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Mr. Benito Garcia, Chief
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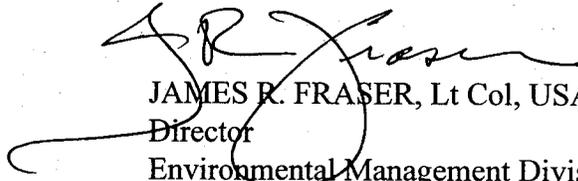
Dear Mr. Garcia

We are forwarding the final draft Long-Term Groundwater Monitoring (LTM) Report for 1 August - 31 October 1996. The shipping box contains three copies of the basic report and one copy of the appendices. One copy of each is also being forwarded to Mr. John Rogers at NMED's Ground Water Quality Bureau.

As discussed in our 6 December 1996 letter to you, LTM sampling was delayed because of a delay in program funding. The remainder of our LTM sampling events and reports will be completed on schedule.

Please contact Mr. Chris DeWitt at (505) 846-0053, or me at (505) 846-2751, if you have any questions.

Sincerely


 JAMES R. FRASER, Lt Col, USAF
 Director
 Environmental Management Division

Attachment:
 LTM Report

cc:
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 EPA Region 6 (Ms. Morlock)
 USACE Omaha (Mr. Rowe)
 Fluor Daniel GTI (Ms. Liakos)
 Foster Wheeler Env. (Mr. Weber)

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KAFB-4N

KIRTLAND AIR FORCE BASE

Long-Term Groundwater Monitoring Report August 1 - October 31, 1996

Final Draft - December 1996



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**INSTALLATION RESTORATION PROGRAM
KIRTLAND AIR FORCE BASE**

**FINAL DRAFT
LONG-TERM GROUNDWATER MONITORING REPORT -
AUGUST 1 - OCTOBER 31, 1996**

DECEMBER 1996

received

Prepared For
U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

TERC CONTRACT NO. DACW45-94-D-0003
DELIVERY ORDER 7, WORK AUTHORIZATION DIRECTIVE 11
DELIVERY ORDER 7, WORK AUTHORIZATION DIRECTIVE 17
DELIVERY ORDER 10, WORK AUTHORIZATION DIRECTIVE 9
DELIVERY ORDER 12, WORK AUTHORIZATION DIRECTIVE 5

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NOTICE

This report has been prepared for the U.S. Army Corps of Engineers by Foster Wheeler Environmental Corporation and Groundwater Technology Government Services, Inc., for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate.

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CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



JAMES R. FRASER, Lt Col, USAF
Director
Environmental Management Division

PREFACE

This report presents the results of the August 1996 event of the Long-Term Groundwater Monitoring (LTM) Program for six Resource Conservation and Recovery Act (RCRA) sites at Kirtland Air Force Base (AFB), New Mexico. The LTM Program consists of the collection of groundwater samples for site-specific analyses on a quarterly basis. The August 1996 sampling event was the second round of sampling for the sites in the LTM Program. The primary objective of this round of samples was to establish background concentrations and a baseline for a broad suite of parameters against which to compare future sampling results.

This work was performed under the authority of the U.S. Army Corps of Engineers, TERC Contract No. DACW45-94-D-0003, Subcontract No. DENS-94-1159-JM(MOA). All work was conducted in August 1996. Mr. Scott Wagner, U.S. Army Corps of Engineers (USACE), is the Technical Manager for this program.

The Remedial Program Manager for this program is Mr. Chris DeWitt of Kirtland AFB, Environmental Management Division. Mr. Mark Holmes of Kirtland AFB is the Project Manager. Mr. Steven B. Weber of Foster Wheeler Environmental Corporation (FWENC) is the Delivery Order Manager. Ms. Cymantha Liakos of Groundwater Technology Government Services, Inc. (GTGSI) is the subcontractor Project Manager. The report was prepared by Ms. Teresa J. Bennett (GTGSI) with administrative assistance from Ms. Christine Duncan. Field sampling was performed by Mssrs. Mark Smith and Charles Madewell of GTGSI.



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ACRONYMS

AFB	Air Force Base
AML	Assessment Monitoring Level
ARES	Advanced Research Electromagnetic Simulator
ART	Armament Research Test
BLEST	Berm Loaded Explosive Simulation Technique
CFR	Code of Federal Regulations
CHEBS	Conventional High Explosive Blast Simulation
COC	Chain-of-Custody
DABS	Dynamic Air Blast Simulation
DCQAP	Data Collection Quality Assurance Plan
DCT	DiHest Calibration Test
DIP-5	DiHest Improvement Program - Test No. 5
DQCR	Daily Quality Control Report
EBM	Enhanced Blast Munitions
EBS	Environmental Baseline Survey
EPA	Environmental Protection Agency
FAE	Fuel-Air Explosive
FSP	Field Sampling Plan
ft	Feet
HEST	High Explosive Simulation Test
HIGHFI	High Fidelity Test
HSWA	Hazardous and Solid Waste Amendments
IDW	Investigation Derived Waste
IRPIMS	Installation Restoration Program Information Management System
LIMS	Location Information Management System
LTM	Long-Term Groundwater Monitoring
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MDL	Method Detection Limit
mg/l	Milligrams per Liter
MRD	Missouri River Division
MSL	Mean Sea Level
N	Nitrogen
NEI/GTEL	NEI/GTEL Environmental Laboratories, Inc.
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department

ACRONYMS (Concluded)

NMSWMR	New Mexico Solid Waste Management Regulations
NMWQCCR	New Mexico Water Quality Control Commission Regulations
NOI	Notice of Intent
NTU	Nephelometric Turbidity Unit
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
pCi/L	Picocuries per Liter
PID	Photoionization Detector
PQL	Practical Quantitation Limit
PPE	Personal Protection Equipment
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act (of 1976)
RFI	RCRA Facility Investigation
RL	Reporting Limit
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SNL	Sandia National Laboratories
SOP	Standard Operating Procedure
SOW	Scope of Work
SSTM	Standard Silo Test Mechanism
SVOC	Semi-volatile Organic Compound
SWB	Solid Waste Bureau
SWMU	Solid Waste Management Unit
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TOX	Total Organic Halogen
µg/l	Micrograms per Liter
µmhos/cm	Micromhos per centimeter
USAF	United States Air Force
USACE	United States Army Corps of Engineers
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

This report presents the results of the August 1996 event of the Long-Term Groundwater Monitoring (LTM) Program for six Resource Conservation and Recovery Act (RCRA) sites at Kirtland Air Force Base (AFB), New Mexico. The Kirtland AFB Environmental Restoration Program is conducted under the regulatory authority of the New Mexico Environment Department (NMED) and the U.S. Environmental Protection Agency (EPA) Region 6. Kirtland AFB was granted a permit to operate a waste facility by the EPA under the Hazardous and Solid Waste Amendments (HSWA) of 1984 in October 1990. The NMED was granted HSWA authority in January 1996. Module IV of the permit required the installation of groundwater monitoring wells around Solid Waste Management Units (SWMUs) identified in Appendix I of the permit (EPA Region 6, 1990). The purpose of these wells is to determine if there have been any releases of hazardous substances from the SWMUs to groundwater. Groundwater monitoring wells were installed at nine sites at Kirtland AFB by the U.S. Geological Survey (USGS) Water Resources Division in Albuquerque, New Mexico, during the Appendix I RCRA Facility Investigation (RFI), as documented in the Stage 2A RFI Report (United States Air Force [USAF], 1993). Additional investigation is being conducted under the "KAFB Final Draft Appendix I Phase 2 RFI Sampling and Analysis Plan (SAP)" (USAF, 1996a).

Continued groundwater monitoring for certain SWMUs is being initiated voluntarily to collect baseline groundwater data for eventual use during post-closure monitoring. The programs proposed substantially adhere to the requirements under 40 Code of Federal Regulations (CFR) 264.97 and New Mexico Solid Waste Management Regulations (NMSWMR) 20 New Mexico Administrative Code (NMAC) 9.1, effective November 1995. These regulations require the owner of a surface impoundment, landfill, or land treatment facility to implement a groundwater monitoring program capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility.

The LTM Program consists of the collection of groundwater samples for site-specific analyses on a quarterly basis. The August 1996 sampling event was the second round of sampling for the sites in the LTM Program. The first sampling event was completed in May 1996. An additional out-of-cycle sampling event was conducted for Landfills 4, 5, and 6 in July 1996. The wells were sampled using dedicated sampling pumps and analyzed for various parameters in accordance with the LTM Plan. The primary objective of the first year of sampling is to establish background concentrations and a baseline for a broad suite of parameters against which to compare future sampling results.

The LTM Program is being conducted at six sites: SWMU 6-1, Landfill 1 (LF-01); SWMU 6-2, Landfill 2 (LF-02); SWMU 6-31, McCormick Ranch/Range (OT-28); SWMU 6-4, Landfills 4, 5, and 6 (LF-08); Tijeras Arroyo - Wells KAFB-0901 and -0902; and SWMU 6-22, Lake Christian (OT-46).

Of the six sites sampled, three sites had wells which yielded analyte concentrations above NMSWMR health-based groundwater standards. One well at Landfills 4, 5, and 6 contained total chromium concentrations above applicable NMSWMR standards. Two wells at Landfill 1 and one well at Landfill 2 contained methylene chloride concentrations above the NMSWMR health-based standard. However, methylene chloride was also detected in quality control (QC) method blank samples and its presence in the groundwater samples was therefore considered to be laboratory contamination. Groundwater samples from several wells also exceeded the Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL) for gross beta radioactivity, including one well at Landfill 2, two wells at McCormick Ranch, and one well at Landfills 4, 5, and 6. The single well sampled at Lake Christian also contained gross alpha and gross beta radioactivity in excess of the SDWA MCLs.

1. INTRODUCTION

1.1 Purpose and Project Objective

This report presents the results of the August 1996 event of the LTM Program for six RCRA sites at Kirtland AFB, New Mexico (Figure 1-1). The Kirtland AFB Environmental Restoration Program is conducted under the regulatory authority of the NMED and the U.S. EPA Region 6. Kirtland AFB was granted a permit to operate a waste facility by the EPA under the HSWA of 1984 in October 1990. The NMED was granted HSWA authority in January 1996. Module IV of the permit required the installation of groundwater monitoring wells around SWMUs identified in Appendix I of the permit (EPA Region 6, 1990). The purpose of these wells is to determine if there have been any releases of hazardous substances from the SWMUs to groundwater. Groundwater monitoring wells were installed at nine sites at Kirtland AFB by the USGS Water Resources Division in Albuquerque, New Mexico, during the Appendix I RFI, as documented in the Stage 2A RFI Report (USAF, 1993). Additional investigation is being conducted under the "*KAFB Final Draft Appendix I Phase 2 RFI Sampling and Analysis Plan (SAP)*" (USAF, 1996a).

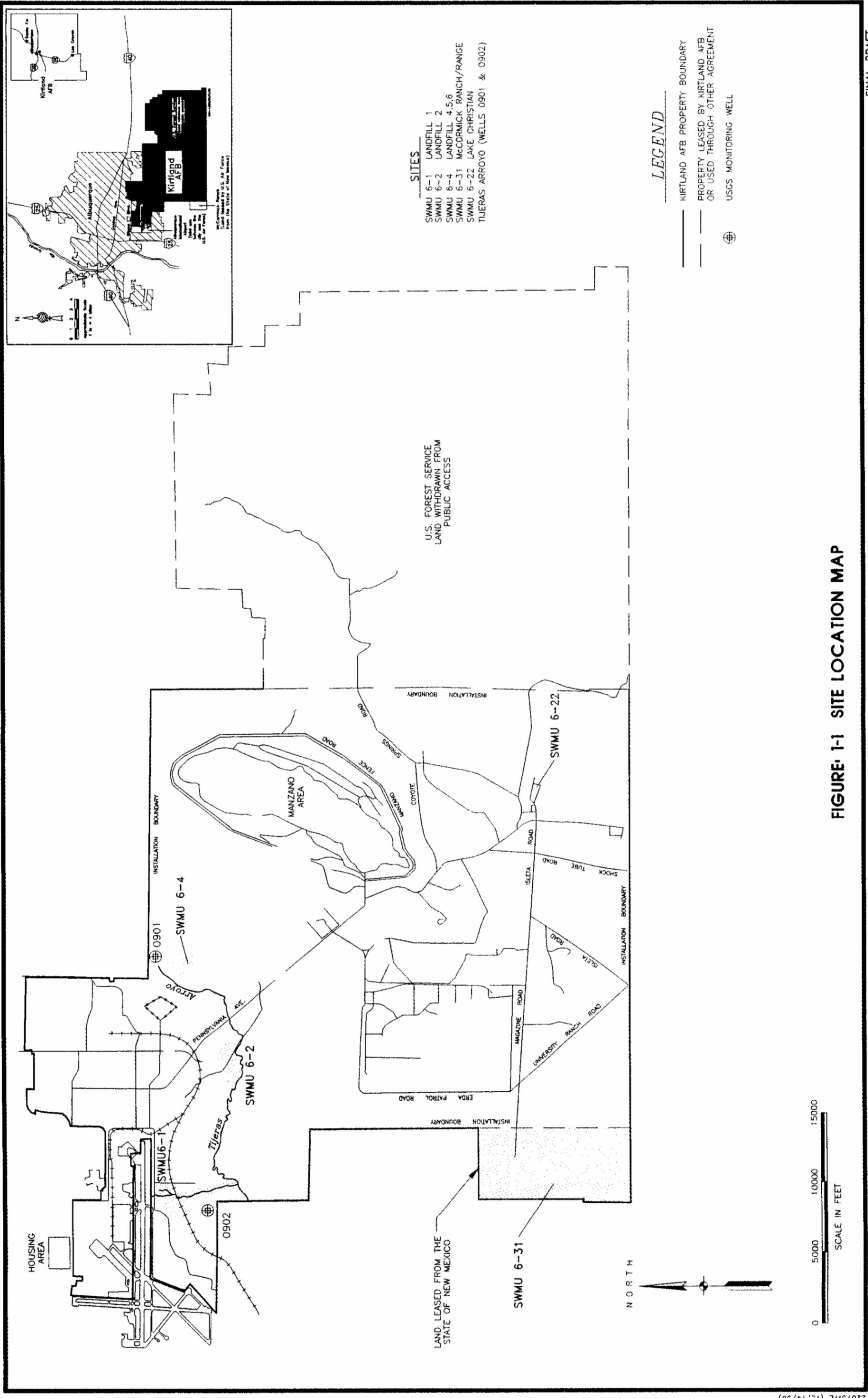
Continued groundwater monitoring for certain SWMUs is being initiated voluntarily to collect baseline groundwater data for eventual use during post-closure monitoring. The programs proposed substantially adhere to the requirements under 40 CFR 264.97 and NMSWMR 20 NMAC 9.1, effective November 1995. These regulations require the owner of a surface impoundment, landfill, or land treatment facility to implement a groundwater monitoring program capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility.

The LTM Program consists of the collection of groundwater samples for site-specific analyses on a quarterly basis. The August 1996 sampling event was the second round of sampling for the sites in the LTM Program. The first sampling event was completed in May 1996 (USAF, 1996b). An additional out-of-cycle sampling event was conducted for Landfills 4, 5, and 6 in July 1996 (USAF, 1996c). The primary objective of the first year of sampling is to establish background concentrations and a baseline for a broad suite of parameters against which to compare future sampling results.

The LTM Program is being conducted at six sites (Figure 1-1):

- SWMU 6-1, Landfill 1 (LF-01)
- SWMU 6-2, Landfill 2 (LF-02)
- SWMU 6-31, McCormick Ranch/Range (OT-28)
- SWMU 6-4, Landfills 4, 5, and 6 (LF-08)
- Tijeras Arroyo - Wells KAFB-0901 and -0902
- SWMU 6-22, Lake Christian (OT-46)

Four quarterly events will be completed during the first year for all LTM sites, except Landfills 4, 5, and 6 which will be monitored five times. It is anticipated that after the first year of monitoring, the frequency of monitoring and number of analytical parameters will be reduced for subsequent events based on the comparison against background concentrations and state and federal standards.



1.2 Document Organization

The scope of work performed at each site is briefly discussed in this report. The LTM was performed in accordance with the "*Kirtland Air Force Base Final Long-Term Groundwater Monitoring Plan*" (USAF, 1996d) which contains project-specific information and procedures. The LTM Plan also incorporates by reference detailed explanations and protocols from the "*Kirtland Air Force Base, Base-Wide Plans for Investigations Under the Installation Restoration Program*" (USAF, 1996e).

Specific variances from the procedures and protocols in the above-referenced documents due to field conditions or other factors are identified in Sections 2.0 and 5.0 of this report.

The LTM Report for the August 1996 event includes discussions of results from the groundwater monitoring and sampling conducted. This report is organized as follows:

Section 1	Introduction
Section 2	Sampling Procedures
Section 3	Site-Specific Long-Term Monitoring Results
Section 4	Investigation Derived Waste (IDW) Management Procedures
Section 5	Quality Assurance/Quality Control (QA/QC) Summary

2. SAMPLING PROCEDURES

2.1 Project Summary

Groundwater monitoring and sampling for the LTM Program for the August 1996 event were conducted from August 19 - August 30, 1996. All sites involved in the LTM Program were accessible for sampling. Specific procedures followed for the LTM Program were detailed in Section 2.0 of the LTM Plan and appropriate standard operating procedures (SOPs) contained in Appendix A of the Field Sampling Plan (FSP) of the Base-Wide Data Collection Quality Assurance Plan (DCQAP) (USAF, 1996e). The August 1996 monitoring and sampling episode of the LTM Program generally followed the outlined procedures. Noted variances or exceptions to the procedures encountered during the field activities are described in the following subsections.

2.2 Field Equipment Calibration and Measurements

Calibration of field equipment used during the LTM Program was conducted in accordance with the procedures described in Section 2.1 of the LTM Plan and in the Quality Assurance Project Plan (QAPP) of the Base-Wide DCQAP. Equipment calibration logs were maintained for each instrument and are provided in Appendix A. No variances from the outlined procedures were encountered during equipment calibration.

In accordance with the LTM Plan, several field measurements were collected during the monitoring well sampling. They included:

- Photoionization detector (PID) readings at the wellhead, and explosimeter and percent oxygen readings inside the well upon opening the well cap. These measurements are included in Appendix B;
- Static water level prior to purging. These measurements are included on the well gauging forms in Appendix B. Total depth of the wells was not measured prior to purging at the request of the Kirtland AFB project manager in order to limit turbidity. Previous total depth measurements recorded during installation of the dedicated sampling pumps were used for purging calculations instead;
- Temperature, pH, specific conductance, and turbidity during purging. These data are included in Appendix B; and
- Water level recovery during and following purging.

To prevent any potential cross-contamination and to protect the integrity of the samples, the pH of preserved samples was not measured in the field.

2.3 Water Level Measurements

Groundwater level measurements were obtained with an electronic water level indicator following the procedures detailed in the LTM Plan in Section 2.2 and in SOP A-3.6 of the Base-Wide DCQAP. Water level measurements were collected at each site prior to conducting the sampling activities. Well gauging data forms containing the measurements are included in Appendix B. All water level measurements at each site were collected on the same day.

2.4 Well Purging

Each monitoring well sampled was purged of stagnant water within the well using dedicated submersible piston sampling pumps (Bennett Sample Pump, Model No. 1800). Well purging was conducted in general accordance with the protocols established in Section 2.3 of the LTM Plan, SOP A1.2 of the Base-Wide FSP, and the Groundwater Monitoring System Plan, amended October 2, 1995 (for Landfills 4, 5, and 6 only). Compressed nitrogen was used to operate the pumps. All wells had a minimum of one saturated casing volume removed and were purged to stabilization of field parameters of pH, temperature, conductivity, and turbidity. Well purging records are included in Appendix B as part of the Water Quality Field Data Sheets.

Variances to the outlined procedures include:

- A sample was collected after purging nearly 1.2 casing volumes, but before the turbidity values were within 10%. The groundwater sample from KAFB-0214 at Landfill 2 was collected after 19 gallons of water were removed and the turbidity changes were 14.2% between the last four consecutive readings. However, the pH, temperature, and conductivity consecutive readings were within 0.1 units, 1 degree Celsius, and 5%, respectively. Additionally, turbidity readings for purge water from well KAFB-0218 (Landfill 2) were within 18.3%, and pH was within 0.2 units for wells KAFB-1004 and KAFB-1005 (McCormick Ranch), though all other purge water field parameters for these wells had stabilized. These unapproved variances were due to sampler error and will be corrected for future LTM events.
- Purging and sampling of Sandia National Laboratory (SNL) well TJA-2 at Landfills 4, 5, and 6 were coordinated with onsite SNL personnel. This well was purged and sampled using the existing SNL dedicated pump in the well. The well was sampled in accordance with SNL's SOP for micro-purge groundwater sampling which is based on purging two delivery tube volumes and subsequent stabilization of groundwater parameters. Purging of this well in accordance with the SNL SOP was approved by Mr. Mark Holmes of Kirtland AFB.

2.5 Groundwater Sample Collection

All groundwater sampling procedures detailed in Section 2.4 of the LTM Plan were followed during the August 1996 LTM sampling episode. Samples were collected in order of highest to lowest volatility, with samples collected for volatile organic analysis first and metals last. Samples collected for dissolved metals analysis were field-filtered in accordance with SOP A1.17 of the Base-Wide DCQAP prior to sample preservation.

2.6 Sample Handling and Documentation

Sample handling and documentation procedures for the project were conducted in general accordance with the procedures detailed in the LTM Plan and the Base-Wide QAPP. Documentation used for the August 1996 LTM sampling event included the field notebook, instrument calibration logs, well gauging forms, monitoring well purging and sample collection logs, chain-of-custody (COC) forms, sample labels, log forms, and Daily Quality Control Reports (DQCR).

As required for the LTM Program, all groundwater samples (with the exception of total coliform samples) were segregated by site. Separate COC documentation was prepared for each site and the samples were shipped to NEI/GTEL Environmental Laboratories (NEI/GTEL) in separate containers. Because of the short holding time for coliform analysis, samples were hand-delivered to Assaigai Analytical Laboratories in

Albuquerque, New Mexico, for analysis. Coliform samples from two or more sites were combined on COC forms and in shipping containers.

2.7 Sample Containers

As identified in the LTM Plan, different analytical parameters were specified for the various sites in the LTM Program. Samples for each specific class of analytes were collected in containers and preserved as required by the analytical method. Details concerning these requirements are summarized in Table 2-1 of the LTM Plan and Tables 5-1 and 5-2 of the Base-Wide QAPP. These procedures were provided to the field personnel and were followed during the August 1996 event of the LTM Program.

2.8 Sample Numbering System

The existing well identifiers were used for the wells involved with the LTM Program. The sample numbering system followed during the August 1996 LTM event varied from that specified in Section 2.7 of the LTM Plan. Because the sample designations are limited to 10 characters for the Installation Restoration Program Information Management System (IRPIMS) format, an abbreviated sample identifier was used for this LTM event and will be used for all future events. This variance has been approved by the project chemists. Sample designations consist of the four-character site name (e.g., LF08, OT28, etc.), followed by the four-digit well identifier (e.g., 0307, 1005, etc.), and two-digit identifier (01 for original sample, 02 for field duplicate, and 03 for Missouri River Division [MRD] duplicate). Trip and field blank samples are numbered consecutively (e.g., KAFBTB01, KAFBTB02, etc.). The laboratory used the same sample designations when reporting the results. Analytical data will be compiled in the IRPIMS format as required in the scope of work (SOW) and in accordance with the LTM Plan.

2.9 Sample Packaging and Shipping

All sample handling and shipping procedures detailed in the LTM Plan and referenced in the Base-Wide FSP (Section 7.1) were followed.

2.10 Equipment Decontamination

Dedicated sampling equipment was installed in all wells in the LTM Program. All sample and field monitoring equipment decontamination procedures detailed in SOP A2.1 of the FSP of the Base-Wide DCQAP were followed.

3. SITE-SPECIFIC LONG-TERM MONITORING RESULTS

This section describes the monitoring program followed at each site designated for LTM at Kirtland AFB and presents the analytical results. Because historical analytical data is several years old, the first year of sampling to be conducted in 1996-1997 will be used as the baseline analytical data for each site in the program. For discussion purposes, the baseline analytical data in this report have been compared to applicable NMSWMR health-based groundwater standards (20 NMAC 9.1). For gross alpha and beta radioactivity where NMSWMR standards are not established, MCLs from the federal SDWA were used. Each summary table lists the standard used and highlights values which exceeded the corresponding standard.

Groundwater samples collected during the LTM Program were analyzed by NEI/GTEL in Wichita, Kansas. NEI/GTEL subcontracted Assaigai Analytical Laboratories (Albuquerque, NM) for coliform bacteria analyses, Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK), for explosives analysis, and ThermoNUtech (Richmond, CA) for radiological analyses (gross alpha/beta, radium, etc.).

Site description and background information will not be presented in this or future LTM quarterly reports. This information can be found in the LTM Plan (USAF, 1996d) and in the first quarter (May 1 - July 31, 1996) LTM Report (USAF, 1996b).

3.1 SWMU 6-1, Landfill 1 (LF-01)

3.1.1 Long-Term Groundwater Monitoring

As described in the LTM Plan, the LTM Program for Landfill 1 consisted of gauging all eight groundwater monitoring wells (KAFB-0107, -0110, -0111, -0112, -0113, -0114, -0115, and -0117) and sampling of four of these wells. All wells were operable and accessible for groundwater monitoring. Four wells were sampled including one upgradient (KAFB-0113) and three downgradient (KAFB-0111, -0114, and -0115) wells.

The LTM Program at Landfill 1 is summarized in Table 3-1. The wells were analyzed for the parameters shown in Table 4-1 of the LTM Plan, which adheres to the requirements for groundwater monitoring in 40 CFR 265.92, and for volatile organic compounds (VOCs) by SW 8260. The parameter list in Table 4-1 includes: Groundwater Quality Parameters (chloride, iron, manganese, phenols, sodium and sulfate); Contaminant Indicator Parameters (specific conductance, pH, total organic carbon [TOC], and total organic halogen [TOX]); and Parameters in Appendix III to Part 265 as listed below:

- RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)
- Fluoride
- Nitrate as Nitrogen (N)
- Pesticides (endrin, lindane, methoxychlor, toxaphene)
- Herbicides (2, 4-D, 2,4,5-TP Silvex)
- Radioactivity (radium, gross alpha, gross beta)
- Coliform bacteria

Table 3-1. Summary of LTM Program at SWMU 6-1, Landfill 1 (LF-01)

Wells to Be Sampled	Wells Sampled	Analytes
0111 0113 0114 0115	0111 0113 0114 0115	<i>Table 4-1 of Section 4.0 of the LTM Plan</i> ● Groundwater Quality Parameters ● Contaminant Indicator Parameters ● Appendix III Parameters <i>VOCs by SW 8260</i>

3.1.2 Groundwater Monitoring Results

Depth-to-water at Landfill 1 ranged from 389.62 to 459.26 feet (ft) below top of well casing. The depth-to-water measurements were converted to groundwater elevations relative to mean sea level (MSL) (Appendix B-1). A groundwater elevation contour map was prepared using the August 1996 elevation data and the May 1996 survey data measured by Harris Surveying, Inc., of Albuquerque, NM (Figure 3-1). Review of the map shows that groundwater flows generally to the northeast toward Kirtland AFB Production Well No. 2 at an average gradient of 0.0016 ft/ft. This groundwater flow direction is consistent with previous monitoring conducted in May 1996 (USAF, 1996b), September 1992 (USAF, 1993), and 1960 regional groundwater flow data.

3.1.3 Groundwater Sampling Results

Groundwater analytical results are summarized in Table 3-2. The laboratory reports for this site are provided in Appendix C-1.

No VOCs (except methylene chloride) were detected in any of the monitoring wells sampled (KAFB-0111, -0113, -0114, and -0115). Methylene chloride was detected in KAFB-0114 and KAFB-0115 at concentrations of 11 micrograms per liter ($\mu\text{g/l}$) and 12 $\mu\text{g/l}$, respectively. Methylene chloride is a common laboratory contaminant and was detected in the EPA 8260A method blank associated with the Landfill 1 samples at a concentration of 9.14 $\mu\text{g/l}$ (see Section 5.4).

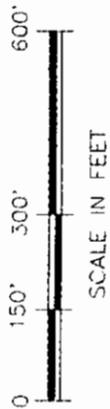
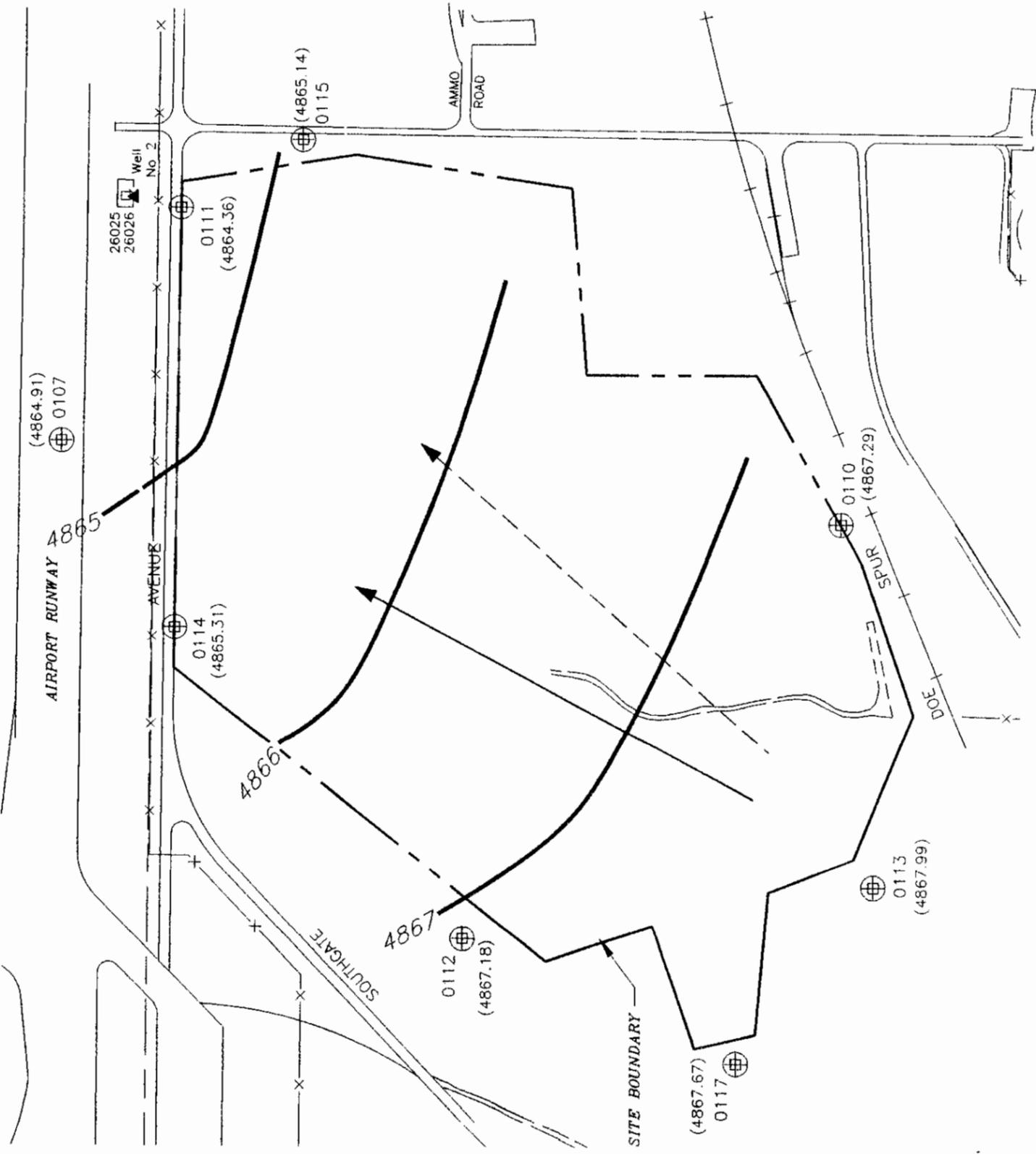
No pesticides or chlorinated herbicides were detected in any of the wells. Sodium was the only metal detected, and was found in all four wells sampled at concentrations ranging from 19,000 to 21,000 $\mu\text{g/l}$.

Other inorganic parameters detected in all the wells included chloride (6.8-9.2 milligrams per liter [mg/l]), fluoride (0.40-0.51 mg/l), nitrate-N (0.14-0.38 mg/l), and sulfate (29-33 mg/l). No phenols, TOC, or TOX were detected in any of the wells. Field measurements of pH and specific conductance for all wells ranged from 6.43 to 8.38 and from 226 to 305 micromhos per centimeter ($\mu\text{mhos/cm}$), respectively. Temperature ranged from 65.8 to 72.9 degrees Fahrenheit. Turbidity ranged from 1.44 to 6.79 nephelometric turbidity units (NTU).

No total or fecal coliforms were detected in any of the wells. The samples were also analyzed for radiological parameters. Gross alpha radioactivity was detected in the samples from all wells at levels ranging from 0.93 to 2.6 picocuries per liter (pCi/L), while gross beta radioactivity ranged from 1.8 to 2.5 millirems per year

NOTES

1. BASE MAP COMPILED FROM THE FOLLOWING SOURCES:
 A) DRAFT APPENDIX I RFI WORK PLAN
 B) USAF RFI STAGE 2A, VOL 1



LEGEND

- x---x--- FENCE
- ▲ PRODUCTION WELL
- ⊕ USGS MONITORING WELL
- +—+—+ RAILROAD
- (4865.14) GROUNDWATER ELEVATION (AUGUST 22, 1996)
- 4867 WATER LEVEL CONTOUR (AUGUST 22, 1996)
- REGIONAL GROUNDWATER FLOW DIRECTION (1960)
- REGIONAL GROUNDWATER FLOW DIRECTION (AUGUST 22, 1996)

KEY MAP

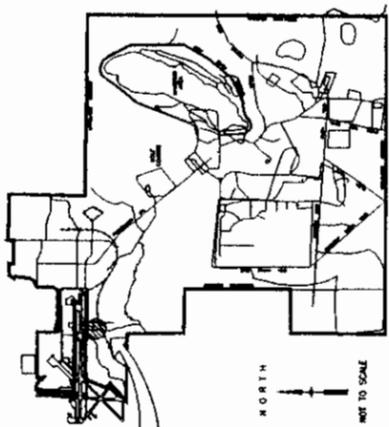


Figure 3-1 Groundwater Elevation Contour Map for SWMU 6-1, Landfill 1 (LF-01)

Table 3-2. Summary of Groundwater Analytical Results at SWMU 6-1, Landfill 1 (LF-01), August 1996

Analytes	NMSWMR Standard	KAFB-0111	KAFB-0113	KAFB-0114	KAFB-0115
Volatile Organic Compounds - EPA Method 8260A (µg/l)					
Methylene Chloride	5	<10	<10	11	12
Dissolved Metals - EPA Methods 6010A & 7000-series (µg/l)					
Sodium	NE	20,000	19,000	20,000	21,000
Inorganics - EPA Methods 300-series, 400-series, and 9020 (mg/l)					
Chloride	250	8.2	7.3	6.8	9.2
Fluoride	1.6	0.40	0.48	0.51	0.46
Nitrate-N	10	0.26	0.14	0.19	0.38
Sulfate	250	31	30	29	33
Field Measurements					
pH	6.5-8.5	8.38	7.36	7.42	6.43
Specific Conductance (µmhos/cm)	NE	271	226	305	295
Temperature (°F)	NE	72.9	72.6	67.6	65.8
Turbidity (NTU)	NE	1.44	6.79	5.81	4.31
Organochlorine Pesticides and Chlorinated Herbicides - EPA Methods 8081 and 8151 (µg/l)					
All Constituents	NE	<RL	<RL	<RL	<RL
Total Coliform - SM 9222B (Colonies/100 ml)					
Total Coliform	NE	Absent	Absent	Absent	Absent
Fecal Coliform	NE	Absent	Absent	Absent	Absent
Radiological Parameters - EPA Methods 900.0, 903.1, and 904.0 (pCi/L)					
Gross Alpha	15	1.9	2.4	2.6	0.93
Gross Beta ⁽¹⁾	4	2.1	2.4	2.5	1.8
Radium-226	combined 5.0	0.38	1.0	0.72	0.72
Radium-228		0.15	-0.014	-0.017	0.12

FOOTNOTES

- (1) Units in mrem/yr. Conversion for gross beta in pCi/L to mrem/yr using 0.967 multiplier.
- 1 Only detected constituents for VOCs, metals, and inorganics are presented in the table.
- 2 Shaded/bolded values indicate concentration exceeded the corresponding NMSWMR standard.
- 3 Standards for gross alpha and gross beta radioactivity are the corresponding Maximum Contaminant Levels from federal Safe Drinking Water Act.
- 4 Methylene chloride was also detected in QC blank samples associated with this sampling event, and is therefore considered to be laboratory contamination.
- < Indicated compound not detected at the stated reporting limit.
- °F Degrees Fahrenheit
- mg/l Milligrams per liter
- ml Milliliters
- mrem/yr Millirems per year
- NE Not established
- NMSWMR New Mexico Solid Waste Management Regulations
- NTU Nephelometric turbidity unit
- pCi/L Picocuries per liter
- RL Reporting limit
- µg/l Micrograms per liter
- µmhos/cm Micromhos per centimeter

(mrem/yr). Radium-226 and radium-228 activities for all wells ranged from 0.38 to 1.0 and from -0.017 to 0.15 pCi/L, respectively.

All detected concentrations for this site are below applicable NMSWMR health-based groundwater standards, with the exception of one VOC detected in two wells. Methylene chloride, detected in wells KAFB-0114 (11 µg/l) and KAFB-0115 (12 µg/l), exceeds the NMSWMR health-based standard of 5 µg/l. However, methylene chloride was also detected in QC blank samples and its presence in the groundwater samples is therefore considered to be laboratory contamination (see Section 5.4). The pH (6.43) for well KAFB-0115 also exceeds the NMSWMR aesthetic groundwater standard of 6.5-8.5.

3.1.4 Recommendations

The first year of LTM sampling analytical results are the baseline values for evaluating future sampling data. No formal modifications to the LTM Plan for Landfill 1 are proposed at this time.

3.2 SWMU 6-2, Landfill 2 (LF-02)

3.2.1 Long-Term Groundwater Monitoring

As described in the LTM Plan, the LTM Program for Landfill 2 consisted of gauging all six groundwater monitoring wells (KAFB-0213, -0214, -0215, -0216, -0217, and -0218) and sampling of four of these wells. All wells were operable and accessible for groundwater monitoring. Four wells were sampled including one upgradient (KAFB-0215) and three downgradient (KAFB-0214, -0216, and -0218) wells.

The LTM Program at Landfill 2 is summarized in Table 3-3. The wells were analyzed for the parameters shown in Table 4-1 of the LTM Plan, which adheres to the requirements for groundwater monitoring in 40 CFR 265.92, and for VOCs by SW 8260. The parameter list in Table 4-1 includes: Groundwater Quality Parameters (chloride, iron, manganese, phenols, sodium and sulfate); Contaminant Indicator Parameters (specific conductance, pH, TOC, and TOX); and Parameters in Appendix III to Part 265 as listed below:

- RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)
- Fluoride
- Nitrate as N
- Pesticides (endrin, lindane, methoxychlor, toxaphene)
- Herbicides (2,4-D, 2,4,5-TP Silvex)
- Radioactivity (radium, gross alpha, gross beta)
- Coliform bacteria

Table 3-3. Summary of LTM Program at SWMU 6-2, Landfill 2 (LF-02)

Wells to Be Sampled	Wells Sampled	Analytes
0214 0215 0216 0218	0214 0215 0216 0218	<i>Table 4-1 of Section 4.0 of the LTM Plan</i> ● Groundwater Quality Parameters ● Contaminant Indicator Parameters ● Appendix III Parameters <i>VOCs by SW 8260</i>

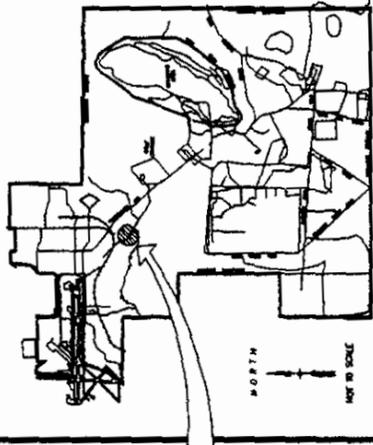
3.2.2 Groundwater Monitoring Results

Depth-to-water at Landfill 2 ranged from 365.40 to 407.12 ft below top of well casing. The depth-to-water measurements were converted to groundwater elevations relative to MSL (Appendix B-2). A groundwater elevation contour map was prepared using the August 1996 elevation data and the May 1996 survey data measured by Harris Surveying, Inc., of Albuquerque, NM (Figure 3-2). Review of the map shows that groundwater flows generally to the north at an average gradient of 0.002 ft/ft. This groundwater flow direction is fairly consistent with previous monitoring conducted in May 1996 (USAF, 1996b) and September 1992 (USAF, 1993) which showed a flow direction to the northwest, but differs from 1960 regional data which indicated a westward groundwater flow.

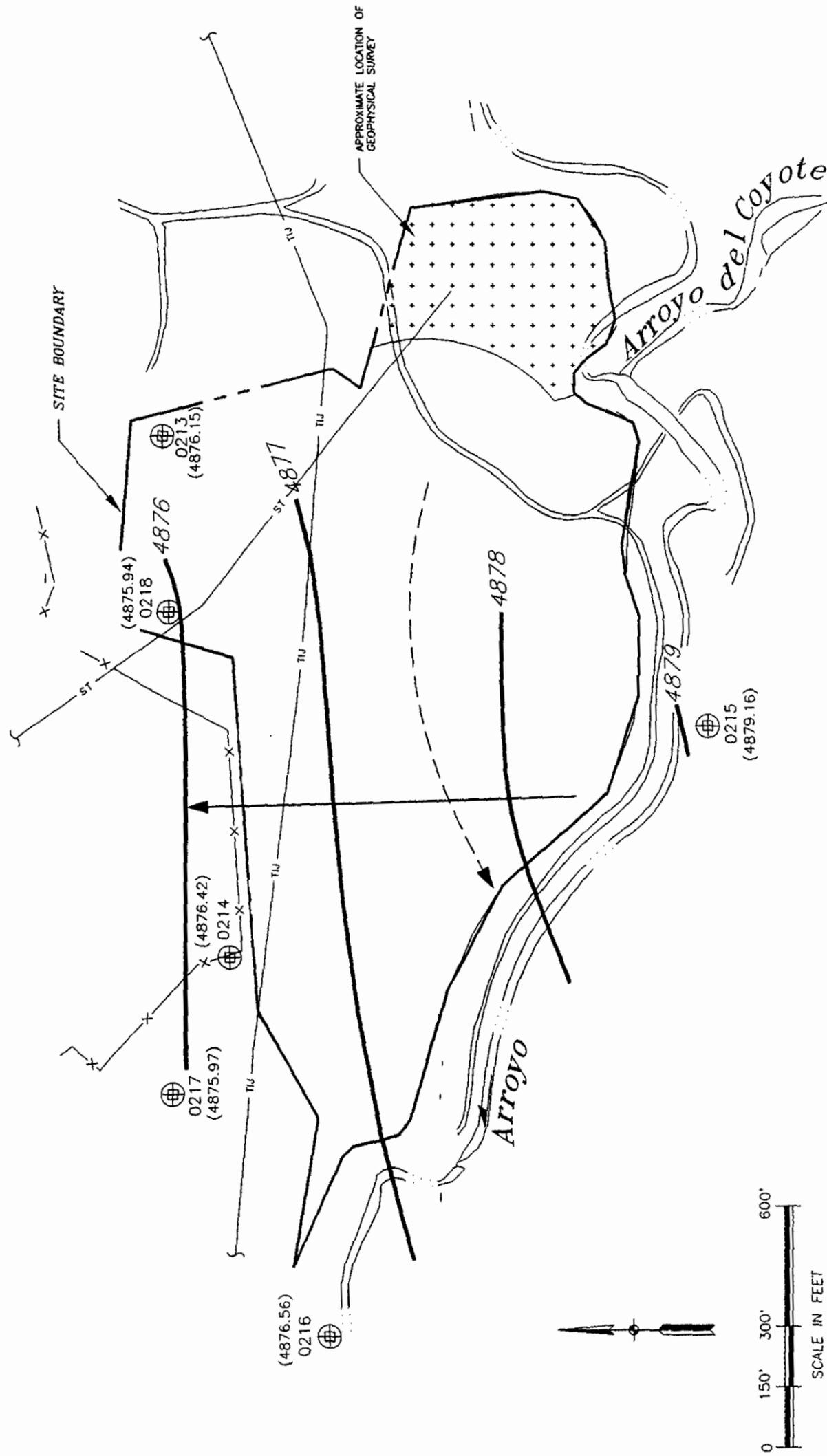
N O T E S

1. BASE MAP COMPILED FROM THE FOLLOWING SOURCES:
 A) DRAFT APPENDIX I RFI WORK PLAN
 B) USAF RFI STAGE 2A, VOL. 1

SITE LOCATION



KEY MAP



L E G E N D

- X-X- FENCE
- ST- SEWAGE EFFLUENT TRANSMISSION LINE
- TU- THERAS INTERCEPTOR SANITARY SEWER LINE
- ⊕ USGS MONITORING WELL
- (4875.94) GROUNDWATER ELEVATION (AUGUST 22, 1996)
- 4877 WATER LEVEL CONTOUR (AUGUST 22, 1996)
- REGIONAL GROUNDWATER FLOW DIRECTION (1960)
- REGIONAL GROUNDWATER FLOW DIRECTION (AUGUST 22, 1996)

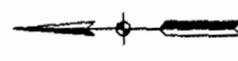


Figure 3-2 Groundwater Elevation Contour Map For SWMU 6-2, Landfill 2 (LF-O2)

U:\ECM\DWG (12/14/96)

3.2.3 Groundwater Sampling Results

Groundwater analytical results are summarized in Table 3-4. The laboratory reports for this site are provided in Appendix C-2.

No VOCs (except methylene chloride) were detected in any of the monitoring wells sampled (KAFB-0214, -0215, -0216, and -0218). Methylene chloride was detected in KAFB-0215 at a concentration of 10 µg/l. Methylene chloride is a common laboratory contaminant and was detected in the EPA 8260A method blank associated with the Landfill 2 samples at a concentration of 8.10 µg/l (see Section 5.4).

No pesticides or chlorinated herbicides were detected in any of the wells. Sodium was the only metal detected in wells at Landfill 2, and was found in all four wells sampled at concentrations ranging from 24,000 to 28,000 µg/l. Other inorganic parameters detected in all the wells include chloride (15-16 mg/l), fluoride (0.21-0.35 mg/l), nitrate-N (3.0-5.0 mg/l), and sulfate (53-98 mg/l). No phenols, TOC, or TOX were detected in any of the wells. Field measurements of pH and specific conductance for all wells ranged from 7.88 to 8.16 and from 521 to 612 µmhos/cm, respectively. Temperature ranged from 66.3 to 69.1 degrees Fahrenheit. Turbidity ranged from 0.58 to 7.79 NTU.

No total or fecal coliforms were detected in wells KAFB-0214 or KAFB-0218. Coliform analysis was not performed on the samples collected from wells KAFB-0215 and -0216 because the sample holding times were exceeded by the subcontract laboratory (Assaigai Analytical Laboratories in Albuquerque, New Mexico).

The samples were also analyzed for radiological parameters. Gross alpha radioactivity was detected in the samples from all wells at levels ranging from 2.2 to 4.5 pCi/L, while gross beta radioactivity ranged from 2.1 to 5.0 mrem/yr. Radium-226 and radium-228 activities for all wells ranged from -0.35 to 0.71 and from -0.002 to 0.22 pCi/L, respectively.

All detected concentrations for this site are below applicable NMSWMR health-based groundwater standards, with the exception of one VOC detected in one well. Methylene chloride detected in KAFB-0215 (10 µg/l) exceeds the NMSWMR health-based standard of 5 µg/l. However, methylene chloride was also detected in QC blank samples and its presence in the groundwater sample is therefore considered to be laboratory contamination (see Section 5.4). Gross beta radioactivity in well KAFB-0215 (5.0 mrem/yr) also exceeds the SDWA MCL of 4 mrem/yr.

3.2.4 Recommendations

The first year of LTM sampling analytical results are the baseline values for evaluating future sampling data. No formal modifications to the LTM Plan for Landfill 2 are proposed at this time.

Table 3-4. Summary of Groundwater Analytical Results at SWMU 6-2, Landfill 2 (LF-02), August 1996

Analytes	NMSWMR Standard	KAFB-0214	KAFB-0215	KAFB-0216	KAFB-0218
Volatile Organic Compounds - EPA Method 8260A (µg/l)					
Methylene Chloride	5	<RL	10	<RL	<RL
Dissolved Metals - EPA Methods 6010A & 7000-series (µg/l)					
Sodium	NE	26,000	26,000	28,000	24,000
Inorganics - EPA Methods 300-series, 400-series, and 9020 (mg/l)					
Chloride	250	16	16	16	15
Fluoride	1.6	0.21	0.29	0.35	0.32
Nitrate-N	10	3.4	4.3	3.0	5.0
Sulfate	250	73	81	98	53
Field Measurements					
pH	6.5-8.5	8.16	7.88	8.01	7.98
Specific Conductance (µmhos/cm)	NE	521	563	612	531
Temperature (oF)	NE	69.1	66.3	67.0	69.0
Turbidity (NTU)	NE	2.13	7.79	1.11	0.58
Organochlorine Pesticides and Chlorinated Herbicides - EPA Methods 8081 and 8151 (µg/l)					
All Constituents	NE	<RL	<RL	<RL	<RL
Total Coliform - SM 9222B (Colonies/100 ml)					
Total Coliform	NE	Absent	NA	NA	Absent
Fecal Coliform	NE	Absent	NA	NA	Absent
Radiological Parameters - EPA Methods 900.0, 903.1, and 904.0 (pCi/L)					
Gross Alpha	15	3.1	4.3	4.5	2.2
Gross Beta ⁽¹⁾	4	3.0	5.0	3.0	2.1
Radium-226	combined 5.0	0.71	-0.35	-0.17	0.63
Radium-228		-0.002	0.22	0.001	0.056

FOOTNOTES

- (1) Units in mrem/yr. Conversion for gross beta in pCi/L to mrem/yr using 0.967 multiplier.
- 1 Only detected constituents for VOCs, metals, and inorganics are presented in the table.
- 2 Shaded/bolded values indicate concentration exceeded the corresponding NMSWMR standard.
- 3 Standards for gross alpha and gross beta radioactivity are the corresponding Maximum Contaminant Levels from federal Safe Drinking Water Act.
- 4 Methylene chloride was also detected in QC blank samples associated with this sampling event, and is therefore considered to be laboratory contamination.
- < Indicated compound not detected at the stated reporting limit.
- °F Degrees Fahrenheit
- mg/l Milligrams per liter
- ml Milliliters
- mrem/yr Millirems per year
- NA Not available; analysis canceled due to missed sample holding time.
- NE Not established
- NMSWMR New Mexico Solid Waste Management Regulations
- NTU Nephelometric turbidity unit
- pCi/L Picocuries per liter
- RL Reporting limit
- µg/l Micrograms per liter
- µmhos/cm Micromhos per centimeter

3.3 SWMU 6-31, McCormick Ranch/Range (OT-28)

3.3.1 Long-Term Groundwater Monitoring

During previous site investigations, five groundwater monitoring wells (KAFB-1001 through KAFB-1005) were installed at McCormick Ranch/Range. Two monitoring wells, KAFB-1006 and KAFB-1007, were installed during the Appendix I Phase 2 RFI. Drilling and development of these wells were completed by September 12, 1996. Since these wells were not installed prior to the August 1996 LTM event, they were not monitored. Both wells KAFB-1006 and KAFB-1007 will be gauged and sampled during future events as part of the LTM Program. All existing wells were operable and accessible for groundwater monitoring. Water level measurements were recorded for all five wells at the site. Three wells were sampled including one upgradient (KAFB-1002) and two downgradient (KAFB-1004 and KAFB-1005) wells.

The LTM Program at McCormick Ranch/Range is summarized in Table 3-5. The wells were analyzed for the parameters shown in Table 4-1 of the LTM Plan, which adheres to the requirements for groundwater monitoring in 40 CFR 265.92, and for explosives by Method SW846-8330. The parameter list in Table 4-1 includes: Groundwater Quality Parameters (chloride, iron, manganese, phenols, sodium and sulfate); Contaminant Indicator Parameters (specific conductance, pH, TOC, and TOX); and Parameters in Appendix III to Part 265 as listed below:

- RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)
- Fluoride
- Nitrate as N
- Pesticides (endrin, lindane, methoxychlor, toxaphene)
- Herbicides (2,4-D, 2,4,5-TP Silvex)
- Radioactivity (radium, gross alpha, gross beta)
- Coliform bacteria

Table 3-5. Summary of LTM Program at SWMU 6-31, McCormick Ranch/Range (OT-28)

Wells to Be Sampled	Wells Sampled	Analytes
1002 1004 1005 1006 1007	1002 1004 1005 Not installed Not installed	<i>Table 4-1 of Section 4.0 of the LTM Plan</i> <ul style="list-style-type: none"> ● Groundwater Quality Parameters ● Contaminant Indicator Parameters ● Appendix III Parameters <i>Explosives by EPA 8330</i>

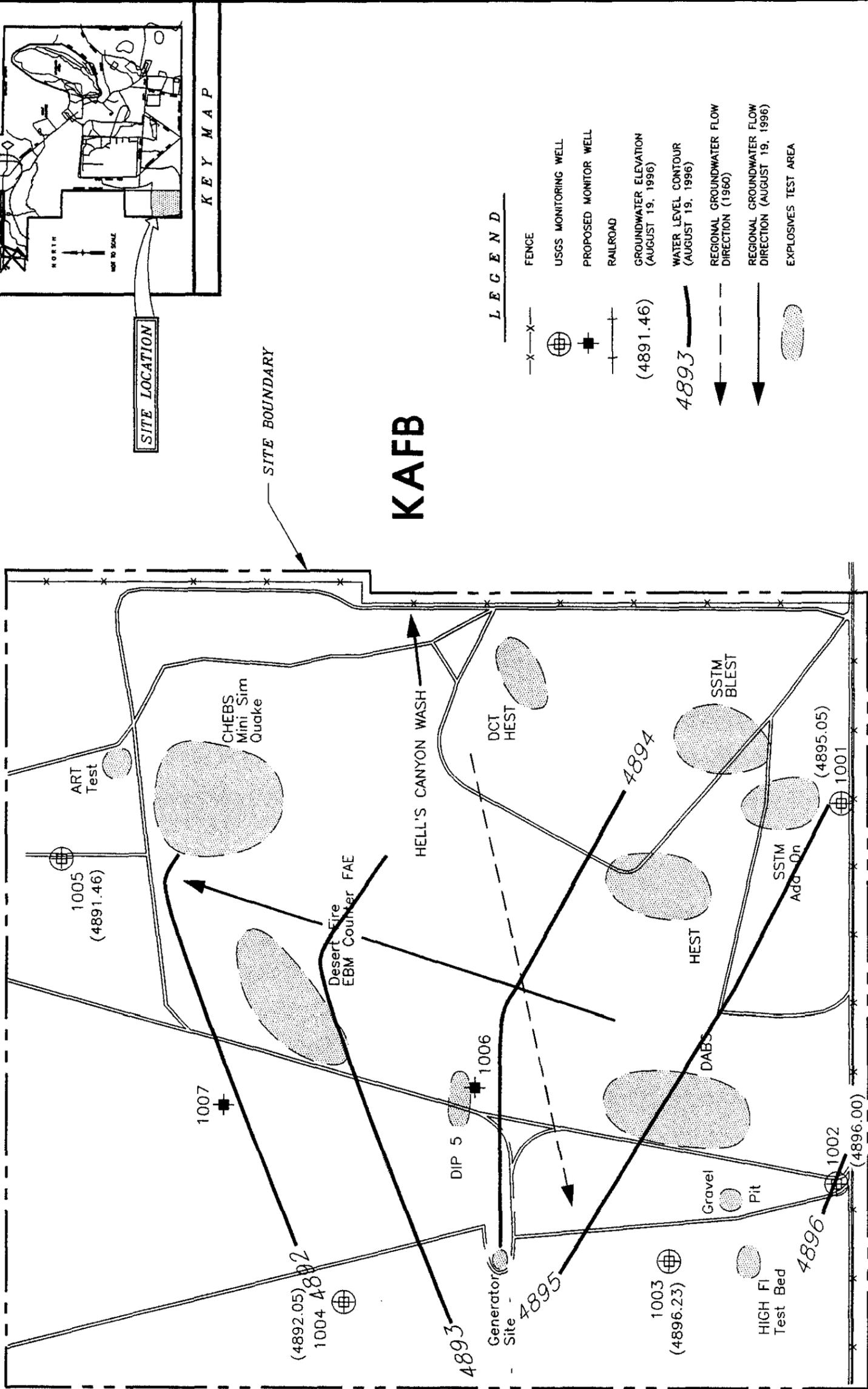
3.3.2 Groundwater Monitoring Results

Depth-to-water at McCormick Ranch/Range ranged from 357.68 to 381.09 ft below top of well casing. The depth-to-water measurements were converted to groundwater elevations relative to MSL (Appendix B-3). A groundwater elevation contour map was prepared using the August 1996 elevation data and the 1992/1993 survey data measured by the USGS (Figure 3-3). Review of the map shows that groundwater flows to the northeast at an average gradient of 0.0007 ft/ft. This groundwater flow direction is consistent with previous

NOTES

1. BASE MAP COMPILED FROM THE FOLLOWING SOURCES:
 A) DRAFT APPENDIX I RFI WORK PLAN
 B) USAF RFI STAGE 2A, VOL. 1
2. WELLS 1006 AND 1007 WERE INSTALLED AFTER THE AUGUST 1996 LTM EVENT.
3. ART Armament Research Test
 BLEST Berm Loaded Explosive Simulation Technique
 CHEBS Conventional High Explosive Blast Simulation
 DABS Dynamic Air Blast Simulation
 DCHest DiHest Calibration Test
 DIP-S DiHest Improvement Program - Test No. 5
 EBM Enhanced Blast Munitions
 FAE Fuel-Air Explosive
 HEST High Explosive Simulation Test
 HIGH FI High Fidelity Hest
 SSTM Standard Silo Test Mechanism

CMDWG (12/14/96)



KAFB

LEGEND

- FENCE
- USGS MONITORING WELL
- PROPOSED MONITOR WELL
- RAILROAD
- GROUNDWATER ELEVATION (AUGUST 19, 1996)
- WATER LEVEL CONTOUR (AUGUST 19, 1996)
- REGIONAL GROUNDWATER FLOW DIRECTION (1960)
- REGIONAL GROUNDWATER FLOW DIRECTION (AUGUST 19, 1996)
- EXPLOSIVES TEST AREA



Isleta Indian Reservation

Figure 3-3 Groundwater Elevation Contour Map for SWMU 6-31, McCormick Ranch/Range (OT-28)

monitoring conducted in May 1996 (USAF, 1996b), but differs from 1960 regional data which indicated a westward groundwater flow.

3.3.3 Groundwater Sampling Results

Groundwater analytical results are summarized in Table 3-6. The laboratory reports for this site are provided in Appendix C-3.

Sodium was the only metal detected, and was found in all three wells sampled (KAFB-1002, -1004, and -1005) at concentrations ranging from 21,000 to 27,000 $\mu\text{g/l}$. Other inorganic parameters detected in all the wells include chloride (10-11 mg/l), nitrate-N (2.9-6.6 mg/l), and sulfate (34-45 mg/l). Fluoride was detected in KAFB-1004 and KAFB-1005 at 0.46 mg/l and 0.52 mg/l, respectively. Total recoverable phenols (0.047 mg/l) and TOC (2.3 mg/l) were detected in KAFB-1005. Field measurements of pH and specific conductance for all wells ranged from 6.11 to 7.16 and from 377 to 411 $\mu\text{mhos/cm}$, respectively. Temperature ranged from 70.3 to 78.1 degrees Fahrenheit. Turbidity ranged from 2.63 to 3.12 NTU.

No pesticides or chlorinated herbicides were detected in any of the wells. No total or fecal coliforms were detected in any of the wells.

The samples were also analyzed for radiological parameters. Gross alpha radioactivity was detected in the samples from all wells at levels ranging from 1.2 to 3.8 pCi/L, while gross beta radioactivity ranged from 4.0 to 6.4 mrem/yr. Radium-226 and radium-228 activities for all wells ranged from 0.68 to 1.4 pCi/L and from -0.14 to 0.35 pCi/L, respectively.

No explosives were detected in any of the three wells sampled at the site.

All detected concentrations for this site are below applicable NMSWMR health-based groundwater standards. Concentrations of total phenols (0.047 mg/l) and pH (6.11) in well KAFB-1005 exceed the NMSWMR aesthetic groundwater standards for these analytes of 0.005 mg/l and 6.5-8.5, respectively. In addition, gross beta radioactivity in wells KAFB-1002 (6.4 mrem/yr) and KAFB-1004 (4.3 mrem/yr) exceeds the SDWA MCL of 4 mrem/yr.

3.3.4 Recommendations

The first year of LTM sampling analytical results are the baseline values for evaluating future sampling data. No formal modifications to the LTM Plan for McCormick Ranch/Range are proposed at this time.

Table 3-6. Summary of Groundwater Analytical Results at SWMU 6-31, McCormick Ranch/Range (OT-28), August 1996

Analytes	NMSWMR Standard	KAFB-1002	KAFB-1004	KAFB-1005
Dissolved Metals - EPA Methods 6010A & 7000-series ($\mu\text{g/l}$)				
Sodium	NE	25,000	27,000	21,000
Inorganics - EPA Methods 300-series, 400-series, and 9020 (mg/l)				
Chloride	250	10	10	11
Fluoride	1.6	<0.2	0.46	0.52
Nitrate-N	10	6.6	6.6	2.9
Total Recoverable Phenols	0.005	<0.03	<0.03	0.047
Sulfate	250	45	34	44
TOC	NE	<2	<2	2.3
Field Measurements				
pH	6.5-8.5	7.16	6.99	6.11
Specific Conductance ($\mu\text{mhos/cm}$)	NE	411	400	377
Temperature ($^{\circ}\text{F}$)	NE	70.3	78.1	72.2
Turbidity (NTU)	NE	2.86	3.12	2.63
Organochlorine Pesticides and Chlorinated Herbicides - EPA Methods 8081 and 8151 ($\mu\text{g/l}$)				
All Constituents	NE	<RL	<RL	<RL
Total Coliform - SM 9222B (Colonies/100 ml)				
Total Coliform	NE	Absent	Absent	Absent
Fecal Coliform	NE	Absent	Absent	Absent

Table 3-6. Summary of Groundwater Analytical Results at SWMU 6-31, McCormick Ranch/Range (OT-28), August 1996 (Concluded)

Analytes	NMSWMR Standard	KAFB-1002	KAFB-1004	KAFB-1005
Radiological Parameters - EPA Methods 900.0, 903.1, and 904.0 (pCi/L)				
Gross Alpha	15	1.2	3.5	3.8
Gross Beta ⁽¹⁾	4	6.4	4.3	4.0
Radium-226	combined 5.0	0.68	1.1	1.4
Radium-228		-0.021	-0.14	0.35
Explosives - SW846-8330 (µg/l)				
All Constituents	NE	<RL	<RL	<RL

FOOTNOTES

(1)	Units in mrem/yr. Conversion for gross beta in pCi/L to mrem/yr using 0.967 multiplier.
1	Only detected constituents for metals and inorganics are presented in the table.
2	Shaded/bolded values indicate concentration exceeded the corresponding NMSWMR standard.
3	Standards for gross alpha and gross beta radioactivity are the corresponding Maximum Contaminant Levels from federal Safe Drinking Water Act.
<	Indicated compound not detected at the stated reporting limit.
°F	Degrees Fahrenheit
mg/l	Milligrams per liter
ml	Milliliters
mrem/yr	Millirems per year
NE	Not established
NMSWMR	New Mexico Solid Waste Management Regulations
NTU	Nephelometric turbidity unit
pCi/L	Picocuries per liter
RL	Reporting limit
TOC	Total organic carbon
µg/l	Micrograms per liter
µmhos/cm	Micromhos per centimeter

3.4 SWMU 6-4, Landfills 4, 5, and 6 (LF-08)

3.4.1 Long-Term Groundwater Monitoring

As described in the LTM Plan, the LTM Program for Landfills 4, 5, and 6 consisted of gauging and sampling of all six groundwater monitoring wells (KAFB-0307 through KAFB-0311 and TJA-2) at the site. All wells were operable and accessible for LTM.

The LTM Program at Landfills 4, 5, and 6 is summarized in Table 3-7. Discussion and reporting of analytical results for this site have been revised from previous reports to include only data listed in Table 4-1 of the LTM Plan for consistency with the other LTM sites. Presentation of analytical data shown in Table 4-2 of the LTM Plan (Table 1 of Appendix A of 20 NMAC 9.1 parameters) has been omitted and will be provided to the NMED Solid Waste Bureau (SWB) under separate cover.

The wells at Landfills 4, 5, and 6 were analyzed for the parameters shown in Table 4-1 of the LTM Plan, with the exception of TOX which will be added to the analyses for this site for future LTM events. The parameter list in Table 4-1 includes: Groundwater Quality Parameters (chloride, iron, manganese, phenols, sodium and sulfate); Contaminant Indicator Parameters (specific conductance, pH, TOC, and TOX); and Parameters in Appendix III to Part 265 as listed below:

- RCRA (total) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)
- Fluoride
- Nitrate as N
- Pesticides (endrin, lindane, methoxychlor, toxaphene)
- Herbicides (2, 4-D, 2,4,5-TP Silvex)
- Radioactivity (radium, gross alpha, gross beta)
- Coliform bacteria

In addition to the QA/QC samples discussed in Section 2.10 of the LTM Plan, three ambient condition blanks were collected during the monitoring event (one per day of sampling) and analyzed for VOCs. The ambient condition blanks were collected in the field by pouring reagent-grade water into sample containers under field conditions.

Table 3-7. Summary of LTM Program at SWMU 6-4, Landfills 4, 5, and 6 (LF-08)

Wells to Be Sampled	Wells Sampled	Analytes
0307	0307	<i>Table 4-1 of Section 4.0 of LTM Plan</i> ● Groundwater Quality Parameters ● Contaminant Indicator Parameters except TOX ● Appendix III Parameters <i>VOCs by SW 8260</i>
0308	0308	
0309	0309	
0310	0310	
0311	0311	
TJA-2	TJA-2	

3.4.2 Groundwater Monitoring Results

Depth-to-water at Landfills 4, 5, and 6 ranged from 365.48 to 491.39 ft below top of well casing, as measured in all wells except TJA-2. Depth-to-water in TJA-2, completed in a perched aquifer, was 274.22 ft. The depth-to-water measurements were converted to groundwater elevations relative to MSL (Appendix B-4). A groundwater elevation contour map was prepared using the August 1996 elevation data and the May 1996 survey data measured by Harris Surveying, Inc., of Albuquerque, NM (Figure 3-4). The water table was above the top of the screen in all wells except KAFB-0307 when gauged in August 1996. Review of the map shows that groundwater flows to the northeast-northwest at an approximate gradient of 0.05 ft/ft. This differs from groundwater data collected in May 1996 (USAF, 1996b) and July 1996 (USAF, 1996c) which indicated an apparent groundwater mound near KAFB-0307, possibly due to recharge from the Tijeras Arroyo. The August 1996 groundwater flow direction is fairly consistent with previous monitoring conducted in September 1992, which indicated a northwestward flow (USAF, 1993). Regional data from 1960 indicated a westward groundwater flow.

3.4.3 Groundwater Sampling Results

Groundwater analytical results are summarized in Table 3-8. The laboratory reports for this site are provided in Appendix C-4.

No VOCs were detected in any of the monitoring wells sampled (KAFB-0307, -0308, -0309, -0310, -0311, and TJA-2). Additionally, no VOCs were detected in the ambient condition field blanks (LF08FB01, LF08FB02, and LF08FB03).

Several metals were detected in the wells at Landfills 4, 5, and 6. Sodium was detected in all wells sampled at concentrations ranging from 20,000 to 30,000 $\mu\text{g/l}$. Chromium was detected in KAFB-0310 at a concentration of 82 $\mu\text{g/l}$. Well KAFB-0310 also yielded concentrations of iron (600 $\mu\text{g/l}$) and selenium (10 $\mu\text{g/l}$).

Other inorganic parameters detected in all the wells included chloride (11-160 mg/l), fluoride (0.34-0.44 mg/l), and sulfate (34-130 mg/l). Well KAFB-0311 contained 3.1 mg/l TOC. Field measurements of pH and specific conductance for all wells ranged from 7.20 to 7.98 and from 462 to 978 $\mu\text{mhos/cm}$, respectively. Temperature ranged from 65.7 to 70.9 degrees Fahrenheit. Turbidity values ranged from 0.29 to 9.10 NTU.

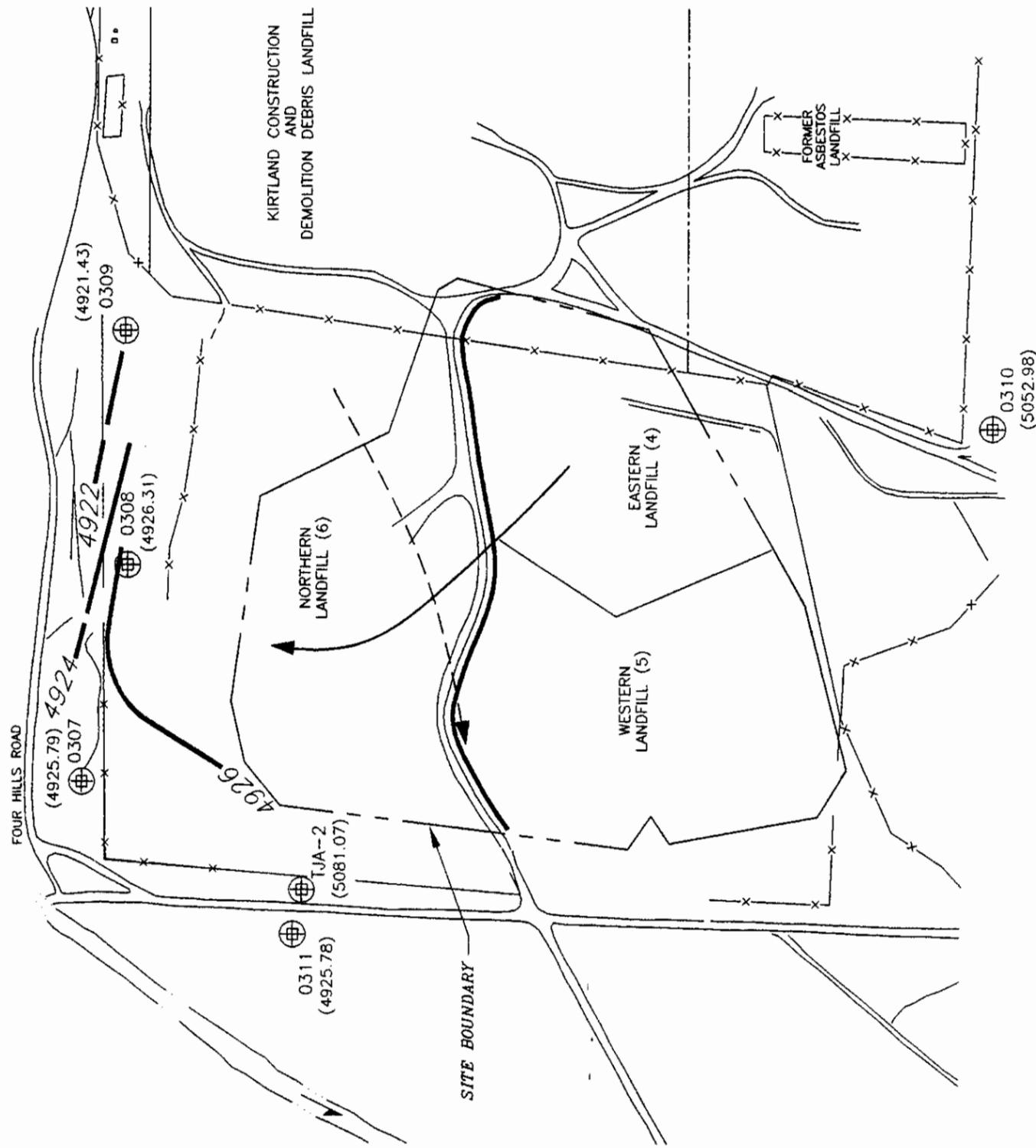
No pesticides or chlorinated herbicides were detected in any of the wells. No total or fecal coliforms were detected in any of the wells.

The samples were also analyzed for radiological parameters. Gross alpha radioactivity was detected in the samples from all wells at levels ranging from 1.8 to 4.9 pCi/L, while gross beta radioactivity ranged from 1.7 to 5.6 mrem/yr. Radium-226 and radium-228 activities for all wells ranged from -0.75 to 0.39 and -0.26 to 0.16 pCi/L, respectively. Total uranium activities for all wells ranged from 1.3 to 43 pCi/L.

All detected concentrations for this site are at or below applicable NMSWMR health-based groundwater standards, with the exception of total chromium (82 $\mu\text{g/l}$) in well KAFB-0310, exceeding the NMSWMR health-based standard of 50 $\mu\text{g/l}$. Concentrations of iron (600 $\mu\text{g/l}$) in well KAFB-0310 also exceeds the NMSWMR aesthetic groundwater standard of 300 $\mu\text{g/l}$. Gross beta radioactivity in well KAFB-0311 (5.6 mrem/yr) also exceeds the SDWA MCL of 4 mrem/yr.

NOTES

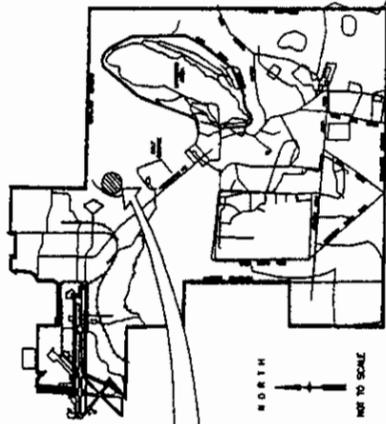
1. BASE MAP COMPILED FROM THE FOLLOWING SOURCES:
 A) DRAFT APPENDIX I RFI WORK PLAN
 B) USAF RFI STAGE 2A, VOL. 1
2. THE TOP OF SCREEN IS BELOW THE WATER TABLE IN ALL WELLS, EXCEPT 0307.



LEGEND

- x—x— FENCE
- ⊕ USGS MONITORING WELL
- +—+— RAILROAD
- (4921.43)— GROUNDWATER ELEVATION (AUGUST 27, 1996)
- 4924 WATER LEVEL CONTOUR (AUGUST 27, 1996)
- REGIONAL GROUNDWATER FLOW DIRECTION (1960)
- REGIONAL GROUNDWATER FLOW DIRECTION (AUGUST 27, 1996)

SITE LOCATION



KEY MAP

Figure 3-4 Groundwater Elevation Contour Map For SWMU 6-4, Landfills 4,5, AND 6 (LF-O8)

Table 3-8. Summary of Groundwater Analytical Results at SWMU 6-4, Landfills 4, 5, and 6 (LF-08), August 1996

Analytes	NMSWMR Standard	KAFB-0307	KAFB-0308	KAFB-0309	KAFB-0310	KAFB-0311	TJA-2
Volatile Organic Compounds - EPA Method 8260A (µg/l)							
All Constituents	various	<RL	<RL	<RL	<RL	<RL	<RL
Total Metals - EPA Methods 6010A & 7000-series (µg/l)							
Chromium	50	<300	<30	<30	82	<30	<30
Iron	300	<100	<100	<100	600	<100	<100
Selenium	10	<10	<10	<10	10	<10	<10
Sodium	NE	20,000	21,000	21,000	30,000	21,000	23,000
Inorganics - EPA Methods 160.1, 300-series, and 400-series (mg/l)							
Chloride	250	21	12	11	160	18	72
Fluoride	1.6	0.43	0.44	0.41	0.35	0.44	0.34
Sulfate	250	35	66	70	130	34	66
TOC	NE	<2	<2	<2	<2	3.1	<2
Field Measurements							
pH	6.5-8.5	7.71	7.71	7.98	7.20	7.90	7.51
Specific Conductance (µmhos/cm)	NE	462	498	494	978	488	628
Temperature (°F)	NE	67.4	65.7	66.5	66.3	67.1	70.9
Turbidity (NTU)	NE	2.40	0.29	0.78	9.10	1.29	0.52

Table 3-8. Summary of Groundwater Analytical Results at SWMU 6-4, Landfills 4, 5, and 6 (LF-08), August 1996 (Concluded)

Analytes	NMSW/MR Standard	KAFB-0307	KAFB-0308	KAFB-0309	KAFB-0310	KAFB-0311	TJA-2
Organochlorine Pesticides and Chlorinated Herbicides - EPA Methods 8081 and 8151 ($\mu\text{g/l}$)							
All Constituents	NE	<RL	<RL	<RL	<RL	<RL	<RL
Total Coliform - SM 9222B (Colonies/100 ml)							
Total Coliform	NE	Absent	Absent	Absent	Absent	Absent	Absent
Fecal Coliform	NE	Absent	Absent	Absent	Absent	Absent	Absent
Radiological Parameters - EPA Methods 900.0, 903.1, 904.0, and ASTM D-5174-91 (pCi/L)							
Gross Alpha	15	3.5	3.7	3.7	4.9	4.8	1.8
Gross Beta ⁽¹⁾	4	1.7	1.7	3.9	1.9	5.6	3.8
Radium-226	combined	0.39	-0.60	0.081	-0.31	0.061	-0.75
Radium-228	5.0	-0.21	-0.012	-0.23	-0.085	0.16	-0.26

FOOTNOTES

(1)	Units in mrem/yr. Conversion for gross beta in pCi/L to mrem/yr using 0.967 multiplier.
1	Only detected constituents for metals and inorganics are presented in the table.
2	Shaded/bolded values indicate concentration exceeded the corresponding NMSWMR standard.
3	Standards for gross alpha and gross beta radioactivity are the corresponding Maximum Contaminant Levels from federal Safe Drinking Water Act.
4	Conversion for uranium standard in ug/L to pCi/L using 0.6872 multiplier.
<	Indicated compound not detected at the stated reporting limit.
°F	Degrees Fahrenheit
mg/l	Milligrams per liter
ml	Milliliters
mrem/yr	Millirems per year
NE	Not established
NMSWMR	New Mexico Solid Waste Management Regulation
NTU	Nephelometric turbidity unit
pCi/L	Picocuries per liter
RL	Reporting limit
TOC	Total Organic Carbon
µg/l	Micrograms per liter
µmhos/cm	Micromhos per centimeter

3.4.4 Recommendations

The first year of LTM sampling analytical results are the baseline values for evaluating future sampling data. No formal modifications to the LTM Plan for Landfills 4, 5, and 6 are proposed at this time.

3.5 Tijeras Arroyo - Wells KAFB-0901 and KAFB-0902

3.5.1 Long-Term Groundwater Monitoring

As described in the LTM Plan, the LTM Program for the Tijeras Arroyo consists of gauging and sampling of two groundwater monitoring wells (KAFB-0901 and KAFB-0902). Both wells were operable and accessible for LTM.

The LTM Program at the Tijeras Arroyo is summarized in Table 3-9. The wells were analyzed for the parameters shown in Table 4-1 of the LTM Plan, which adheres to the requirements for groundwater monitoring in 40 CFR 265.92, and for VOCs by SW 8260. The parameter list in Table 4-1 includes: Groundwater Quality Parameters (chloride, iron, manganese, phenols, sodium and sulfate); Contaminant Indicator Parameters (specific conductance, pH, TOC, and TOX); and Parameters in Appendix III to Part 265 as listed below:

- RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)
- Fluoride
- Nitrate as N
- Pesticides (endrin, lindane, methoxychlor, toxaphene)
- Herbicides (2,4-D, 2,4,5-TP Silvex)
- Radioactivity (radium, gross alpha, gross beta)
- Coliform bacteria

Table 3-9. Summary of LTM Program at Tijeras Arroyo - Wells KAFB-0901 and KAFB-0902

Wells to Be Sampled	Wells Sampled	Analytes
0901 0902	0901 0902	<i>Table 4-1 of Section 4.0 of the LTM Plan</i> <ul style="list-style-type: none"> ● Groundwater Quality Parameters ● Contaminant Indicator Parameters ● Appendix III Parameters <i>VOCs by SW 8260</i>

3.5.2 Groundwater Monitoring Results

Depth-to-water at the Tijeras Arroyo ranged from 353.50 ft at KAFB-0902 to 479.15 ft below top of well casing at KAFB-0901. The depth-to-water measurements were converted to groundwater elevations relative to MSL (Appendix B-5). A groundwater elevation map was prepared using the August 1996 elevation data and the 1990 survey data measured by the USGS (Figure 3-5). Groundwater elevation contours were not constructed, since data from two wells separated by almost 20,000 ft (over 3 miles) is insufficient for contouring.

3.5.3 Groundwater Sampling Results

Groundwater analytical results are summarized in Table 3-10. The laboratory reports for this site are provided in Appendix C-5.

No VOCs were detected in either of the two wells sampled (KAFB-0901 and KAFB-0902). Sodium was the only metal detected, and was found at concentrations ranging from 21,000 to 27,000 $\mu\text{g/l}$. Other inorganic parameters detected in both wells include chloride (21-22 mg/l), fluoride (0.29-0.31 mg/l), nitrate-N (0.59-2.5 mg/l), and sulfate (52-92 mg/l). Well KAFB-0901 contained 2.4 mg/l TOC. No phenols or TOX were detected in either of the wells. Field measurements of pH and specific conductance for the wells ranged from 7.15 to 7.41 and from 395 to 550 $\mu\text{mhos/cm}$, respectively. Temperature ranged from 69.3 to 71.3 degrees Fahrenheit. Turbidity ranged from 0.36 to 1.25 NTU.

No pesticides or chlorinated herbicides were detected in either of the wells. No total or fecal coliforms were detected in either of the wells.

The samples were also analyzed for radiological parameters. Gross alpha radioactivity was detected in the samples from both wells at levels ranging from 2.2 to 2.9 pCi/L , while gross beta radioactivity ranged from 1.5 to 1.8 mrem/yr . Radium-226 and radium-228 activities for both wells ranged from 0.73 to 0.89 and from -0.32 to -0.092 pCi/L , respectively.

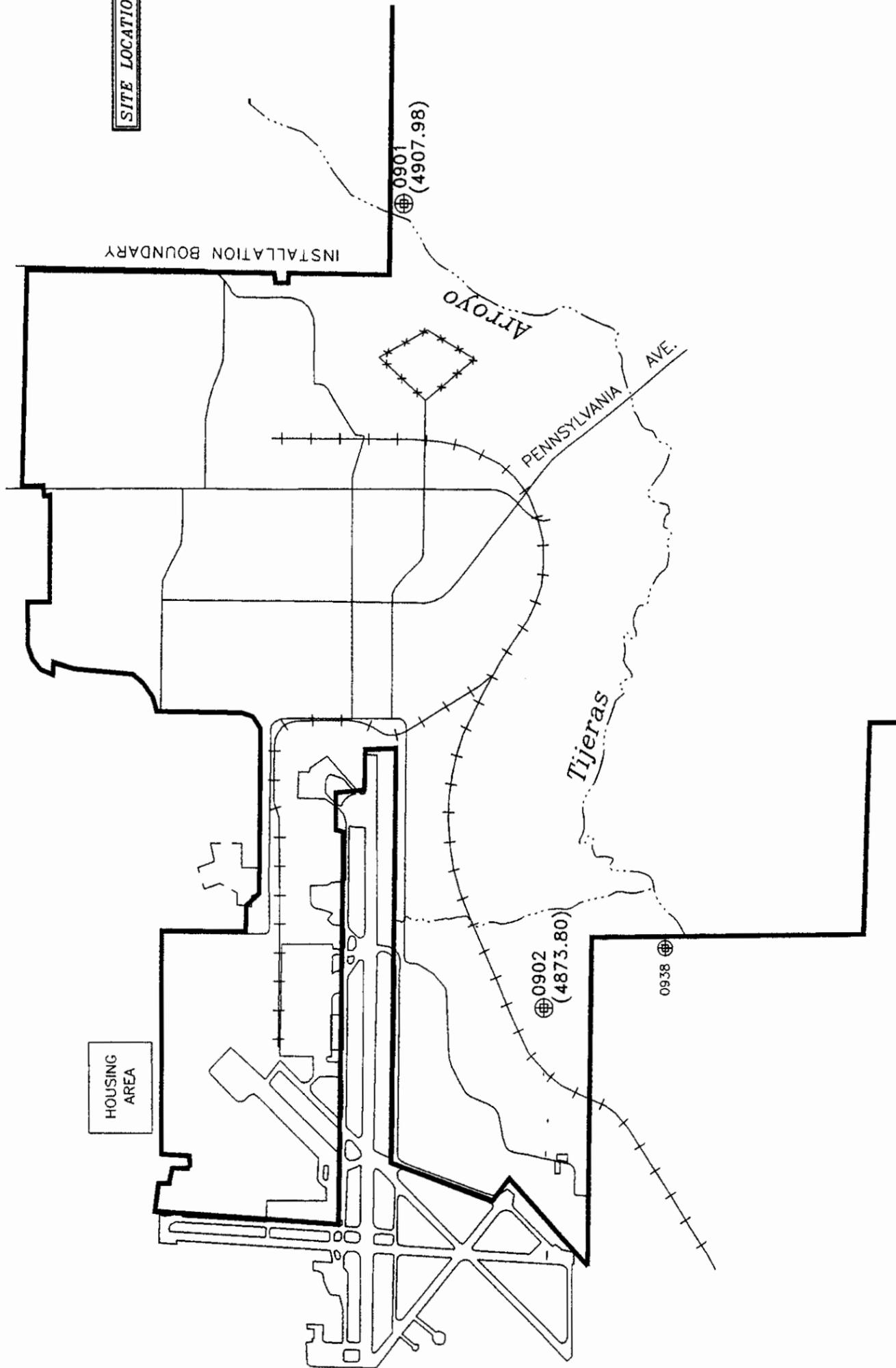
All detected concentrations for this site are below applicable NMSWMR health-based groundwater standards.

3.5.4 Recommendations

The first year of LTM sampling analytical results are the baseline values for evaluating future sampling data. No formal modifications to the LTM Plan for the Tijeras Arroyo are proposed at this time.

NOTES

1. BASE MAP COMPILED FROM THE FOLLOWING SOURCE:
 A) USAF RFI STAGE 2A, VOL. 1



LEGEND

- ⊕ USGS MONITORING WELL
- +— RAILROAD
- ...— SURFACE WATER
- (4907.98) GROUNDWATER ELEVATION (AUGUST 21, 1996)
- *- FENCE

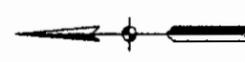


Figure 3-5 Groundwater Elevation Map for Tijeras Arroyo-Wells KAFB O901 and O902

1AWGEM.DWG (12/14/96)

Table 3-10. Summary of Groundwater Analytical Results at Tijeras Arroyo - Wells KAFB-0901 and KAFB-0902, August 1996

Analytes	NMSWMR Standard	KAFB-0901	KAFB-0902
Volatile Organic Compounds - EPA Method 8260A ($\mu\text{g/l}$)			
All Constituents	various	<RL	<RL
Dissolved Metals - EPA Methods 6010A & 7000-series ($\mu\text{g/l}$)			
Sodium	NE	27,000	21,000
Inorganics - EPA Methods 300-series, 400-series, and 9020 (mg/l)			
Chloride	250	21	22
Fluoride	1.6	0.29	0.31
Nitrate-N	10	2.5	0.59
Sulfate	250	92	52
TOC	NE	2.4	<2
Field Measurements			
pH	6.5-8.5	7.15	7.41
Specific Conductance ($\mu\text{mhos/cm}$)	NE	550	395
Temperature ($^{\circ}\text{F}$)	NE	71.3	69.3
Turbidity (NTU)	NE	0.36	1.25
Organochlorine Pesticides and Chlorinated Herbicides - EPA Methods 8081 and 8151 ($\mu\text{g/l}$)			
All Constituents	NE	<RL	<RL
Total Coliform - SM 9222B (Colonies/100 ml)			
Total Coliform	NE	Absent	Absent
Fecal Coliform	NE	Absent	Absent
Radiological Parameters - EPA Methods 900.0, 903.1, and 904.0 (pCi/L)			
Gross Alpha	15	2.9	2.2
Gross Beta ⁽¹⁾	4	1.8	1.5
Radium-226	combined 5.0	0.89	0.73
Radium-228		-0.092	-0.32

FOOTNOTES

(1)	Units in mrem/yr. Conversion for gross beta in pCi/L to mrem/yr using 0.967 multiplier.
1	Only detected constituents for metals and inorganics are presented in the table.
2	Shaded/bolded values indicate concentration exceeded the corresponding NMSWMR standard.
3	Standards for gross alpha and gross beta radioactivity are the corresponding Maximum Contaminant Levels from federal Safe Drinking Water Act.
<	Indicated compound not detected at the stated reporting limit.
°F	Degrees Fahrenheit
mg/l	Milligrams per liter
ml	Milliliters
mrem/yr	Millirems per year
N	Nitrogen
NE	Not established
NMSWMR	New Mexico Solid Waste Management Regulations
NTU	Nephelometric turbidity unit
pCi/L	Picocuries per liter
RL	Reporting limit
TOC	Total organic carbon
µg/l	Micrograms per liter
µmhos/cm	Micromhos per centimeter

3.6 SWMU 6-22, Lake Christian (OT-46)

3.6.1 Long-Term Groundwater Monitoring

As described in the LTM Plan, the LTM Program for Lake Christian consists of gauging all three wells (KAFB-1901, -1902, and -1903) and sampling of one of these wells (KAFB-1903). All wells were operable and accessible for LTM.

During the Appendix I Phase 2 RFI and following the August 1996 LTM event, an additional groundwater monitoring well (1904) was installed southwest of Lake Christian. The well was installed to a depth of 120 ft and will be sampled as part of the LTM Program for subsequent events.

The LTM Program at Lake Christian is summarized in Table 3-11. Well KAFB-1903 was analyzed for the parameters shown in Table 4-1 of the LTM Plan, which adheres to the requirements for groundwater monitoring in 40 CFR 265.92, and for heptachlor epoxide by SW 8081. The parameter list in Table 4-1 includes: Groundwater Quality Parameters (chloride, iron, manganese, phenols, sodium and sulfate); Contaminant Indicator Parameters (specific conductance, pH, TOC, and TOX); and Parameters in Appendix III to Part 265 as listed below:

- RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)
- Fluoride
- Nitrate as N
- Pesticides (endrin, lindane, methoxychlor, toxaphene)
- Herbicides (2,4-D, 2,4,5-TP Silvex)
- Radioactivity (radium, gross alpha, gross beta)
- Coliform bacteria

Table 3-11. Summary of LTM Program at SWMU 6-22, Lake Christian (OT-46)

Wells to Be Sampled	Wells Sampled	Analytes
1903 1904	1903 Not installed	<i>Table 4-1 of Section 4.0 of the LTM Plan</i> <ul style="list-style-type: none"> ● Groundwater Quality Parameters ● Contaminant Indicator Parameters ● Appendix III Parameters <i>Heptachlor epoxide by SW 8081</i>

3.6.2 Groundwater Monitoring Results

Depth-to-water at Lake Christian ranged from 54.73 to 88.50 ft below top of well casing. The depth-to-water measurements were converted to groundwater elevations relative to MSL (Appendix B-6). A groundwater elevation map was prepared using the August 1996 elevation data and the 1992/1993 survey data measured by the USGS (Figure 3-6). Due to the lack of topographic and groundwater elevation data between wells

KAFB-1901 and KAFB-1902 in the northeast part of the site, and well KAFB-1903 to the southwest, groundwater elevation contours were not drawn. A survey is being completed for this site as part of the Appendix I Phase 2 RFI and this data will be compiled in January 1997. Groundwater elevation contours will be added to the map for the third quarter (November 1 - January 31, 1996) LTM Report using the new survey data.

3.6.3 Groundwater Sampling Results

Groundwater analytical results are summarized in Table 3-12. The laboratory reports for this site are provided in Appendix C-6.

Detected metals from well KAFB-1903 at Lake Christian include iron (14,000 µg/l), manganese (210 µg/l), and sodium (100,000 µg/l). Other inorganic parameters detected in the well include chloride (120 mg/l), fluoride (1.6 mg/l), nitrate-N (0.48 mg/l), sulfate (83 mg/l), and TOC (3.4 mg/l). No phenols or TOX were detected in the well. Field measurements of pH and specific conductance for the well were 5.96 and 1,493 µmhos/cm, respectively. Temperature and turbidity measurements were 68.5 degrees Fahrenheit and 5.29 NTU, respectively.

No pesticides or chlorinated herbicides were detected in the well. No total or fecal coliforms were detected in the well.

The sample from KAFB-1903 was also analyzed for radiological parameters. Gross alpha radioactivity was detected in the sample at a level of 19 pCi/L, while gross beta radioactivity was 9.7 mrem/yr. Radium-226 and radium-228 activities in the well were 0.81 and 0.21 pCi/L, respectively.

All detected concentrations for this site are at or below applicable NMSWMR health-based groundwater standards. Concentrations of iron (14,000 µg/l), manganese (210 µg/l), and pH (5.96) exceed NMSWMR aesthetic groundwater standards for these analytes of 300 µg/l, 50 µg/l, and 6.5-8.5, respectively. Gross alpha radioactivity in KAFB-1903 (19 pCi/L) exceeds the SDWA MCL of 15 pCi/L. Gross beta levels in KAFB-1903 (9.7 mrem/yr) also exceed the SDWA MCL of 4 mrem/yr.

3.6.4 Recommendations

The first year of LTM sampling analytical results are the baseline values for evaluating future sampling data. No formal modifications to the LTM Plan for Lake Christian are proposed at this time. The project chemists have approved the reduction of the laboratory data package for this site to the standard reporting format consistent with the other LTM sites (except LF-08) for future LTM events.

NOTES

1. BASE MAP COMPILED FROM THE FOLLOWING SOURCE:

A) USAF RFI STAGE 2A, VOL. 1

2. WELL 1904 WAS INSTALLED AFTER THE AUGUST 1996 LTM EVENT.

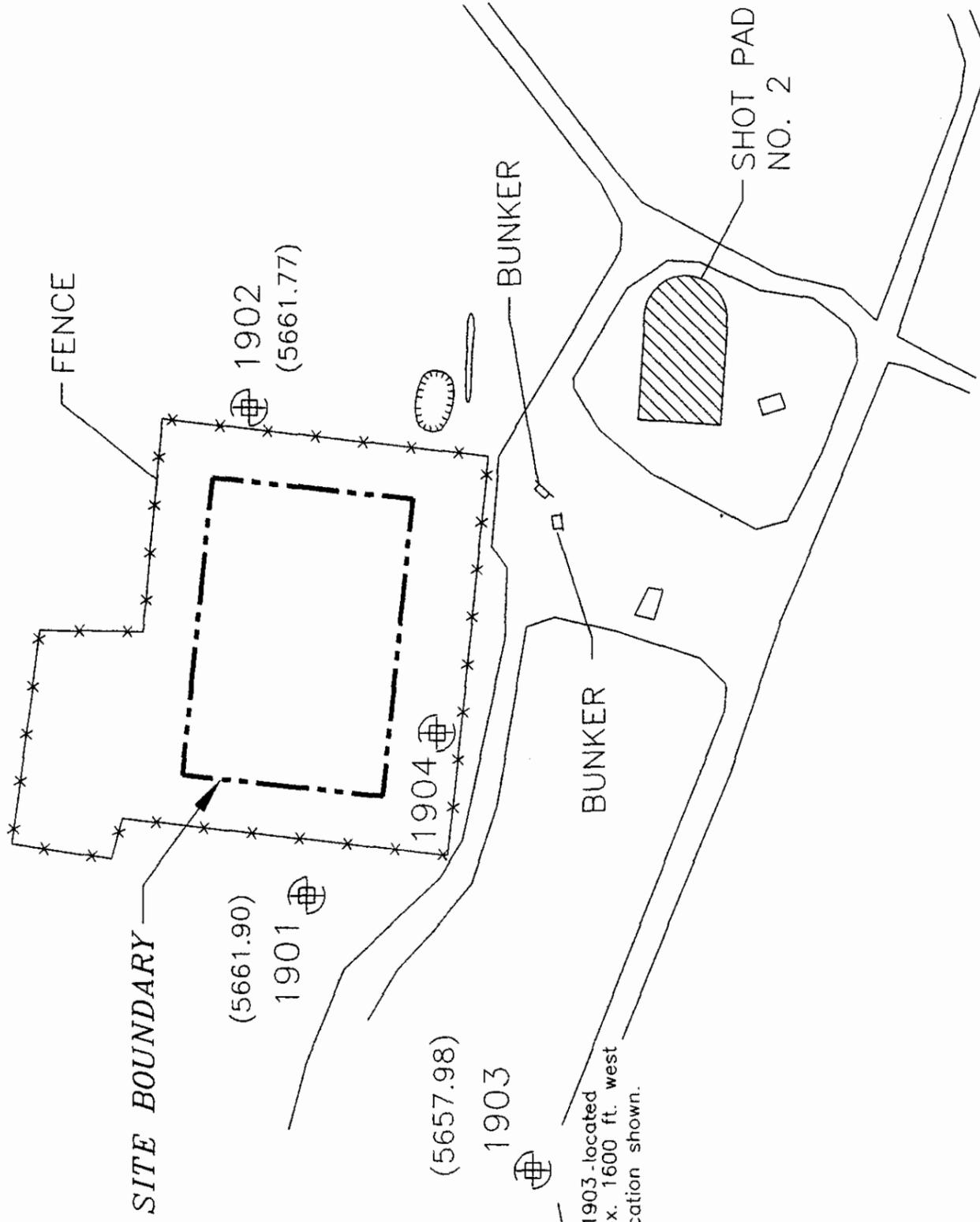


Figure 3-6 Groundwater Elevation Map For SWMU 6-22, Lake Christian (OT-46)

Table 3-12. Summary of Groundwater Analytical Results at SWMU 6-22, Lake Christian (OT-46), August 1996

Analytes	NMSWMR Standard	KAFB-1903
Dissolved Metals - EPA Methods 6010A & 7000-series (µg/l)		
Iron	300	14,000
Manganese	50	210
Sodium	NE	100,000
Inorganics - EPA Methods 300-series, 400-series, and 9020 (mg/l)		
Chloride	250	120
Fluoride	1.6	1.6
Nitrate-N	10	0.48
Sulfate	250	83
TOC	NE	3.4
Field Measurements		
pH	6.5-8.5	5.96
Specific Conductance (µmhos/cm)	NE	1,493
Temperature (°F)	NE	68.5
Turbidity (NTU)	NE	5.29
Organochlorine Pesticides and Chlorinated Herbicides - EPA Methods 8081 and 8151 (µg/l)		
All Constituents	NE	<RL
Total Coliform - SM 9222B (Colonies/100 ml)		
Total Coliform	NE	Absent
Fecal Coliform	NE	Absent
Radiological Parameters - EPA Methods 900.0, 903.1, and 904.0 (pCi/L)		
Gross Alpha	15	19
Gross Beta ⁽¹⁾	4	9.7
Radium-226	combined 5.0	0.81
Radium-228		0.21

FOOTNOTES

(1)	Units in mrem/yr. Conversion for gross beta in pCi/L to mrem/yr using 0.967 multiplier.
1	Only detected constituents for metals and inorganics are presented in the table.
2	Shaded/bolded values indicate concentration exceeded the corresponding NMSWMR standard.
3	Standards for gross alpha and gross beta radioactivity are the corresponding Maximum Contaminant Levels from federal Safe Drinking Water Act.
<	Indicated compound not detected at the stated reporting limit.
°F	Degrees Fahrenheit
mg/l	Milligrams per liter
ml	Milliliters
mrem/yr	Millirems per year
N	Nitrogen
NE	Not established
NMSWMR	New Mexico Solid Waste Management Regulations
NTU	Nephelometric turbidity unit
pCi/L	Picocuries per liter
RL	Reporting limit
TOC	Total organic carbon
µg/l	Micrograms per liter
µmhos/cm	Micromhos per centimeter

4. INVESTIGATION DERIVED WASTE (IDW) MANAGEMENT PROCEDURES

4.1 Introduction

The procedures for handling IDW generated during the field activities as defined in the LTM Plan were generally followed. Based on the data collected during previous investigations, the IDW generated during the 1996 LTM Program was not anticipated to be hazardous.

4.2 Waste Characterization

The IDW generated during the LTM consisted of purge water from each well, personal protection equipment (PPE), paper towels, and soapy decontamination water. Waste minimization techniques (including the use of dedicated sampling pumps) were employed where possible to reduce the quantity of IDW generated. Waste characterization was primarily based on comparison of the field analytical data with applicable regulatory levels. No direct sampling of IDW for waste characterization was conducted.

4.3 Management of Purged Water and Decontamination Water

Purge and decontamination waters were the primary wastes generated during the LTM. The water from each site was placed in permanently mounted, 175-gallon, polyethylene storage tanks located adjacent to each well head. A sign was posted on each tank indicating the contents and that no material should be added or removed. Purge water was stored in the tanks pending waste characterization. Waste characterization was performed by reviewing the groundwater sample analytical results for all sites. Any detected constituents were compared to Toxicity Standards (40 CFR 261.24, Table 1) and New Mexico Water Quality Control Commission Regulations (NMWQCCR), Part 2, 3103, A, B, and C groundwater quality standards. No analytical results were greater than the listed standards in 40 CFR. The following wells yielded analytical results exceeding those listed in NMWQCCR, Part 2, 3103: Well KAFB-0310 at Landfills 4, 5, and 6 (82 µg/l chromium); well KAFB-1005 at McCormick Ranch (0.047 mg/l phenols); and well KAFB-1903 at Lake Christian (OT-46) (14,000 µg/l iron, 210 µg/l manganese, pH 5.96).

A Notice of Intent (NOI) to discharge purge water generated during the LTM Program onto the ground surface was prepared and submitted by Kirtland AFB (June 18, 1996) to the NMED. The NMED's approval was received in correspondence dated August 12, 1996. After each sampling round, Kirtland AFB will notify the NMED that purge water was discharged and the amount discharged.

4.4 Personal Protective Equipment and Sampling Equipment

All PPE and disposable sampling equipment were placed in double plastic trash bags and sealed. These items were disposed of in dumpsters at the base as specified in the LTM Plan.

5. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) SUMMARY

5.1 QA/QC Sampling Requirements

In accordance with the field QA/QC program presented in Section 2.10 of the LTM Plan and in accordance with the Base-Wide FSP (Section 8.0), the following QA/QC sampling is to be conducted for each groundwater event under the LTM Program:

- Trip Blank - One trip blank to accompany every cooler of aqueous samples sent to the laboratory for the analysis of VOCs only.
- Temperature Blank - One temperature blank to be placed in the middle portion of every cooler shipped containing samples which are temperature sensitive. The purpose of this blank is to verify the cooler temperature.
- Duplicate - Ten percent of all water samples will be field duplicates. Samples and their respective duplicates will be analyzed for the same parameters in the laboratory.
- QA Duplicates - In addition to field QC samples, 10 percent of all field samples will be collected as QA duplicates and submitted to the United States Army Corps of Engineers (USACE) MRD laboratory for analysis.

For the August 1996 LTM sampling event, samples were sent to the MRD laboratory with the reference project Location Information Management System (LIMS) Number of 2899.

The above QA/QC sampling protocol was generally followed during the August 1996 LTM event with the following variance:

- Not every cooler sent to the laboratory containing VOC samples contained a trip blank. The following samples shipped for VOC analysis were not accompanied by a trip blank due to sampler error: LF01011301, LF01011501, LF02021801, and TIJA090101. This was not an approved variance. Trip blanks will be shipped with every cooler containing VOC samples for all future LTM events.

5.2 Duplicate Groundwater Sample Results

Duplicate groundwater samples were collected from three of the six LTM sites and analyzed for all proposed analytes. Duplicate sample locations were selected in advance of the event, based on the locations most likely to have contamination. In most cases, the well believed to be the most hydraulically downgradient was selected for duplicate analysis. An exception was well KAFB-0310 (Landfills 4, 5, and 6) which is located hydraulically upgradient. This well was selected for duplicate analysis based on the presence of contaminants previously detected during the May 1996 and July 1996 LTM events. A comparison of the duplicate groundwater sample results with the original sample results is summarized in Table 5-1. Laboratory analytical reports are provided in Appendix C.

Groundwater samples were collected following the procedures detailed in the FSP. Duplicate samples were collected at LF-08, the Tijeras Arroyo, and OT-46. The analytical results for the primary and duplicate field

Table 5-1. Comparison of Duplicate Groundwater Sample Results, August 1996

Analytes	LF08031001 LF08031002	RPD (%)	TIJA090201 TIJA090202	RPD (%)	OT46190301 OT46190302	RPD (%)
Volatile Organic Compounds - EPA Method 8260A (µg/l)						
All Constituents	<RL/<RL	NA	<RL/<RL	NA	NA/NA	NA
Metals - EPA Methods 6010A & 7000-series (µg/l)						
Chromium	82/81	1.2	<30/<30	NA	<30/<30	NA
Iron	600/620	3.3	<100/<100	NA	14,000/15,000	6.9
Manganese	<15/<15	NA	<15/<15	NA	210/210	0
Nickel	<40/45	NA	NA/NA	NA	NA/NA	NA
Selenium	10/12	18.2	<10/<10	NA	<10/<10	NA
Sodium	30,000/30,000	0	21,000/21,000	0	100,000/98,000	2.0
Inorganics - EPA Methods 160.1, 300-series, and 400-series (mg/l)						
Chloride	160/160	0	22/22	0	120/120	0
Fluoride	0.35/0.31	0	0.31/0.31	0	1.6/1.6	0
Nitrate-N	NA/NA	NA	0.59/0.57	3.4	0.48/0.40	18.2
Sulfate	130/130	0	52/53	1.9	83/82	1.2
TOC	<2/<2	NA	<2/<2	NA	3.4/8.6	86.7
Organochlorine Pesticides and Chlorinated Herbicides - EPA Methods 8081 and 8151 (µg/l)						
All Pesticide Constituents	<RL/<RL	NA	<RL/<RL	NA	<RL/<RL	NA
All PCB Constituents	<RL/<RL	NA	NA/NA	NA	NA/NA	NA
All Herbicide Constituents	<RL/<RL	NA	<RL/<RL	NA	<RL/<RL	NA
Total Coliform - SM 9222B (Colonies/100 ml)						
Total Coliform	Absent/Absent	NA	Absent/Absent	NA	Absent/Absent	NA
Fecal Coliform	Absent/Absent	NA	Absent/Absent	NA	Absent/Absent	NA

Table 5-1. Comparison of Duplicate Groundwater Sample Results, August 1996 (Concluded)

Analytes	LF08031001 LF08031002	RPD (%)	TIJA090201 TIJA090202	RPD (%)	OT46190301 OT46190302	RPD (%)
Radiological Parameters - EPA Methods 900.0, 903.1, 904.0, and ASTM D-5174-91 (pCi/L)						
Gross Alpha	4.9/2.9	51.3	2.2/2.2	0	19/19	0
Gross Beta ⁽¹⁾	1.9/3.1	48	1.5/3.0	NA	9.7/11.6	17.8
Radium-226	-0.31/-0.27	NA	0.73/0.69	NA	0.81/0.13	NA
Radium-228	-0.085/-0.038	NA	-0.32/-0.025	NA	0.21/0.25	NA

FOOTNOTES

(1)	Units in mrem/yr. Conversion for gross beta in pCi/L to mrem/yr using 0.967 multiplier.
1	Only detected constituents for metals and inorganics are presented in the table.
<	Indicated compound not detected at the stated reporting limit.
%	Percent
mg/l	Milligrams per liter
ml	Milliliters
N	Nitrogen
NA	Not applicable
pCi/L	Picocuries per liter
RL	Reporting limit
RPD	Relative percent difference
TOC	Total organic carbon
µg/l	Micrograms per liter

samples were consistent for VOCs, pesticides, and herbicides, since none of these constituents were detected in any of the samples. The relative percent differences (RPDs) for the metal samples ranged from 0 to 18.2%, and from 0 to 86.7% for the inorganic parameters. The absence of total coliforms was consistently replicated in the duplicate samples. For radiological parameters, the RPD between the primary and duplicate samples ranged from 0 to 51.3%. For all compounds, a RPD was not calculated if either the primary or the duplicate sample (or both) had a result below the reporting limit (RL), or the minimum detectable activity (MDA) for radioactivity. The duplicate sample results were all within acceptable limits.

5.3 Trip Blank and Temperature Blank Results

Trip blanks were analyzed for most coolers containing samples submitted for VOC analysis (total of 11 trip blanks). Laboratory analytical reports are provided in Appendix C. No VOCs were detected above the applicable RLs in any of the blanks (Table 5-2). Shipping cooler temperatures for all shipments upon receipt at the laboratory ranged from 0 to 3 degrees Celsius.

5.4 Laboratory QA/QC

In accordance with the LTM Plan, a detailed discussion of the laboratory QA/QC (summary of laboratory analytical methods, method detection limits [MDLs], QC activities, conformance/nonconformance summaries, summary of any deviations, and summary of the evaluation of the data quality for each analysis and matrix) is not presented herein, but will be included in the annual monitoring report.

A cursory review of the laboratory QA/QC data for the August 1996 LTM sampling event was conducted, however, to flag any potential problems or concerns that may effect future LTM events. The following notations are made:

- Analytical holding times were exceeded for two coliform samples at Landfill 2 and the explosives analyses for the three wells at McCormick Ranch. The laboratory exceeded the holding time for coliform analysis for samples KAFB-0215 and KAFB-0216 (Landfill 2) and subsequently canceled the coliform analyses for these two samples. Cancellation of these analyses was not approved by any project personnel. The laboratory has been instructed to seek approval for any variances for future LTM events. The laboratory exceeded the holding time for explosives analysis for samples KAFB-1002, KAFB-1004, and KAFB-1005. This was an unapproved variance due to laboratory error. A new subcontract laboratory approved by the project chemists will be used for explosives analysis for future LTM events.
- The required RLs (as specified in Tables 4-1 and 4-2 of the LTM Plan) were not met for the following compounds: dibromochloropropane, 1,2-dibromoethane, thallium, and nitrate as N. However, for the first three aforementioned compounds, the laboratory reported down to the MDL, flagging any values detected below the practical quantitation limit (PQL). The RL for nitrate as N was 0.05 mg/l, whereas the PQL listed in Table 4-1 is 0.0005 mg/l. It should be noted that the MCL for nitrate is 10 mg/l and the PQL required in the NMSWMR is 1.0 mg/l. These variances were approved by the USACE project chemist and will be incorporated into the next revision of the LTM Plan.
- The required RLs as specified in Table 4-2 of the LTM Plan were met for methylene chloride (10 µg/l) and total recoverable phenols (0.03 mg/l), however, the RLs exceeded the NMSWMR standards for these two compounds of 5 µg/l and 0.005 mg/l, respectively. For more meaningful

Table 5-2. Trip Blank Results, August 1996

Trip Blank ID	Trip Blank Date	Shipment Date	VOCs (EPA 8260A) ($\mu\text{g/l}$)
KAFBTB01	8/5/96	8/21/96	<RL
KAFBTB03	8/9/96	8/22/96	<RL
KAFBTB05	8/9/96	8/23/96	<RL
KAFBTB06	8/9/96	8/26/96	<RL
KAFBTB08	8/16/96	8/27/96	<RL
KAFBTB09	8/5/96	8/28/96	<RL
KAFBTB10	8/16/96	8/28/96	<RL
KAFBTB12	8/9/96	8/28/96	<RL
KAFBTB13	8/9/96	8/28/96	<RL
KAFBTB14	8/16/96	8/29/96	<RL
KAFBTB15	8/20/96	8/30/96	<RL

Notes:

1. Trip blanks KAFBTB02, KAFBTB04, KAFBTB07, and KAFBTB11 sent to MRD laboratory.

FOOTNOTES

<	Indicated compound not detected at the stated reporting limit.
MRD	Missouri River Division
RL	Reporting limit
µg/l	Micrograms per liter
VOC	Volatile organic compound

results, future LTM results will be reported to the MDLs of 5 µg/l (methylene chloride) and 0.005 mg/l (total recoverable phenols) and any values detected below the PQLs will be flagged.

- The following analytical methods reported for the August 1996 LTM event were variances from the LTM Plan. These variances were approved by the USACE project chemist prior to the first sampling event and will be incorporated into the next revision of the LTM Plan:

<u>Analysis</u>	<u>Proposed Method</u>	<u>Actual Method</u>
Total Kjeldahl Nitrogen	EPA 351.3	EPA 351.2
Nitrate-Nitrite-N	EPA 353.2	EPA 353.1
Nitrate as N	EPA 353.2	EPA 353.1
Ammonia	EPA 350.3	EPA 350.1
Chloride	EPA 325.3	EPA 325.2

- Methylene chloride (EPA 8260A) was detected at concentrations ranging from 8.10 to 10.6 µg/l in the method blank samples. This was attributed to laboratory contamination. Methylene chloride was detected in samples from the following monitoring wells: KAFB-0114 (11 µg/l) and KAFB-0115 (12 µg/l) at Landfill 1; and KAFB-0215 (10 µg/l) at Landfill 2. These samples were analyzed on August 29, 1996 (KAFB-0114 and KAFB-0115) and August 30, 1996 (KAFB-0215). The method blanks analyzed on these dates contained 9.14 µg/l and 8.10 µg/l methylene chloride, respectively. Because the concentrations detected in the method blanks were less than or slightly above the RL of 10 µg/l, this is not considered a significant problem.
- Samples collected from Landfill 1 (KAFB-0111, -0113, 0114, and -0115) for fecal coliform analysis (SM 9222B) were subjected to temperatures slightly below criteria during analysis. The temperature of the water bath was 44.0 degrees Celsius instead of 44.5 degrees Celsius. The laboratory stated that the results should not have been affected.

5.5 Daily Reports

The DQCRs which summarized the activities conducted on site were prepared by the field team leader. The reports describe the activities conducted during the work day and include problems encountered and any deviations. Copies of the DQCRs are presented in Appendix A.

REFERENCES

- New Mexico Environment Department-Solid Waste Bureau, November 1995. *New Mexico Solid Waste Management Regulations 20 NMAC 9.1.*
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- USAF, 1996c. *Kirtland Air Force Base, Final Draft Long-Term Groundwater Monitoring Report - July 1996 Out-of-Cycle Event*, Kirtland Air Force Base, New Mexico.
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