade) were collected at four locations in the spill area. Hydrocarbon odors were noted at all sample locations and Kirtland AFB personnel reported a small area of surface soil contamination around the base of the UST standpipe and extending a few feet west.

The condensate holding tank is located in an urban/industrial zone, as discussed in Section 2.0. The nearest production wells to this site are: KAFB-2, 2,700 ft southwest; KAFB-7, 3,900 ft, southeast; and KAFB-14, 5,100 ft west-northwest.

18.2 Study Area Investigation

The area of investigation was limited to the soil in the vicinity of ST-341 from ground surface to approximately 12 ft below grade and one borehole at the evaporation pond that extended to 58 ft below grade.

18.2.1 Previous Investigations

Analytical results from the 1992 soil sample collected near the UST standpipe indicated that petroleum hydrocarbons were present in the soil at concentrations of 7,660 mg/kg and that ethylbenzene, toluene, and xylenes were present at concentrations of 52.2, 82.4, and 338 mg/kg, respectively (USAF, 1993). A follow-up visual survey by Kirtland AFB indicated that the lateral extent of soil contamination may extend a minimum of 7 ft away from the standpipe.

18.2.2 Data Gaps

The objective of the investigation was to collect soil samples in the immediate vicinity of the holding tank to define the horizontal and vertical extent of soil contamination at this site. One borehole was drilled at the evaporation pond to check for potential contamination.

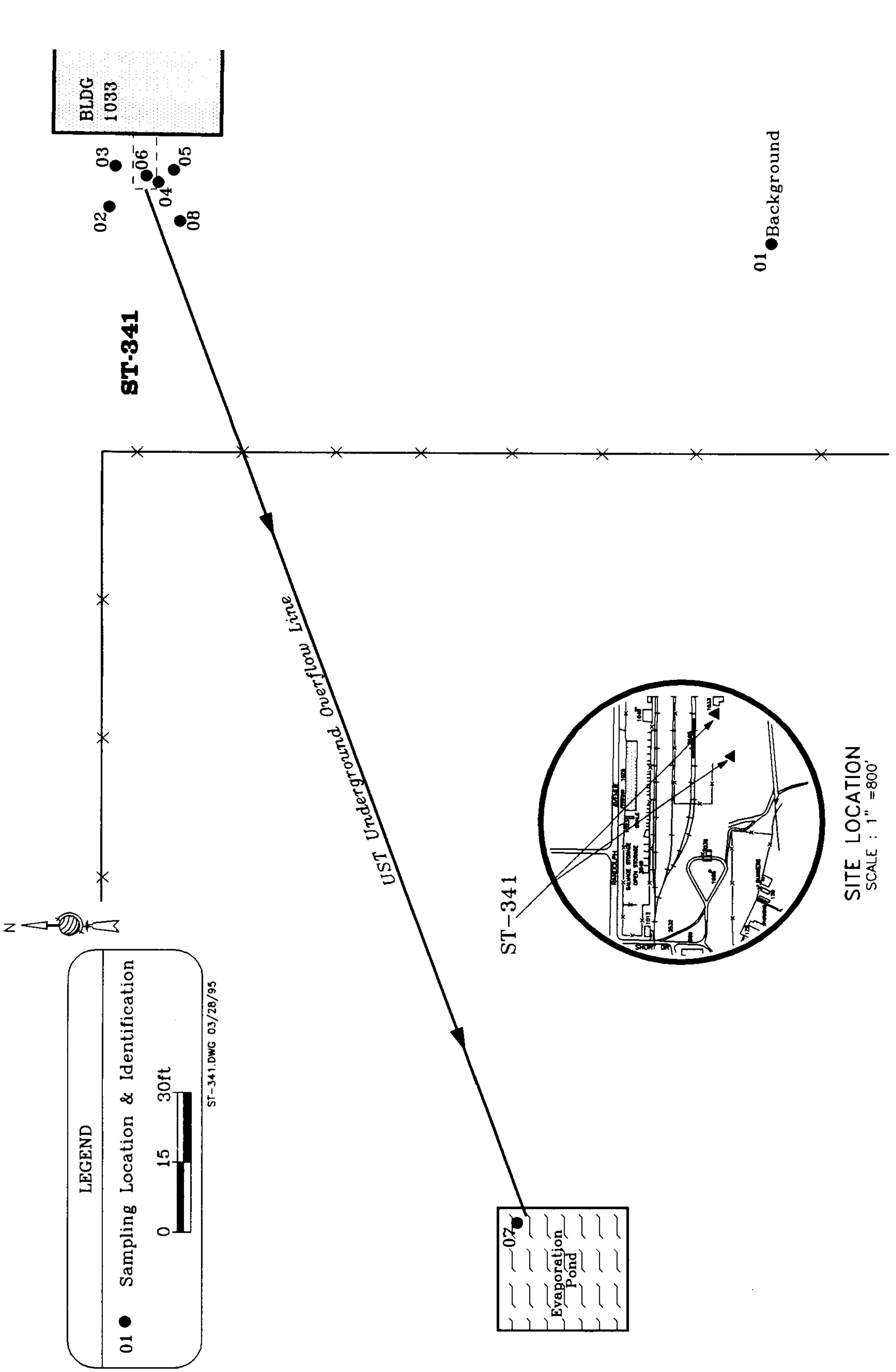


Figure 18-1. Soil Sampling Locations at ST-341, Building 1033, Condensate Holding Tank (ST-341)

18.2.3 RFI Field Investigation

On July 26-27, 1994, eight boreholes, ST-341C-01 through ST-341C-08, were drilled and sampled using either a Geoprobe or a hand auger. To collect background concentration data for ST-341, ST-341C-01 was drilled 134 ft south of the UST. This location was assumed to be in an area away from any known or suspected sources of contamination. This borehole was sampled at depths of 5 to 7 ft and 10 ft to 12 ft below grade. Six boreholes were drilled around the UST. ST-341C-03, ST-341C-05, and ST-341C-08 were drilled and sampled with a hand auger. At the boreholes around the UST, samples were collected at the surface and depths of 2 to 3 ft, 5 to 7 ft, and 10 to 12 ft. The east side of the UST was inaccessible for sampling because of the building wall. ST-341C-07 was drilled in the evaporation pond at the discharge point for the UST overflow pipe; the borehole was sampled to a depth of 58 ft. Elevated PID readings were observed in samples from locations are shown on Figure 18-1. Sample depths and PID readings for recovered sample intervals are listed in Table 18-1.

Sampling operations and sampling handling procedures are described in Section 3.0. Borehole locations, sample depths, and replicate samples collected and submitted for analysis for this site are shown in Table 18-1. Borehole logs are included in Appendix C.

18.2.4 Laboratory Analysis

Soil samples were analyzed for VOCs, SVOCs, TPH (the expected contaminants associated with normal operations at this site), and soil moisture. The four brass tubes in each 2-ft sample interval were field-screened for possible contamination using a beta-gamma meter and a PID. Elevated readings (ranging from 1 to 300 ppm_V above background) were measured in all but the background soil sample collected except those from ST-341C-01 (Table 18-1).

18.3 Site Characteristics

18.3.1 Geology

As a result of UST installation, it is probable that backfill material is present to a depth of at least 4 ft around the holding tank. Sediment encountered at ST-341 consisted predominantly of very fine-grained sand to fine-grained silty sand. At the evaporation pond, sediment was predominantly very fine-grained sand to fine-grained silty sand with increasing clay content below 12 ft. No boreholes penetrated into the Santa Fe Group sediments that presumably underlie this area. A discussion of the general geology at Kirtland AFB is presented in Section 2.4. Borehole logs for this site are presented in Appendix C.

18.3.2 Hydrogeology

Groundwater beneath ST-341 is found within the Upper Santa Fe sediments and is generally thought to be unconfined in the upper portion of the aquifer. This area is within the HR1 saturated zone setting as defined by SNL studies (Figure 2-9) (SNL, 1994). Hydrogeologic characterization in this portion of Kirtland AFB is complicated by the presence of numerous production wells (Figure 2-11). It is probable that uniform groundwater conditions do not exist in this region. Local cones of depression associated with groundwater withdrawal have altered the groundwater flow direction in the vicinity of the well fields (Figure 2-7).

Table 18-1. Boreholes and Samples Collected at ST-341, Building 1033, Condensate Holding Tank (ST-341)

Borehole	Borehole Location	Sample Depths (ft)	PID (ppm_V) [a,b]
01	Background sampling borehole 134 ft S of standpipe	5-7	0
		10-12	0
02	~ 10 ft NW of standpipe	0-2	0
		2-4	0
		5-7	54
		10-12	240
03	~ 6 ft NE of standpipe	0-2[c]	0
		2-3	25
		5-6	25
		9-10	250
04	~ 5 ft W of standpipe	0-2	250
		2-4	250
		5-7	300
		10-12	300
05	~ 6 ft S of standpipe	0-1	200
		2-3	30
		5-6	5
		8-9	6
06	Adjacent to standpipe	0-1	5
		1-2	120
07	At discharge point for the UST overflow line in the evaporation pond	0-2	140
		2-4	140
		5-7	110
		10-12	150
		20-22	200
		56-58	160
08	~ 12 ft SW of standpipe	0-1	1
		2-3	0.2
		5-6	200

a. ppm_V = parts-per-million volume (ml/L) as isobutylene for the PID.

b. PID readings are values above background. Only the highest value for the interval is listed.

c. Replicate sample also collected in this depth interval.

The gradient is probably northwest at this site. Three production wells are located near ST-341: KAFB-2 is upgradient or cross-gradient 2,700 ft southwest, KAFB-7 is upgradient 3,900 ft southeast, and KAFB-14 is cross-gradient 5,100 ft west-northwest. Depth to groundwater is estimated to be 350 ft below grade (Figure 2-10); however, shallower perched water zones may occur. Hydraulic conductivity within HR1 is estimated at 2 to 171 ft/day (SNL, 1994). A general discussion of the hydrogeology at Kirtland AFB is presented in Section 2.5.

18.4 Nature and Extent of Contamination

The following section describes the nature and extent of contamination based on analytical results for soil samples collected at ST-341. Analytical results are presented in Table 18-2, where only reportable concentrations of detected analytes are listed. Full analytical results are presented in Appendix F. Laboratory validation reports are presented in Appendix K.

Organic Compounds

Five VOCs were detected in samples submitted for analysis from ST-341 (Table 18-2). These VOCs were chlorobenzene, ethylbenzene, toluene, m, p-xylene (sum of isomers), and o-xylene. Chlorobenzene (0.124 to 0.375 mg/kg) was only detected in the 2- to 4-ft sample from ST-341C-04, the 8- to 9-ft sample from ST-341C-05, and the 1- to 2-ft sample from ST-341C-06. Ethylbenzene (0.072 to 45.0 mg/kg) was detected in 6 of the 30 samples (including one replicate) collected at ST-341. Toluene (0.048 to 6.6 mg/kg) was detected in eight of the 30 samples (including one replicate). m,p-Xylene (0.006 to 150 mg/kg) were detected in 20 of the 30 site samples. o-Xylene (0.004 to 60.0 mg/kg) was detected in 16 of the 30 samples. The highest VOC concentrations were detected in the 9- to 10-ft sample from ST-341C-03 and the 5- to 6-ft sample from ST-341C-08 (Table 18-2). All concentrations detected were below the respective HHRB action levels. No VOCs were detected in the background sampling borehole ST-341C-01.

A total of 22 SVOCs were detected in samples from ST-341 (Table 18-2). Thirteen of the 22 SVOCs are PAHs. The greatest variety and highest SVOC concentrations were detected in the 9- to 10-ft sample from ST-341C-03, the 8- to 9- ft sample from ST-341C-05, and the 5- to 6-ft sample from ST-341C-08. Benzo(a)anthracene (0.51 to 4.9 mg/kg), benzo(a)pyrene (0.30 to 1.8 mg/kg), and benzo(b)fluoranthene (0.11 to 2.4 mg/kg) were detected at concentrations exceeding the respective HHRB action levels in one or more samples at ST-341. Except for a 0.30 mg/kg detection of benzo(a)pyrene in the 8- to 9-ft sample from ST-341C-05, the SVOC concentrations exceeding the HHRB action levels were all in the 9- to 10-ft sample from ST-341C-03 and the 5- to 6-ft sample from ST-341C-08. Indeno(1,2,3-c,d)pyrene (0.45 to 0.88 mg/kg) was detected in the 9- to 10-ft sample from ST-341C-03 at a concentration equal to the 0.88 mg/kg HHRB action level.

Petroleum Hydrocarbons

Diesel range hydrocarbons (5.2 to 10,000 mg/kg) were detected in 18 of the 30 samples (including one replicate) submitted for analysis from ST-341; 15 of the 18 concentrations exceed the 100 mg/kg NMED action level (Table 18-2). The results from boreholes sampled around the holding tank indicate that diesel range hydrocarbon concentrations exceeding the NMED action level of 100 mg/kg are present in soil to at least a depth of 12 ft. At the evaporation pond, diesel hydrocarbon concentrations apparently decrease with depth. The 110 mg/kg detection in the 56- to 58-ft sample from borehole ST-341C-07 indicates that contamination extends deeper at this location (Table 18-2).

Table 18-2. Summary of Reportable Concentrations for Soil Analyses at SWMU ST-341, Building 1033, Condensate Holding Tank (ST-341)[1] (Concentrations mg/kg)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)										
				ST-341C-01		ST-341C-02				ST-341C-03				
				5–7	10–12	0–2	2–4	5–7	10–12	0–2 FR	0–2	2–3	5–6	9–10
VOC	Chlorobenzene	1,600	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	45.0
	Toluene	16,000	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	M,p-xylene (sum of isomers)	160,000	N/A	ND	ND	0.016	ND	0.56	0.43	ND	0.006	ND	ND	150
	O-xylene	160,000	N/A	ND	ND	ND	ND	0.29	0.25	ND	ND	ND	ND	60.0
SVOC	Acenapthene	4,700	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8
	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.1
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.9
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	0.11	ND	ND	ND	ND	2.4
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.71
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	0.094	ND	ND	ND	ND	2.6
	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.5
	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	0.37	ND	ND	ND	ND	ND	ND
	Dibenzofuran	310	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1
	1,2-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1,3-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1,4-Dichlorobenzene	27.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	0.45	ND	ND	ND	ND	10.0
	Fluorene	3,100	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.88
	2-Methylnaphthalene	N/A	0.70	ND	ND	ND	ND	ND	8.3	ND	ND	ND	ND	8.7
	Naphthalene	3,100	0.70	ND	ND	ND	ND	ND	3.2	ND	ND	ND	ND	6.0
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	0.43	ND	ND	ND	ND	9.0
	Phenol	47,000	0.30	0.44	0.68	0.61	0.96	1.0	2.3	ND	ND	ND	ND	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	0.30	ND	ND	ND	ND	9.9
TPH	Diesel fraction	100	10.0	ND	ND	ND	ND	ND	2,000	ND	ND	ND	ND	2,000
	Gasoline fraction	100	1.0	ND	ND	0.25	0.50	2,700	37.0	ND	0.80	ND	0.22	360,000
OTHER	Moisture (%)			6.1	8.9	6.3	10.3	9.1	10.8	9.4	9.6	9.3	10.1	7.2

Table 18-2. Summary of Reportable Concentrations for Soil Analyses at SWMU ST-341, Building 1033, Condensate Holding Tank (ST-341)[1] (Concentrations mg/kg) (Continued)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)									
				ST-341C-04				ST-341C-05				ST-341C-06	
				0–2	2–4	5–7	10–12	0–1	2–3	5–6	8–9	0–1	1–2
VOC	Chlorobenzene	1,600	0.005	ND	0.124	ND	ND	ND	ND	ND	0.375	ND	0.46
	Ethylbenzene	7,800	0.005	ND	0.072	0.068	ND	ND	ND	ND	0.375	ND	ND
	Toluene	16,000	0.005	ND	0.107	0.17	1.7	ND	ND	ND	0.17	ND	ND
	M,p-xylene (sum of isomers)	160,000	N/A	0.12	0.36	0.156	12.0	ND	ND	0.008	0.75	ND	0.64
	O-xylene	160,000	N/A	0.12	0.124	0.058	5.0	ND	0.004	ND	0.375	ND	0.50
SVOC	Acenapthene	4,700	0.70	ND	ND	ND	ND	ND	ND	ND	0.22	ND	ND
	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND	ND	0.24	ND	ND
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND	0.51	ND	ND
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND	ND	0.30	ND	ND
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND	0.35	ND	ND
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND	ND	0.31	ND	ND
	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	ND	ND	ND	ND	0.26	ND	ND
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Di-n-butylphthalate	7,800	0.70	0.23	ND	ND	ND	ND	ND	ND	ND	0.26	ND
	Dibenzofuran	310	0.70	ND	ND	ND	0.30	ND	ND	ND	ND	ND	ND
	1,2-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	0.003	ND	0.19	ND	0.33
	1,3-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	0.006	0.006	ND	0.375	0.016	0.26
	1,4-Dichlorobenzene	27.0	0.005	ND	ND	ND	ND	ND	ND	ND	0.31	ND	0.48
	Fluoranthane	3,100	0.70	ND	ND	ND	0.38	ND	ND	ND	1.2	ND	ND
	Fluorene	3,100	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2-Methylnaphthalene	N/A	0.70	1.0	ND	5.8	6.0	ND	ND	ND	0.37	ND	2.0
	Naphthalene	3,100	0.70	0.36	ND	3.0	2.5	ND	ND	ND	ND	ND	0.98
	Phenanthrene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND	0.70	ND	ND
	Phenol	47,000	0.30	1.1	1.4	2.5	1.4	ND	ND	ND	ND	ND	ND
	Pyrene	2,300	0.70	ND	ND	ND	0.31	ND	ND	ND	1.1	ND	ND
TPH	Diesel fraction	100	10.0	630	57.0	1,000	1,200	ND	7.4	ND	130	200	500
	Gasoline fraction	100	1.0	25.0	6,300	1.1	6,900	ND	ND	0.43	1,200	ND	16.0
OTHER	Moisture (%)			8.5	10.7	10.5	12.1	2.5	9.9	10.7	5.9	9.0	8.1

Table 18-2. Summary of Reportable Concentrations for Soil Analyses at SWMU ST-341, Building 1033, Condensate Holding Tank (ST-341)[1] (Concentrations mg/kg) (Concluded)

Chemical Class	Analyte	HHRB Action Level	PQL UTL	Borehole Number and Sample Depth Interval (ft)								
				ST-341C-07						*ST-341C-08*		
				0–2	2–4	5–7	10–12	20–22	56–58	0–1	2–3	5–6
VOC	Chlorobenzene	1,600	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Ethylbenzene	7,800	0.005	ND	ND	ND	0.11	ND	ND	ND	ND	30.0
	Toluene	16,000	0.005	ND	ND	0.093	0.048	0.045	ND	ND	ND	6.6
	M,p-xylene (sum of isomers)	160,000	N/A	32.0	22.0	1.8	0.36	0.15	0.008	0.006	ND	64.0
	O-xylene	160,000	N/A	14.0	8.5	0.85	0.15	0.085	ND	ND	ND	27.0
SVOC	Acenapthene	4,700	0.70	ND	ND	ND	ND	ND	ND	ND	ND	0.75
	Anthracene	23,000	N/A	ND	ND	ND	ND	ND	ND	ND	ND	0.91
	Benzo(a)anthracene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND	0.39	2.6
	Benzo(a)pyrene	0.088	0.70	ND	ND	ND	ND	ND	ND	ND	ND	0.85
	Benzo(b)fluoranthene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND	ND	1.5
	Benzo(g,h,i)perylene	N/A	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Benzo(k)fluoranthene	8.8	N/A	ND	ND	ND	ND	ND	ND	ND	ND	1.3
	Bis(2-ethylhexyl)phthalate	46.0	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Chrysene	88.0	0.70	ND	ND	ND	ND	ND	ND	ND	0.44	1.8
	Di-n-butylphthalate	7,800	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Dibenzofuran	310	0.70	ND	ND	ND	ND	ND	ND	ND	ND	0.66
	1,2-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1,3-Dichlorobenzene	7,000	0.70	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1,4-Dichlorobenzene	27.0	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Fluoranthane	3,100	0.70	ND	ND	ND	ND	ND	ND	ND	1.0	6.0
	Fluorene	3,100	0.70	ND	0.54	ND	ND	ND	ND	ND	ND	0.76
	Indeno(1,2,3-c,d)pyrene	0.88	0.70	ND	ND	ND	ND	ND	ND	ND	ND	0.45
	2-Methylnaphthalene	N/A	0.70	ND	6.5	13.0	5.6	3.8	ND	ND	ND	6.5
	Naphthalene	3,100	0.70	ND	1.8	3.7	1.7	1.1	ND	ND	ND	3.0
	Phenanthrene	N/A	0.70	ND	1.8	0.77	0.53	ND	ND	ND	1.0	5.5
	Phenol	47,000	0.30	ND	1.6	ND	0.70	1.1	0.64	ND	ND	ND
	Pyrene	2,300	0.70	ND	ND	ND	ND	ND	ND	ND	0.95	5.6
TPH	Diesel fraction	100	10.0	2,000	10,000	3,700	800	2,000	110	ND	5.2	340
	Gasoline fraction	100	1.0	14,800	2,100	8,800	69.0	102	4.5	ND	ND	25,000
OTHER	Moisture (%)			12.3	13.3	8.8	9.4	8.1	4.1	7.0	8.4	9.2

FOOTNOTES

1	Complete laboratory analytical results and method detection limits are presented in Appendix K.
2	Action level of RCRA Proposed Rule Subpart S (55 *FR* 30814, 7/27/90).
*	TPH action level is 100 mg/kg adopted from NMED UST regulations (NMED, 1990). SW-8015 analyzes volatile and semivolatile petroleum hydrocarbon fractions separately. The total concentration of the two fractions analyzed under SW-8015 will be used to assess compliance with stipulated action levels for the purpose of this RFI.
#	Denotes TCLP analysis, results in mg/l.
--	No Data.
FR	Field Replicate.
HHRB	Human health risk based.
J	Estimated value.
N/A	Not Applicable.
NA	Not Analyzed.
ND	Not detected above the method detection limit.
pCi/g	picocuries per gram.
PQL	Practical quantitation limits (defines VOC, SVOC, and TPH).
R	Reject NDs due to interference.
RAD	Radionuclides.
RE	Resample.
SVOC	Semivolatile organic compounds.
TPH	Total petroleum hydrocarbons.
U	Accept data (positive results may be influenced by lab contamination).
UJ	Estimated nondetect.
UTL	Upper tolerance limits (defines metals).
VOC	Volatile organic compounds.

Gasoline range hydrocarbons (0.22 to 360,000 mg/kg) were detected in 21 of the 30 samples (including one replicate) submitted for analysis from ST-341, and 11 of the 21 concentrations exceed the 100 mg/kg NMED action level. The analytical results indicate that gasoline range concentrations exceeding the 100 mg/kg NMED action level are present to at least a depth of 12 ft. The highest concentration (360,000 mg/kg) was detected in the 9- to 10-ft sample from ST-341C-03. At the evaporation pond, 102 mg/kg of gasoline range hydrocarbons were detected in the 20- to 22-ft sample from ST-341C-07. The 4.5 mg/kg detection in the 56- to 58-ft sample may define the limit of gasoline hydrocarbon contamination, although 110 mg/kg of diesel hydrocarbons were also detected in this sample.

Soil Moisture

Soil moisture values ranged from 2.5 to 13.3 percent.

18.5 Conclusions and Recommendations

Conclusions

- Five VOCs were detected in samples collected from this site; all concentrations were below HHRB action levels.
- Twenty-two SVOCs were detected in samples collected at this site; 13 were PAHs, seven of which were at concentrations exceeding the HHRB action levels. Specific compounds detected at concentrations at or above HHRB action levels include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene.
- Diesel range hydrocarbons were detected in 18 samples; the concentrations detected in 15 samples exceeded the 100 mg/kg NMED action level.
- Gasoline range hydrocarbons were detected in 21 samples; the concentrations detected in 11 samples exceeded the HHRB action level for TPH of 100 mg/kg.
- The analytical results at ST-337 indicate a contaminant release at this site. Fuel hydrocarbon contamination extends to at least a depth of 12 ft near the holding tank and to a depth of about 58 ft at the evaporation pond.

Recommendations

- Because of the presence of PAHs and TPH above HHRB action levels, additional sampling and analysis is required to define the vertical and horizontal extent of contamination.

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