DEPARTMENT OF THE AIR FORCE
377th Civil Engineer Squadron (AFMC)

(Federal Express)

RECEIVED
AUG 2006
NMED Hazardous
Waste Bureau

10 Aug 06

MEMORANDUM FOR MR. JOHN KIELING, MANAGER
RCRA PERMITS MANAGEMENT PROGRAM
HAZARDOUS WASTE BUREAU (HWB)
NEW MEXICO ENVIRONMENT DEPARTMENT (NMED)
2905 RODEO PARK DRIVE EAST, BUILDING 1
SANTA FE, NM 87505-6313

FROM: 377 MSG/CEVR
2050 Wyoming Blvd SE, Suite 118
Kirtland AFB NM 87117-5270

SUBJECT: Submission of the Resource Conservation and Recovery Act Facility Investigation (RFI) Work Plan for Solid Waste Management Unit (SWMU) WP-26, Golf Course Main Pond Vadose Zone, Kirtland Air Force Base (AFB), NM EPA ID # NM9570024423

1. The Environmental Management (EM) Branch at Kirtland AFB is submitting two copies of the subject report, including one electronic copy with each document. One copy is being submitted to your office, and one copy is being submitted to Mr. Bill McDonald of your staff.

2. If you have any questions, please do not hesitate to contact me at (505) 853-6534 or Rob Warder at (505) 853-0012

.

Carl J. Lanz

CARL J. LANZ, P.G., GS-13
Chief, Restoration Section

Attachments:

1. RFI Work Plan for SWMU WP-26
2. Electronic copies of RFI Work Plan for SWMU WP-26

KAFB3023

cc:
NMED HWB, Mr. Bearzi, w Atchs
NMED HWB-KAFB, Mr. McDonald, w Atchs
USEPA-Region 6 (6PD-N), Ms. King w Atchs
HQ AFMC/A7CVP, Ms. Linthicum, wo Atchs
USACE Omaha, Mr. Ott, wo Atchs
MWH America's Inc., Ms. Drain, wo Atchs
Central New Mexico Community College, Admin Record, Montoya Campus, w Atch 2 only
AR/IR, w Atch 2 only
File

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

RESOURCE CONSERVATION AND RECOVERY ACT
FACILITY INVESTIGATION WORK PLAN FOR
SOLID WASTE MANAGEMENT UNIT WP-26,
GOLF COURSE MAIN POND VADOSE ZONE

August 2006

377 MSG/CEVR
2050 Wyoming Blvd. SE
Kirtland AFB, New Mexico 87117-5270

INSTALLATION RESTORATION PROGRAM
KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION WORK PLAN FOR SOLID WASTE MANAGEMENT UNIT WP-26, GOLF COURSE MAIN POND VADOSE ZONE

AUGUST 2006

Prepared for
U.S. ARMY CORPS OF ENGINEERS
ENVIRONMENTAL RESTORATION DIVISION
OMAHA, NEBRASKA

USACE CONTRACT NO. DACA45-03-D-0001
TASK ORDER 011

Prepared by
MWH AMERICAS, INC.
SALT LAKE CITY, UTAH

NOTICE

This work plan has been prepared for the U.S. Air Force by MWH Americas, Inc., to aid in the implementation of a final remedial action plan under the Environmental Restoration Program (ERP). As the plan relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this plan and the ongoing nature of the ERP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this plan, because subsequent facts may become known that may make this plan premature or inaccurate.

A copy of this document is available for public review at the Central New Mexico Community College, Montoya Campus Library Reference Section, at 4700 Morris NE, Albuquerque, New Mexico.

Government agencies and their contractors registered with the Defense Technical Information Center should direct requests for copies of this study to the Defense Technical Information Center, Cameron Station, Alexandria, Virginia 22304-6145.

Nongovernment agencies may purchase copies of this document from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, Virginia 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503.

1. AGENCY USE ONLY	2. REPORT DATE August 2006	3. REPORT TYPE AND DATES COVERED Resource Conservation Recovery Act Facility Investigation Work Plan, August 2006

4. TITLE AND SUBTITLE	5. FUNDING NUMBERS
Kirtland Air Force Base (AFB) Albuquerque, New Mexico *Resource Conservation and Recovery Act* Facility Investigation Work Plan for Solid Waste Management Unit WP-26, Golf Course Main Pond Vadose Zone	USACE Contract No. DACA45-03-D0001 Delivery Order No. 0011 Mod 1
6. AUTHOR(S) Deborah Drain and Tony Magliocchino, P.G. MWH Americas, Inc.	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) MWH Americas, Inc. 10619 South Jordan Gateway, Suite 100 South Jordan, Utah 84095	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) USACE Omaha District 106 South 15th Street, Omaha, NE 68102-1618 Project Manager: Steve Rowe	10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
Approved for public release; distribution is unlimited.	

13. ABSTRACT (Maximum 200 words)

This work plan specifies the field activities that will be performed during a soil boring/soil gas survey at Solid Waste Management Unit WP-26, Golf Course Main Pond under the *Resource Conservation and Recovery Act* Part B permit for Kirtland AFB, New Mexico.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Soil gas survey, soil sampling, WP-26, RFI	71
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std 239-18 298-102

40 CFR 270.11
DOCUMENT CERTIFICATION
AUGUST 2006

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to ensure 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 that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

CARL J. LANZ, P.G., GS-13
Chief, Restoration Section

This document has been approved for public release.

ROBERT S. MILLIGAN
Environmental Public Affairs Officer

THIS PAGE INTENTIONALLY LEFT BLANK

PREFACE

This work plan specifies the activities that will be performed for a *Resource Conservation and Recovery Act* [RCRA] Facility Investigation (RFI) at Solid Waste Management Unit WP-26, Golf Course Main Pond. The work plan addresses the requirements for Project MHMV03-7023, as designated in the U.S. Air Force statement of work dated for Environmental Restoration Work under contract number DACA45-03-D-0001, Task Order 011, in accordance with the U.S. Army Corps of Engineers (USACE) Statement of Work dated September 2, 2004.

This work plan was prepared by MWH Americas, Inc., from November 2005 through August 2006. Steve Ott serves as the Project Manager for the United States Army Corps of Engineers, Omaha District.

Deborah Drain
MWH Project Manager

Anthony Magliocchino, P.G.
MWH Hydrogeologist

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

Section **Page**

ACRONYMS ix

1.0 INTRODUCTION 1-1

1.1 Objectives and Scope 1-1
1.2 Approach and Implementation 1-1
1.2.1 Regulatory Requirements 1-1
1.2.2 Other Issues 1-2
1.3 Data Quality Objectives Process 1-2

2.0 SOLID WASTE MANAGEMENT UNIT WP-26, SEWAGE LAGOONS AND GOLF COURSE POND 2-1

2.1 Characterization and Setting 2-1
2.1.1 Site Description 2-1
2.1.2 Operational History 2-1
2.1.3 Waste Characteristics 2-4
2.2 Investigative Approach 2-4
2.2.1 Existing Data 2-4
2.2.2 Conceptual Model 2-10
2.2.3 Evaluation of Media Potentially Affected by Transport of Contaminants 2-11

3.0 DATA COLLECTION DESIGN AND PROCEDURES 3-1

3.1 Data Quality Objectives 3-1
3.1.1 Data Types 3-2
3.2 Quality Assurance/Quality Control 3-3
3.2.1 Data Validation 3-4
3.3 Field Activities 3-7
3.3.1 Soil Borings and Soil Gas Monitoring Point Installation 3-8
3.3.2 Soil and Soil Gas Sampling 3-10
3.3.3 Investigation-Derived Waste Management 3-11

4.0 PROJECT MANAGEMENT 4-1

4.1 Project Scheduling and Reporting Requirements 4-1
4.2 Health and Safety Plan 4-2

REFERENCES R-1

CONTENTS
(CONCLUDED)

APPENDICES

APPENDIX A SITE SAFETY AND HEALTH PLAN

APPENDIX B QUALITY ASSURANCE PROJECT PLAN

APPENDIX C LITHOLOGIC LOGGING FORM

FIGURES

Figure **Page**

Figure 1-1 Site Location Map for Solid Waste Management Unit WP-26, Former Sewage Lagoons and Golf Course Main Pond, Kirtland Air Force Base, New Mexico 1-3
Figure 2-1 Solid Waste Management Unit WP-26 - Golf Course Main Pond – Kirtland Air Force Base, New Mexico 2-2
Figure 2-2 Solid Waste Management Unit WP-26 - Golf Course Main Pond Interim Corrective Measures Recovery Well RG-1598-S-4 and Monitoring Wells KAFB-0602, KAFB-0609, and KAFB-0610 Locations - Kirtland Air Force Base, New Mexico 2-3
Figure 2-3 Phase II, Stage 2 WP-26 Golf Course Main Pond Resource Conservation and Recovery Act Facility Investigation Monitoring Well and Sample Locations - Kirtland Air Force Base, New Mexico 2-6
Figure 2-4 Proposed Locations of Soil Gas Monitoring Points for the Resource Conservation and Recovery Act Facility Investigation at Solid Waste Management Unit WP-26 Golf Course Main Pond - Kirtland Air Force Base, New Mexico 2-13
Figure 3-1 Soil Boring Target Depths, Drilling Angle, and Required Length of Drill Pipe 3-9

TABLES

Table **Page**

Table 2-1 Nitrogen Results for Dry Pond Sediment Samples Collected at the Golf Course Pond 2-7
Table 2-2 Nitrogen Results for Soil Samples Collected at the Golf Course Pond 2-7
Table 2-3 Nitrate Concentrations in Groundwater Samples from Golf Course Pond Monitoring Wells 2-10
Table 2-4 Proposed Investigation Activities for Solid Waste Management Unit WP-26, Golf Course Main Pond, Kirtland Air Force Base, New Mexico..... 2-14
Table 2-5 Proposed Sampling and Analyses for Solid Waste Management Unit WP-26, Golf Course Main Pond, at Kirtland Air Force Base, New Mexico..... 2-15
Table 3-1 Laboratory Quality Control Sample Descriptions..... 3-3
Table 3-2 Field and Laboratory Quality Control Sample Descriptions..... 3-5
Table 3-3 Standard Operating Procedures for Field Activities..... 3-8
Table 4-1 Proposed Schedule for Resource Conservation and Recovery Act Facility Investigation at Solid Waste Management Unit WP-26..... 4-1

THIS PAGE INTENTIONALLY LEFT BLANK

ACRONYMS

AFB	Air Force Base
ASA	American Society of Agronomy
bgs	below ground surface
BWP	base-wide plans
CAU	Corrective Action Unit
COC	constituent of concern
DPT	direct-push technology
DQO	data quality objective
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
ft	foot/feet
GCMP	Golf Course Main Pond
HDPE	high density polyethylene
HSA	hollow stem auger
ICM	Interim Corrective Measures
ID	inside diameter
IDW	investigation-derived waste
ERP	Environmental Restoration Program
LTM	long-term monitoring
MCL	maximum contaminant level
ug/L	micrograms per liter
mg/L	milligrams per liter
mg/kg	milligrams per kilograms
MS/MSD	matrix spike/matrix spike duplicate
MWH	MWH Americas, Inc.
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NMSWMR	New Mexico Solid Waste Management Regulations
OD	outside diameter

ACRONYMS (CONCLUDED)

PARCC	precision, accuracy, representativeness, completeness, and comparability
PCBs	polychlorinated biphenyls
PCP	Post Closure Plan
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RPD	relative percent difference
RPMP	RCRA Permits Management Program
SGMP	soil gas monitoring point
SOP	standard operating procedure
SSHP	site-specific safety and health plan
SWMU	solid waste management unit
SVOC	semivolatile organic compound
TAL	Target Analyte List
TBD	to be determined
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USGS	U.S. Geological Survey
VOC	volatile organic compound

EXECUTIVE SUMMARY

This work plan presents the organization, functional activities, and project-specific quality assurance (QA) and quality control (QC) procedures for a *Resource Conservation and Recovery Act* (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) WP-26, Sewage Lagoons and Golf Course Main Pond, at Kirtland Air Force Base (AFB), New Mexico. This work plan was developed to serve as a guide in the field. It contains a site description, results from previous investigations, proposed field activities, proposed sampling activities and their rationale, a site-specific safety and health plan, and a QA project plan.

The vadose zone beneath the Golf Course Main Pond (GCMP) will be the only area investigated by this RFI. The specific RFI tasks described in this work plan include drilling angled borings into the vadose zone within the footprint of the original GCMP in order to collect soil samples and to install soil gas monitoring points (SGMPs), collecting soil gas samples from the completed SGMPs, and managing the investigation-derived waste. Additionally, the soil samples will be monitored for moisture content to assess integrity of the GCMP liner. The soil and soil gas data will be used to evaluate the nature and extent of potential contamination in the vadose zone beneath the GCMP at SWMU WP-26.

A total of nine angled soil borings will be advanced under the footprint of the original GCMP during this RFI. Six angled soil borings/SGMPs will be installed to an approximate vertical depth of 40 feet and three angled borings/SGMPs will be installed to an approximate vertical depth of 100 feet. Two soil samples and two SGMPs will be installed at different depths within each boring based on field-screening results. The soil samples will be analyzed for volatile organic compounds (VOCs), Target Analyte List (TAL) Metals, nitrate, nitrite, ammonia, total Kjeldahl nitrogen (TKN), and total organic carbon (TOC). Soil gas samples will be analyzed for VOCs.

THIS PAGE INTENTIONALLY LEFT BLANK

1.0 INTRODUCTION

This *Resource Conservation and Recovery Act* (RCRA) Facility Investigation (RFI) work plan has been developed to guide activities at Solid Waste Management Unit (SWMU) WP-26, Sewage Lagoons and Golf Course Main Pond, at Kirtland Air Force Base (AFB), New Mexico (Figure 1-1). This RFI is being performed to determine the extent of contamination in the subsurface soil and soil gas beneath the Golf Course Main Pond (GCMP) location of WP-26. The planned effort includes soil and soil gas analysis of samples collected from beneath the GCMP. This investigation will be conducted under contract number DACA45-03-D-0001, Task Order 011, in accordance with the U.S. Army Corps of Engineers (USACE) Statement of Work dated 2 September 2004.

1.1 Objectives and Scope

The objective of this RFI is to evaluate the nature and extent of potential contamination in the vadose zone under the footprint of the original GCMP at SWMU WP-26. The constituents of concern (COCs) include volatile organic compounds (VOCs), Target Analyte List (TAL) Metals, and nitrate, and are based on the results of previous investigations at SWMU WP-26. The proposed activities include collecting soil gas and soil samples from both shallow and deep locations beneath the GCMP. Soil gas will be analyzed for VOCs only. Analyses of soil samples will include VOCs, TAL metals, nitrite, ammonia, total Kjeldahl nitrogen (TKN), and total organic carbon (TOC).

This RFI work plan was developed to serve as a guide in the field and contains a site description, results of previous investigations, and a site-specific work plan. This RFI will be conducted in accordance with the *Final Base-Wide Plans for Investigations Under the Installation Restoration Program, 2004 Update, Kirtland Air Force Base, Albuquerque, New Mexico* (base-wide plans [BWP]) (USAF, 2004), the site-specific safety and health plan (SSHP) addendum presented in Appendix A, the Quality Assurance Project Plan (QAPP) addendum presented in Appendix B, and applicable regulations of the New Mexico Environment Department (NMED).

1.2 Approach and Implementation

The nature and extent of potential contaminants in the vadose zone under the footprint of the original GCMP will be assessed by collecting and analyzing soil and soil gas samples. Soil samples also will be collected to log site stratigraphy and to assess fate and transport mechanisms.

1.2.1 Regulatory Requirements

SWMU WP-26 comprises the former sewage lagoons and the GCMP at Kirtland AFB. Only the vadose zone under the footprint of the original GCMP will be investigated during this RFI, which is being performed to satisfy the requirements of the Kirtland AFB RCRA Part B permit. Samples will be collected and analyzed in compliance with applicable regulations of the NMED. This work plan was prepared in accordance with the *RPMP* [RCRA Permits Management Program] *Document Requirement Guide* provided to Kirtland AFB by the NMED (NMED, 1998).

1.2.2 Other Issues

This work plan defines the procedures that will be followed to conduct soil and soil gas sampling and analysis to investigate the nature and extent of potential COCs in the vadose zone beneath the GCMP. The BWP serves as procedural guidance for the RFI and includes:

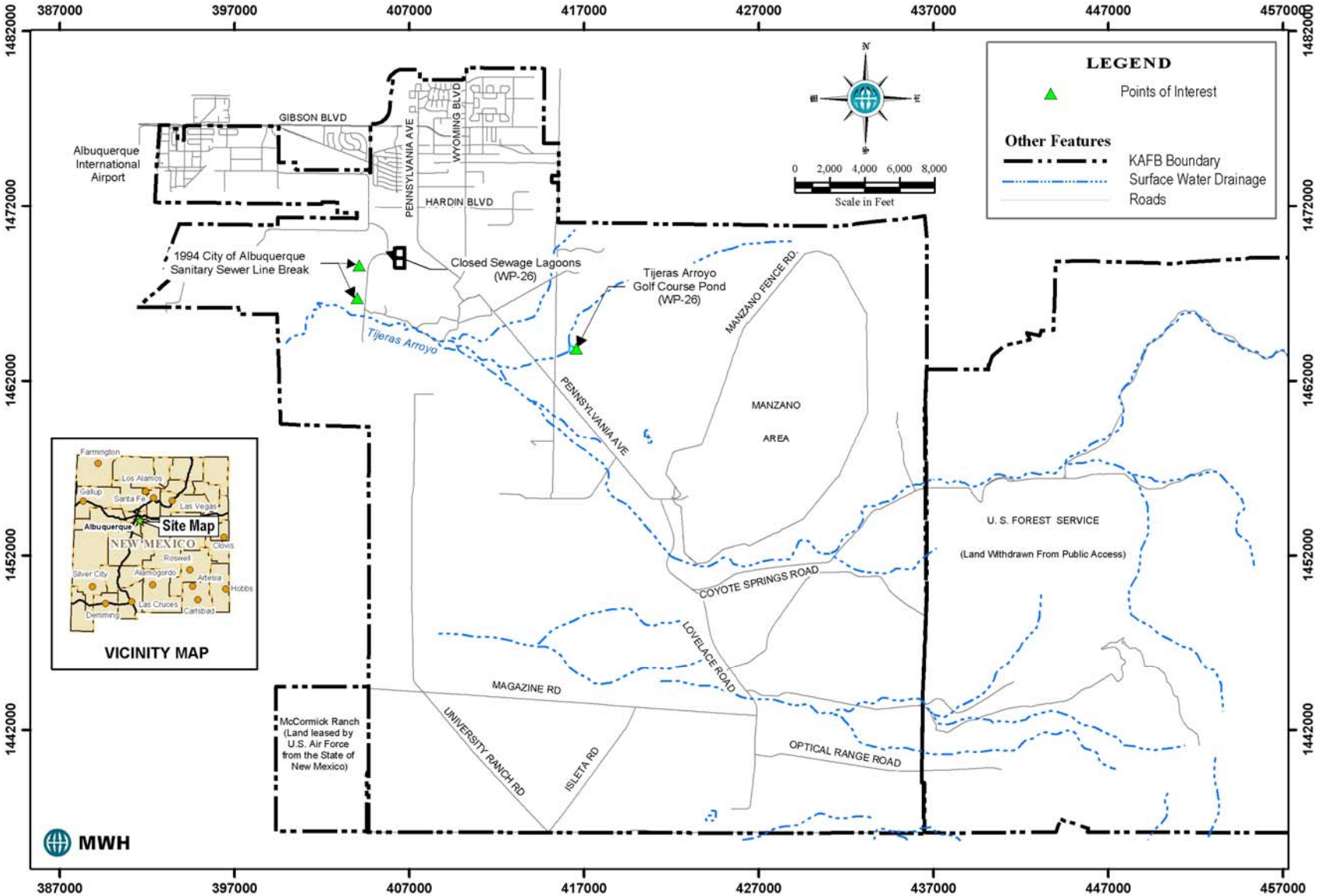
- Project Management Plan (Section 2.0 of the BWP)
- Field Sampling Plan (Appendix A of the BWP)
- Standard Operating Procedures (Appendix B of the BWP)
- Quality Assurance Plan (Appendix C of the BWP)
- Data Management Plan (Appendix D of the BWP)
- Waste Management Plan (Appendix E of the BWP)

The procedures detailed in the Base-wide plans will be followed for the RFI activities unless they are specifically modified by this work plan, the SSHP addendum (Appendix A), or the QAPP addendum (Appendix B).

1.3 Data Quality Objectives Process

This RFI work plan was prepared in accordance with the data quality objectives (DQOs) development process specified in the BWP. Specific DQOs were developed, building upon recommendations made as the result of previous investigations. DQOs for the analytical data and an outline of quality assurance/quality control (QA/QC) samples to be collected are presented in Section 3.0. A QAPP was prepared for this work plan and is included as Appendix B.

Figure 1-1. Site Location Map for Solid Waste Management Unit WP-26, Former Sewage Lagoons and Golf Course Main Pond, Kirtland Air Force Base, New Mexico



THIS PAGE INTENTIONALLY LEFT BLANK

2.0 SOLID WASTE MANAGEMENT UNIT WP-26, SEWAGE LAGOONS AND GOLF COURSE POND

2.1 Characterization and Setting

2.1.1 Site Description

The GCMP is located between holes three and four of the Tijeras Arroyo Golf Course at Kirtland AFB (Figure 2-1). The pond was reshaped in 1998-1999 and currently covers approximately 1.85 acres.

2.1.2 Operational History

The GCMP was constructed in 1962 and was used for storage of wastewater delivered via pipeline from the Sewage Lagoons. The GCMP received wastewater during the months of April through October from 1962 to 1987. As part of a water conservation program, the wastewater in the pond was mixed with surface-water runoff and well water and was pumped through a sprinkler system to irrigate the golf course. The Sewage Lagoon/Main Golf Course Pond irrigation system was used from April to October each year. Depending upon irrigation needs, 40 to 100 percent of the untreated Base sewage was routed through the lagoons to the GCMP during this period. From November to March of each year, Base sewage was routed to the City of Albuquerque sewage treatment facilities. The pond last received water from the Sewage Lagoons in 1987 and reportedly evaporated to dryness in January 1989. The pond bottom was lined with a thin layer (approximately 4 millimeters) of plastic sheeting. The pond liner material had weathered and disintegrated in most locations and the pond bottom had re-vegetated with a number of native plants including sage, grasses, non-native salt cedar, and Russian olive (U.S. Air Force [USAF], 1993a and 1999).

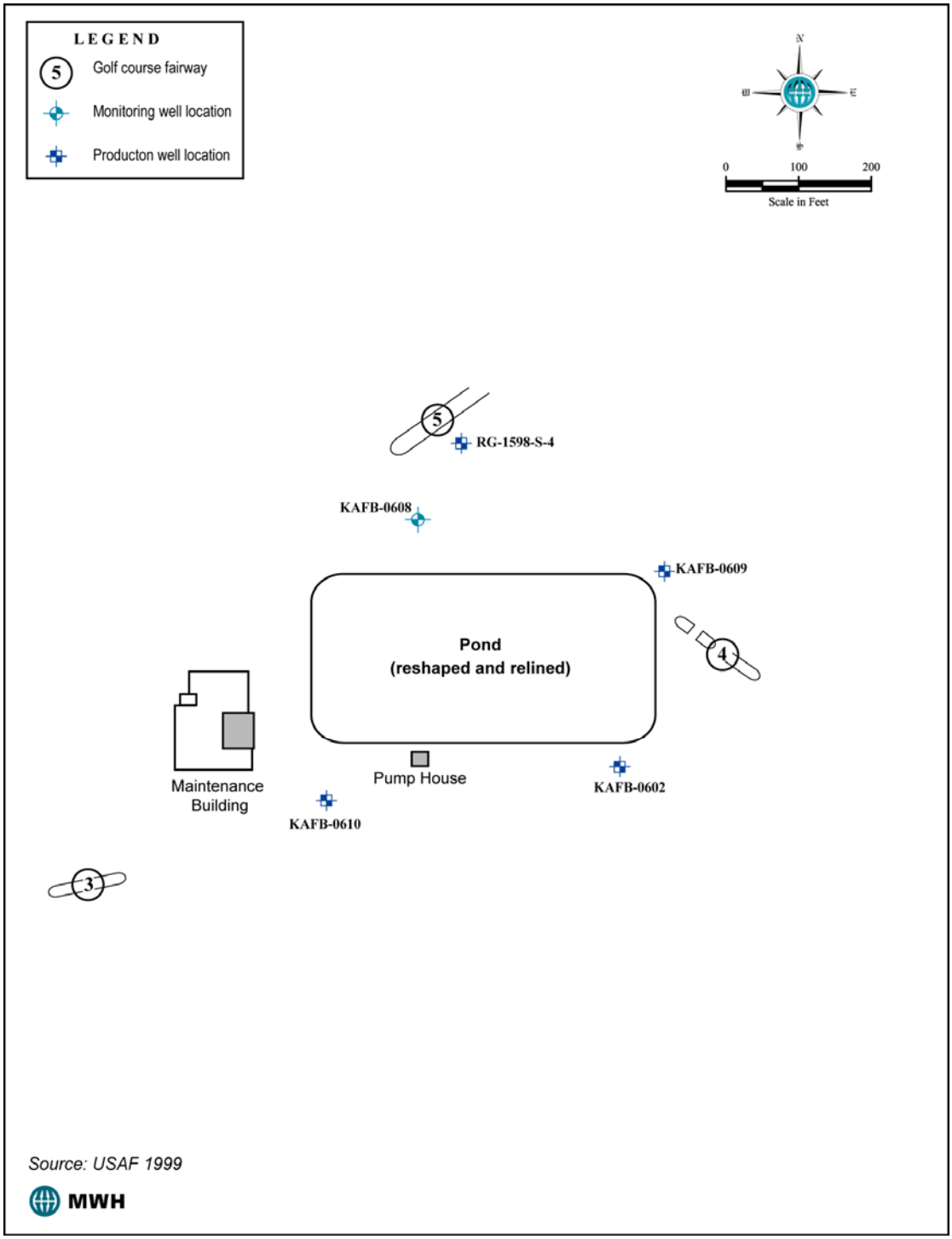
The pond was reconstructed from October 1998 to February 1999 during the Interim Corrective Measures (ICM) activities for Solid Waste Management Unit (SWMU) WP-26. Reconstruction activities included re-grading and shaping of the pond, and lining the pond with a 40-mil, high-density polyethylene (HDPE) liner. The purpose of the ICM was to capture and recover nitrate-contaminated groundwater in the immediate area of the golf course (via recovery wells), store the water in the pond, and apply the water to the Tijeras Arroyo Golf Course via the irrigation system. Prior to the ICM, the golf course received all of its irrigation water from the Base water system (USAF, 1999).

In addition to reshaping and lining the pond in preparation for water storage, ICM activities included installation of a groundwater recovery well; installation of piping and electrical connections; and replacement of one pump used to draw water from the GCMP into the irrigation system. Recovery well RG-1598-S-4 was installed north of the GCMP and monitoring wells KAFB-0602, KAFB-0609, and KAFB-0610 (Figure 2-2) were converted to recovery wells including the installation of submersible pumps and the necessary plumbing to connect into the pumping system. Currently, the GCMP receives water from recovery wells (RG-1598-S-4, KAFB-0602, KAFB-0609, and KAFB-0610) near the pond (Figure 2-2) and from production wells KAFB-4 and KAFB-7 (USAF, 1999). A pump house is located at the GCMP and serves as the control center for the automated golf course irrigation system.

Production well KAFB-7 (located northeast of the former sewage lagoons) was used as a potable water supply well serving Kirtland AFB until nitrate concentrations were detected above drinking water

Figure 2-1. Solid Waste Management Unit WP-26 - Golf Course Main Pond – Kirtland Air Force Base, New Mexico

Figure 2-2. Solid Waste Management Unit WP-26 - Golf Course Main Pond Interim Corrective Measures Recovery Well RG-1598-S-4 and Monitoring Wells KAFB-0602, KAFB-0609, and KAFB-0610 Locations - Kirtland Air Force Base, New Mexico



standards in 1995. Production well KAFB-7 was shut down in 1995 due to the presence of nitrate at concentrations above state and federal drinking water standards of 10 milligrams per liter (mg/L). In 2002, activities completed as part of the Interim Stage 2 Abatement Plan for Corrective Action Unit (CAU) ST-105, Trichloroethylene (TCE) and Nitrate Contaminated Groundwater, at Kirtland AFB, New Mexico included developing and rehabilitating production well KAFB-7. These activities also included determining the specific capacity of production well KAFB-7, sampling and analyzing the discharge water from production well KAFB-7, and building a new pipeline to convey nitrate-contaminated groundwater from production well KAFB-7 to GCMP. These activities completed the primary objective of the Phase II, Interim Stage 2 Abatement Plan, returning production well KAFB-7 to service, thereby hydraulically containing the nitrate-contaminated groundwater plume while beneficially using the nitrate-contaminated groundwater (USAF, 2003).

2.1.3 Waste Characteristics

The Sewage Lagoons contained raw sewage from facilities on Kirtland AFB, including office buildings, flight line units, aircraft maintenance shops, Sandia National Laboratories, and Base-housing units. The waste stream that discharged to the sewage lagoons was presumably comparable to municipal wastewater with commercial and light industrial components that received some pretreatment through sumps, catch basins, and oil/water separators. Wastewater decanted from the sewage treatment lagoons to the GCMP was of considerably better quality than raw sewage. Residence time in the treatment lagoons allowed for settling, oxidation, and digestion by facultative bacteria. The effluent from the lagoons probably retained an elevated concentration of nitrate: the result of oxidation of organic wastes. The treated effluent supplied the inorganic nitrate ion as an important nutrient to the golf course grass when the GCMP contents were pumped into the irrigation system.

2.2 Investigative Approach

This section summarizes the previous investigations at the GCMP, presents a conceptual model, and recommends sampling and analysis activities to complete the contaminant characterization in the vadose zone.

2.2.1 Existing Data

The GCMP has been investigated in several studies. The existing soil, soil gas, and groundwater data for VOCs, including TCE and related constituents are summarized and referenced below.

2.2.1.1 Non-sampling Data

Non-sampling data is limited to visual inspections associated with previous investigations. The previous investigations are described in the following sections.

2.2.1.2 Sampling Data

Soil, sediment, and groundwater samples have been collected from the GCMP since 1988. The data that have been collected and the programs (if specified) under which the data were collected are listed below.

- Water and sediment samples were collected by the U.S. Geological Survey (USGS) from the golf course pond in March 1988 prior to complete evaporation of the contained liquids (USAF, 1993a).
- Dry-pond sediment, soil, and groundwater samples were collected by the USGS from the GCMP and vicinity during the Phase II, Stage 2/2A RCRA Facility Investigation (USAF, 1993a and 1993b).
- Post-closure groundwater monitoring was conducted at the golf course pond from 1994 through 1996. In 1996, monitoring wells located at the golf course pond were included as part of the Base-wide, long-term monitoring (LTM) program.
- In 1998, ICMs were initiated at the golf course pond, which included re-grading and shaping the pond, and lining the pond with a 40-mil, HDPE liner (USAF, 1999).
- Groundwater samples have been collected from the wells installed in the vicinity of the GCMP since 2001 as part of the Stage 1 and Stage 2 Nitrate Abatement Plans.

The results of the sampling that occurred during GCMP activities or programs listed above are presented in the following paragraphs.

Early Sampling of the Golf Course Pond (Prior to 1989). The USGS sampled the pond water and sediment in March of 1988 after transfer of wastewater to the GCMP ceased, and prior to complete evaporation of the golf course pond in 1989. Water samples were analyzed for VOCs, total recoverable metals, arsenic, mercury, and selenium. Concentrations of these constituents did not exceed their respective U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs) (USAF, 1993a). The water samples were not analyzed for nitrate.

Phase II, Stage 2/2A RCRA Facility Investigation. As part of the Phase II, Stage 2 RFI, the USGS collected dry-pond sediment, soil, and groundwater samples from the GCMP and vicinity. These samples were collected between November 1989 and December 1990. Four groundwater monitoring wells (KAFB-0602, KAFB-0608, KAFB-0609, and KAFB-0610) were installed in the perched aquifer as part of the RFI. Monitoring well and sampling locations for the Phase II, Stage 2 RFI are shown in Figure 2-3. Sediment samples were collected from the ground surface of the dry pond in three locations (KAFB-0605, -0606, and -0607). Boreholes were advanced at four locations around the GCMP (KAFB-0601, -0602, -0603, and -0604). These boreholes were augered to a total depth of 100 feet below ground surface (bgs). Two-foot core samples every 5 feet were taken for lithologic description, and soil samples were collected at 5-, 20-, 50-, and 100-feet bgs in each borehole. The soil and sediment samples were analyzed for VOCs, metals, chromium, mercury, nitrogen, and Extraction Procedure (EP) Toxicity Test metals and pesticides. The only analyte of interest that was detected above an action level was beryllium, which was determined to be consistent with naturally occurring concentrations. Table 2-1 presents the nitrogen-species results for the dry-pond sediment samples, and Table 2-2 presents the nitrogen-species results for the soil samples. Results from the dry-pond sediment samples show highest ammonia and TKN in sample KAFB-0605, while the highest nitrate/nitrite concentration is measured in sample KAFB-0607. All nitrate/nitrite concentrations in the soil samples are below 10 mg/kg, with the highest value measures at 50-ft bgs in sample KAFB-0603. The highest soil TKN value was measured at 5 ft bgs in sample KAFB-0603 (USAF, 1993a).

Figure 2-3. Phase II, Stage 2 WP-26 Golf Course Main Pond Resource Conservation and Recovery Act Facility Investigation Monitoring Well and Sample Locations - Kirtland Air Force Base, New Mexico

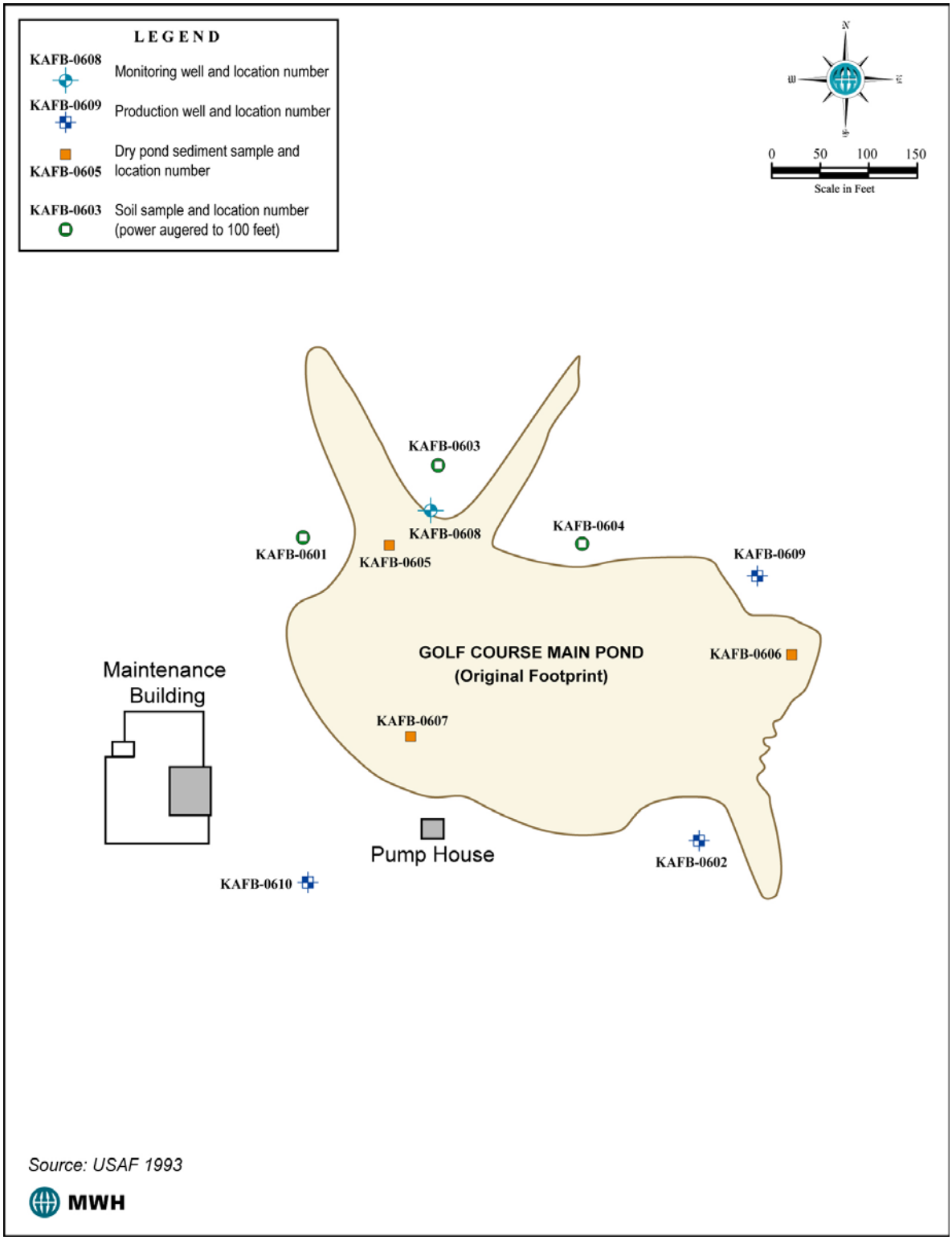


Table 2-1. Nitrogen Results for Dry Pond Sediment Samples Collected at the Golf Course Pond

Nitrogen Species	KAFB-0605	KAFB-0606	KAFB-0607
Ammonia (mg/kg)	82	78	59
Total Kjeldahl Nitrogen (mg/kg)	4773	1509	2341
Nitrate/Nitrite (mg/kg)	3.8	4.0	31.0

Notes:
USAF, 1993a. *RFI Technical Report, Stage 2, Kirtland Air Force Base, Albuquerque, New Mexico.* Prepared by the U.S. Geological Survey, Water Resources Division, for the Air Force Center for Environmental Excellence, Environmental Services Office, Environmental Restoration Division, Brooks Air Force Base. December 1993.
mg/kg milligrams per kilogram

Table 2-2. Nitrogen Results for Soil Samples Collected at the Golf Course Pond

Borehole	Depth (ft)	Total Kjeldahl Nitrogen (mg/kg)	Nitrate/Nitrite (mg/kg)
KAFB-0601	5	154	0.8
KAFB-0601	20	<50	1.4
KAFB-0601	50	129	3.5
KAFB-0601	100	103	0.7
KAFB-0602	5	240	<0.5
KAFB-0602	20	86	1.0
KAFB-0602	50	65	<0.5
KAFB-0602	100	116	<0.5
KAFB-0603	5	294	1.3
KAFB-0603	20	161	1.2
KAFB-0603	50	<50	4.8
KAFB-0604	5	94	<0.5
KAFB-0604	20	88	<0.5
KAFB-0604	50	76	<0.5
KAFB-0604	100	<50	1.2

Notes:
USAF, 1993a. *RFI Technical Report, Stage 2, Kirtland Air Force Base, Albuquerque, New Mexico.* Prepared by the U.S. Geological Survey, Water Resources Division, for the Air Force Center for Environmental Excellence, Environmental Services Office, Environmental Restoration Division, Brooks Air Force Base. December 1993.
ft feet
mg/kg milligrams per kilogram

Groundwater samples were collected from monitoring wells KAFB-0602, -0608, -0609, and -0610 in May, August/September, and November/December 1990. Samples from the May 1990 event were analyzed for petroleum hydrocarbons, arsenic, chromium, lead, mercury, selenium, total dissolved solids, common anions, nitrogen (nitrate-nitrite, ammonia, and total Kjeldahl nitrogen), RCRA Appendix IX contaminants VOCs, semivolatile organic compounds [SVOCs], dioxins and furans, organochlorine pesticides and polychlorinated biphenyls (PCBs), chlorinated herbicides, total recoverable and dissolved metals, cyanide, fluoride, and sulfide), gross alpha and beta, radium-226, and radium-228. Samples from the August/September and November/December 1990 events were analyzed for a reduced parameter list including metals, anions, nitrate-nitrite (August/September 1990 only), and SVOCs.

Constituents detected at or above action levels in the 1990 groundwater samples included dissolved chromium, total-recoverable chromium, nitrate, and gross alpha activity. Dissolved chromium was

detected above the action-level in the May 1990 groundwater sample collected from well KAFB-0602. Dissolved chromium concentrations were below the action level of 0.010 mg/L in the August/September and November/December 1990 samples collected from KAFB-0602, and in all the ground-water samples collected from wells KAFB-0608, KAFB-0609, and KAFB-0610.

Gross alpha activity was reported above the action level in the May 1990 groundwater samples collected from KAFB-0608 and KAFB-0609. Radiochemistry analysis was not performed on the August/September and November/December 1990 groundwater samples.

Total-recoverable chromium was reported above the action level in the May 1990 groundwater sample collected from well KAFB-0602, and in the August 1990 groundwater sample collected from well KAFB-0610. Total-recoverable chromium concentrations were below the action level in all other 1990 groundwater samples. The detected total-recoverable chromium was considered to have been introduced into the groundwater samples by well construction and completion methods. Other detected constituents, including bis(2-ethylhexyl)phthalate, hexane, and petroleum hydrocarbons also were considered to be present due to well installation procedures, sampling procedures, or field decontamination procedures.

Nitrate was reported above the action level in all the May 1990 groundwater samples. Nitrate concentrations ranged from 21.7 mg/L to 31.7 mg/L (refer to Table 2-3). Nitrate was not analyzed for in the next sample round (August/September 1990), but nitrate plus nitrite concentrations ranged from 20.9 mg/L to 26.4 mg/L in the groundwater samples. Nitrate represented 83% to 100% of the nitrate plus nitrite concentrations in the May 1990 samples; therefore, most of the nitrate plus nitrite reported in the August/September 1990 round of groundwater samples probably also represented nitrate. No nitrogen analyses were performed on the ground-water samples collected in November/December 1990.

Groundwater samples were collected from the four wells in February/March 1991, May/June 1991, November 1991, and May 1992 during the Stage 2A RFI (USAF, 1993b). Samples were analyzed for nitrate plus nitrite during each event. Samples also were analyzed for total and dissolved chromium, and total and dissolved hexavalent chromium during the first three events. Samples collected in May 1992 were analyzed for Appendix IX VOCs, SVOCs, pesticides, herbicides, dioxins, total and dissolved metals, cyanide, and sulfide. All groundwater samples collected from wells KAFB-608 and KAFB-609 also included uranium, gross alpha and gross beta radioactivity. Constituents exceeding action levels during the Stage 2A RFI sampling events included nitrates, which exceeded the action level in groundwater from all wells during all four events (concentrations raged from 18.8 mg/L to 32.3 mg/L), heptachlor epoxide in one groundwater sample during one event, gross beta in one groundwater sample during one event, and tetrachloroethene in one groundwater sample during one event. Other detected VOCs (including acetone, methylene chloride, and 2-butanone) and one SVOC (bis(2-ethylhexyl)phthalate) were attributed to laboratory or field contamination. One additional groundwater sample was collected from monitoring well KAFB-610 in February 1993 and analyzed for Appendix IX VOCs to confirm the previous VOC detections in this well. Only methylene chloride (a common laboratory contaminant) was detected in the February 1993 sample.

Post-Closure and Long-Term Groundwater Monitoring of the Golf Course Pond. A Post-Closure Plan (PCP) (USAF, 1994) for the Sewage Lagoons and GCMP was approved by the NMED in correspondence dated July 6, 1994. Quarterly groundwater monitoring under the PCP was initiated in June 1994 and continued through March 1996, and included analyses for total and hexavalent chromium and turbidity. Statistical analysis of chromium detections performed after the March 1996 sampling event indicated that the one event during which chromium exceeded the action levels (February 1995) was not

significant. A request for clean closure was submitted to NMED on 18 April 1996; and in a letter dated 9 July 1996, NMED indicated the GCMP was eligible for clean closure based the low frequency of chromium detections above action levels. However, Kirtland AFB agreed to continue monitoring the GCMP wells for nitrates and VOCs based on historical results.

The *Interim Corrective Measures Report for Site WP-26, Golf Course Main Pond (WP-26), and Areas of Concern SS-79, Building 381 Spill Site (SS-79), and WP-87, GRABS Site Waste Pile (WP-87), Kirtland Air Force Base, Albuquerque, New Mexico* (USAF, 1998) indicated that groundwater samples were collected from monitoring wells KAFB-0608, -0609, and -0610 in March and September 1996 for VOCs and nitrates analyses. However, only the VOCs data are presented in this report; the nitrate results are not available. The following discussion presents the information that was included in the ICM report. Groundwater monitoring at the GCMP during and after March 1996 included monitoring wells KAFB-0608, 0609, and 0610. Groundwater samples were analyzed for VOCs and nitrates based on historical results. During the March 1996 sampling event, chloroform (1.1 micrograms per liter [ug/L]) and trichloroethylene (TCE) (0.4 ug/L) were detected in groundwater from well KAFB-0609. Toluene was detected in groundwater from two wells during the June 1996 event: KAFB-0608 (1.2 ug/L) and KAFB-0610 (2.9 ug/L). No VOCs were detected in any of the groundwater samples collected in September 1996. The September 1996 event was the last monitoring event prior to incorporating the GCMP into the LTM Program in December 1996.

Under the LTM Program, groundwater elevation data were collected between 1996 and 2000 from all four GCMP monitoring wells and groundwater samples were collected from KAFB-0608, 0609, and 0610 on a quarterly basis or semi-annual basis. Groundwater samples were analyzed for VOCs and nitrates as nitrogen. To date, only nitrates have exceeded the federal drinking water MCL and the New Mexico Water Quality Control Commission (NMWQCC) Human Health Groundwater Standards and New Mexico Solid Waste Management Regulations (NMSWMR) health based groundwater standards. Nitrate concentrations from 1990 to 2006 are presented in Table 2-3. No VOCs have been detected in the groundwater samples, with the exception of methylene chloride and TCE. Methylene chloride was detected between 5.1 ug/L and 7.6 ug/L in groundwater each of the wells during one quarterly sampling round. Based on the data validation, the detection of methylene chloride in the groundwater samples is attributed to laboratory contamination, as it was also detected in associated method blank samples. TCE was detected during three quarterly events in groundwater from KAFB-0609 at concentrations ranging from 0.7 ug/L to 0.9 ug/L and during one event in groundwater from KAFB-0608 at 0.7 ug/L. For reference, the federal drinking water MCL for TCE is 5.0 ug/L.

Beginning in 2001, semi-annual groundwater samples have been collected from the four GCMP wells to comply with the Stage 1/Stage 2 abatement plan to investigate nitrate-contaminated groundwater (USAF, 2005). Groundwater samples are analyzed for nitrate, nitrite, TKN, and ammonia. Nitrate concentrations in all four wells have consistently been above the NMWQCC standard of 10 mg/L (refer to Table 2-3).

Table 2-3. Nitrate Concentrations in Groundwater Samples from Golf Course Pond Monitoring Wells

Date	KAFB-0602 (perched)	KAFB-0608 (perched)	KAFB-0609 (perched)	KAFB-0610 (perched)
Phase II, Stage 2/2A RCRA Facility Investigation Monitoring				
5/90	31.7	24.8	21.7	28.8
9/90	23.9	26.4	20.9	26
2/91	20.5	25.4	25.3	23
5/91	22.1	32.3	23.2	23.2
11/91	20.7	24	18.8	23.2
5/92	20.1	25.7	21.5	21.6
Post-Closure and Long-Term Monitoring				
12/96	NA	23	19	17
3/97	NA	23	17	15
6/97	NA	23	18	16
9/97	NA	22	17	16
3/98	NA	17	21	15
9/98	NA	23	18	16
3/99	NA	23	18	15
9/99	NA	22	17	18
3/00	NA	24/24	16	NA
9/00	NA	22/23	16	19
Stage 1/Stage 2 Nitrate Abatement Sampling				
10/01	18	25	13	17
7/02	16.2	24.1	12.8	17.5
1/03	15.9	26.5/26.4	12	17.1
7/03	16	23	13	17
1/04	16	20	13	18
8/04	16	25	20	18
1/05	16	23.7	13.2	17.4
6/05	15.3	24.5/24	19.8	16.7
1/06	15.6	25.3	19.1	17

Notes:
Results in milligrams per Liter (mg/L) NA = Not Analyzed

2.2.2 Conceptual Model

A conceptual model for VOC contamination at SWMU WP-26, GCMP was developed as part of this work plan, and is discussed below.

2.2.2.1 Contaminant Sources

To date, four known sources of nitrate are suspected as contributing to contaminating the regional aquifer at Kirtland AFB: effluent from the former Sewage Lagoons; septic tanks within Sandia National Laboratories/New Mexico Technical Areas I, II, and IV; the Sandia National Laboratory's acid outfall line; and the 1994 City of Albuquerque sanitary sewer line break (USAF, 2003). The historic discharges of nitrate containing treated effluent to the original GCMP may be a contributing factor of nitrate contamination in the portion of the perched and regional aquifers underlying and downgradient of the GCMP. However, nitrate concentrations in groundwater from monitoring locations upgradient and cross gradient of the GCMP exceed the 10-mg/L standard, which suggests other potential source areas.

2.2.2.2 Nature and Extent of Contamination

TCE has been detected in perched groundwater beneath the GCMP at concentrations up to 0.9 μg/L. No soil gas data exists for the vadose zone beneath the GCMP. TCE has not been detected in the regional aquifer. Nitrate is present in both the perched and regional ground water beneath the GCMP. Chromium analyses have been eliminated from the groundwater LTM program due to the low frequency of detections above action levels. It is not known if VOCs, nitrate, or elevated metals concentrations are present in the vadose zone beneath the GCMP.

2.2.2.3 Fate and Transport

As noted above, the original GCMP-liner material had weathered and disintegrated in most locations prior to reconstruction of the pond during the ICM in 1998 and 1999. As a result, COCs present in water that originated in the Sewage Lagoons and subsequently stored in the GCMP between 1962 and 1987 may have infiltrated vertically into the subsurface soils under the pond.

2.2.2.4 Data Gaps

The nature and extent of VOCs, nitrate, and metals in the vadose zone underlying the footprint of the original GCMP is a data gap in the conceptual model. The soil sampling and soil gas survey is intended to provide information to address this data gap.

2.2.3 Evaluation of Media Potentially Affected by Transport of Contaminants

The proposed scope of work at SWMU WP-26 GCMP includes conducting a soil gas survey and sampling subsurface soil to define the extent of VOCs, nitrates, and metals in the vadose zone beneath the GCMP.

Shallow Soil and Soil Gas Investigation. The shallow soil investigation will be performed using direct-push technology (DPT) methods. Six 2-inch diameter soil borings will be continuously cored at an angle beneath the GCMP to a vertical depth of 40 feet. The proposed soil boring locations are presented in Figure 2-4. Continuous coring will allow for field screening of the cored interval for organic vapors using a photo-ionization detector (PID). Field screening will assist in soil sample collection and placement of soil gas monitoring points (SGMPs). If field screening fails to detect significant organic vapors within the cores, SGMPs will be installed at 20 and 40 feet within each boring. At a minimum, soil samples for offsite laboratory analyses will be collected at the same depth that the SGMPs are installed.

Deep Soil and Soil Gas Investigation. The deep soil investigation will be performed using hollow-stem auger (HSA) drilling techniques. Three deep soil borings will be installed at an angle beneath the GCMP to a vertical depth of 100 feet. Soil samples will be collected continuously from a depth of 40 feet to a depth of 100 feet and screened in the field for organic vapors with a PID. Field screening will assist in sample collection and placement of SGMPs. If field screening fails to detect significant organic vapors within the cores, SGMPs will be installed at 70 and 100 feet within each deep boring. At a minimum, soil samples for offsite laboratory analyses will be collected at the same depth as the SGMPs are installed.

Sample Analyses. A summary of the proposed sampling is presented in Table 2-4. Soil samples will be collected during the advancement of the borings. It is anticipated that two soil samples will be collected from each boring (18 samples), with two additional samples as replicates for QC, for a total of 20 soil samples. Sample analyses for soil samples will include VOCs, nitrate/nitrite, total Kjeldahl nitrogen, ammonia, total organic carbon, and TAL Metals. Details for sample analysis are provided in Table 2-5. Soil gas samples will be collected after the SGMPs have equilibrated with the subsurface for 1 week. It is anticipated two soil gas samples will be collected from each boring (18 samples), with two additional samples as replicates for QC, for a total of 20 soil gas samples. The soil gas samples will be collected in Summa® canisters from each monitoring point. The soil gas samples will be analyzed for VOCs using an offsite laboratory.

Figure 2-4. Proposed Locations of Soil Gas Monitoring Points for the Resource Conservation and Recovery Act Facility Investigation at Solid Waste Management Unit WP-26 Golf Course Main Pond - Kirtland Air Force Base, New Mexico

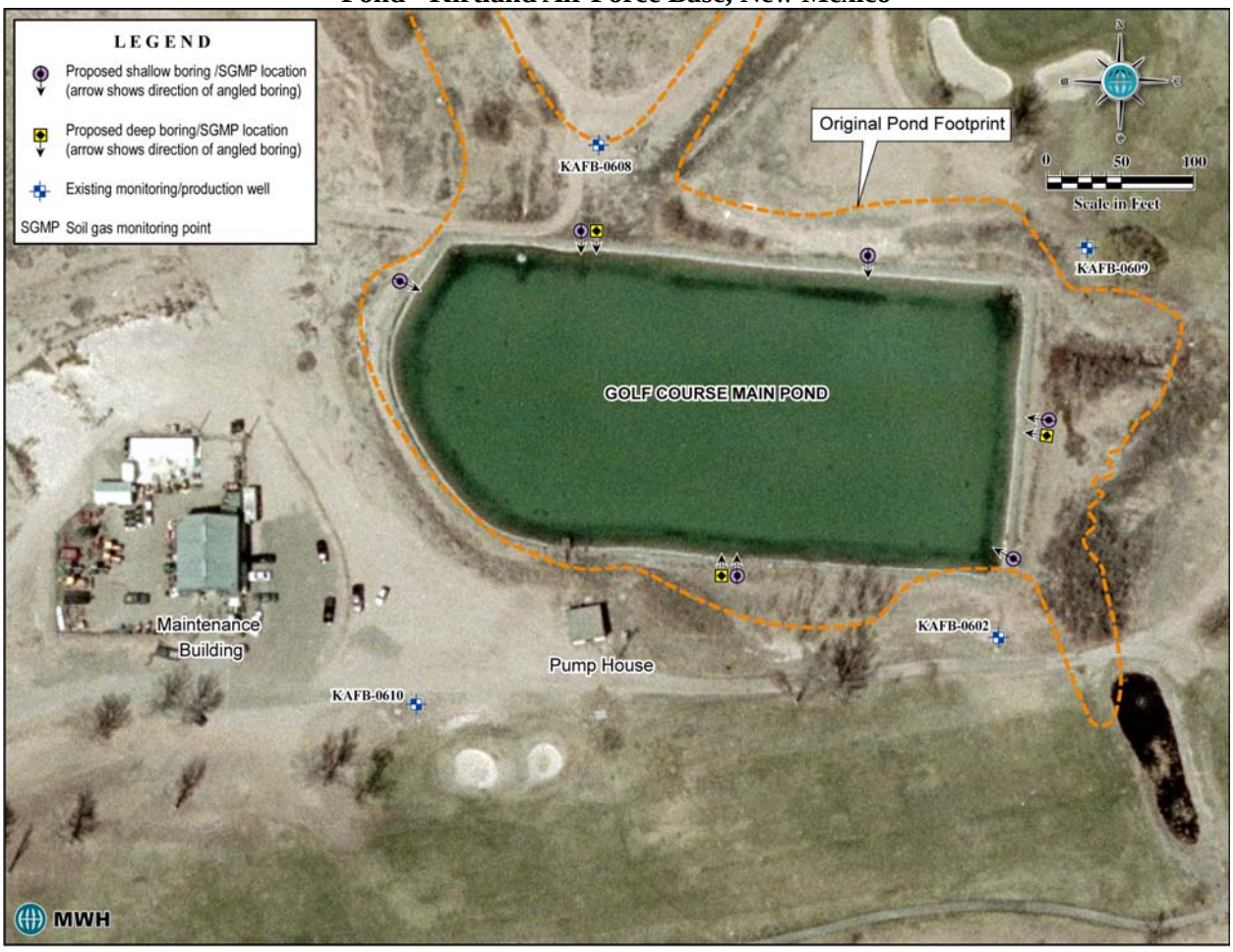


Table 2-4. Proposed Investigation Activities for Solid Waste Management Unit WP-26, Golf Course Main Pond, Kirtland Air Force Base, New Mexico

Data Needs	Investigation Technique	Location	Number of Samples	Analysis	Selected Analytical Option
Determine nature and extent of VOCs in shallow (0 to 40 feet bgs) soil gas under the footprint of the original GCMP	Install 2 SGMPs at 20' and 40' bgs in six DPT angled boreholes. Alternate completion depths may be selected based on field screening for organic vapors.	Boreholes will be angled within the footprint of the original GCMP	12 soil gas	VOCs by EPA TO-15[a] (offsite laboratory)	Definitive
Determine nature and extent of VOCs in deep (40 to 100 feet bgs) soil gas under the footprint of the original GCMP	Install 2 SGMPs at 70' and 100' bgs in three HSA angled boreholes. Alternate completion depths may be selected based on field screening for organic vapors.	Boreholes will be angled under the footprint of the original GCMP	6 soil gas	VOCs by EPA TO-15[a]	Definitive
Determine nature and extent of VOCs, TAL metals, and nitrogen species in subsurface soil	Collect two subsurface soil samples from the nine boreholes completed as SGMPs. Samples will be collected from the same depth as the installed SGMPs.	Boreholes will be angled under the footprint of the original GCMP	18 soil	VOCs by SW846 8260B[b] TAL Metals by SW846 6010B/7470A[b] Nitrate/Nitrite by EPA 300[c] Ammonia by EPA 350.2[c] TKN by EPA 351.3[c] TOC by Walkley Black[d]	Definitive

Notes:
a EPA, 1995
b EPA, 1996
c EPA, 1994
d ASA, 1982
ASA = American Society of Agronomy
BGS = below ground surface
DPT = direct-push technology
EPA = U.S. Environmental Protection Agency
HSA = hollow-stem auger
SGMP = soil gas monitoring point
TAL = Target Analyte List
TKN = total Kjeldahl Nitrogen
TOC = total organic carbon
VOCs = volatile organic compounds

Table 2-5. Proposed Sampling and Analyses for Solid Waste Management Unit WP-26, Golf Course Main Pond, at Kirtland Air Force Base, New Mexico

Sample Location	Sample Media	Sample Number[a]	Sample Depth (ft bgs unless otherwise noted)	Sample Analysis	EPA Method[b]
SWMU WP-26 GCMP	Air	WP26-GCMP-SG-001-depth	20	VOCs	TO-15
		WP26-GCMP-SG-001-depth	40		
		WP26-GCMP-SG-002-depth	20		
		WP26-GCMP-SG-002-depth	40		
		WP26-GCMP-SG-003-depth	20		
		WP26-GCMP-SG-003-depth	40		
		WP26-GCMP-SG-004-depth	20		
		WP26-GCMP-SG-004-depth	40		
		WP26-GCMP-SG-005-depth	20		
		WP26-GCMP-SG-005-depth	40		
		WP26-GCMP-SG-006-depth	20		
		WP26-GCMP-SG-006-depth	40		
		WP26-GCMP-SG-007-depth	70		
		WP26-GCMP-SG-007-depth	100		
		WP26-GCMP-SG-008-depth	70		
		WP26-GCMP-SG-008-depth	100		
		WP26-GCMP-SG-009-depth	70		
		WP26-GCMP-SG-009-depth	100		
	Soil	WP26-GCMP-SB-001-depth	20	VOCs TAL Metals Nitrate/Nitrite Ammonia TKN TOC	8260B 6010B/7470A 300 350.2 351.3 Walkley Black
		WP26-GCMP-SB-001-depth	40		
		WP26-GCMP-SB-002-depth	20		
		WP26-GCMP-SB-002-depth	40		
		WP26-GCMP-SB-003-depth	20		
		WP26-GCMP-SB-003-depth	40		
		WP26-GCMP-SB-004-depth	20		
		WP26-GCMP-SB-004-depth	40		
		WP26-GCMP-SB-005-depth	20		
		WP26-GCMP-SB-005-depth	40		
		WP26-GCMP-SB-006-depth	20		
		WP26-GCMP-SB-006-depth	40		
		WP26-GCMP-SB-007-depth	70		
		WP26-GCMP-SB-007-depth	100		
		WP26-GCMP-SB-008-depth	70		
		WP26-GCMP-SB-008-depth	100		
		WP26-GCMP-SB-009-depth	70		
		WP26-GCMP-SB-009-depth	100		
Quality Control Samples[c]					
Field replicate (collocated) samples[d]	Air	WP26-GCMP-SG-1001 WP26-GCMP-SG-1002 (Two samples to be determined in the field)	TBD	VOCs	TO-15
Field replicate samples[d]	Soil	WP26-GCMP-SB-1001 WP26-GCMP-SB-002 (Two samples to be determined in the field)	TBD	VOCs TAL Metals Nitrate/Nitrite Ammonia TKN TOC	8260 6010B/7470A 300 350.2 351.3 Walkley Black
Laboratory QA/QC samples (MS/MSD)[e]	Soil	WP26-GCMP-SB-boring # -depth-MS WP26-GCMP-SB-boring # -depth-MSD (One MS/MSD sample set to be determined in the field)	TBD	VOCs TAL Metals Nitrate/Nitrite Ammonia TKN TOC	8260B 6010B/7470A 300 350.2 351.3 Walkley Black

Table 2-5. Proposed Sampling and Analyses for Solid Waste Management Unit WP-26, Golf Course Main Pond, at Kirtland Air Force Base, New Mexico, Concluded

Sample Location	Sample Media	Sample Number[a]	Sample Depth (ft bgs unless otherwise noted)	Sample Analysis	EPA Method[b]
Quality Control Samples, Continued[c]					
Equipment Blank[f]	Equipment rinsate	WP26-GCMP-SB-boring # -depth-EB (Daily for each analysis and media type when non-dedicated equipment is used for sampling)	TBD	VOCs TAL Metals Nitrate/Nitrite Ammonia TKN TOC	8260B 6010B/7470A 300 350.2 351.3 Walkley Black
Trip Blank[g]	Organic Free Water	WP-GCMP-Date (##/##/####)	Not Applicable	VOCs	8260B

Notes:

[a] *Sample Number*—Denotes site designation-borehole number-sampling interval relative to ft bgs; for example, sample number WP26-GCMP-SB-001-018020 would be the soil sample collected at WP26, from soil boring 001, at sampling interval of 18 to 20 ft bgs.

[b] EPA, 1996; EPA, 1995; EPA, 1994; ASA, 1982

[c] Estimated number of field QC samples.

[d] *Field Replicate Samples*—A single sample split into two equal portions during a single act of sampling; to assesses the overall precision of the sampling and analysis program; collected at a frequency of 10 percent of the total number of samples. Field replicate air samples will be collocated meaning that the air sample and replicate will be collected in series from the same sampling port.

[e] *MS/MSD*—Collected for QA/QC purposes at a frequency of 5 percent of the total number of samples for each media type.

[f] *Equipment Blank*—Collected for verification of proper decontamination procedures.

[g] *Trip Blank*—Included with each cooler containing soil samples for VOC analysis to assess whether sample cross contamination is occurring during sample shipment or storage at the laboratory.

ASA = American Society of Agronomy
bgs = below ground surface
EPA = U.S. Environmental Protection Agency
ft = foot or feet
MS/MSD = matrix spike/matrix spike duplicate
QA/QC = quality assurance/quality control
RCRA = *Resource Conservation and Recovery Act*
SWMU = solid waste management unit
TAL = Target Analyte List
TBD = to be determined
TKN = total Kjeldahl nitrogen
VOCs = volatile organic compound

3.0 DATA COLLECTION DESIGN AND PROCEDURES

This section presents the project-specific DQOs and the field and analytical procedures that will be followed to ensure that data collected during the field activities are of sufficient quality to support the end uses of the data. Also included in this section are the project-specific QA and QC procedures that will be used for this RFI. The DQOs for this project were developed in accordance with the BWP and the *Guidance for the Data Quality Objectives Process* (EPA, 1994a).

3.1 Data Quality Objectives

DQOs are statements that specify the quality and quantity of the field and laboratory data required to support specific decisions or regulatory actions. The DQOs describe the type and quality of data required to support the project. DQOs also establish numeric limits for the data to allow the data user (or reviewers) to determine if the data collected are of sufficient quality for their intended use. The investigation summary for SWMU WP-26 is presented in Table 2-4. This table has information regarding sample collection, analysis, and selected analytical options. The DQOs for this project are described below.

1. *Statement of the problem.*

   The nature and extent of potential VOC, nitrate, and metals contamination in the vadose zone under the footprint of the original GCMP is unknown.

2. *Identification of a decision that addresses the problem.*

   Determine the lateral and vertical extent of VOC, nitrate, and metals contamination in the subsurface soil and soil gas (VOCs only), from sampling, analysis and evaluation of analytical results. The extent of contamination will be estimated by comparing analytical results with regulatory action levels, where established. Action levels will include NMED soil screening levels.

3. *Identification of inputs that affect the decision.*

   Inputs that will establish the limits of contamination at the GCMP include validated laboratory analytical results for soil and soil gas.

4. *Specification of the domain of the decision.*

   The domain of decision is limited to the area from which the environmental samples are collected and the evaluation of only the parameters for which the samples are analyzed and for which a regulatory standard or screening level exists.

5. *Development of logic statement.*

If the validated laboratory analytical data for the environmental samples collected during this RFI exceed existing screening levels, the area or depth from which the samples were collected will be considered to be contaminated. Additional horizontal or vertical delineation may be required to fully delineate the nature and extent of contamination in the vadose zone under the footprint of the original GCMP.

6. *Establishment of constraints on uncertainty*

Uncertainty in the data used to evaluate the logic statement will be constrained by following the applicable standard operating procedures (SOP) and QA/QC guidelines specified in the BWP, by selecting the appropriate analytical support level for the environmental sample data, and by adhering to both the field and laboratory data quality indicator objectives (precision, accuracy, representativeness, completeness, comparability [PARCC]) discussed in the QAPP (located in Appendix C of the BWP) and the QAPP Addendum (located in Appendix B of this work plan).

7. *Optimization of design for obtaining data.*

To optimize the quality of data collected for evaluation, this work plan will be used as guidance during field activities. Furthermore, field activities will be conducted as specified by the applicable sections of the Base-wide plan FSP and SOPs (USAF, 2004) unless specifically modified in this work plan or in the site-specific DQOs or SSHP addendum.

3.1.1 Data Types

The data types required for this project are based on the type of investigation, the project-specific DQOs, the end use of the analytical data, and the level of documentation. Definitive data will be collected during this investigation as defined in Table 3-1. Definitive data include data that are collected using standard sampling and analytical methods of known precision and accuracy. All samples will be collected following standard sampling methods and will be analyzed by a commercial contract laboratory following the guidance specified in *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846)* (EPA, 1996).

Table 3-1. Laboratory Quality Control Sample Descriptions

Data Type	Media Type	Data Type Definition	Parameters
Definitive	Soil gas	Data that are collected using standard sampling methods as defined in the available and applicable guidance, and using rigorous analytical methods of known precision and accuracy. The data are analyte-specific, with confirmation of both the analyte identity and concentration. The analytical methods provide tangible raw data (such as chromatograms, spectra, and digital values) in the form of paper printouts (hard copies) or electronic files that can be stored and recovered. These data are generated onsite or offsite and meet the method-specific quality control requirements.	EPA Method TO-15[a] (offsite laboratory)
Definitive	Soil	Data that are collected using standard sampling methods as defined in the available and applicable guidance, and using rigorous analytical methods of known precision and accuracy. The data are analyte-specific, with confirmation of both the analyte identity and concentration. The analytical methods provide tangible raw data (such as chromatograms, spectra, and digital values) in the form of paper printouts (hard copies) or electronic files that can be stored and recovered. These data are generated onsite or offsite and meet the method-specific quality control requirements.	EPA MethodSW846 8260[b] EPA Method SW846 6010B/7470A[b] EPA 300[d] EPA 350.2[d] EPA 351.3[d] Walkley Black[e]

Notes:
[a] EPA, 1995
[b] EPA, 1996
[c] EPA, 1994
[d] ASA, 1982
ASA = American Society of Agronomy
EPA = U.S. Environmental Protection Agency

3.2 Quality Assurance/Quality Control

Data quality refers to the level of reliability associated with a particular data set or data point. The data quality associated with environmental measurement data is a function of the sampling plan rationale, the sample collection procedures, and the analytical methods and instrumentation used in making the measurements. The overall QA objective for this project is to develop and implement procedures for field sampling, chain of custody, laboratory analysis, and data reporting that provide data that meet the project-specific DQOs and that are legally defensible.

QA objectives for laboratory measurement data are expressed in terms of the PARCC parameters. Data quality for this project will be assessed in terms of the PARCC parameters. The criteria against which the data will be assessed are presented in Appendix B. In addition, the corrective action procedures to be followed in case of out-of-compliance calibration or QC sample failure are defined in Appendix B.

The QC samples that will be used to evaluate analytical data for this project are defined in Table 2-5, and their relation to PARCC parameters are described in Section 4.2 of the BWP QAPP (USAF, 2004).

The frequency of QC sample collection is listed in Table 3-2. The contract laboratories will, at a minimum, analyze internal QC samples at the frequency specified by the analytical method and this RFI work plan.

3.2.1 Data Validation

As described previously, the validity of the field and analytical data will be evaluated using the PARCC parameters, which are statements that describe data quality and quantity. The PARCC parameters will be used to determine whether the DQOs of this investigation have been met by comparing QC sample results and standard procedures with acceptance criteria established for the RFI (Appendix B). For this project, all definitive data will be validated based on the principles outlined in the project specific QAPP (Appendix B).

Table 3-2. Field and Laboratory Quality Control Sample Descriptions

Field/Laboratory QC Samples	QC Sample Type	Rationale	Frequency	Description	QC Sample Data Assessment
Field QC samples	Trip blank	Identify target analytes that may have been introduced into samples during sample handling, shipping, or storage at the laboratory. Applicable to soil.	One per each cooler containing samples for VOC analysis.	Two 40-ml amber glass vials with Teflon septum caps containing reagent-grade water and preserved to a pH of ≤2. Prepared by the laboratory.	All target analyte detections will be evaluated in accordance with the principles for data validation outlined in Appendix B.
	Field replicates	Assess sampling and analytical precision. Applicable to all media.	Ten percent of the total number of samples for each media and for each analytical method.	A field replicate consists of a discrete sample split into two equal portions. One sample is labeled with the correct field identification; the other is submitted "blind" to the laboratory with fictitious sample identification..	The RPD will be calculated for each analyte (reported above the project practical quantitation limit) between the sample and its replicate and compared to the project-specific acceptance criteria (Appendix B).
	Equipment blank	Assess the completeness of the decontamination process for non-dedicated sampling equipment used for soil samples.	Daily for each analysis and media type when non-dedicated equipment is used for sampling.	An equipment blank consists of rinsate from equipment decontamination that is carried through the same sample collection, handling, and analytical procedures as the investigative samples. Equipment blank samples are only collected when non-dedicated or non-disposable equipment is used for sample collection.	All target analyte detections will be evaluated in accordance with the principles for data validation outlined in Appendix B.
	Temperature blank	Assess sample temperature criterion. Applicable to all samples that have specified temperature criteria.	Each sample cooler.	A 40-ml amber glass bottle filled with reagent-grade water. The temperature of this sample is measured at the time samples are received by laboratory.	Assess whether the temperature criterion of 4°C ± 2°C has been met and, if not, assess whether corrective actions are necessary.
Laboratory QC samples	Method blank	Identify target analytes that may have been introduced into the sample during analysis. Applicable to all media.	Each sample–or extraction–batch (≤20 samples) for each analytical method.	Reagent-grade water that is carried through the same analytical process as native samples.	All target analyte detections will be evaluated in accordance with the principles for data validation outlined in Appendix B.
	Surrogate spikes	Assess analytical accuracy. Applicable to soil.	Each sample for organic analysis including both investigative and QC samples for each method.	Each sample will be spiked in the laboratory with surrogate spikes in accordance with the laboratory's SOPs for the respective methods.	Percent recovery is calculated for each spiked analyte and compared to the acceptance criteria for surrogate accuracy specified in Appendix B.
	MS/MSD	Assess analytical accuracy and precision and identify media interference during analysis. Applicable to soil.	Each sample–or extraction–batch (≤20 samples) for each analytical method for each media type.	The samples for MS/MSD analysis are prepared in the laboratory by adding a standard of known concentration to the samples in accordance with the laboratory's SOPs for the respective methods.	Percent recovery and the RPD for each spiked analyte is calculated and compared to the acceptance criteria for accuracy and precision specified in Appendix B.
	MS/MD[a]	Assess analytical accuracy and precision and identify media interference during analysis. Applicable to soil for inorganic analyses.	Each sample or extraction batch (≤20) for each analytical method.	The samples for MS analysis are prepared in the laboratory by adding a standard of known concentration to the samples in accordance with the laboratory's SOPs for the respective methods. The MD consists of one discrete sample split into two fractions and analyzed as two samples in accordance with the laboratory's SOPs for the respective methods.	The percent recovery for each spiked analyte in the MS is calculated and compared to the acceptance criteria for accuracy specified in this QAPP (Appendix B). The RPD is calculated between the MD and its parent sample and is compared to the acceptance criteria for precision specified in Appendix B.
	Laboratory control sample	Assess analytical accuracy. Applicable to all media.	Each sample-or extraction-batch (≤20 samples) for each analytical method.	The laboratory control sample is prepared by the laboratory and consists of reagent-grade water or sand spiked with a standard (either from a source other than, or the same source used for the initial calibration standard) in accordance with analytical method and the laboratory's SOPs for each respective method.	Percent recovery for each spiked analyte is calculated and compared to the acceptance criteria for accuracy specified in Appendix B.
	Laboratory control sample duplicate[b]	Assess analytical accuracy and precision. Applicable to all media.	Same as the laboratory control sample.	Same as the laboratory control sample.	Percent recovery for each spiked analyte is calculated and compared to the acceptance criteria for accuracy specified in Appendix B. The RPD is calculated between the laboratory control sample and its duplicate and compared to the laboratory's established criteria for the respective methods[a].

Notes:
Source: EPA, 1996
[a] Matrix spike/matrix duplicate samples may be analyzed for inorganic parameters instead of matrix spike/matrix spike duplicate samples.
[b] Laboratory control sample duplicates are not method-specific requirements, but are commonly analyzed by laboratories to assess precision. The inclusion of laboratory control sample duplicates in an analytical program will be dependent upon the contract laboratory.
°C = degrees centigrade
DQO = data quality objective
EPA = U.S. Environmental Protection Agency
MD = matrix duplicate
ml = milliliter
MS/MSD = matrix spike/matrix spike duplicate
QAPP = Quality Assurance Project Plan
QC = quality control
RPD = relative percent difference
SOPs = standard operating procedures
VOC = volatile organic compound

THIS PAGE INTENTIONALLY LEFT BLANK

3.3 Field Activities

The field activities that will be conducted under this RFI work plan are as follows:

- Drill six shallow angled borings using DPT to a vertical depth of 40 feet below the GCMP. Collect continuous soil samples for lithologic logging and field screening with a PID. Retain samples with elevated organic vapors from two depths for laboratory analyses (samples will be retained from 20 and 40 feet below the GCMP if elevated organic vapors are not detected with the PID).
- Complete each shallow boring with SGMPs at two depths where elevated organic vapors were observed in the soil samples (or at 20 and 40 feet below the GCMP if no organic vapors were detected).
- Drill three deep angled borings using HSA drilling techniques to a vertical depth of 100 feet below the GCMP footprint. Collect continuous soil cores between 40 and 100 feet below the GCMP footprint for lithologic logging and field screening with a PID. Retain all soil samples with elevated PID measurements. Submit the samples from the two depth intervals with the highest PID measurements (at the depth the SGMPs will be installed) for laboratory analyses (samples will be retained from 70 and 100 feet below the GCMP if elevated organic vapors are not detected with the PID).
- Complete each deep boring with two SGMPs at the depth intervals where the highest elevated organic vapors were observed in the soil samples (or at 70 and 100 feet below the GCMP if no organic vapors were detected).
- Collect soil gas samples from each SGMP after a 1-week equilibration period. Submit soil gas samples for laboratory analysis.
- Survey the borehole locations relative to New Mexico State Plane Coordinates.
- Manage, characterize, and dispose of investigation-derived waste (IDW).

Specific field activities conducted during the RFI investigation will comply with the Field Sampling Plan (FSP) and the SOPs in the *BWP* (USAF, 2004) unless modified in this work plan. The activities and applicable SOPs are shown in Table 3-3.

Table 3-3. Standard Operating Procedures for Field Activities

Field Activity	Applicable Standard Operating Procedures[a]
Borehole and Sample Logging	SOP B1.1
Soil Gas Investigation	SOP B 1.7
Land Surveys	SOP B1.9
Equipment Decontamination	SOP B1.11
Subsurface Soil Sampling	SOP B2.3
Photoionization Detectors and Organic Vapor Analyzers	SOP B3.1
Headspace Screening	SOP B3.3
Approved Background Concentrations for Kirtland AFB	SOP B7.1
Use of NMED Soil Screening Levels	SOP B7.2
Field Sampling Plan	Appendix A of BWP
Waste Management Plan	Appendix E of BWP

Notes:
a USAF, 2004
BWP = Base-Wide Plans
SOP = standard operating procedure

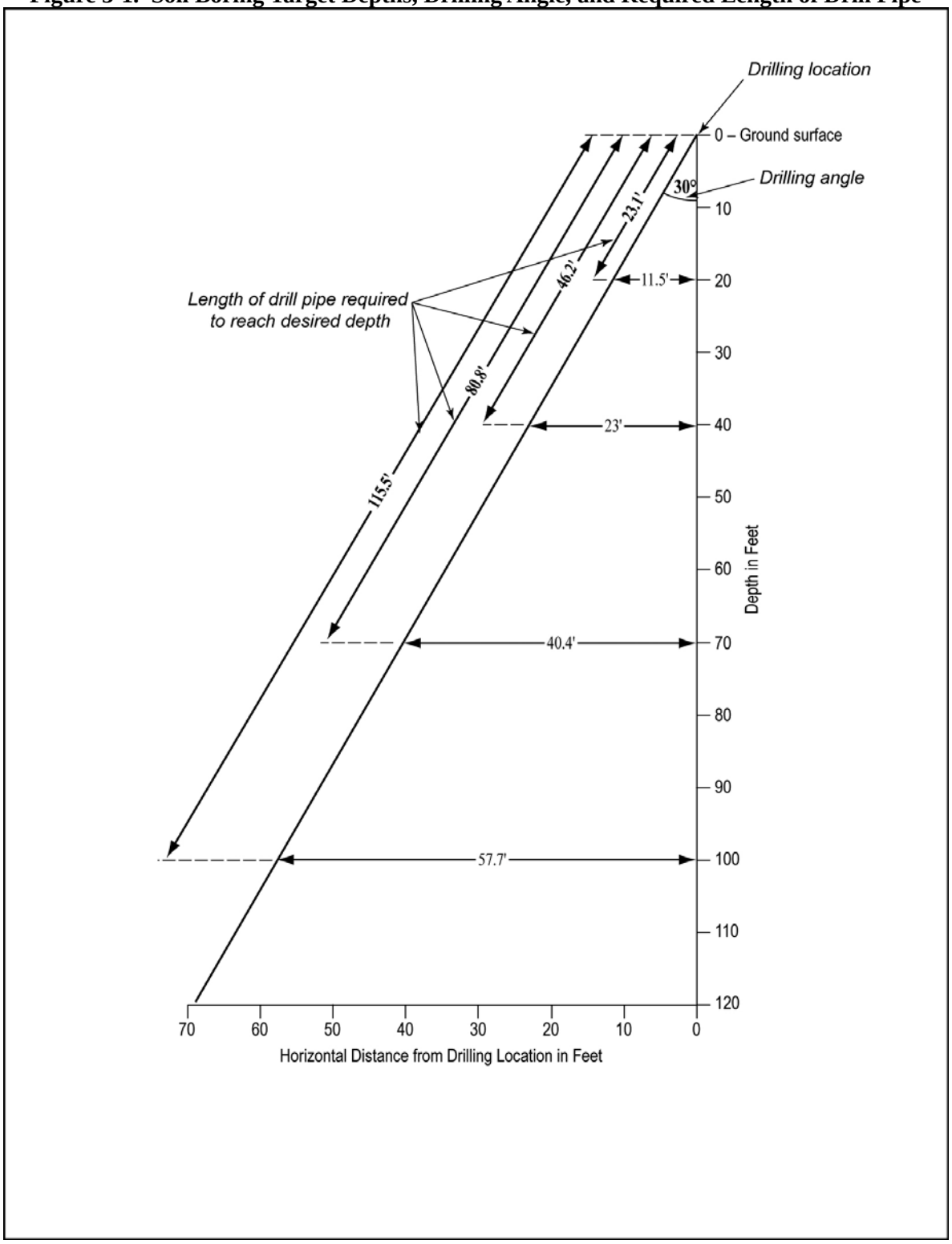
3.3.1 Soil Borings and Soil Gas Monitoring Point Installation

A soil gas survey will be performed by installing and sampling SGMPs in nine boreholes drilled around the GCMP. The SGMPs will be installed at an angle so that the monitoring points are located under the original footprint of the pond. Figure 2-4 shows the proposed SGMP locations. The borings will be drilled at an angle of 30 degrees from vertical, which is the maximum angle for soil sampling and installing SGMPs using DPT and HSA drilling techniques. Figure 3-1 shows the length of drill pipe required to reach the target depths (i.e., 20, 40, 70, and 100 feet below the GCMP) assuming a 30 degree angle from vertical (the drill pipe represents the hypotenuse of the right triangle shown on the figure). For example, 115.5 feet of drill pipe is required to reach a vertical depth of 100 feet when drilling at a 30 degree angle.

Six shallow boreholes will be installed using DPT, and three deep boreholes will be advanced using HSA drilling techniques. The shallow DPT borings will be advanced using 2-inch diameter drill rod equipped with a core sampler. The DPT borings will be continuously cored at an angle of 30 degrees to a vertical depth of 40 feet beneath the GCMP. The soil core samples will be screened in the field with a PID for the presence of organic vapors. The depth of the SGMPs will be based on the PID screening results. If field screening fails to detect significant organic vapors within the soil cores, SGMPs will be installed at 20 and 40 feet within the boring.

The deep HSA borings will be advanced using 4.25-inch inside diameter (ID)/ 8.25-inch outside diameter (OD) HSA. The HSA borings will be drilled at an angle of 30 degrees to a vertical depth of 100 feet beneath the footprint of the GCMP. Soil samples will not be collected until a depth of 40 feet below the GCMP is reached (soil cuttings from the HSA will be used to the log upper portion of the borehole). After a depth of 40 feet below the GCMP is reached, soils will be continuously cored to a vertical depth

Figure 3-1. Soil Boring Target Depths, Drilling Angle, and Required Length of Drill Pipe



of 100 feet bgs using a split-spoon sampler as the HSA is advanced. The split-spoon samples will be screened in the field with a PID for the presence of organic vapors. The depth of the SGMPs will be based on the PID field screening results. If field screening fails to detect significant organic vapors within the soil cores, SGMPs will be installed at 70 and 100 feet within the HSA boring.

The field personnel will use judgement when selecting the depth intervals for completing the SGMPs in both the shallow and deep soil borings. For example, if organic vapors are detected in more than two depth intervals, the SGMPs should be located far enough apart to provide a vertical soil gas profile in each boring (i.e., the two SGMPs should not be closely spaced in the same borehole). Likewise, the SGMPs should not be completed in silt and clay zones if possible, as it likely will not be possible to draw soil gas from low permeability soils.

Each SGMP will be completed with a short section (e.g., 6- to 24-inches long) of small diameter (e.g., 0.5- to 1-inch diameter) polyvinyl chloride (PVC), Teflon®, or stainless steel screen. Polyethylene tubing will extend from the screen to the ground surface. Clean silica sand will be placed around the screen via a tremie pipe to at least 2-feet above the top of the screen section. A minimum 2-foot layer of granular bentonite or bentonite slurry will be placed above the top of the sandpack via a tremie pipe. Two SGMPs will be installed in each boring at the depths described above. The interval between the SGMPs will be filled with cement or bentonite slurry. The SGMPs will be completed at the surface with a lockable, protective, steel stick-up casing or a flush-mount vault box set in concrete. The polyethylene tubing will be clearly marked at the surface to identify the depth interval of the screen section.

3.3.2 Soil and Soil Gas Sampling

The proposed sampling scheme for the GCMP vadose zone investigation is summarized in Table 2-4. Table 3-2 summarizes the QC samples required for data validation. Additional soil and soil gas sampling information is presented below.

3.3.2.1 Soil Sampling

Soil samples will be collected while advancing the DPT and HSA borings as described above. Upon opening the split-spoon sampler or DPT sample core, the soils will be screened with a PID for the presence of organic vapors. If above-background organic vapors are detected with the PID, samples intended for VOC analyses should be immediately collected with an En Core® sampler from those intervals with elevated organic vapors prior to disturbing the sample for lithologic logging. If the grain size of the drill cuttings are too large to be retained in an En Core® sampler (i.e., larger than medium-grain sized sand), the soil samples intended for volatile analyses will be collected directly into 4-ounce glass jars with a Teflon®-lined lid using a clean stainless steel spoon.

Following collection of the samples intended for VOC analyses, the soils then will be logged for stratigraphy (logging will include a description of moisture content to help evaluate if the pond liner is leaking) and transferred to the appropriate (non-volatile analysis) sample containers. The samples intended for non-volatile analyses will be homogenized with a clean stainless steel spoon. The composite samples will be collected by transferring representative soils from the sampling device to a clean stainless steel bowl. The soils will be thoroughly homogenized in the bowl and transferred to laboratory-supplied sample containers with the stainless steel spoon.

Samples from two depth intervals in each boring will be submitted for laboratory analyses. However, because the sample intervals retained for laboratory analysis will not be determined until all samples have been screened with the PID, all samples with above-background organic vapors must be transferred to appropriate sample containers upon collection. It will be necessary for the field personnel to anticipate the sample intervals that will be submitted for laboratory analyses so that the appropriate number of sample containers is filled for QC purposes. For example, if elevated organic vapors are observed in a sample interval, it may be necessary to fill extra sample containers for blind replicate or matrix spike/matrix spike duplicate (MS/MSD) analyses in anticipation the interval will be submitted for analyses. Samples that are not submitted to the laboratory will be discarded and handled as investigation-derived waste. Also, due the number of required analyses and required QC, it may be necessary to sample over a longer interval in order to obtain enough soil to fill all the required sample containers. For example, when collecting the soil sample from 20 feet below the GCMP, it may be necessary to use the cores from 20 to 24 feet to in order to obtain enough soil to fill the sample containers for the normal samples and QC samples.

3.3.2.2 Soil Gas Sampling

Each SGMP will be allowed to come into equilibrium with the subsurface for approximately 1 week prior to sampling. Soil gas samples then will then be collected from the individual monitoring points using a vacuum pump and a Suma® canister or similar container supplied by the analytical laboratory. The soil gas samples will be analyzed at an offsite laboratory by EPA Method TO-15 (EPA, 1995).

3.3.2.3 Sample Designation

Sample site designations will follow the Kirtland AFB guidelines as outlined in Section 3.2 of the FSP (located in Appendix A of the Kirtland Air Force Base, Base-Wide Plans for the Installation Restoration Program [USAF, 2004]). The numbering system consists of an alpha-numeric code that identifies the sampling site, medium, location, and a sample depth. The media type codes include SB for subsurface soil, SG for soil gas, EB for equipment blank, and TB for trip blank. Borehole numbers will be used for the specific location code. Sample depths will be noted by six numbers, with the first three identifying the top of the sampling interval and the second three identifying the bottom of the sampling interval (for example, a sample collected from 25 to 27 ft bgs will be designated as 025027).

3.3.3 Investigation-Derived Waste Management

All IDW will be handled as described in the Waste Management Plan (located in Appendix E of the BWP [USAF, 2004]) and as summarized below. The types of IDW expected to be generated while installing and sampling the SGMPs include personal protective equipment (PPE), miscellaneous disposable equipment, drill cuttings, and decontamination fluids. All field activities are expected to be conducted in Level D PPE (refer to the SSHP Addendum located in Appendix A); therefore, the only PPE that will be discarded will be disposable work gloves and Tyvek coveralls. The PPE and miscellaneous disposable equipment (e.g., paper towels, empty 5-gallon buckets, disposable bailers, etc.) will be discarded as non-hazardous municipal waste due to the low levels of contaminants anticipated during this investigation.

3.3.3.1 Liquid IDW Handling and Disposal

All decontamination fluid IDW will be contained in DOT-approved 55-gallon drums or trailer-mounted tanks for temporary storage pending disposal. Each IDW container will be clearly labeled to indicate:

- Source and location (boring number)
- Contents and quantity of material in the container
- Potential health, safety and environmental hazards
- Accumulation start date (the date the first drop of material was put in the container)
- Date container sampled
- Analytical Parameters
- Analysis Pending

Disposal-profiling samples will be collected from the liquid IDW as described below in order to determine the appropriate disposal options. IDW Disposal will be in accordance with the Waste Management Plan (Appendix E of the BWP).

3.3.3.2 Solid IDW Handling

All drill cuttings will be contained in DOT-approved 55-gallon drums or 20-cubic-yard roll-off containers for temporary storage pending characterization and disposal. The storage containers will be labeled as described above. If approved by the Kirtland AFB project manager, soil cuttings may be managed as soil stockpiles on site in a designated area that is lined in plastic sheeting and covered when soil is not being staged.

3.3.3.3 Disposal-Profile Sampling Procedures

One disposal-profiling sample will be collected from both the liquid IDW and drill cuttings. The liquid-IDW disposal-profiling sample will be collected with a single-use disposable bailer and transferred to the appropriate sample containers. The liquid IDW sample intended for VOC analysis will be slowly transferred to 40-milliliter vials and capped so that there is no headspace (air bubbles) in the sample vials. All other liquid IDW sample containers will be filled to the neck of the bottle. The liquid IDW samples intended for metals analysis will not be filtered in the field.

The drill cuttings disposal-profiling sample intended for volatile analyses will be a “grab” type sample collected using an En Core® sampler, if appropriate. If the grain size of the drill cuttings are too large to be retained in an En Core® sampler (i.e., larger than medium-grain sized sand), the disposal-profiling sample intended for volatile analyses will be collected directly into 4-ounce glass jars with a Teflon®-lined lid using a clean stainless steel spoon. The samples intended for VOC analyses will not be homogenized prior to collection and the samples. In addition, the sampler will dig at least 6-inches into the drill cuttings prior to sampling as contaminants near the surface of the cuttings may volatilize prior to sampling. The drill cuttings samples intended for non-volatile analyses will be a 3-point composite that

will be collected with a clean stainless steel spoon. The composite samples will be collected by transferring representative soils from three separate locations in the drill cuttings container(s) to a clean stainless steel bowl. The soils will be thoroughly homogenized in the bowl and transferred to laboratory-supplied sample containers with the stainless steel spoon.

3.3.3.4 Disposal-Profile Sample Analyses and IDW Disposal

The disposal-profiling samples will be analyzed for toxicity characteristic leaching procedure (TCLP) VOCs, SVOCs, metals, pesticides, and herbicides. In addition, the following tests and procedures will be performed on the disposal-profiling soil samples; ignitability, corrosivity, reactivity, and paint filter test. The soil cuttings will be disposed as non-hazardous waste in the Kirtland AFB landfill, pending sample results. If sample results indicate that the liquid IDW is not contaminated, the contained water will be released to the ground surface at the site. If the sample results indicate the solid or liquid IDW are considered hazardous waste, the IDW will be disposed in an appropriate off-site facility. Prior to release, appropriate notifications will be given and/or permission obtained from involved agencies.

THIS PAGE INTENTIONALLY LEFT BLANK

4.0 PROJECT MANAGEMENT

This section outlines the project management milestones and deadlines and describes the SSHP.

4.1 Project Scheduling and Reporting Requirements

The proposed schedule for implementation of this investigation is presented in Table 4-1. If additional borehole installations are necessary to define the nature and extent of contamination, the schedule will be revised to reflect the additional investigation.

Table 4-1. Proposed Schedule for *Resource Conservation and Recovery Act* Facility Investigation at Solid Waste Management Unit WP-26

Activity	Duration (calendar days)	Start Date	Finish Date
Preparation of WP-26 RFI Work Plan	**253**	**30-Nov-05**	**10-Aug-06**
Submit WP-26 RFI Work Plan to USACE/Kirtland AFB	195	30-Nov-05	13-Jun-06
WP-26 RFI Work Plan USACE/Kirtland AFB review	30	14-Jun-06	14-Jul-06
Prepare Revised WP-26 RFI Work Plan in response to USACE/Kirtland AFB Review Comments	25	15-Jul-06	9-Aug-06
Submit WP-26 Work Plan to USACE/Kirtland AFB/NMED	0	10-Aug-06	10-Aug-06
WP-26 RFI Work Plan NMED Review	30	10-Aug-06	9-Sep-06
Prepare Revised WP-26 Work Plan in response to NMED Comments	15	10-Sep-06	25-Sep-06
Distribute WP-26 RFI Work Plan	0	26-Sep-06	26-Sep-06
Field Investigation	**52**	**10-Oct-06**	**1-Dec-06**
Drill Soil Borings, Collect Soil Samples, and Install Soil Gas Monitoring Points	14	10-Oct-06	24-Oct-06
Collect Soil Gas Samples	2	31-Oct-06	2-Nov-06
Sample Analysis	28	3-Nov-06	1-Dec-06
Prepare WP-26 RFI Report	**148**	**2-Dec-06**	**29-Apr-07**
Prepare WP-26 RFI Report	45	2-Dec-06	16-Jan-07
Submit WP-26 RFI Report to USACE/Kirtland AFB	0	17-Jan-07	17-Jan-07
WP-26 RFI Report USACE/Kirtland AFB Review	30	18-Jan-07	17-Feb-07
Prepare revised WP-26 RFI Report in Response to USACE/Kirtland AFB Review Comments	15	18-Feb-07	5-Mar-07
Submit WP-26 RFI Report to USACE/Kirtland AFB/NMED	0	6-Mar-07	6-Mar-07
WP-26 RFI Report NMED Review	30	7-Mar-07	6-Apr-07
Prepare Revised WP-26 Report in response to NMED Comments	21	7-Apr-07	28-Apr-07
Distribute WP-26 RFI Report	0	29-Apr-07	29-Apr-07

Notes:
USACE United States Army Corps of Engineers
AFB = Air Force Base
NMED = New Mexico Environment Department
RFI = *Resource Conservation and Recovery Act* Facility Investigation

4.2 Health and Safety Plan

An SSHP addendum to the Kirtland AFB Base-wide Health and Safety Plan (USAF, 2004) has been prepared and is included as Appendix A. Health and safety practices specified in the Kirtland AFB Base-wide Health and Safety Plan will be adhered to unless modified by the SSHP addendum.

REFERENCES

ASA, 1982. *Methods of Soils Analysis*. American Society of Agronomy, Madison, Wisconsin. 1982.

EPA, 1989. *Soil Sampling Quality Assurance User's Guide* (EPA/600/8-89/046). U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

EPA, 1991. *Representative Sampling Guidance, Vol.1, Soil,* Directive Number 9360.4-10. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, .

EPA, 1993. *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA 100–400 Series, EPA/600R-93/100.* U.S. Environmental Protection Agency. National Technical Information Service, Washington, D.C. August.

EPA, 1994a. *Guidance for the Data Quality Objectives Process*. U.S. EPA QA/G-4, EPA 600/R-96/055. U.S. Environmental Protection Agency.

EPA, 1995. Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air (EPA/625/R-96/010b, June 1995).

EPA, 1996. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, Third Edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996. U.S. Environmental Protection Agency, Office of Solid Waste. December 1996.

EPA, 1999. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition.* U.S. Environmental Protection Agency, Office of Research and Development. EPA/625/R-96/010B. January

NMED, 1998. *RCRA Permits Management Program Document Requirement Guide*. New Mexico Environment Department, Hazardous and Radioactive Materials Bureau, RCRA Permits Management Program, Santa Fe, New Mexico.

USAF, 1993a. *RFI Technical Report, Stage 2, Kirtland Air Force Base, Albuquerque, New Mexico.* U.S. Air Force Center for Environmental Excellence, Environmental Services Office, Environmental Restoration Division, Brooks Air Force Base. December.

USAF, 1993b. *RFI Technical Report, Stage 2A, Kirtland Air Force Base, Albuquerque, New Mexico.* U.S. Air Force Center for Environmental Excellence, Environmental Services Office, Environmental Restoration Division, Brooks Air Force Base. December.

USAF, 1994. *Post-Closure Plan Sewage Lagoons and Golf Course Main Pond*. Prepared by Daniel B. Stephens & Associates, Inc., for U.S. Air Force, Kirtland Air Force Base, New Mexico. April 1.

REFERENCES (CONCLUDED)

USAF, 1999. *Interim Corrective Measures Report for Site WP-26, Golf Course Main Pond (WP-26), and Areas of Concern SS-79, Building 381 Spill Site (SS-79), and WP-87, GRABS Site Waste Pile (WP-87), Kirtland Air Force Base, Albuquerque, New Mexico*. U.S. Air Force Center for Environmental Excellence, Environmental Services Office, Environmental Restoration Division, Brooks Air Force Base. May.

USAF, 2000. *Supplemental Investigation Report for Post-Closure Activities at Site WP-26, Sewage Lagoons and Golf Course Main Pond*. U.S. Air Force, Kirtland Air Force Base, New Mexico. March.

USAF, 2003. *Interim Stage 2 Abatement Report for Nitrate-Impacted Groundwater Within Corrective Action Unit ST-105, Trichloroethylene and Nitrate Contaminated Groundwater, Kirtland Air Force Base, Albuquerque, New Mexico*. U.S. Air Force Center for Environmental Excellence, Environmental Services Office, Environmental Restoration Division, Brooks Air Force Base. January.

USAF, 2004. *Kirtland Air Force Base, Final Base-Wide Plans for the Environmental Restoration Program, 2004 Update*. U.S. Air Force, Environmental Restoration Branch, Kirtland Air Force Base, New Mexico. April.

USAF, 2005. *Eighth Semiannual Groundwater Monitoring Report for the Stage 2, Phase 1 and Interim Stage 2 Abatement Plans for Nitrate Contaminated Groundwater at Kirtland Airforce Base, New Mexico*. U.S. Air Force, Environmental Restoration Branch, Kirtland Air Force Base, New Mexico. December.

UNITED STATES CODE OF FEDERAL REGULATIONS

40 CFR Part 141. "National Primary Drinking Water Regulations," Title 40, Protection of Environment, Chapter 1. U.S. Environmental Protection Agency, *Code of Federal Regulations*, Washington, D.C. July 1, 2000.

APPENDIX A

SITE SAFETY AND HEALTH PLAN ADDENDUM

CONTENTS

Section **Page**

ACRONYMS A-3

A1.0 INTRODUCTION A-5

A1.1 Specific Base-wide Health and Safety Plan Modifications A-5
A1.2 Project Organization and Responsibilities A-6
A1.3 Site History and Description A-6
A1.3.1 Solid Waste Management Unit WP-26, Golf Course Main Pond (GCMP) A-6
A1.4 Chemical Hazards A-11
A1.4.1 Chemical Hazards Associated with GCMP A-11
A1.4.2 Chemical Hazards Summary A-12
A1.5 Physical Hazards A-12
A1.6 Training A-13
A1.7 Monitoring A-16
A1.7.1 Personal Monitoring Procedures A-16
A1.7.2 Personal Air Monitoring A-16
A1.8 Medical Surveillance A-16
A1.9 Safety Considerations for Site Operations A-17
A1.9.1 Daily Safety and Health Briefings A-17
A1.9.2 Safe Work Permits A-17
A1.10 Emergency Response Plan A-19

REFERENCES A-21

Attachment 1 Tailgate Safety Meeting Sheet A-23

Attachment 2 Equipment Record Sheet A-27

FIGURES

Figure **Page**
A1-1 Site-Specific Training Documentation A-15
A1-2 Visitor Log Sheet A-16
A1-3 Safe Work Permit A-19
A1-4 Hospital Route Map A-21

TABLES

Table **Page**
A1-1 Properties of Contaminants of Concern for Solid Waste Management Unit WP-26 Sewage Lagoons A-9
A1-2 Job Hazard Analysis for Solid Waste Management Unit WP-26, Sewage Lagoons A-10
A1-3 Health and Safety Documentation A-14
A1-4 Emergency Contacts A-20

ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AFB	Air Force Base
APR	air purifying respirator
BWP	Base-Wide Plan
BZ	breathing zone
C	Celsius
CAU	Corrective Action Unit
CFR	Code of Federal Regulations
COC	constituents of concern
CPR	cardiopulmonary resuscitation
EPA	U.S. Environmental Protection Agency
F	Fahrenheit
FID	flame ionization detector
FOL	Field Operations Leader
GCMP	Golf Course Main Pond
HDPE	high-density polyethylene
HEPA	high efficiency particulate air
Hg	mercury
HSA	hollow stem auger
ICM	Interim Corrective Measures
IDLH	immediately dangerous to life and health
IDW	investigation-derived waste
LTM	long term monitoring
MCL	maximum contaminant level
mg/L	milligram per liter
mg/m^3	milligrams per cubic meter
mm	millimeter
MWH	MWH Americas, Inc.
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration

ACRONYMS
(Concluded)

PAH	polynuclear aromatic hydrocarbon
PHSM	Project Health and Safety Manager
PHSO	Project Health and Safety Officer
PID	photoionization detector
PM	Project Manager
PPE	personal protection equipment
ppm	parts per million
Pt	point
PVC	polyvinylchloride
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SSHP	Site Safety and Health Plan
SSO	Site Safety Officer
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TCE	trichloroethylene
TWA	total waste analysis
USAF	U.S. Air Force
UV	ultraviolet
UXO	unexploded ordinance
VOC	volatile organic compound

A1.0 INTRODUCTION

This addendum is intended to provide information on site-specific health and safety practices and procedures related to activities for a *Resource Conservation and Recovery Act* [RCRA] Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) WP-26, Golf Course Main Pond at Kirtland Air Force Base (AFB), New Mexico. Specifically, this addendum addresses the following tasks:

- Multi-depth soil gas probe installation and surveying,
- Subsurface soil sampling,
- Investigative-derived waste (IDW) sampling,
- Horizontal and vertical survey of each new well location,
- Mobilization and demobilization, and
- Heavy equipment decontamination.

This addendum represents a modification to the *Kirtland AFB Base-wide Health and Safety Plan*, Appendix F of the *Base-Wide Plan* (BWP) (U.S. Air Force [USAF], 2004). This addendum is to be used in conjunction with the Base-wide Health and Safety Plan. Specific sites and proposed activities are included in the SWMU WP-26 work plan and this addendum.

A1.1 Specific Base-wide Health and Safety Plan Modifications

The following sections and tables of the Base-wide Health and Safety Plan are addended by this document:

- Section 2.0, Project Organization and Responsibilities;
- Section 3.0, Site History and Description;
- Section 4.1, Chemical Hazards;
- Section 4.5, Physical Hazards;
- Section 7.0, Monitoring;
- Section 9.0, Medical Surveillance Procedures;
- Section 10.0, Safety Considerations;
- Section 12.0, Emergency Response Plan; and
- Section 13.0, Training.

It is the responsibility of the Project Manager (PM) to forward copies of this addendum to the field crew to be inserted into the field copies of the Base-wide Health and Safety Plan. It is the responsibility of the Field Operations Leader (FOL) to ensure that all members of the field crew review this addendum. The

FOL will ensure all field crew members sign the site-specific training documentation sheet (Figure A1-1 of this addendum), indicating they have reviewed the elements of this addendum and the Base-wide Health and Safety Plan, understand its requirements, and have received satisfactory answers to any questions they may have had.

A1.2 Project Organization and Responsibilities

Section 2.0 (Project Organization and Responsibilities) of the Base-wide Health and Safety Plan is addended by adding the following discussion on personnel assignments.

The following personnel assignments apply to site activities covered under this addendum. Refer to Section 2.0 of the Base-wide Health and Safety Plan for the specific roles and responsibilities of project personnel.

Assignment	Responsible Party	Point of Contact
Project Manager (PM)	Deborah Drain	(801).617.3221
Field Operations Leader/Site Safety Officer	William Bragdon	(801).550.7407 (Cell)
Project Health and Safety Manager	Jack Storace, Certified Industrial Hygienist	(925).975.3544 (415).298.8664 (Cell)
Project Health and Safety Officer	William Bragdon	(801).550.7407 (Cell)

A1.3 Site History and Description

Section 3.0 (Site History and Description) is addended by adding the following description of the areas of interest for the SWMU WP-26 work plan.

A1.3.1 Solid Waste Management Unit WP-26, Golf Course Main Pond (GCMP)

The GCMP is located between holes three and four of the Tijeras Arroyo Golf Course at Kirtland AFB. The GCMP was constructed in 1962 and was used for storage of wastewater delivered via pipeline from the Sewage Lagoons. The GCMP received wastewater during the months of April through October from 1962 to 1987. As part of a water conservation program, the wastewater in the pond was mixed with surface-water runoff and well water and was pumped through a sprinkler system to irrigate the golf course. The Sewage Lagoon/Main Golf Course Pond irrigation system was used from April to October each year. Depending upon irrigation needs, 40 to 100 percent of the untreated Base sewage was routed through the lagoons to the GCMP during this period. From November to March, Base sewage was routed to the City of Albuquerque sewage treatment facilities. The pond last received water from the Sewage Lagoons in 1987 and reportedly evaporated to dryness in January 1989. The pond bottom was lined with a thin layer (approximately 4 millimeters) of plastic sheeting. By 1998 the pond liner material had

Table A1-1. Properties of Contaminants of Concern for Solid Waste Management Unit WP-26 Sewage Lagoons

Substance	CAS No.	Air Monitoring	Exposure Limits	Warning Property Ratings	Chemical/Physical Properties	Health Hazard Information
VOCs	CAS number vary depending on specific compounds.	Refer to NIOSH methods for specific compounds for appropriate air sampling protocols. Many VOCs can be monitored using PID with a 10.2 eV lamp or FID detection.	Exposure limits are compound specific. For total VOCs, an exposure limit of 25 ppm will be used to evaluate personnel protection equipment requirements.	Warning property ratings are compound specific. VOCs are common constituents of gasoline, solvents, and many household cleaners. Odor thresholds vary. The use of air purifying respirators with combination organic vapor/HEPA cartridges up to 100 ppm is acceptable provided cartridges are changed at the beginning of each shift. Nitrile gloves are recommended.	Properties of VOCs are compound specific. For Benzene: Boiling Pt: 176°F; 80°C; Melting Pt: 42°F; 5.5°C; Solubility: 0.07%; Flash Pt: 12°F; -11°C; LEL/LFL: 1.3%; UEL/UFL: 7.9%; Vapor Density: 2.77; Vapor Pressure: 75 mm Hg; Specific Gravity: 0.88; Incompatibilities: Strong oxidizers, fluorides, perchlorates, and acids; Appearance and Odor: Colorless to a light yellow liquid with an aromatic odor	VOCs are regulated based on effects on respiratory tract, skin irritation, and possible carcinogenic effects. Other effects may include eye irritation and central nervous system disturbances (headache, slowed reactions, nausea, and vomiting). Acute exposures may result in difficulty breathing, respiratory failure, skin and eye irritation, and burns. Chronic exposure may damage the liver, kidneys, lungs, and skin.
Metals	CAS numbers vary depending on specific compound.	Metals are not volatile and can not be detected by PID or FID. Metals can be measured as particulate matter in air.	Exposure limits are compound specific.	Warning property ratings are compound specific. The use of an air purifying, full face-piece respirator with a HEPA filter for concentrations up to 2.5 mg/m^3. Metals are in the particulate form. Therefore, any glove suitable to prevent skin contact. (Nitrile has been the most widely used).	Properties of metals are compound specific. For Lead: Boiling Pt: 3164°F; 1740°C; Melting Pt: 621°F; 327°C; Solubility: Insoluble; Flash Pt: Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals); LEL/LFL: Not applicable; UEL/UFL: Not applicable; Vapor Density: Not available; Vapor Pressure: 0 mm Hg; Specific Gravity: 11.34; Incompatibilities: Strong oxidizers, peroxides, sodium acetylide, zirconium, and acids; Appearance and Odor: Metal: A heavy ductile, soft gray solid.	Metals are regulated based on effects to the immune system and central nervous system. Overexposure to metals via ingestion or inhalation may result in metallic taste in the mouth, dry throat, thirst, Gastrointestinal disorders (burning stomach pain, nausea, vomiting, possible diarrhea sometimes bloody or black, accompanied by severe bouts of colic), central nervous system effects (muscular weakness, pain, cramps, headaches, insomnia, depression, partial paralysis possibly coma and death. Chronic exposure may damage liver, kidneys, lungs, and brain.
Chromium	7440-47-3 (Elemental)	Chromium is not volatile and can not be detected by PID or FID. Chromium can be measured as particulate matter in air.	OSHA & NIOSH: (Chromium II, III) 0.5 mg/m^3; (Chromium VI) 0.1 mg/m^3 (Ceiling) ACGIH: 0.5 mg/m^3 (Chromium II, III compounds); 0.05 mg/m^3 (Chromium VI compounds) IDLH: 30 mg/m^3 (Chromium VI compounds)	The use of an air purifying, full face-piece respirator with a HEPA filter for concentrations up to 0.1 mg/m^3. Metals are in the particulate form. Therefore, any glove suitable to prevent skin contact. (Nitrile has been the most widely used).	Boiling Pt: 4788°F; 2642°C; Melting Pt: 3452°F; 1900°C; Solubility: Insoluble; Flash Pt: Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals); LEL/LFL: Not applicable; UEL/UFL: Not applicable; Vapor Density: Not available; Vapor Pressure: 0 mm Hg; Specific Gravity: 7.14; Incompatibilities: Strong oxidizers, peroxides, and alkalis ; Appearance and Odor: Appearance and odor vary depending upon the specific compound.	Health hazards are characterized normally through chronic exposure manifesting as histologic fibrosis of the lungs and ulceration of the nasal septum and skin. Various chromium compounds may have carcinogenic effects.
Nitrate	14797-55-8	Nitrate is not volatile and can not be measured with a PID or FID.	None	Nitrile gloves are recommended.	Boiling Pt: 249.8°F; 121°C Molecular Weight 63; Solubility: Soluble; Flash Pt: Not applicable; LEL/LFL: Not applicable; UEL/UFL: Not applicable; Vapor Density: Not available; Vapor Pressure: Not available; Specific Gravity: 1.4; Incompatibilities: Not applicable	Drinking water MCL: 10 mg/L. Ingestion of water containing nitrate above the MCL is suspected to cause methemoglobinemia in infants. Carcinogenic effects of nitrate are not known.
Trichloroethylene (TCE)	79-01-6	TCE can be detected by PID using a 10.2 eV lamp or by FID. Ionization potential: 9.45eV	OSHA TWA: 100 ppm 300 ppm (5-minute max peak in any 2 hours)	The use of air purifying respirators with combination organic vapor/HEPA cartridges up to 500 ppm is acceptable provided cartridges are changed at the beginning of each shift. Nitrile gloves are recommended.	Boiling Pt: 189°F; Melting Pt: 48°F; Solubility: 0.0001%; Flash Pt: 160°F; LEL/LFL: 8%; UEL/UFL: 10.5%; Vapor Pressure: 58 mm Hg; Specific Gravity: 1.464; Incompatibilities: Strong caustics and alkalis, chemically-active metals (such as barium, lithium, sodium, magnesium, titanium, and beryllium); Appearance and Odor: colorless liquid with a chloroform-like odor.	Breathing large amounts of TCE may cause impaired heart function, coma, and death. Breathing TCE for extended periods may cause nerve, lung, kidney, and liver damage. Breathing small amounts for short periods of time may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Ingestion of TCE may cause nausea, liver and kidney damage, convulsions, impaired heart function, coma, or death. Skin contact with TCE for may cause skin rashes.

Notes:
References: U.S. Environmental Protection Agency (EPA), 2000. *Integrated Risk Information System (IRIS).* U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment. www.epa.gov/ngispgm3/iris/index.html July 2000.
NIOSH, 1994. *Pocket Guide to Chemical Hazards.* U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. June 1994.
ACGIH = American Conference of Governmental Industrial Hygienists
C = Celsius
CAS = Chemical Abstracts Service
F = Fahrenheit
FID = flame ionization detector
HEPA = high efficiency particulate air
Hg = mercury
IDLH = immediately dangerous to life and health
MCL = maximum contaminant level
mg/m^3 = milligrams per cubic meter
mm = millimeter
NIOSH = National Institute for Occupational Safety and Health
OSHA = Occupational Safety and Health Administration
PAH = polynuclear aromatic hydrocarbon
PID = photoionization detector
ppm = parts per million
Pt = point
SVOC = semivolatile organic compound
TWA = total waste analysis
VOC = volatile organic compound

Table A1-2. Job Hazard Analysis for Solid Waste Management Unit WP-26, Sewage Lagoons

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Subsurface multi-depth soil vapor survey and soil sampling utilizing direct push technology, hollow-stem auger (HSA) at SWMU WP-26.	*Chemical Hazards* 1) Potential air/particulate/water borne contaminants primarily consisting VOCs including TCE, metals including chromium, and nitrate/nitrite. Contaminants are not anticipated to present an inhalation hazard due to the low concentrations detected. Other potential air/particulate contaminants related to drilling activities primarily consist of gasoline and diesel range hydrocarbons. Contaminants are not expected to be present at inhalation hazards. 2) Transfer of contamination into clean areas or onto site personnel *Physical hazards* 3) Hazards associated with drilling equipment (pinch/compression points, heavy lifting, etc.) 4) Noise 5) Energized systems 6) Lifting (muscle strains and pulls) 7) Ambient temperature extremes (heat stress) 8) Flying objects (debris) 9) Chance of contacting a buried or overhead utility 10) Slip/Trip/Fall	1) Use real-time monitoring instrumentation, action levels, and identified PPE to control exposures to potentially contaminated media (e.g. air, soils, groundwater. etc.). Generation of dust should be minimized to the greatest extent possible. If airborne dust is observed, area wetting methods will be used to reduce the generation of dust created during drilling activities. If area-wetting methods are not feasible, upgraded levels of protection or termination of activities will be used to minimize exposure to observed airborne dust. 2) Decontaminate all equipment and supplies between boreholes and prior to leaving the site. 3) All equipment to be used will be - Inspected by the operator in accordance with Federal safety and transportation guidelines, OSHA (1926.600, .601, .602), and manufacturers design. - Operated by Certified operators, and knowledgeable ground crew. - Used within establish safe zones and routes of approach - Only manufacturer approved equipment may be used in conjunction with equipment repair procedures (i.e. pins, etc.). Additionally, the following safe operating procedures will be incorporated: - All personnel not directly supporting the subsurface investigation will remain at least 15 feet from the point of operation. - Drill masts or other projecting devices shall be at least 20 feet from overhead power lines and a minimum of 3 feet from underground utilities unless the exact location of the underground utility is known. - Work areas will be kept clear of clutter. - Secure all loose articles to avoid possible entanglement. - All equipment shall be equipped with movement warning systems. - All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility. - All personnel will be instructed in the location and operations of the emergency shut off device(s). This device will be tested initially (and then periodically) to insure its operational status. - Areas will be inspected prior to the movement of the drill rig and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. - The drill rig and support vehicles will be moved no closer than 3 feet to banks, ditches, and other excavations and unstable terrain unless the sidewalls are supported. - Use proper lifting techniques (use legs to lift the weight, keep spine straight, minimize twisting motions, etc.). Whenever possible use multiple personnel or machinery to lift and move heavy objects. - Use pinch bars or other appropriate tools to keep hands away from potential pinch/compression points. 4) Hearing protection will be used during all subsurface activities until the SSO can quantify associated noise levels. 5) All utility clearances shall be obtained prior to subsurface activities. Prior to any subsurface investigations, the locations of all underground utilities will be identified and marked. Obtain written permit clearance prior to all subsurface investigations. 6) Employ machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress concerns is provided in Number 809 of the Montgomery Watson Safety and Health Policies and Procedures Manual.	It is anticipated that potential contaminant concentrations at outdoor sample locations will be dispersed via natural wind currents and dilution prior to reaching worker breathing zones. Photoionization Detector w/ 10.2 eV UV lamp source, or a Flame Ionization Detector, will be used as follows: Source (borehole) monitoring will be conducted at regular intervals determined by the SSO. The SSO will also monitor the breathing zone (BZ) of all potentially affected employees, with the following guidance: - Workers must don Level C PPE [half face piece APR with organic vapor cartridges changed every shift] as indicated below: 1) If sustained (fifteen minutes) BZ concentrations are above 1 ppm collect a benzene detector tube (order number 8101841 or Drager CMS for benzene). 2) If there is no detection, upgrade to Level C at 25 ppm. 3) If there is detection on the benzene tube, upgrade to Level C (half face piece APR with organic vapor cartridges changed every shift) up to 10 ppm. 4) At 10 ppm benzene upgrade to a full-face APR. 5) At 50 ppm benzene workers must evacuate to a safe area and contact the PHSM. - Workers must evacuate to a safe area if sustained BZ concentrations exceed 100 ppm on the PID regardless of the benzene concentration. Some of the contaminants of concern are solids, and are non-detectable using PID/FID direct reading instruments. Also, other site contaminants may adhere to or be part of airborne dust or particulates generated during site activities. Generation of dust should be minimized to the greatest extent possible to avoid inhalation of contaminated dust or particulates. Evaluation of dust concentrations will be qualitative by observing work conditions for visible dust clouds or accumulations. Potential exposure to contaminants attached to dust particles will be controlled by using water to suppress dust, by avoiding dust plumes, or by upgrading the level of protection. Upgrade to Level C protection shall occur anytime sustained visible dust is present in a worker's breathing zone. Where the utility clearance cannot be obtained in a reasonable period, or not located, drilling shall proceed with extreme caution using a hand auger with a magnetometer for periodic downhole surveys every 2 feet to a depth of at least 6 feet.	All drilling operations are to be initiated in level D protection. Level D protection constitutes the following minimum protection - Standard field dress (long pants long sleeve shirts) - Steel toe safety shoes - Hardhat, safety glasses, and earplugs or muffs. - Surgical style inner gloves with leather or cotton outer work gloves. Nitrile gloves may be substituted for these gloves if preferred. *- Tyvek coveralls will be worn if there is a possibility of soiling work attire* *- PVC or PE coated tyvek will be incorporated if there is a potential for saturation of work attire.* *(Items in italics are optional as conditions dictate)* Level C protection upgrade will consist of APR with organic vapor filter cartridges (changed before each new shift), and will be required based on monitoring instrument results indicated in the column to the left. Chemical protective clothing will consist of impermeable boot covers; nitrile gloves with a cotton liner, surgical style inner gloves, and Tyvek coveralls (unless free phase product is encountered). Free phase product or splash potential PVC or PE splash suit.	**Personnel Decontamination** - Will consist of a soap/water wash and rinse for outer protective equipment (e.g. boots, gloves, PVC splash suits, etc.). This decontamination procedure for **Level D** protection will consist of - Equipment drop - Soap/water wash and rinse of outer boots and outer gloves (if applicable and washable) - Soap/water wash and rinse of the splash suit, as applicable - Removal of disposable PPE beginning with coveralls, then outer boots, and then gloves. - Wash hands and face (optional), leave contamination reduction zone For **Level C Protection** in addition to that described above: **Note:** APR cartridge change out would take place at this point. - Outer suit, boot covers, outer glove removal and disposal - Respiratory (face mask) protection removal - Inner surgical style glove removal and disposal - Wash hands and face, leave contamination reduction zone

Table A1-2. Job Hazard Analysis for Solid Waste Management Unit WP-26, Sewage Lagoons, Continued

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
IDW sampling at SWMU WP-26.	*Chemical Hazards* 1) Potential air/water borne contaminants primarily consisting VOCs including TCE, metals including chromium, and nitrate/nitrite. Contaminants are not anticipated to present an inhalation hazard due to the low concentrations detected. TCE is the primary contaminant of concern. 2) Transfer of contamination into clean areas *Physical hazards* 3) Lifting (muscle strains and pulls) 4) Slip, trips, and falls 5) Ambient temperature extremes (heat stress) 7) Slip/Trip/Fall	1) Use real-time monitoring instrumentation, action levels, and identified PPE to control exposures to potentially contaminated media (e.g. air, soils, groundwater. etc.). Generation of dust should be minimized to the greatest extent possible. If airborne dust is observed, area wetting methods will be used to reduce the generation of dust created during drilling activities. If area wetting methods are not feasible, upgraded levels of protection or termination of activities will be used to minimize exposure to observed airborne dust. 2) Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. 3) Use proper lifting techniques (use legs to lift the weight, keep spine straight, minimize twisting motions, etc.). Whenever possible use multiple personnel or machinery to lift and move heavy objects. 4) Preview work locations for unstable/uneven terrain. Barricade all excavations and other associated drop off points at least 3 feet from the edge. 5) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress concerns is provided in Section VII of the Montgomery Watson Safety and Health Policies and Procedures Manual.	Note: Given previous analytical results of groundwater samples, excessive chemical contaminant concentrations impacting field crews during this task are not anticipated to be encountered. The following information is based on a contingency action only. Photoionization Detector w/ 10.2 eV UV lamp source, or a Flame Ionization Detector, will be used as follows: Source (borehole) monitoring will be conducted at regular intervals determined by the SSO. The SSO will also monitor the BZ of all potentially affected employees, with the following guidance: - Workers must don Level C PPE if sustained BZ concentrations are above background but less than 25 ppm. - Workers must evacuate to a safe area if sustained BZ concentrations exceed 100 ppm. Some of the contaminants of concern are solids, and are non-detectable using PID/FID direct reading instruments. Also, other site contaminants may adhere to or be part of airborne dust or particulates generated during site activities. Generation of dust should be minimized to the greatest extent possible to avoid inhalation of contaminated dust or particulates. Evaluation of dust concentrations will be qualitative by observing work conditions for visible dust clouds or accumulations. Potential exposure to contaminants attached to dust particles will be controlled by using water to suppress dust, by avoiding dust plumes, or by upgrading the level of protection. Upgrade to Level C protection shall occur anytime sustained visible dust is present in a worker's breathing zone.	Level D protection will be utilized for the initiation of all sampling activities. Level D protection constitutes the following minimum protection - Standard field dress (long pants long sleeve shirts - Steel toe/shank safety shoes - *Inner surgeon style gloves, layered if necessary.* - *Hardhat, safety glasses, impermeable boot covers, and earplugs or muffs.* - *Tyvek coveralls will be worn if there is a possibility of soiling work attire* - *PVC or PE coated Tyvek will be incorporated if there is a potential for saturation of work attire.* *(Items in italics are optional as conditions dictate or as directed by the FOL or SSO)* Level C protection upgrade will consist of APR with combination GMC-H (GMC-P100) cartridges, and will be based on monitoring instrument results of the following: - Breathing zone PID/FID readings >25 ppm above background. - Observations of airborne particulates that cannot be controlled with area wetting methods. Chemical protective clothing will consist of impermeable boot covers, surgical style inner gloves with nitrile outer gloves with a cotton liner, Tyvek coveralls (unless free phase product is encountered). Free phase product or splash potential PVC or PPE splash suit.	**Personnel Decontamination** will consist of a soap/water wash and rinse for outer protective equipment (e.g. boots, gloves, PVC splash suits, etc.). This function will take place at a satellite location. Disposable PPE will be bagged between sampling events. This procedure will consist of - Sample acquisition - Clean (Deionized water spray) the outside of the sample containers/label/bag The personnel decontamination procedure for **Level D** protection will consist of: - Equipment drop - Soap/water wash and rinse of outer boots and outer gloves (as applicable and washable) - Soap/water wash and rinse of the splash suit, as applicable - Outer coveralls, boot covers, and glove removal and disposal - Wash hands and face, leave contamination reduction zone For **Levels C** in addition to that described above: **Note:** APR cartridge change out would take place at this point. - Outer suit, boot covers, outer glove removal and disposal - Respiratory (face mask) protection removal - Wash hands and face, leave contamination reduction zone
Mobilization/ Demobilization	*Physical Hazards* 1) Lifting (muscle strains and pulls) 2) Pinches and compressions 3) Slip, trips, and falls 4) Moving machinery 5) Vehicular and foot traffic	1) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 2) Keep hands out of machine points of operation. 3) Preview work locations for unstable/uneven terrain. Barricade all excavations or hazardous areas from access closer than two feet. 4) All equipment will be - Inspected in accordance with OSHA, and manufacturers design. - Operated by Certified operators, and knowledgeable ground crew. 5) Establish safe zones of approach. When working in traffic areas wear high visibility vests.	Not required	Level D - (Minimum Requirements) - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - *Safety glasses* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Reflective vest for high traffic areas* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.* *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Not required

Table A1-2. Job Hazard Analysis for Solid Waste Management Unit WP-26, Sewage Lagoons, Continued

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Decontamination of Sampling and Heavy Equipment	*Chemical Hazards* 1) Potential air/particulate/water borne contaminants primarily consisting VOCs including TCE, metals including chromium, and nitrate/nitrite. Contaminants are not anticipated to present an inhalation hazard due to the low concentrations detected. 2) Decontamination fluids - Liquinox (detergent), isopropyl alcohol, methanol, etc. *Physical Hazards* 2) Lifting (muscle strains and pulls) 3) Pinches and compressions 4) Flying projectiles from debris or pressure washers 5) Noise 6) Ambient temperature extremes (heat stress)	1) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Refer to manufacturer's MSDS for hazards associated with decontamination fluids and solvents used during decontamination activities. 2) Use multiple persons where necessary for lifting and handling sampling equipment for decontamination purposes. 3) Keep hands out of machine points of operation. 4) Utilize face shields to prevent flying debris from striking the face and eyes of personnel performing decon using pressure washers 5) Use hearing protection when working in areas of excessive noise (i.e., near pressure washers). 6) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress concerns is provided in Section VII of the Montgomery Watson Safety and Health Policies and Procedures Manual.	1) Use visual observation, and real-time monitoring instrumentation to ensure all equipment, which has been cleaned and dried, is properly cleaned of potentially contaminated media (e.g. air, water, soils). Generation of dust should be minimized to the greatest extent possible. If airborne dust is observed, area wetting methods will be used to reduce the generation of dust created during drilling activities. If area wetting methods are not feasible, upgraded levels of protection or termination of activities will be used to minimize exposure to observed airborne dust.	*For Heavy Equipment (i.e., drilling):* This applies to high pressure soap/water, steam cleaning wash and rinse procedures. Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Chemical resistant boot covers - Nitrile outer gloves, cotton liners - PVC Rain suits or PE or PVC coated Tyvek - Safety glasses underneath a splash shield Respiratory protection is not anticipated for this activity. *For sampling equipment including trowels, Samplers, bailers, etc. the following PPE is required* Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Surgical style gloves and nitrile outer gloves - Safety glasses or goggles In case of overspray of chemical decontamination fluids employ PVC Rain suits or PE or PVC coated Tyvek as necessary.	**Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing steam or pressure washers. Heavy equipment such as the drill rig, will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will be restricted access to exclusion zones, or also have their wheels/tires sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the onsite activity. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving onsite and that which is to leave the site. No equipment will be authorized access or exit without this authorization. Evaluation will consist of - Visual inspection - Scanning equipment with monitoring instruments This decontamination procedure for **Level D** protection will consist of - Soap/water wash and rinse of outer gloves - Soap/water wash and rinse of the splash suit, as applicable - Removal of disposable PPE (outer splash suit, then boot covers, then gloves) - Wash hands and face, leave contamination reduction zone

Notes:

ACGIH	American Conference of Governmental Industrial Hygienists
APR	air purifying respirator
BZ	breathing zone
FID	flame ionization detector
FOL	field operations leader
HEPA	high efficiency particulate air
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PID	photoionization detector
PPE	personal protection equipment
PPM	parts per million
PVC	polyvinylchloride
SSO	site safety officer
VOCs	volatile organic compounds
TCE	trichloroethene
UV	ultraviolet
VOC	volatile organic compound

weathered and disintegrated in most locations and the pond bottom had re-vegetated with a number of native plants including sage and grasses and non-native salt cedar and Russian olive (USAF, 1993a and 1999).

The pond was reconstructed from October 1998 to February 1999 during the Interim Corrective Measures (ICM) activities for Corrective Action Unit (CAU) WP-26. Reconstruction activities included re-grading and shaping of the pond, and lining the pond with a 40-millimeter, high-density polyethylene (HDPE) liner. The purpose of the ICM was to capture and recover nitrate-contaminated groundwater in the immediate area of the golf course (via recovery wells), store the water in the pond, and apply the water to the Tijeras Arroyo Golf Course via the irrigation system. Prior to the ICM, the golf course received all of its irrigation water from the Base water system (USAF, 1999).

In addition to reshaping and lining the pond in preparation for water storage, ICM activities included installation of a groundwater recovery well; installation of piping and electrical connections; and replacement of one pump used to draw water from the GCMP into the irrigation system. Recovery well RG-1598-S-4 was installed north of the GCMP and monitoring wells KAFB-0602, KAFB-0609, and KAFB-0610 were converted to recovery wells including the installation of submersible pumps and the necessary plumbing to connect into the pumping system. Currently, the GCMP receives water from recovery wells (RG-1598-S-4, KAFB-0602, KAFB-0609, and KAFB-0610) near the pond and from production wells KAFB-4 and KAFB-7. A pump house is located at the GCMP and serves as the control center for the automated golf course irrigation system.

Production well KAFB-7 (located northeast of the former sewage lagoons) was used as a potable water supply well serving Kirtland AFB until nitrate concentrations were detected above drinking water standards in 1995. Production well KAFB-7 was shut down in 1995 due to the presence of nitrate at concentrations above state and federal drinking water standards of 10 milligrams per liter (mg/L). In 2002, activities completed as part of the Interim Stage 2 Abatement Plan for CAU ST-105, Trichloroethylene (TCE) and Nitrate Contaminated Groundwater, at Kirtland AFB, New Mexico included developing and rehabilitating production well KAFB-7. These activities also included determining the specific capacity of production well KAFB-7, sampling and analyzing the discharge water from production well KAFB-7, and building a new pipeline to convey nitrate-contaminated groundwater from production well KAFB-7 to GCMP. These activities completed the primary objective of the Phase II, Interim Stage 2 Abatement Plan, returning production well KAFB-7 to service, thereby hydraulically containing the nitrate-contaminated groundwater plume while beneficially using the nitrate-contaminated groundwater (USAF, 2003).

A1.4 Chemical Hazards

Section 4.1 (Chemical Hazards) of the Base-wide Health and Safety Plan is addended by adding the following discussion on specific chemical hazard issues associated with the GCMP.

A1.4.1 Chemical Hazards Associated with GCMP

The contaminant source at the GCMP (SWMU WP-26) is treated effluent delivered from the sewage lagoons that infiltrated into the subsurface. Within the boundaries of the sewage lagoons, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals have been sporadically

detected in the vadose zone. Detections of VOCs, SVOCs, and metals have not indicated a pattern of contamination within the boundaries of the sewage lagoons.

TCE has been detected in perched groundwater beneath the GCMP at concentrations up to 0.9 microgram per liter (µg/L). No soil gas data exists for the vadose zone beneath the GCMP. TCE has not been detected in the regional aquifer. Nitrate is present in both the perched and regional ground water beneath the GCMP. Chromium analyses have been eliminated from the groundwater long term monitoring (LTM) program due to the low frequency of detections above action levels. The GCMP investigation activities will include drilling and sampling angled borings into the vadose zone under the pond. Nitrogen species, VOCs, including TCE, and metals are the expected constituents of concern (COC) for the GCMP.

A1.4.2 Chemical Hazards Summary

The site-specific COC are discussed in Table A1-1, which includes the signs and symptoms of exposure, the physical characteristics, exposure limits, and air monitoring needs of each potential contaminant of concern. If additional information regarding site hazards or contaminants becomes available, this addendum will be modified accordingly.

Based upon the nature and extent of contamination associated with the GCMP (SWMU WP-26), the potential exists for workers engaged in planned activities (soil gas survey, subsurface soil sampling) to be exposed to COC, which include nitrogen species, VOCs, and metals. Field monitoring for the general presence or absence of total VOCs will be conducted as prudent occupational health practice.

None of these COC have been detected in soil samples in concentrations significant enough to represent an inhalation hazard to site workers. Furthermore, any volatile contaminants that might be generated by site activities would be dissipated by natural wind currents and, consequently, are not likely to produce a significant occupational exposure. Nonetheless, it is prudent occupational health practice to minimize potential exposures to all chemicals when possible. Control measures and air monitoring activities are discussed as part of Table A1-2.

Radiological hazards are not anticipated to be present in areas of proposed site activities associated with this addendum. Therefore, radiological surveys will not be performed during site operations associated with this addendum. Additionally, unexploded ordinance (UXO) hazards should not be encountered at these areas of the site. However, if any unidentified objects or drums are encountered, site activities will be suspended and the appropriate site contact will be informed of the discovery.

A1.5 Physical Hazards

Section 4.5 of the Base-wide Health and Safety Plan is addended by adding the following discussion on specific physical hazard issues associated with activities conducted as part of the SWMU WP-26 RFI.

The physical hazards associated with site activities at the GCMP (SWMU WP-26) are discussed for each task on Table A1-2 of this addendum. Additional information on some of the physical hazards are discussed in detail in the Base-wide Health and Safety Plan; therefore, no further discussion of these hazards will appear in this section of the addendum.

A1.6 Training

Section 13.0 (Training) of the Base-wide Health and Safety Plan is addended by adding the following discussion on training.

Training requirements for site personnel and visitors are discussed in Section 13.0 of the Base-wide Health and Safety Plan (USAF, 2004). As applicable, all site employees and visitors will be required to submit documentation of introductory, supervisory (as appropriate), and refresher training prior to the commencement of site activities. Certificates of training will be maintained at the project site for the duration of the project. Copies of the certificates or other official documentation will be used to fulfill this requirement. Table A1-3 documents initial Occupational Safety and Health Administration (OSHA) 40-hour, supervisory, and refresher training, first aid and cardiopulmonary resuscitation (CPR) training (where applicable), and medical surveillance information for the field team. Visitors will be required to register with the FOL and to sign in on a daily log sheet.

Under MWH's standard subcontract agreement, all subcontractor personnel are required to meet the medical surveillance and training requirements of 29 *Code of Federal Regulation* (CFR) 1910.120/1926.65 (Hazardous Waste Operations and Emergency Response Standard).

Table A1-3. Health and Safety Documentation

Field Team	OSHA 40-hour	8-hr Refresher Training	Supervisory Training	Medical Surveillance	CPR/First Aid (where applicable)

All site personnel, including site visitors, will be given site-specific training by the Project Health and Safety Officer (PHSO) or FOL/Site Safety Officer (SSO). These personnel will be required to sign a statement indicating receipt of site-specific training and an understanding of the site hazards and control measures. Figure A1-1 will be used to document site-specific training, and Figure A1-2 serves as a record of visitors on the site.

Figure A1-1. Site-Specific Training Documentation

My signature below indicates that I am aware of the potential hazardous nature of performing remedial installation activities at Kirtland AFB and that I have received site-specific training, which included the following elements:

- Names of designated personnel and alternates responsible for site safety and health;
- Physical, chemical, biological and other hazards present on site;
- Use of personal protective equipment;
- Work practices to minimize risks from hazards;
- Safe use of engineering controls and equipment;
- Medical surveillance requirements;
- Signs and symptoms of overexposure;
- Contents of the Health and Safety Plan and this addendum;
- Emergency response procedures (evacuation and assembly points);
- Spill response procedures;
- Review of contents of relevant Material Safety Data Sheets; and
- Associated hazards and restricted areas within the facility.

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

I further state that, by the presence of my signature below, the date of my training (introductory, refresher, and supervisory, as applicable) and my medical surveillance requirements are accurate and correct to the best of my knowledge.

Name	40-Hour OSHA	8-Hour Refresher	8-Hour Supervisory	Medical Surveillance	Signature

Figure A1-2. Visitor Log Sheet

Site: _____ **Date:** _____

NAME	ORGANIZATION	PURPOSE	ARRIVAL TIME	DEPARTURE TIME

A1.7 Monitoring

Sections 7.0 (Air, Noise, and Other Monitoring) and 9.0 (Medical Surveillance Procedures) of the Base-wide Health and Safety Plan is addended by adding the following discussion on personal monitoring procedures and medical surveillance).

A1.7.1 Personal Monitoring Procedures

This section supplements Section 7.0 of the Base-wide Health and Safety Plan.

A1.7.2 Personal Air Monitoring

VOCs are not anticipated to be encountered at significant levels during the proposed site activities based on information presented in the Base-wide Health and Safety Plan (USAF, 2004), as discussed previously in this SSHP Addendum, and based on previously detected low concentrations and some physical properties of contaminants (such as vapor pressure). Nonetheless, air monitoring will be performed to evaluate the presence of any airborne or source area concentrations of detectable contaminants. It is anticipated that any airborne concentrations of VOCs encountered will be adequately dissipated by wind and natural dispersion so as not to result in an occupational exposure concern.

A photoionization detector (PID) will be used to monitor source areas and worker breathing zones. Any elevated readings observed at source areas (such as a borehole) will require that the breathing zones of site workers be monitored. As a conservative measure, any sustained airborne concentrations in worker breathing zones greater than 25 parts per million (ppm) above established background levels will require site personnel to upgrade to Level C protection. Any breathing zone readings greater than 100 ppm will require site personnel to suspend site activities until the identity and source of the readings are determined.

A1.8 Medical Surveillance

This section supplements Section 9.0 of the Base-wide Health and Safety Plan.

All personnel participating in project field activities will have had a physical examination meeting the requirements of the medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection. Documentation for medical clearances will be maintained and made available, as necessary.

In situations in which the exclusion zone is not entered or when there is no potential for exposure to site contaminants, subcontractor personnel may be exempt from some of the training and medical surveillance requirements. All subcontractors and visiting personnel are required to receive site-specific training (as discussed in Section 13.0 of the Base-wide Health and Safety Plan) regarding information provided in this SSHP addendum. Examples of subcontractors who may be exempt from training and medical surveillance requirements may include surveyors who perform surveying activities in areas were there is no potential for exposure to site contaminants. Typically, surveying activities are performed after intrusive activities are completed. Additionally, surveying activities generally do not require contact with

any potentially contaminated media. However, no subcontractor will be granted exception without the expressed consent of the PHSM.

A1.9 Safety Considerations for Site Operations

Section 10.0 (Safety Considerations) of the Base-wide Health and Safety Plan is addended by adding the following discussion on specific safety practices and procedures not previously discussed in the Base-wide Health and Safety Plan.

A1.9.1 Daily Safety and Health Briefings

Daily safety and health briefings (tailgate meetings; see Attachment 1) will be performed prior to initiation of work and during operations at the site. Daily inspections will also be performed to determine if operations are being executed in accordance with the Base-wide Health and Safety Plan, this addendum, OSHA regulations, and contract requirements. It will be the responsibility of the SSO to perform the briefings and the daily inspections. The briefings and all inspection findings will be documented in the site logbook.

A1.9.2 Safe Work Permits

All exclusion zone activities conducted in support of this project will be performed in accordance with this addendum as well as the Base-wide Health and Safety Plan. Safe work permits will be used to incorporate site-specific information in order to guide and direct field crews on a task-by-task basis. An example of the safe work permit is included as Figure A1-3. The equipment report sheet is associated with the safe work permit. An example of an equipment record sheet is included in Attachment 2. All permits will be issued by the SSO or his/her onsite representative in the morning prior to the commencement of onsite activities. All personnel identified on the permit as participating in the task will be informed of its contents by the supervisor accepting the permit. Any problems, which occurred throughout the task, will be documented by the supervisor on the permit. All permits will be returned to the FOL or the SSO at the end of the day. Safe work permits will be developed as part of daily operations.

Figure A1-3. Safe Work Permit

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): _____

II. Names: _____

III. Onsite Inspection conducted ☐ Yes ☐ No Initials of Inspector _____

MW

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☐ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☐

Modifications/Exceptions: _____

V. Chemicals of Concern | Action Level(s) | Response Measures

_____ _____ _____

VI. Additional Safety Equipment/Procedures

Hardhat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☐ No	Radio	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type)	☐ Yes	☐ No
Steel toe/shank Workboots	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No

Modifications/Exceptions: _____

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment inspected	☐	☐	Assembly points	☐	☐

VIII. Equipment Preparation

	Yes	NA
Equipment drained/depressured	☐	☐
Equipment purged/cleaned	☐	☐
Isolation checklist completed	☐	☐
Electrical lockout required/field switch tested	☐	☐
Blinds/misalignments/blocks & bleeds in place	☐	☐
Hazardous materials on walls/behind liners considered	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No

If yes, fill out appropriate section(s) on safety work permit addendum

X. Special instructions, precautions: _____

Permit Issued by: _____ Permit Accepted by: _____

Job Completed by: _____ Date: _____

A1.10 Emergency Response Plan

Section 12.0 (Emergency Response Plan) of the Base-wide Health and Safety Plan is amended with the following information, Table A1-4 Emergency Contacts and Figure A1-4 Hospital Route Map.

Table A1-4 Emergency Contacts

Fire department, police, ambulance	911 (cell phone **853.9111)**
MWH - Health and Safety	Bill Bragdon (801).550.7407
Project Health and Safety Manager	Jack Storace, CIH (925).975.3544, (415).298.8664 (Cell)
Hospitals Lovelace, Gibson Lovelace, Gibson Emergency Room 5400 Gibson Blvd. SE Albuquerque, NM	(505).262.7000 (505).262.7222
Safety (Kirtland AFB)	Wayne Ragan (505).846.4226
NM Poison Control Center (UNM, north campus)	(505).843.2551
Explosives Ordinance Disposal/UXO Safety	SMSgt Kent Gray (505).846.2229
Bioenvironmental Coordination for Radioactive Work	Capt. Murren, (505).846.3625
CE Fire Department Notification	Juan Salas; 377 MSG/CEF, Fire Chief, (505).853.3639 Lillian Gonzales (505).846.8305

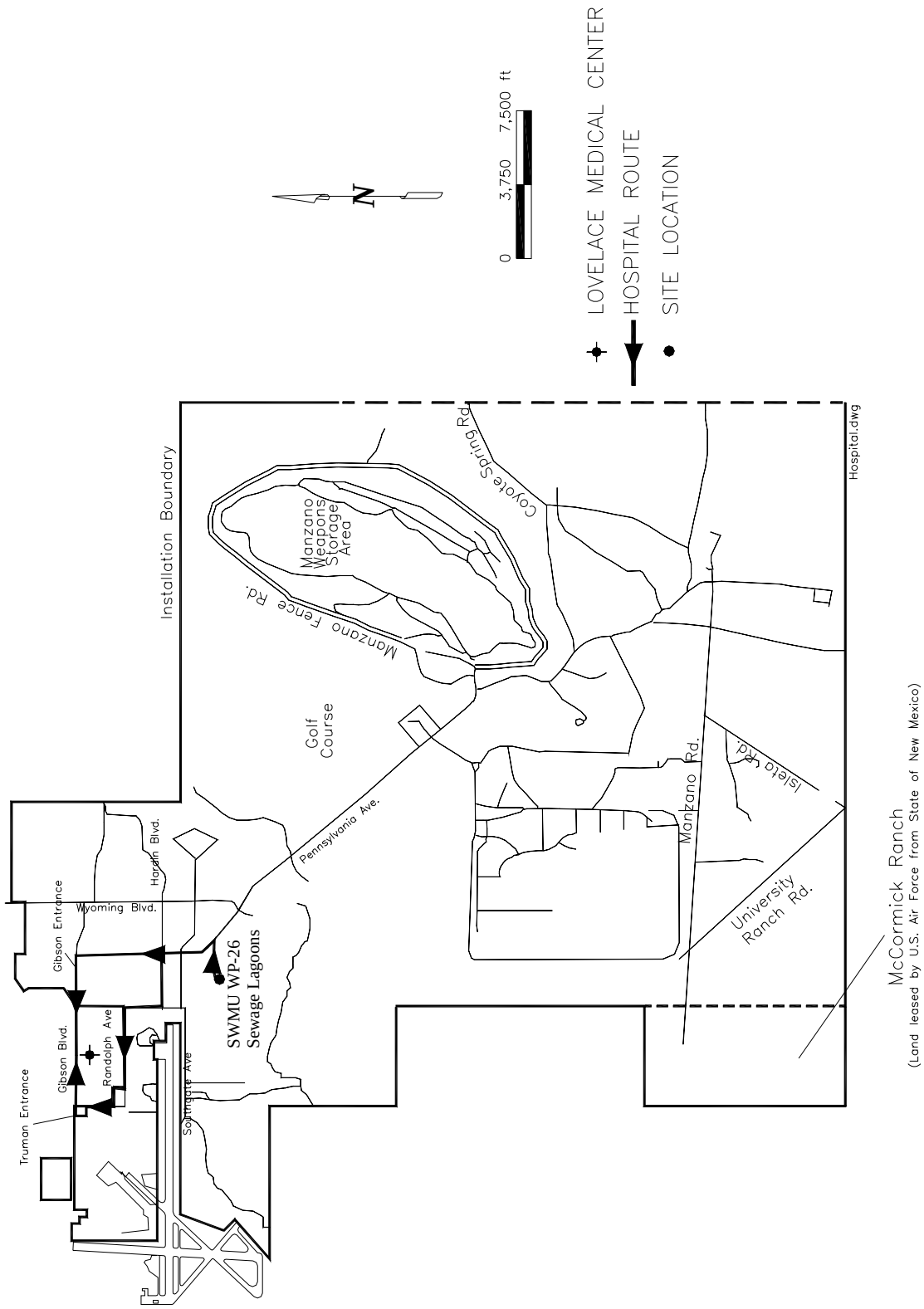


Figure A1-4
Hospital Route Map, Kirtland Air Force Base, New Mexico

REFERENCES

EPA, 2000. *Integrated Risk Information System (IRIS).* U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment. www.epa.gov/ngispgm3/iris/index.html. July.

NIOSH, 1994. *Pocket Guide to Chemical Hazards.* U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. June.

USAF, 2004. *Base-Wide Plans for the Environmental Restoration Program, 2004 Update, Kirtland Air Force Base, New Mexico.* U.S. Air Force, Kirtland Air Force Base, New Mexico. April.

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT 1
TAILGATE SAFETY MEETING SHEET

THIS PAGE INTENTIONALLY LEFT BLANK

TAILGATE SAFETY MEETING FORM

Date:_____ Time:_____ Job Number:_____

Client:_____

Site Specific Location:_____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment:_____

Chemical Hazards:_____

Physical Hazards:_____

Special Equipment:_____

Other (Accident Prevention Program):_____

Emergency Procedures:_____

Hospital:_____ Phone:_____ Ambulance Phone:_____

Hospital Address and Route:_____

ATTENDEES

NAME PRINTED SIGNATURE

_____

_____

Meeting Conducted By:_____ _____

Name Printed Signature

Project Safety Officer:_____ Project Manager:_____

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT 2
EQUIPMENT RECORD SHEET

THIS PAGE INTENTIONALLY LEFT BLANK

EQUIPMENT INSPECTION (page 1 of 3)

COMPANY:_____ **UNIT NO.**_____
FREQUENCY: Inspect daily, document prior to use and as repairs are needed.

Inspection Date: ____/____/____ Time: _____ Equipment Type:_____
(e.g., bulldozer)

	Good	Need Repair	N/A
Tires or tracks	❒	❒	❒
Hoses and belts	❒	❒	❒
Cab, mirrors, safety glass	❒	❒	❒
- Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	❒	❒	❒
- Is the equipment equipped with audible back-up alarms and back-up lights?	❒	❒	❒
Horn and gauges	❒	❒	❒
Brake condition (dynamic, park, etc.)	❒	❒	❒
Fire extinguisher (Type/Rating -_____)	❒	❒	❒
Fluid Levels:			
- Engine oil	❒	❒	❒
- Transmission fluid	❒	❒	❒
- Brake fluid	❒	❒	❒
- Cooling system fluid	❒	❒	❒
- Windshield wipers	❒	❒	❒
- Hydraulic oil	❒	❒	❒
Oil leak/lube	❒	❒	❒
Coupling devices and connectors	❒	❒	❒
Exhaust system	❒	❒	❒
Blade/boom/ripper condition	❒	❒	❒
Accessways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	❒	❒	❒
Power cable and/or hoist cable	❒	❒	❒
Steering (standard and emergency)	❒	❒	❒

EQUIPMENT INSPECTION (page 2 of 3)

Safety Guards:	**Yes**	**No**
– Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact?_____	❒	❒
– Hot pipes and surfaces exposed to accidental contact?_____	❒	❒
– All emergency shut offs have been identified and communicated to the field crew?_____	❒	❒
– Have emergency shutoffs been field tested? _____	❒	❒
– Results?_____	❒	❒
– Are any structural members bent, rusted, or otherwise show signs of damage?_____	❒	❒
– Are fueling cans used with this equipment approved type safety cans?_____	❒	❒
– Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use?_____	❒	❒
Portable Power Tools:		
– Tools and Equipment in Safe Condition?_____	❒	❒
– Saw blades, grinding wheels free from recognizable defects (grinding wheels have been sounded)?_____	❒	❒
– Portable electric tools properly grounded?_____	❒	❒
– Damage to electrical power cords?_____	❒	❒
– Blade guards in place?_____	❒	❒
– Components adjusted as per manufacturers recommendation?_____	❒	❒

Cleanliness:

- Overall condition (is the decontamination performed prior to arrival on-site considered acceptable)?_____
- Where was this equipment used prior to its arrival on site?_____
- Site Contaminants of concern at the previous site?_____
- Inside debris (coffee cups, soda cans, tools and equipment) blocking free access to foot controls?_____

EQUIPMENT INSPECTION (page 3 of 3)

Operator Qualifications (as applicable for all heavy equipment):

- Does the operator have proper licensing where applicable, (e.g., CDL)?_____
- Does the operator, understand the equipment's operating instructions?_____
- Is the operator experienced with this equipment? _____
- Does the operator have emotional and/or physical limitations which would prevent him/her from performing this task in a safe manner?_____
- Is the operator 21 years of age or more?_____

Identification:

- Is a tagging system available, for positive identification, for tools removed from service?_____

Additional Inspection Required Prior to Use On-Site

	Yes	No
– Does equipment emit noise levels above 90 decibels?	❒	❒
– If so, has an 8-hour noise dosimetry test been performed?	❒	❒

- Results of noise dosimetry:_____
- Defects and repairs needed:_____
- General Safety Condition: _____
- Operator or mechanic signature:_____

Approved for Use: ❒ Yes ❒ No

_____
Site Safety Officer Signature

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

CONTENTS

Section **Page**

ACRONYMS 4

B1.0 INTRODUCTION 7

B2.0 PROJECT DESCRIPTION 8

B2.1 Site Description 8
B2.2 Project Scope and Objectives 8

B3.0 PROJECT ORGANIZATION AND RESPONSIBILITES 9

B4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA 10

B4.1 Data Quality Objectives 10
B4.2 Data Quality Indicators 10
B4.3 Level of Field Quality Control Effort 10

B5.0 FIELD INVESTIGATION PROCEDURES 12

B5.1 Sampling Procedures 12
B5.2 Sample Designation 12
B5.3 Field Measurements 13
B5.4 Equipment Decontamination 13

B6.0 SAMPLE CUSTODY AND RECORD KEEPING 14

B6.1 Record Keeping 14

B7.0 CALIBRATION PROCEDURES AND FREQUENCY 16

B8.0 ANALYTICAL PROCEDURES 17

B9.0 INTERNAL QUALITY CONTROL CHECKS 19

B10.0 DATA VALIDATION, REDUCTION, AND REPORTING 20

B11.0 PERFORMANCE AND SYSTEM AUDITS 21

B12.0 PREVENTIVE MAINTENANCE 22

B13.0 DATA ASSESSMENT 23

B14.0 CORRECTIVE ACTION 24

B15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT 25

REFERENCES 26

ATTACHMENT 1 27

TABLES

Table		Page
B1-1a	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method SW-846 8260B, Quality Control Criteria For Laboratory Data Evaluation	B-29
B1-1b	Toxicity Characteristic Leaching Procedure Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method SW-846 8260B, Quality Control Criteria for Laboratory Data Evaluation	B-30
B1-2	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, Calibrations Specifications and Corrective Action Summary	B-31
B1-3a	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, Reporting Limits	B-33
B1-3b	Toxicity Characteristic Leaching Procedure Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, Reporting Limits	B-35
B1-4	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, 4-Bromofluorobenzene (BFB) Mass Intensity Criteria	B-36
B1-5	Toxicity Characteristic Leaching Procedure Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method SW-846 8260B, Quality Control Criteria for Laboratory Data Evaluation	B-37
B1-6	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8270C, Calibrations Specifications and Corrective Action Summary	B-39
B1-7	Toxicity Characteristic Leaching Procedure Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8270C, Reporting Limits	B-41
B1-8	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8270C, Decafluorotriphenyl Phosphine (DFTPP) Key Ions and Ion Abundance Criteria	B-42
B1-9	Toxicity Characteristic Leaching Procedure Organochlorine Pesticides by Gas Chromatography - Method SW-846 8081A, Quality Control Criteria for Laboratory Data Evaluation	B-43
B1-10	Organochlorine Pesticides by Gas Chromatography, Method SW-846 8081A, Calibrations Specifications and Corrective Action Summary	B-44
B1-11	Toxicity Characteristic Leaching Procedure-Organochlorine Pesticides by Gas Chromatography - Method SW-846 8081A, Method Detection Limits, Reporting Limits, and Maximum Contaminant Levels	B-46
B1-12	TCLP-Organochlorine Herbicides by Gas Chromatography - Method SW-846 8151A, Quality Control Criteria for Laboratory Data Evaluation	B-47
B1-13	Organochlorine Herbicides by Gas Chromatography- SW-846 8151A, Calibration Specifications and Corrective Action Summary	B-48
B1-14	Toxicity Characteristic Leaching Procedure-Organochlorine Herbicides by Gas Chromatography - Method SW-846 8151A, Method Detection Limits, Reporting Limits, and Maximum Contaminant Levels	B-50
B1-15	Inductively Coupled Plasma Metals Analysis Using SW-846 6010B, Quality Control Criteria for Laboratory Data Evaluation	B-51
B1-16	Inductively Coupled Plasma Atomic Emission Spectrometry Metals Analysis Using SW-846 6010B, Calibration Specification and Corrective Action Procedures	B-52
B1-17	Inductively Coupled Plasma Atomic Emission Spectrometry Metals Analysis, Using SW-846 6010B, Reporting Limits	B-53

TABLES
(CONCLUDED)

Table		Page
B1-18	Mercury Analysis Cold Vapor Using SW-846 7470A/7471A, Quality Control Criteria for Laboratory Data Evaluation	B-54
B1-19	Inductively Coupled Plasma Atomic Emission Spectrometry Metals Analysis Using SW Mercury Analysis Cold Vapor Using SW-846 7470A/7471A, Calibration Specification And Corrective Action Procedures	B-55
B1-20	Mercury Analysis Cold Vapor Using SW-846 7470A/7471A, Reporting Limits	B-57
B1-21	Groundwater/Soil Anions and Water/Soil Quality, Quality Control Criteria for Laboratory Data Evaluation	B-58
B1-22	Determination of Anions by Ion Chromatography- EPA 300.0, Calibration Specifications and Corrective Action Summary	B-59
B1-23	Determination of Ammonium by Ion Selective Electrode, EPA 350.2, Calibration Specifications and Corrective Action Summary	B-60
B1-24	Determination of Total Kjeldahl Nitrogen by Ion Selective Electrode, EPA 351.3, Calibration Specifications and Corrective Action Summary	B-61
B1-25	Groundwater/Soil Anions and Water/Soil Quality, Reporting Limits	B-62
B1-26	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method TO-15, Quality Control Criteria for Laboratory Data Evaluation	B-63
B1-27	Volatile Organic Compound Analysis in Air by Gas Chromatography/Mass Spectrometry – EPA Method TO-15, Calibrations Specifications and Corrective Action Summary	B-64
B1-28	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - EPA Method TO-15, Reporting Limits	B-66
B1-29	Volatile Organic Compound Analysis in Ambient Air by Gas Chromatography/Mass Spectrometry – EPA Method TO-15, 4-Bromofluorobenzene (BFB) Mass Intensity Criteria	B-67

ACRONYMS

AFB	Air Force Base
ASA	American Society of Agronomy
bgs	below ground surface
BWP	Base-Wide Plan
DQO	data quality objective
EMR	Environmental Management, Restoration Branch
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Resource Program Information Management Systems
FSP	field sampling plan
ft	foot/feet
GCMP	Golf Course Main Pond
IDW	investigation-derived waste
MWH	MWH Americas, Inc.
NMED	New Mexico Environmental Department
OCH	organochlorine herbicide
OCP	organochlorine pesticide
PARCC	precision, accuracy, representativeness, completeness, and comparability
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
QCSR	quality control summary report
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RL	reporting limit
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit

ACRONYMS (CONCLUDED)

TAL	target analyte list
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
VOC	volatile organic compound

THIS PAGE INTENTIONALLY LEFT BLANK

B1.0 INTRODUCTION

This quality assurance project plan (QAPP) has been prepared to provide supplemental project-specific information and criteria for the *Resource Conservation and Recovery Act* [RCRA] Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) WP-26, Golf Course Main Pond, at Kirtland Air Force Base (AFB), New Mexico. This QAPP is Appendix B of the WP-26 RFI Work Plan.

This investigation will be consistent with the Base-Wide Plan (BWP) QAPP (U.S. Air Force [USAF], 2004) unless otherwise specified in this document. In many if not most instances, no substantive changes will result. Technical guidance will follow the BWPs for the Installation Restoration Program, as interpreted and implemented by the Kirtland AFB Environmental Management Division, Restoration Branch (EMR) Chief, or his representative.

The BWP QAPP will guide all investigation activities associated with this project unless modified in the following sections. Applicable sections of the BWP QAPP are otherwise incorporated by reference and not repeated in this document except for purposes of emphasis or amplification.

B2.0 PROJECT DESCRIPTION

B2.1 Site Description

A description of the SWMU WP-26 Golf Course Main Pond (GCMP), its operational history, and previous investigation results are described in Section 2.0 of the WP-26 RFI Work Plan.

B2.2 Project Scope and Objectives

The scope and objectives of the investigation activities at SWMU WP-26 GCMP are presented in Sections 1.0 and 3.0 of the WP-26 RFI Work Plan and described in Section 4.0 of this project-specific QAPP.

B3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The individuals listed in Table B-1 will supervise or perform the management and quality assurance (QA) activities associated with this project.

Table B-1. Project Management Personnel for the Solid Waste Management Unit WP-26 *Resource, Conservation, and Recovery Act* GCMP Facility Investigation Work Plan

Title	Name	Organization
Kirtland AFB Client Services Manager	Deborah Drain	MWH
USACE Project Manager	Steve Ott	USACE Omaha District
MWH Program Manager	Karen Kramer	MWH
MWH Delivery Order Manager	Deborah Drain	MWH
Project Quality Assurance Manager	Michael Gronseth	MWH
Project Chemist	Craig Moore	MWH
Field Operations Leader	William Bragdon	MWH
Field Quality Assurance Manager	Anthony Magliochinno	MWH
Project Health and Safety Officer	William Bragdon	MWH

AFB = Air Force Base
USACE = U.S. Army Corps of Engineers
MWH = MWH Americas, Inc.

B4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

B4.1 Data Quality Objectives

Data quality objectives (DQOs) are statements that specify the quantity and quality of data generated to support decision making. DQOs are scoping and planning tools applicable to every data-generation effort and are a necessary step in the development of project-specific plans. For each data-gathering task, DQOs have been developed to describe the purpose of the task, the specific activities to be performed, the intermediate and end uses of the generated data, and the resultant data quality that is required. Based on the end use of the data, both screening and definitive levels of data quality will be required. The DQOs for this investigation are presented in Table B-2.

B4.2 Data Quality Indicators

The precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters will be used as indicators of data quality and are defined in Section 4.2 of the BWP QAPP.

B4.3 Level of Field Quality Control Effort

Quality control (QC) samples will be collected and submitted for laboratory analysis with the following frequency:

- Equipment blank (soil)—10 percent of the total number of samples collected with non-dedicated equipment;
- Field replicate samples (soil gas and soil)—10 percent of the total number of samples (that is, one replicate sample for every 10 environmental samples collected);
- Matrix spike (soil)—5 percent of the total number of samples (that is, one matrix spike sample for every 20 environmental samples collected);
- Matrix spike duplicate (soil)—5 percent of the total number of samples (that is, one matrix spike duplicate sample for every 20 environmental samples collected); and
- Trip blanks will be submitted with each set of soil samples collected for volatile organic compounds (VOCs) analysis.

The QA/QC samples will be analyzed for the same suite of chemical parameters as the environmental samples collected.

The method-specific QC procedures, frequency of QC sample analysis, QC acceptance criteria (control limits), reporting limits (RLs), and corrective action procedures are included in Attachment 1 of this project-specific QAPP, except for constituents of hazardous waste methods reactivity, ignitibility, corrosivity, and paint filter test. The constituents of hazardous waste methods do not have specific QC sample analysis or corrective action procedures.

Table B-2. Data Quality Objectives and Data Types/Issues

Sampling Program	Data Quality Objectives and Rationale	Data	Method[a]	Data Type	Data Uses
Soil vapor sampling	Collect soil vapor samples to determine TCE-impacted soil vapor.	VOCs	TO-15	Definitive	Site characterization
Subsurface soil sampling	Collect soil samples to determine TCE-, metals-, and nitrogen-impacted sediments.	VOCs	SW-846 8260B	Definitive	Site characterization
		TAL Metals	SW-846 610B/7470A	Definitive	
		Nitrate/Nitrite	EPA 300	Definitive	
		Ammonia	EPA 350.2	Definitive	
		TKN	EPA 351.3	Definitive	
Water and soil investigation-derived waste	Collect soil and water composite samples to determine waste disposal	TCLP VOCs	SW-846 1311/8260B	Definitive	Waste disposal
		TCLP SVOCs	SW-846 1311/8270C	Definitive	
		TCLP Organochlorine pesticides	SW-846 1311/8081A	Definitive	
		TCLP Organochlorine herbicides	SW-846 1311/8151A	Definitive	
		TCLP Metals	SW-846 1311/6010B/7470 A	Definitive	
		Ignitibility	SW-846 1030	Definitive	
		Corrosivity	SW-846 9045D	Definitive	
		Reactivity	SW-846 Sec. 7.3.3 and 7.3.4	Definitive	
		Paint Filter Test	SW-846 9095B	Definitive	

Notes:
[a] Analytical Methods:
EPA, 1996; EPA, 1993; EPA, 1999; ASA, 1982
ASA = American Society of Agronomy
EPA = U.S. Environmental Protection Agency
RCRA = *Resource Conservation and Recovery Act*
SVOC = semivolatile organic compound
SW = solid waste
TAL = target analyte list
TCE = trichloroethene
TCLP = toxicity characteristic leaching procedure
TKN = total Kjeldahl nitrogen
VOC = volatile organic compound

B5.0 FIELD INVESTIGATION PROCEDURES

The samples collected during the field investigation at the SWMU WP-26 GCMP will include subsurface soil vapor, subsurface soil, and investigation-derived waste (IDW). Soil samples will be collected with a split-spoon sampler. Unless the equipment used is dedicated for a particular sampling location, the equipment will be decontaminated between sampling intervals or locations according to BWP Appendix B SOP B1.11 Equipment Decontamination (USAF, 2004).

B5.1 Sampling Procedures

The following sampling procedures outlined in the BWP Field Sampling Plan (FSP) (USAF, 2004) are applicable to this RFI at SWMU WP-26 GCMP:

Field Activity	Applicable Standard Operating Procedures
Borehole and Sample Logging	SOP B1.1
Soil Gas Investigation	SOP B 1.7
Land Surveys	SOP B1.9
Equipment Decontamination	SOP B1.11
Subsurface Soil Sampling	SOP B2.3
Photoionization Detectors and Organic Vapor Analyzers	SOP B3.1
Headspace Screening	SOP B3.3
Approved Background Concentrations for Kirtland AFB	SOP B7.1
Use of NMED Soil Screening Levels	SOP B7.2
Field Sampling Plan	Appendix A of BWP
Waste Management Plan	Appendix E of BWP

NMED = New Mexico Environmental Department

B5.2 Sample Designation

Site sample designations will follow the Kirtland AFB guidelines as outlined in Section 3.2 of the BWP FSP. The numbering system established in Section 3.2 of the BWP FSP consists of an alphanumeric code that identifies the sampling site, location, media, and a sequential sample number. The sampling site code for this project includes WP-26-GCMP. The location identification is a sequential number starting with 001, and the media type codes include SB for soil and SG for soil gas. Sample depths will follow the location identification and will consist of four numbers. The first two numbers will identify the top of the sampling interval and the second two numbers the bottom of the sampling interval. For example, the soil sample collected from soil boring 001 from 20 feet below ground surface (bgs) will be labeled WP26-GCMP-SB-001-20-22 and the soil gas sample collected from soil boring 001 from 20 feet bgs will be labeled WP26-GCMP-SG-001-20-22.

The analytical laboratory will assign a unique identification number to each sample for internal tracking and control of the samples. The laboratory will provide a table that cross-references the field sample number with the sample number used to report analytical results. This procedure ensures proper tracking and accurate accounting for all samples.

B5.3 Field Measurements

This section identifies the elements to be considered during field measurements and outlines the standard operating procedures (SOPs) to be used when collecting specific types of data. Generally, field measurements include, but are not limited to, water quality parameters (such as temperature, pH, and conductivity), water levels, and well depth. Field screening techniques, such as soil gas or ambient air, also fall under this category. The Site Safety and Health Plan (SSHP), found in Appendix A of the WP-26 GCMP RFI Work Plan, will be used as guidance when measurements are made for health and safety monitoring.

The SOPs for measurement activities outline the specific steps to be followed when collecting data using field instrumentation. These guidelines have been developed from manufacturers' operations manuals and standard industry practices. The SOPs for measurement procedures are presented in the BWP FSP. For each of these field parameters, Section 7.5 of the BWP QAPP lists specific information about the frequency of control checks and sources of any control materials, the acceptance criteria for each of the parameters, and the actions to be taken in the event that controlled parameters exceed acceptance criteria.

B5.4 Equipment Decontamination

The methods for the proper decontamination of all field sampling equipment are detailed in SOP B1.11 of the BWP (USAF, 2004). Procedures differ according to the type and the intended use of the sampling equipment, as well as guidelines specified by government agencies. All equipment that may directly or indirectly contact samples will be decontaminated in designated onsite decontamination areas. Such equipment includes casing, drill bits, auger flights, the portions of drill rigs that stand above boreholes, buckets of excavators, sampling devices, and instruments such as slugs and sounders. Care will be taken to prevent sample devices from coming into contact with potentially contaminating substances such as tape, oil, engine exhaust, corroded surfaces, and dirt.

B6.0 SAMPLE CUSTODY AND RECORD KEEPING

Sample custody and record keeping will be consistent with Section 6.0 of the BWP QAPP (USAF, 2004). Record keeping is discussed in detail below.

B6.1 Record Keeping

This section lists record keeping requirements that apply to all measuring and sampling activities. Field records sufficient to recreate all sampling and measurement activities will be maintained and will meet all Environmental Resource Program Information Management Systems (ERPIMS) data loading requirements. The information will be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages. These records will be archived in an easily accessible form and made available to the USAF upon request.

The following information will be recorded in the logbook for all activities:

- Location,
- Date and time,
- Identity of people performing activity and any visitors,
- Weather conditions,
- Summary of daily activities, and
- Level of personnel protection equipment.

No erasures will be permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark, initialed, and dated. At the completion of all entries for a given task or at the end of the day, the logbook will be signed and dated.

The following additional information will be recorded for all field measurements:

- The numerical value and units of each measurement, and
- The identity of any calibration results for each field instrument.

The following additional information will be recorded for all sampling activities:

- Sample type and sampling method;
- The identity of each sample and depth(s), where applicable, from which it was collected;
- The amount of each sample;
- Sample description (such as color, odor, and clarity);

- Sampling devices used;
- Conditions that might affect the representativeness of a sample (such as refueling operations or damaged casing); and
- The rationale for any deviations to the number, location, or frequency of sampling (including a reference to the associated Field Change Request form).

B7.0 CALIBRATION PROCEDURES AND FREQUENCY

Calibration procedures will be consistent with Section 7.0 of the BWP QAPP (USAF, 2004). All laboratory instruments will be calibrated in accordance with the analytical method and the laboratory's SOPs. The minimum method-specific requirements for laboratory instrument calibration are presented in Attachment 1 of this project-specific QAPP, except for constituents of hazardous waste methods reactivity, ignitibility, corrosivity, and paint filter test. The constituents of hazardous waste methods do not have specific corrective actions for calibration procedures.

B8.0 ANALYTICAL PROCEDURES

The analytical procedures for this project will be consistent with those outlined in Section 8.0 of the BWP QAPP (USAF, 2004). The following analyses will be used during the SWMU WP-26 GCMP RFI:

- Volatile organic compounds (VOCs) for soil samples, will be analyzed by U.S. Environmental Protection Agency (EPA) Method SW-846 8260B, as specified in the laboratory SOP (EPA, 1996).
- VOCs for air samples, will be analyzed by EPA Method TO-15, as specified in the laboratory SOP (EPA, 1999).
- Toxicity characteristic leaching procedure (TCLP) VOCs for IDW samples, will be analyzed by EPA Method SW-846 1311/8260B, as specified in the laboratory SOP (EPA, 1996).
- TCLP semi-volatile organic compounds (SVOCs) for IDW samples, will be analyzed by EPA Method SW-846 1311/8270C, as specified in the laboratory SOP (EPA, 1996).
- TCLP organochlorine pesticides (OCPs) for IDW samples, will be analyzed by EPA Method SW-846 1311/8081A, as specified in the laboratory SOP (EPA, 1996).
- TCLP organochlorine herbicides (OCHs) for IDW samples, will be analyzed by EPA Method SW-846 1311/8151A, as specified in the laboratory SOP (EPA, 1996).
- TCLP metals for IDW samples, will be analyzed by EPA Method SW-846 1311/6010B/7470A as specified in the laboratory SOP (EPA, 1996).
- Ignitibility by EPA Method SW-846 1030 (EPA 1996).
- Corrosivity by EPA Method SW-846 9054D (EPA, 1996).
- Reactivity by EPA Method SW-846 Section 7.3.3 and 7.3.4 (EPA, 1996).
- Paint Filter Test by EPA Method SW-846 9056B (EPA, 1996).
- Nitrate and nitrite for soil and water samples, will be analyzed by EPA Method 300.0, as specified in the laboratory SOP (EPA, 1993).
- Ammonia for soil and water samples, will be analyzed by EPA Method 350.2, as specified in the laboratory SOP (EPA, 1993).
- Total Kjeldahl nitrogen (TKN) for soil and water samples, will be analyzed by EPA Method 351.3, as specified in the laboratory SOP (EPA, 1993).
- Total organic carbon (TOC) for soil samples will be analyzed by the American Society of Agronomy method Walkley Black (ASA, 1982).

The analytical method and the associated performance criteria (control limits, RLs, and corrective action procedures) to be used for this investigation are presented in Attachment 1 of this project-specific QAPP, except for constituents of hazardous waste methods reactivity, ignitibility, corrosivity, and paint filter test. The constituents of hazardous waste methods do not have specific control limits or corrective action procedures.

B9.0 INTERNAL QUALITY CONTROL CHECKS

The internal QC checks program will be consistent with Section 9.0 of the BWP QAPP (USAF, 2004).

B10.0 DATA VALIDATION, REDUCTION, AND REPORTING

All data validation, reduction, and reporting will be consistent with Section 10.0 of the BWP QAPP (USAF, 2004).

B11.0 PERFORMANCE AND SYSTEM AUDITS

Audits will be conducted as outlined in Section 11.0 of the BWP QAPP (USAF, 2004).

B12.0 PREVENTIVE MAINTENANCE

Preventive maintenance of equipment will be consistent with Section 12.0 of the BWP QAPP (USAF, 2004).

B13.0 DATA ASSESSMENT

Assessment of data generated during the investigation of SWMU WP-26 (GCMP) will be consistent with Section 13.0 of the BWP QAPP (USAF, 2004).

B14.0 CORRECTIVE ACTION

Corrective action will be exercised, as necessary, to maintain data quality and in a manner consistent with Section 14.0 of the BWP QAPP (USAF, 2004).

B15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

A separate quality control summary report (QCSR) will not be prepared. Instead, the elements of a QCSR will be incorporated into the investigation report that will be prepared.

REFERENCES

ASA, 1982. *Methods of Soils Analysis*. American Society of Agronomy, Madison, Wisconsin. 1982.

EPA, 1993. *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA 100–400 Series, EPA/600R-93/100. U.S. Environmental Protection Agency. National Technical Information Service, Washington, D.C. August.

EPA, 1996. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996*. U.S. Environmental Protection Agency, Office of Solid Waste. December.

EPA, 1999. *Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air,* Second Edition. U.S. Environmental Protection Agency, EPA/625/R-96/010b. January.

USAF, 2004. *Base-Wide Plans for the Environmental Restoration Program, 2004 Update, Kirtland Air Force Base, New Mexico.* U.S. Air Force, Kirtland Air Force Base, New Mexico. April.

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT 1

THIS PAGE INTENTIONALLY LEFT BLANK

Table B1-1a. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method SW-846 8260B, Quality Control Criteria For Laboratory Data Evaluation

Spiking Compounds	Accuracy[a] (Percent Recovery)		Precision[a] (RPD Percent)	
	Water	Soil	Water	Soil
SW-846 8260B[b]				
Matrix Spike/Matrix Spike Duplicate				
Spike Compounds				
1,1-Dichloroethene	61-145	59-172	14	22
Trichloroethene	71-120	62-137	14	24
Benzene	76-127	66-142	11	21
Toluene	76-125	59-139	13	21
Chlorobenzene	75-130	60-133	13	21
Surrogate Spike				
Toluene-d8	88-110	84-138	NA	NA
Bromofluorobenzene	86-115	59-113	NA	NA
1,2-Dichloroethane-d4	76-114	70-121	NA	NA
Dibromofluromethane	77-123	75-125	NA	NA
Laboratory Control Sample				
Spike Compounds				
1,1-Dichloroethene	61-145	59-172	NA	NA
Trichloroethene	71-120	62-137	NA	NA
Benzene	76-127	66-142	NA	NA
Toluene	76-125	59-139	NA	NA
Chlorobenzene	75-130	60-133	NA	NA
Surrogate Spike				
Toluene-d8	88-110	84-138	NA	NA
Bromofluorobenzene	86-115	59-113	NA	NA
1,2-Dichloroethane-d4	76-114	70-121	NA	NA
Dibromofluromethane	77-123	75-125	NA	NA

Notes:
[a] Control limits from Applied Physics and Chemistry Laboratory of Chino, California, March 2004.
[b] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition; Final Update III, December 1996).
NA = Not applicable

Table B1-1b. Toxicity Characteristic Leaching Procedure Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method SW-846 8260B, Quality Control Criteria for Laboratory Data Evaluation

Spiking Compounds	Accuracy[a] (Percent Recovery)	Precision[a] (RPD)
	TCLP Extract	TCLP Extract
SW-846 8260B[b]		
Matrix Spike/Matrix Spike Duplicate		
Spike Compounds		
1,2-Dichloroethane (107-06-02)	70-130	20
1,1-Dichloroethene (75-35-4)	61-145	14
Benzene (71-43-2)	76-127	11
2-Butanone (78-93-3)	40-179	24
Carbon tetrachloride (56-23-5)	57-135	20
Chlorobenzene (108-90-7)	75-130	13
Chloroform (67-66-3)	62-139	20
Tetrachloroethene (PCE) (127-18-4)	57-121	20
Trichloroethene (TCE) (79-01-6)	71-120	14
Vinyl chloride (75-01-4)	45-150	24
Surrogate Spike		
Toluene-d8	88-110	NA
Bromofluorobenzene	86-115	NA
1,2-Dichloroethane-d4	76-114	NA
Dibromofluromethane	77-123	NA
Laboratory Control Sample		
Spike Compounds		
1,2-Dichloroethane (107-06-02)	70-130	NA
1,1-Dichloroethene (75-35-4)	61-145	NA
Benzene (71-43-2)	76-127	NA
2-Butanone (78-93-3)	40-179	NA
Carbon tetrachloride (56-23-5)	57-135	NA
Chlorobenzene (108-90-7)	75-130	NA
Chloroform (67-66-3)	62-139	NA
Tetrachloroethene (PCE) (127-18-4)	57-121	NA
Trichloroethene (TCE) (79-01-6)	71-120	NA
Vinyl chloride (75-01-4)	45-150	NA
Surrogate Spike		
Toluene-d8	88-110	NA
Bromofluorobenzene	86-115	NA
1,2-Dichloroethane-d4	76-114	NA
Dibromofluromethane	77-123	NA

Notes:
[a] Control limits from Applied Physics and Chemistry Laboratory of Chino, California, March 2004.
[b] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition; Final Update III, December 1996).
NA = Not applicable
RPD = Relative percent difference

Table B1-2. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, Calibrations Specifications and Corrective Action Summary

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8260B	Halogenated and Aromatic Volatile Organic Compounds	Tune instrument with a 4-bromofluorobenzene standard (BFB)	Every 12 hours	• Must meet key ions and ion abundance criteria established by method (Refer to Attachment B1-4)	• Retune instrument • Repeat standard analysis
		Initial multi-point calibration; 5 point minimum. Lowest point at or below Reporting limit (PQL). Includes calibration check compounds (CCC) and system performance check compounds (SPCC), and Internal Standards Compounds (IS).	Prior to analysis, and as required	• RSD< 30 % for CCC; • RF > 0.1 for SPCC (>0.3 for chlorobenzene, 1,1,2,2-Tetrachloroethane) • RSD < 15%, r>0.995, or r2 > 0.990 for all target analytes • RF > 0.01 for all target analytes • Alternate evaluation: Mean %RSD for all target analytes < 15%, with no individual compound > 30%	• Evaluate system • Repeat calibration
		Initial calibration verification (ICV)	Every five-point calibration curve	• % Recovery ± 20%	• Evaluate system • Repeat calibration
		Continuing verification standard(CVS): CCC,SPCC, and IS	Every 12 hours	• Percent difference <20% for CCC; • RF >0.1 for SPCC (>0.3 for chlorobenzene and 1,1,2,2-Tetrachloroethane). • %D or %Drift < 20% for all target analytes • RF > 0.01 for all target analytes	• Evaluate system/standard • Reanalyze calibration check standard • Repeat initial calibration • Repeat all sample analysis to last acceptable CVS
		Method blank	1 per preparation batch (≤20 samples)	• < ½ PQL	• Reanalyze method blank • Re-prep/reanalyze blank and associated samples

Table B1-2. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, Calibrations Specifications and Corrective Action Summary (concluded)

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8260B	Halogenated and Aromatic Volatile Organic Compounds	Internal standards	Every sample, method blank, LCS, and MS/MSD	• Retention time for each internal standard must be within 30 seconds of most recent CVS • EICP area for all internal standards must be within -50% to +100% of the most recent CVS	• Evaluate system/standard • Reanalyze samples once • Reprep reanalyze once • If still out, report both sets of data • Narrate all outliers
		Surrogate spike	Every sample, method blank, LCS and MS/MSD	• % Recovery within quality control (QC) acceptance criteria (Refer to Table B1-1a-b)	• Reanalyze once • If still out, report both sets of data • Narrate all outliers
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-1a-b)	• If surrogate recoveries and LCS OK, matrix interference may be suspected • Reprep/reanalyze if matrix is not a factor • Narrate all outliers
		Matrix spike duplicate (MSD)	1 per preparation batch (≤20 samples)	• % Recovery and/or RPD within QC acceptance criteria (Refer to Table B1-1a-b)	• Same as MS
		Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	• % Recovery within project QC acceptance criteria (Refer to Table B1-1a-b)	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers

Notes:
[a]EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996)
EICP = Extracted ion current profile
%D = Percent difference
QC = Quality control
RF = Response factor
RPD = relative percent difference
RSD = relative standard deviation

Table B1-3a. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, Reporting Limits

Analytical Method[a]	Analyte	MCL (µg/l)	Reporting Limits (PQL)[b] Water (µg/l)	Reporting Limits (PQL)[b] Soil (mg/kg)
SW-846 8260B	1,1,1,2-Tetrachloroethane	NE	0.5	5
	1,1,1,-Trichloroethane	200	0.5	5
	1,1,2,2-Tetrachloroethane	NE	0.5	5
	1,1,2-Trichloroethane	5.0	0.5	5
	1,1-Dichloroethane	5.0	0.5	5
	1,1-Dichloroethene	7.0	0.5	5
	1,1-Dichloropropene	NE	0.5	5
	1,2,3-Trichlorobenzene	NE	0.5	5
	1,2,3-Trichloropropane	NE	0.5	5
	1,2,4-Trichlorobenzene	70	0.5	5
	1,2,4-Trimethylbenzene	NE	0.5	5
	1,2-Dichlorobenzene	600	0.5	5
	1,2-Dichloroethane	5	0.5	5
	1,2-Dichloropropane	5	0.5	5
	1,3,5-Trimethylbenzene	NE	0.5	5
	1,3-Dichlorobenzene	NE	0.5	5
	1,3-Dichloropropane	NE	0.5	5
	1,4-Dichlorobenzene	75	0.5	5
	2,2-dichloropropane	NE	0.5	5
	2-Butanone	NE	10[c]	50
	2-Chlorotoluene	NE	0.5	5
	2-Hexanone	NE	10[c]	50
	4-Chlorotoluene	NE	0.5	5
	4-Methyl-2-pentanone	NE	10[c]	50
	Acetone	NE	10[c]	50
	Benzene	5	0.5	5
	Brombenzene	NE	0.5	5
	Bromochloromethane	NE	0.5	5
	Bromodichloromethane	80	0.5	5
	Bromoform	80	0.5	5
	Bromomethane	NE	0.5	5
	Carbon disulfide	NE	N/A	5
	Carbon tetrachloride	5	0.5	5
	Chlorobenzene	NE	0.5	5
	Chloroethane	NE	0.5	5
	Chloroform	80	0.5	5
	Chloromethane	NE	0.5	5

Table B1-3a. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, Reporting Limits (concluded)

Analytical Method[a]	Analyte	MCL (µg/l)	Reporting Limits (PQL)[b] Water (µg/l)	Reporting Limits (PQL)[b] Soil (mg/kg)
SW-846 8260B	cis-1,2-Dichloroethene	70	0.5	5
	cis-1,2-Dichloropropene	NE	0.5	5
	Dibromochloromethane	80	0.5	5
	Dibromomethane	NE	0.5	5
	Dichlorodifluoromethane	NE	0.5	5
	Ethylbenzene	700	0.5	5
	Hexachlorobutadiene	NE	0.5	5
	Isopropylbenzene	NE	0.5	5
	Isopropyltoluene	NE	0.5	5
	m/p-Xylenes	10,000	0.5	10
	Methylene chloride	5	0.5	5
	Naphthalene	NE	0.5	5
	n-Butylbenzene	NE	0.5	5
	n-Propylbenzene	NE	0.5	5
	o-Xylene	10,000	0.5	5
	Sec-Butylbenzene	NE	0.5	5
	Styrene	100	0.5	5
	Tert-Butylbenzene	NE	0.5	5
	Tetrachloroethene	5	0.5	5
	Toluene	1,000	0.5	5
	Trans-1,2-dichloroethene	100	0.5	5
	Trans-1,3-dichloropropene	NE	0.5	5
	Trichloroethene	5	0.5	5
	Trichlorofluoromethane	NE	0.5	5
	Vinyl chloride	2	0.5	5

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, February 1986; Final Update III, December 1996).
[b] Reporting and method detection limits from Applied Physics and Chemistry Laboratories (APCL) of Chino, California.
[c] Report to the method detection limit (MDL)
µg/l = micrograms per liter
mg/kg = milligrams per kilogram
MCL = Maximum contamination level
NA = Not applicable
NE = Not established

Table B1-3b. Toxicity Characteristic Leaching Procedure Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, Reporting Limits

Analytical Method[a]	Analyte	Reporting Limits (PQL)[b]	Maximum Contamination Limits (MCL)
		TCLP Extract (µg/l)	TCLP Extract (µg/l)
SW-846 8260B	Benzene (71-43-2)	5	500
	2-Butanone (78-93-3)	5	200,000
	Carbon tetrachloride (56-23-5)	5	500
	Chlorobenzene (108-90-7)	5	100,000
	Chloroform (67-66-3)	5	6,000
	1,2-Dichloroethane (107-06-2)	5	500
	1,1-Dichloroethene (75-35-4)	5	700
	Tetrachloroethene (PCE) (127-18-4)	5	700
	Trichloroethene (TCE) (79-01-6)	5	500
	Vinyl chloride (75-01-4)	5	200

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, February 1986; Final Update III, December 1996).
[b] Reporting and method detection limits from Applied Physics and Chemistry Laboratories (APCL) of Chino, California.
µg/l = micrograms per liter

Table B1-4. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8260B, 4-Bromofluorobenzene (BFB) Mass Intensity Criteria

Mass	Required Intensity (relative abundance)
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base peak, 100% relative abundance
96	5 to 9% of mass 95
173	Less than 2% of mass 174
174	Greater than 50% of mass 95
175	5 to 9% of mass 174
176	Greater than 95%, but less than 101% of mass 174
177	5 to 9% of mass 176

Notes:
EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, February 1986; Final Update III, December 1996).

Table B1-5. Toxicity Characteristic Leaching Procedure Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method SW-846 8260B, Quality Control Criteria for Laboratory Data Evaluation

Spiking Compounds	Accuracy[a] (Percent Recovery)	Precision[a] (RPD)
	TCLP Extract	TCLP Extract
SW-846 8270C[b]		
Matrix Spike/Matrix Spike Duplicate		
Spike Compounds		
2,4-Dinitrotoluene	24-96	38
Hexachlorobenzene	37-89	20
Hexachlorobutadiene	19-109	21
Hexachloroethane	21-104	21
3/4-Methylphenol (m/p-Cresol)[c]	30-92	16
2-Methylphenol (o-Cresol)	26-105	17
Nitrobenzene	36-111	14
Pentachlorophenol	9-103	50
Pyridine	30-136	40
2,4,5-Trichlorophenol	38-108	20
2,4,6-Trichlorophenol	35-110	17
1,4-Dichlorobenzene	36-97	28
Surrogate Spike		
2-Fluorobiphenol	43-116	NA
2-Fluorophenol	21-110	NA
Nitrobenzene-d5	35-114	NA
Phenol-d6	10-110	NA
Terphenyl-d14	33-141	NA
2,4,6-Tribromophenol	10-123	NA
Laboratory Control Sample		
Spike Compounds		
2,4-Dinitrotoluene	24-96	NA
Hexachlorobenzene	37-89	NA
Hexachlorobutadiene	19-109	NA
Hexachloroethane	21-104	NA
3/4-Methylphenol (m/p-Cresol)[c]	30-92	NA
2-Methylphenol (o-Cresol)	26-105	NA
Nitrobenzene	36-111	NA
Pentachlorophenol	9-103	NA
Pyridine	30-136	NA
2,4,5-Trichlorophenol	38-108	NA
2,4,6-Trichlorophenol	35-110	NA
1,4-Dichlorobenzene	36-97	NA

Table B1-5. Toxicity Characteristic Leaching Procedure Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method SW-846 8260B, Quality Control Criteria for Laboratory Data Evaluation (concluded)

Spiking Compounds	Accuracy[a] (Percent Recovery)	Precision[a] (RPD)
	TCLP Extract	TCLP Extract
SW-846 8270C[b]		
Laboratory Control Sample (continued)		
Surrogate Spike		
2-Fluorobiphenol	43-116	NA
2-Fluorophenol	21-110	NA
Nitrobenzene-d5	35-114	NA
Phenol-d6	10-110	NA
Terphenyl-d14	33-141	NA
2,4,6-Tribromophenol	10-123	NA

Notes:
[a] Control limits from Applied Physics and Chemistry Laboratory of Chino, California, March 2004.
[b] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition; Final Update III, December 1996).
[c] 3-Methylphenol and 4-methylphenol can not be differentiated.
NA = Not applicable
RPD = Relative percent difference

Table B1-6. Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8270C, Calibrations Specifications and Corrective Action Summary

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C	Semi-Volatiles	Tune the instrument using a decafluorotriphenylphosine (DFTPP) standard	Every 12 hours	• Must meet the ion abundance criteria specified in the method (Refer to Table B1-8) • Degradation of DDT < 20% • Benzidine and PCP present at normal response without excessive tailing	• Retune instrument • Repeat standard analysis • Perform injection port, column maintenance as necessary
		Initial multi-point calibration; 5 point minimum. Lowest point at or below Reporting limit (PQL). Includes calibration check compounds (CCC) and system performance check compounds (SPCC), and Internal Standards Compounds (IS).	Prior to analysis, and as required	• RSD< 30 % for CCC; • RF > 0.05 for SPCC • RSD < 15%, r>0.995, or r2 > 0.990 for all target analytes • RF > 0.01 for all target analytes • Alternate evaluation: Mean %RSD for all target analytes < 15%, with no individual compound > 40%	• Evaluate system • Repeat calibration
		Initial calibration verification (ICV)	Every five-point calibration curve	• % Recovery ± 30%	• Evaluate system • Repeat calibration
		Continuing verification standard(CVS): CCC,SPCC, and IS	Every 12 hours	• Percent difference <20% for CCC; • RF >0.05 for SPCC • %D or %Drift < 20% for all target analytes • RF $\geq$ 0.01 for all target analytes	• Evaluate system/standard • Reanalyze calibration check standard • Repeat initial calibration as necessary • Repeat all sample analysis to last acceptable CVS
		Method blank	1 per preparation batch (≤20 samples)	• < ½ PQL	• Reanalyze method blank • Reprep/reanalyze method blank and associated samples

Table B1-6. Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8270C, Calibrations Specifications and Corrective Action Summary (concluded)

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C	Semi-Volatiles	Internal standards	Every sample, method blank, LCS, and MS/MSD	• Retention time for each internal standard must be within 30 seconds of most recent CVS • EICP area for all internal standards must be within -50% to +100% of the most recent CVS	• Evaluate system/standard • Reanalyze samples once • Reprep reanalyze once • If still out, report both sets of data • Narrate all outliers
		Surrogate spike	Every sample, method blank, LCS and MS/MSD	• % Recovery within quality control (QC) acceptance criteria (Refer to Table B1-5a-b) • One surrogate per fraction may be out if recovery > 10%	• Reanalyze once • If still out, report both sets of data • Narrate all outliers
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-5a-b)	• If surrogate recoveries and LCS OK, matrix interference may be suspected • Reprep/reanalyze if matrix is not a factor • Narrate all outliers
		Matrix spike duplicate (MSD)	1 per preparation batch (≤20 samples)	• % Recovery and/or RPD within QC acceptance criteria (Refer to Table B1-5a-b)	• Same as MS
		Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	• % Recovery within project QC acceptance criteria (Refer to Table B1-1a-b)	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers

Notes:
[a]EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, Final Update III, December 1996)
EICP = Extracted ion current profile
%D = Percent difference
QC = Quality control
RF = Response factor
RPD = relative percent difference
RSD = relative standard deviation

Table B1-7. Toxicity Characteristic Leaching Procedure Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8270C, Reporting Limits

Analytical Method[a]	Analyte	Reporting Limits (PQL)[b]	Maximum Contamination Limits (MCL)
		TCLP Extract (µg/l)	TCLP Extract (µg/l)
SW-846 8270C	1,4-Dichlorobenzene	10	7,500
	2,4-Dinitrotoluene	10	130
	Hexachlorobenzene	10	130
	Hexachlorobutadiene	10	500
	Hexachloroethane	10	3,000
	2-Methylphenol (o-Cresol)	10	200,000
	3/4-Methylphenol (m/p-Cresol)[C]	10	200,000
	Nitrobenzene	10	2,000
	Pentachlorophenol	50	100,000
	Pyridine	10	5,000
	2,4,5-Trichlorophenol	25	400,000
	2,4,6-Trichlorophenol	10	2,000

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, February 1986; Final Update III, December 1996).
[b] Reporting and method detection limits from Applied Physics and Chemistry Laboratories (APCL) of Chino, California.
[c] 3-Methylphenol and 4-methylphenol can not be differentiated.
µg/l = micrograms per liter

Table B1-8. Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry - SW-846 8270C, Decafluorotriphenyl Phosphine (DFTPP) Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present, but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

Notes:
EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, February 1986; Final Update III, December 1996).

Table B1-9. Toxicity Characteristic Leaching Procedure Organochlorine Pesticides by Gas Chromatography - Method SW-846 8081A, Quality Control Criteria for Laboratory Data Evaluation

Spiking Compounds	Accuracy[a] (Percent Recovery)	Precision[a] (RPD)
	TCLP Extract	TCLP Extract
SW-846 8081A[b]		
Matrix Spike/Matrix Spike Duplicate		
Spike Compounds		
Chlordane (technical) (57-74-9)	43-128	34
Endrin (72-20-8)	56-121	21
Heptachlor (76-44-8)	40-131	20
Heptachlor epoxide (1024-57-3)	20-164	50
Lindane (gamma-BHC) (58-89-9)	30-156	50
Methoxychlor (72-43-5)	56-152	39
Toxaphene (8001-35-2)	NA	NA
Surrogate Spike		
DCB (2051-24-3)	30-150	NA
TCMX (877-09-8)	30-150	NA
Laboratory Control Sample		
Spike Compounds		
Chlordane (technical) (57-74-9)	43-128	NA
Endrin (72-20-8)	56-121	NA
Heptachlor (76-44-8)	40-131	NA
Heptachlor epoxide (1024-57-3)	41-122	NA
Lindane (gamma-BHC) (58-89-9)	30-156	NA
Methoxychlor (72-43-5)	56-152	NA
Toxaphene (8001-35-2)	NA	NA
Surrogate Spike		
DCB (2051-24-3)	30-150	NA
TCMX (877-09-8)	30-150	NA

Notes:
[a] Control limits from Applied Physics and Chemistry Laboratory of Chino, California, September 2003.
[b] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition; Final Update III, December 1996).
NA = Not applicable
RPD = Relative percent difference

Table B1-10. Organochlorine Pesticides by Gas Chromatography, Method SW-846 8081A, Calibrations Specifications and Corrective Action Summary

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081A Organochlorine Pesticides by Gas Chromatography	Organochlorine Pesticides	Column Evaluation Mix	Prior to analysis, both initial and daily	• Degradation of DDT and Endrin < 15%	• Evaluate the system • Repeat standard
		Initial calibration (5 point minimum) Lowest at or below PQLMid level multi-component standards for pattern recognition and retention times	Prior to analysis and as required	• RSD < 20%, average CF may be used; linear calibration required	• Average RSD <20% across all analytes may be used if any analyte fails • Evaluate the system • Repeat initial calibration
		Initial calibration verification (ICV) Mid level standard Expected multi-component compounds	Prior to each 12 hour shift	• % Difference =15% of expected concentration compared to response from ICAL	• Average % difference =15% across all analytes may be used if any analyte fails • Evaluate system/standard • Reanalyze ICV standard • Repeat initial calibration
		Continuing calibration verification (CCV)Mid level standard Expected multi-component compounds	After every 20 samples and at the end of the analytical sequence	• % Difference =15% of expected concentration compared to response from ICAL for each bracketing standard	• Average % difference =15% across all analytes may be used if any analyte fails • Evaluate system/standard • Reanalyze CCV and affected samples • For CCV with response > initial calibration response and % difference >15%, samples need not be reanalyzed if no target compounds are detected
		Retention time windows	Established with each new column installation Updated with each daily initial calibration standard	• Retention times must be within retention time window established by the daily initial calibration standard • Every CCV and every sample	• Evaluate system/standard; pattern recognition may be sufficient for multi-component compounds only • Reanalyze CCV/affected samples

Table B1-10. Organochlorine Pesticides by Gas Chromatography, Method SW-846 8081A, Calibrations Specifications and Corrective Action Summary (concluded)

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081A Organochlorine Pesticides by Gas Chromatography	Organochlorine Pesticides	Method Blank	1 per preparation batch (= 20 samples)	• <Reporting Limit (PQL)	• Reanalyze blank • Re-prep/reanalyze blank and associated samples
		Surrogate spike DCB and TCMX	Every sample, method blank, LCS and MS/MSD	• % Recovery within QC acceptance criteria (Refer to Table B1-9) • One surrogate must fall within established control limits	• Re-extract/reanalyze once • If still out, report both sets of data • Narrate all outliers
		Matrix spike (MS)	1 per preparation batch (=20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-9)	• If LCS and surrogate recoveries are acceptable and MSD also outside criteria consistent with MS, problem may be attributed to matrix interference • Reprep/reanalyze both MS and MSD. • Narrate all outliers
		Matrix spike duplicate(MSD) or Matrix Duplicate (MD)	1 per preparation batch (=20 samples)	• % Recovery and/or RPD within QC acceptance criteria (Refer to Table B1-9)	• Same as MS
		Laboratory control sample (LCS)	1 per preparation batch (= 20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-9)	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).
RSD = Relative standard deviation
CF = Calibration factor
QC = Quality control
RPD = Relative percent difference

Table B1-11. Toxicity Characteristic Leaching Procedure-Organochlorine Pesticides by Gas Chromatography - Method SW-846 8081A, Method Detection Limits, Reporting Limits, and Maximum Contaminant Levels

Analytical Method[a]	Analyte	PQL[b] TCLP Extract (µg/l)	MCL TCLP Extract (µg/l)
SW-846 8081A	Chlordane (technical) (57-74-9)	0.16	30
	Endrin (72-20-8)	0.32	20
	Heptachlor (76-44-8)	0.16	8
	Heptachlor epoxide (1024-57-3)	0.16	8
	Lindane (gamma-BHC) (58-89-9)	0.16	400
	Methoxychlor (72-43-5)	1.5	10,000
	Toxaphene (8001-35-2)	10	500

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).
[b] Reporting limits are from Applied Physics and Chemistry Laboratory of Chino, California, March 2004.
MCL = Maximum contamination limit
MDL = Method detection limit
PQL = Reporting limit
µg/l = Microgram per liter

Table B1-12. TCLP-Organochlorine Herbicides by Gas Chromatography - Method SW-846 8151A, Quality Control Criteria for Laboratory Data Evaluation

Spiking Compounds	Accuracy[a] (Percent Recovery)	Precision[a] (RPD)
	TCLP Extract	TCLP Extract
SW-846 8151A[b]		
Matrix Spike/Matrix Spike Duplicate		
Spike Compounds		
2,4-D (94-75-7)	30-150	60
2,4,5-TP (Silvex) (93-72-1)	30-150	60
Surrogate Spike		
DCAA (19719-28-9)	49-139	NA
Laboratory Control Sample		
Spike Compounds		
2,4-D (94-75-7)	41-149	NA
2,4,5-TP (Silvex) (93-72-1)	40-131	NA
Surrogate Spike		
DCAA (19719-28-9)	49-139	NA

Notes:
[a] Control limits from Applied Physics and Chemistry Laboratory of Chino, California, March 2004
[b] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition; Final Update III, December 1996).
NA = Not applicable
%RPD = Relative percent difference

Table B1-13. Organochlorine Herbicides by Gas Chromatography- SW-846 8151A Calibration Specifications and Corrective Action Summary

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8151A	Organochlorine Herbicides and Pentachlorophenol	Initial calibration (5 point minimum) Lowest point at or below PQL	Prior to analysis and as required	• %RSD <20%, average CF may be used; linear calibration required	• Average RSD <20% across all analytes may be used if any analytes fail • Evaluate the system • Repeat initial calibration
		Initial calibration verification (ICV) second source Mid level standard	Prior to each daily analytical sequence	• % Difference =15% of expected concentration compared to response from ICAL	• Average %D =15% across all analytes may be used if any analytes fail • Evaluate system/standard • Reanalyze ICV standard • Repeat initial calibration
		Continuing calibration verification (CCV) Mid level standard	After every 20 samples and at the end of the analytical sequence	• % Difference =15% of expected concentration compared to response from ICAL for each bracketing standard	• Evaluate system/standard • Reanalyze CCV and all samples back to last acceptable CCV
		Retention time windows	Established with each new column installation Updated with each daily initial calibration standard	• Retention times must be within retention time window established by the daily initial calibration standard • Every CCV and every sample	• Evaluate system/standard; • Reanalyze CCV and affected samples
		Method blank	1 per preparation batch (=20 samples)	• <Reporting Limit (PQL)	• Reanalyze blank • Re-prep/reanalyze blank and all associated samples

Table B1-13. Organochlorine Herbicides by Gas Chromatography- SW-846 8151A, Calibration Specifications and Corrective Action Summary (concluded)

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8151A	Organochlorine Herbicides and Pentachlorophenol	Surrogate spike DCAA	Every sample, method blank, LCS and MS/MSD	• % Recovery within project QC acceptance criteria (Refer to Table B1-12)	• Re-extract/reanalyze once • If still out, report both sets of data • Narrate all outliers
		Matrix spike (MS)	1 per preparation batch (=20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-12)	• Assess data (4x rule) • If LCS and surrogate recoveries are within acceptance criteria, matrix interference maybe suspected • Re-exact/reanalyze once if matrix is not a factor • Narrate all outliers
		Matrix spike duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (=20 samples)	• % Recovery and/or RPD within QC acceptance criteria (Refer to Table B1-12)	• Same as MS
		Laboratory control sample (LCS)	1 per preparation batch (=20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-12)	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).
%RSD = Relative standard deviation
CF = Calibration factor
QC = Quality control

Table B1-14. Toxicity Characteristic Leaching Procedure-Organochlorine Herbicides by Gas Chromatography - Method SW-846 8151A, Method Detection Limits, Reporting Limits, and Maximum Contaminant Levels

Analytical Method[a]	Analyte	PQL[b] TCLP Extract (µg/l)	MCL TCLP Extract (µg/l)
SW-846 8151A	2,4-D (94-75-7)	5	10,000
	2,4,5-TP (Silvex) (93-72-1)	25	1,000

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, September 1986; Final Update III, December 1996).
[b] Reporting limits are from Applied Physics and Chemistry Laboratory of Chino, California, September 2003.
MCL = Maximum contamination limit
MDL = Method detection limit
PQL = Reporting limit
µg/l = Microgram per liter

Table B1-15. Inductively Coupled Plasma Metals Analysis Using SW-846 6010B, Quality Control Criteria for Laboratory Data Evaluation

Spiking Compounds	Accuracy[a] (Percent Recovery)		Precision[a] (RPD Percent)	
	Soil	TCLP Extract	Soil	TCLP Extract
SW-846 6010[b]				
Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate				
Arsenic	75-125	75-125	20	20
Barium	75-125	75-125	20	20
Cadmium	75-125	75-125	20	20
Chromium	75-125	75-125	20	20
Lead	75-125	75-125	20	20
Selenium	75-125	75-125	20	20
Silver	75-125	75-125	20	20
Laboratory Control Sample				
Arsenic	80-120	80-120	NA	NA
Barium	80-120	80-120	NA	NA
Cadmium	80-120	80-120	NA	NA
Chromium	80-120	80-120	NA	NA
Lead	80-120	80-120	NA	NA
Selenium	80-120	80-120	NA	NA
Silver	80-120	80-120	NA	NA

Notes:
[a] Control limits from Applied Physics and Chemistry Laboratory of Chino, California, March 2004.
[b] EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW 846, Third Edition, February 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, February 1994; Final Update IIB, January 1995; Final Update III, December 1996.
NA = Not applicable

Table B1-16. Inductively Coupled Plasma Atomic Emission Spectrometry Metals Analysis Using SW-846 6010B, Calibration Specification and Corrective Action Procedures

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 6010B	Metals	Initial calibration (1 point + blank minimum)	Daily prior to analysis	• Correlation coefficient (r) >0.995	• Recalibrate
		Interference check standard (ICS)	Beginning and end of each analytical run	• Results +/- 20% of true value	• Terminate analysis • Recalibrate instrument • Reanalyze all samples back to last acceptable ICS
		Initial calibration verification (ICV)	After calibration, prior to sample analysis	• Results <10% from calibration standard	• Reanalyze ICV • Recalibrate, if ICV still out
		Continuing calibration verification (CCV)	Every 10 samples and end of analytical sequence	• Results < 10% from calibration standard	• Reanalyze affected samples back to the last acceptable CCV
		Calibration blank - Initial calibration blank (ICB), Continuing calibration blank (CCB)	After initial calibration verification, each subsequent calibration verification, and at the end of the run	• < ½ Reporting limit (PQL)	• Reanalyze blank • Clean system • Reanalyze all samples back to last acceptable blank
		Method blank	1 per preparation batch (≤20 samples)	• < ½ PQL	• Reanalyze method blank. • If fails, analyze a calibration blank • Reprep/reanalyze analytical batch as appropriate
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	• % Recovery +/-25% of actual value	Assess data (4 x rule) • Reanalyze/ reprep once • Narrate all outliers
		Matrix spike duplicate (MSD)	1 per preparation batch (≤20 samples)	• Relative percent difference (RPD) <20%	• Same as MS
		Laboratory Control Sample (LCS)	1 per preparation batch (≤20 samples)	• % Recovery +/- 20% of actual value	• Reanalyze LCS • Reprep/reanalyze LCS and affected samples • Narrate all outliers

Notes:
[a]EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW 846, Third Edition, February 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, February 1994; Final Update IIB, January 1995; Final Update III, December 1996.
CCB = continuing calibration blank CCV = continuing calibration verification ICB = initial calibration blank ICS = interference check standard ICV = initial calibration verification
LCS = laboratory control standard MS = matrix spike MSD = matrix spike duplicate PQL = Reporting limit RPD = relative percent difference

Table B1-17. Inductively Coupled Plasma Atomic Emission Spectrometry Metals Analysis, Using SW-846 6010B, Reporting Limits

Analytical Method[a]	Analyte	Reporting Limits (PQL)[b]		Maximum Contamination Limits (MCL)
		Soil (mg/kg)	TCLP Extract (µg/l)	TCLP Extract (µg/l)
SW-846 6010B	Arsenic	**0.3**	10	5000
	Barium	**1.0**	10	100,000
	Cadmium	**0.2**	5	1,000
	Chromium	**0.5**	5	5,000
	Lead	**0.3**	3	5,000
	Selenium	**0.5**	10	1,000
	Silver	**0.5**	10	5,000

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, February 1986; Final Update III, December 1996).
[b] Reporting and method detection limits from Applied Physics and Chemistry Laboratories (APCL) of Chino, California.
µg/l = micrograms per liter

Table B1-18. Mercury Analysis Cold Vapor Using SW-846 7470A/7471A, Quality Control Criteria for Laboratory Data Evaluation

Spiking Compounds	Accuracy[a] (Percent Recovery)		Precision[a] (RPD Percent)	
	Soil	TCLP Extract	Soil	TCLP Extract
SW-846 7470A/7471[b]				
Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate				
Mercury	75-125	75-125	20	20
Laboratory Control Sample				
Mercury	80-120	80-120	NA	NA

Notes:
[a]EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW 846, Third Edition, February 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, February 1994; Final Update IIB, January 1995; Final Update III, December 1996.
[b]Control limits from Applied Physics and Chemistry Laboratory of Chino, California, March 2004.
NA = Not applicable

Table B1-19. Mercury Analysis Cold Vapor Using SW-846 7470A/7471A, Calibration Specification And Corrective Action Procedures

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 7470A/7471A	Mercury	Initial multipoint calibration (5 point + blank minimum)	Daily, prior to analysis	• Correlation coefficient (r) ≥0.995	• Recalibrate
		Initial calibration verification (ICV),second source; mid-level standard	After calibration, prior to sample analysis	• ± 10% of true value	• Reanalyze ICV • Rerun initial calibration
		Continuing verification standard (CVS); mid-level standard	Every 10 samples and at end of analytical sequence	• ± 20% of true value	• Reanalyze affected samples back to last acceptable CVS
		Instrument precision0	All standards and ICV and CVS	• RPD of 2 injections ± 10%	• Reanalyze affected samples back to last acceptable CVS
		Initial and continuing calibration blank (ICB/CCB)	After calibration, and after each subsequent calibration verification	• < Reporting limit	• Reanalyze blank • Clean system if still out • Reanalyze affected samples back to last acceptable CCB
		Method blank	1 per preparation batch (≤20 samples)	• < ½ Reporting limit (RL)	• Reanalyze method blank. • If fails, analyze a calibration blank • Reprep/reanalyze analytical batch as appropriate
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	• % Recovery within ± 25% of true value	• Use method of standards addition to compensate for matrix interferences • Rerun sample once • If still out, report both sets of data • Narrate all outliers
		Matrix spike duplicate (MSD) or Matrix Duplicate (MD)	1 per preparation batch (≤20 samples)	• RPD < 20%	• Same as MS

Table B1-19. Mercury Analysis Cold Vapor Using SW-846 7470A/7471A, Calibration Specification And Corrective Action Procedures (concluded)

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 7470A/7471A	Mercury	Post digestion spike	1 per preparation batch (≤20 samples) using MS sample	• % Recovery ± 15% of actual value	• Same as MS
		Laboratory control samples (LCS)	1 per preparation batch (≤20 samples)	• % Recovery within ± 20%	• Reanalyze LCS • Reprep/reanalyze LCS and affected samples • Narrate all outliers
		Serial dilution	1 per preparation batch (<20 samples)	• % Difference ±10% for analytes greater than RL when diluted 5 times	• J flag associated analyte as estimated

Notes:
[a]EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW 846, Third Edition, February 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, February 1994; Final Update IIB, January 1995; Final Update III, December 1996.
CCB = continuing calibration blank
CCV = continuing calibration verification
ICB = initial calibration blank
ICS = interference check standard
ICV = initial calibration verification
LCS = laboratory control standard
MS = matrix spike
MSD = matrix spike duplicate
PQL = Reporting limit
RPD = relative percent difference

Table B1-20. Mercury Analysis Cold Vapor Using SW-846 7470A/7471A, Reporting Limits

Analytical Method[a]	Analyte	Reporting Limits (PQL)[b]		Maximum Contamination Limits (MCL)
		Soil (µg/kg)	TCLP Extract (µg/l)	TCLP Extract (µg/l)
SW-846 7470A	Mercury		0.2	200

Notes:
[a] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, February 1986; Final Update III, December 1996).
[b] Reporting and method detection limits from Applied Physics and Chemistry Laboratories (APCL) of Chino, California.
µg/l = micrograms per liter

Table B1-21. Groundwater/Soil Anions and Water/Soil Quality, Quality Control Criteria for Laboratory Data Evaluation

Analytical Method	Spiking Compounds	Accuracy (Percent Recovery)		Precision[b] (RPD Percent)	
		Water	Soil	Water	Soil
Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate					
EPA 300.0[a]	Nitrate	75-125	75-125	25	25
	Nitrite	75-125	75-125	25	25
EPA 350.2[a]	Ammonium	75-125	75-125	25	25
EPA 351.3[a]	Total Kjeldahl Nitrogen	75-125	75-125	25	25
Laboratory Control Samples					
EPA 300.0[a]	Nitrate	80-120	80-120	NA	NA
	Nitrite	80-120	80-120	NA	NA
EPA 350.2[a]	Ammonium	80-120	80-120	NA	NA
EPA 351.3[a]	Total Kjeldahl Nitrogen	80-120	80-120	NA	NA

Notes:
[a] EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).
[b] EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition; Final Update III, December 1996).
[c] Methods of Soils Analysis, American Society of Agronomy, 1982.
NA = not applicable
RPD = Relative percent difference

Table B1-22. Determination of Anions by Ion Chromatography- EPA 300.0, Calibration Specifications and Corrective Action Summary

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
EPA 300.0	Nitrate and Nitrite	Initial multipoint calibration (minimum of three concentrations plus blank)	Initially and as required	• Correlation coefficient (r) ≥ 0.995	• Check calculations • Recalibrate
		Initial calibration verification (ICV)	Daily, prior to sample analysis	• ± 10% of expected concentration	• Reanalyze ICV • Recalibrate if ICV still out
		Continuing calibration verification (CCV) mid-range	Every 10 samples and at end of run	• ± 5% of expected concentration	• Reanalyze affected samples back to last acceptable CCV
		Calibration blank- Initial calibration blank (ICB), Continuing calibration blank (CCB)	Daily after each ICV and CCV	• < Reporting limit (PQL)	• Reanalyze blank • Clean system • Reanalyze samples back to last clean blank
		Method blank	1 per preparation batch (≤ 20 samples)	• < PQL	• Reanalyze blank • Reprep/reanalyze blank and all associated samples
		Matrix spike (MS)	1 per preparation batch (≤ 20 samples)	• % Recovery within quality control (QC) acceptance criteria (Refer to Table B1-21)	• Assess data (4x rule) • If LCS recoveries are within acceptance criteria, matrix interference may be suspected • Reanalyze once if matrix is not a factor • Narrate all outliers
		Matrix spike duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (≤ 20 samples)	• % Recovery and/or RPD within QC acceptance criteria (Refer to Table B1-21)	• Same as MS
		Laboratory control sample (LCS)	1 per preparation batch (≤ 20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-21)	• Reanalyze LCS • Reprep/reanalyze all associated samples

Notes:
[a]EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).
CCB = continuing calibration blank CCV = continuing calibration verification ICB = initial calibration blank ICV = initial calibration verification LCS = aboratory control standard
MD = matrix duplicate MS = matrix spike MSD = matrix spike duplicate PQL = Reporting limit QC = quality control
RPD = relative percent difference

Table B1-23. Determination of Ammonium by Ion Selective Electrode, EPA 350.2, Calibration Specifications and Corrective Action Summary

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
EPA 350.2	Ammonium	Initial multipoint calibration (3 standards + 1 blank)	Initially and as required	• Correlation coefficient (r) =0.995	• Recalibrate
		Initial calibration verification (ICV)	Prior to sample analysis	• 90-110% of initial calibration response	• Reanalyze standard • Recalibrate
		Continuing calibration verification (CCV)	After every 10 samples and at the end of the run	• 90-110% of initial calibration response	• Reprep/reanalyze affected samples back to last acceptable CCV
		Calibration blank- Initial calibration blank (ICB) Continuing calibration blank (CCB)	After each ICV and CCV	• <Reporting limit (PQL)	• Reanalyze all affected samples • Reanalyze blank
		Method Blank	1 per preparation batch (≤20 samples)	• < Reporting limit (PQL)	• Reanalyze blank • Reprep/reanalyze all affected samples back to last acceptable CCV
		Matrix Spike (MS)	1 per preparation batch (≤ 20 samples)	• % recovery within quality control (QC) acceptance criteria (Refer to Table B1-21)	• Assess data (4x rule) • Rerun once, report both sets of data • Narrate outliers
		Matrix Spike Duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (≤ 20 samples)	• % Recovery and/or relative percent difference (RPD) within QC acceptance criteria (Refer to Table B1-21)	• Assess data • Rerun once, report both sets of data • Narrate all outliers
		Laboratory Control Sample (LCS)	1 per preparation batch (≤ 20 samples)	• % recovery within QC acceptance criteria (Refer to Table B1-21)	• Rerun LCS • Reprep/reanalyze all affected samples

Notes:
[a]EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).
CCB = continuing calibration blank
CCV = continuing calibration verification
ICB = initial calibration blank
ICV = initial calibration verification
LCS = laboratory control standard
MD = matrix duplicate
MS = matrix spike
MSD = matrix spike duplicate
PQL = Reporting limit
QC = quality control
RPD = relative percent difference

Table B1-24. Determination of Total Kjeldahl Nitrogen by Ion Selective Electrode, EPA 351.3, Calibration Specifications and Corrective Action Summary

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
EPA 351.3	Total Kjeldahl Nitrogen (TKN)	Initial multipoint calibration (3 standards + 1 blank)	Initially and as required	• Correlation coefficient (r) =0.995	• Recalibrate
		Initial calibration verification (ICV)	Prior to sample analysis	• 90-110% of initial calibration response	• Reanalyze standard • Recalibrate
		Continuing calibration verification (CCV)	After every 10 samples and at the end of the run	• 90-110% of initial calibration response	• Reprep/reanalyze affected samples back to last acceptable CCV
		Calibration blank- Initial calibration blank (ICB) Continuing calibration blank (CCB)	After each ICV and CCV	• <Reporting limit (PQL)	• Reanalyze all affected samples • Reanalyze blank
		Method Blank	1 per preparation batch (≤20 samples)	• < PQL	• Reanalyze blank • Reprep/reanalyze all affected samples back to last acceptable CCV
		Matrix Spike (MS)	1 per preparation batch (≤ 20 samples)	• % recovery within quality control (QC) acceptance criteria (Refer to Table B1-21)	• Assess data (4x rule) • Rerun once, report both sets of data • Narrate outliers
		Matrix Spike Duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (≤ 20 samples)	• % Recovery and/or RPD within QC acceptance criteria (Refer to Table B1-21)	• Assess data • Rerun once, report both sets of data • Narrate all outliers
		Laboratory Control Sample (LCS)	1 per preparation batch (< 20 samples)	• % recovery within Hill Air Force Base QC acceptance criteria (Refer to Table B1-21)	• Rerun LCS • Reprep/reanalyze all affected samples

Notes:
[a]EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).
CCB = continuing calibration blank
CCV = continuing calibration verification
ICB = initial calibration blank
ICV = initial calibration verification
LCS = laboratory control standard
MD = matrix duplicate
MS = matrix spike
MSD = matrix spike duplicate
PQL = Reporting limit
QC = quality control
RPD = relative percent difference

Table B1-25. Groundwater/Soil Anions and Water/Soil Quality, Reporting Limits

Analysis	Analytical Method[a]	Analyte	Reporting Limits[b]	
			Water (mg/l)	Soil (mg/kg)
Anions	EPA 300	Nitrate	0.04	0.2
		Nitrite	0.05	0.2
Ammonia	EPA 350.2	Ammonia	1[c]	25
Total Kjeldahl Nitrogen	EPA 351.3	Total Kjeldahl Nitrogen	1[c]	50

Notes:
[a] EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).
Methods of Soils Analysis, American Society of Agronomy, 1982.
[b] Reporting and method detection limits from Applied Physics and Chemistry Laboratories (APCL) of Chino, California.
[c] Report to the method detection limit (MDL)
NA = not applicable
mg/kg = milligrams per kilogram
mg/L = milligrams per liter

Table B1-26. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Method TO-15, Quality Control Criteria for Laboratory Data Evaluation

Spiking Compounds	Accuracy[a] (Percent Recovery)	Precision[a] (RPD Percent)
	Air	Air
EPA Method TO-15[b]		
Matrix Spike/Matrix Spike Duplicate Samples		
Spiking Compounds	**N/A**	**N/A**
Surrogate Compounds	**N/A**	**N/A**
Laboratory Control Samples		
All Compounds	**70-130**	**25**
Surrogate Compounds	**70-140**	**N/A**

Notes:
[a] Control limits from Columbia Analytical Services of Simi Valley, California, March 2004.
[b] Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, (EPA, January 1999) EPA/625/R-96/010b.
NA = Not applicable
EPA = environmental protection agency
RPD = relative percent difference

Table B1-27. Volatile Organic Compound Analysis in Air by Gas Chromatography/Mass Spectrometry – EPA Method TO-15, Calibrations Specifications and Corrective Action Summary

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
EPA TO-15 Volatile Organics in Ambient Air using Summa Canister Sampling by GC/MS Analysis	VOCs	Tune instrument with a 4-bromofluorobenzene standard (BFB)	Daily, prior to analysis (24-hours)	• Must meet key ions and ion abundance criteria established by method (Refer to Table B1-30)	• Retune instrument • Repeat standard analysis
		Initial multi-point calibration; (3 levels plus zero humic air). Lowest point at or below Reporting limit (PQL).	Prior to analysis, and as required	• %RSD ≤ 30%, with at most two exceptions <40%.	• Evaluate system • Repeat calibration
		Calibration verification standard (CVS)	Daily, prior to analysis.	• %RSD ≤ 30%.	• Evaluate system/standard • Reanalyze calibration check standard • Repeat initial calibration
		Method blank	1 per analytical batch (≤20 samples)	• < PQL	• Reanalyze method blank • Recalibrate
		Internal standards	Every sample, method blank, and LCS/LCSD	• Retention time for each internal standard must be within 30 seconds of most recent CVS • EICP area for all internal standards must be within -40% to +40% of the most recent CVS	• Evaluate system/standard • Reanalyze samples once • If still out, report both sets of data • Narrate all outliers
		Retention time windows	Established with each new column installation; updated with every daily routine calibration standard	• +0.33 minutes of most recent valid calibration	• Reanalyze standard and all affected samples
		Surrogate spike	Every sample, method blank, LCS and MS/MSD	• % Recovery within quality control (QC) acceptance criteria (Refer to Table B1-27)	• Reanalyze once • If still out, report both sets of data • Narrate all outliers

Table B1-27. Volatile Organic Compound Analysis in Air by Gas Chromatography/Mass Spectrometry – EPA Method TO-15, Calibrations Specifications and Corrective Action Summary (concluded)

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
EPA TO-15 Volatile Organics in Ambient Air using Summa Canister Sampling by GC/MS Analysis	VOCs	Surrogate spike	Every sample, method blank, LCS and MS/MSD	• % Recovery within quality control (QC) acceptance criteria (Refer to Table B1-27)	• Reanalyze once • If still out, report both sets of data • Narrate all outliers
		Laboratory control sample (LCS)	1 per analytical batch (≤20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-27)	• Reanalyze LCS • Reanalyze all associated samples • Narrate all outliers
		Laboratory control sample duplicate (LCSD)	1 per analytical batch (≤20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B1-27)	• Same as LCS

Notes:
[a] Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, (EPA, January 1999) EPA/625/R-96/010b.
EICP = Extracted ion current profile
%D = percent difference
QC = quality control
RF = response factor
RPD = relative percent difference
RSD = relative standard deviation
GC/MS = gas chromatography/mass spectrometry
VOC =volatile organic compound
LCS/LCSD =laboratory control standard/laboratory control standard duplicate
MS/MSD =matrix spike/matrix spike duplicate

Table B1-28. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry - EPA Method TO-15, Reporting Limits

Analytical Method[a]	Analyte[c]	Reporting Limits (PQL)[b] Air (ppbV)
EPA TO-15	Dichlorodifluoromethane (CFC 12)	0.23
	Chloromethane	0.48
	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	0.43
	Vinyl Chloride	0.39
	1,3-Butadiene	0.45
	Bromomethane	0.52
	Chloroethane	0.38
	Ethanol	0.53
	Acetonitrile	0.60
	Acrolein	0.44
	Acetone	2.10
	Trichlorofluoromethane	0.36
	Isopropyl Alcohol	0.41
	Acrylonitrile	0.46
	1,1-Dichloroethene	0.25
	Methylene chloride	0.29
	Allyl Chloride	0.32
	Trichlorotrifluoroethane	0.39
	Carbon Disulfide	0.32
	trans-1,2-Dichloroethene	0.25
	1,1-Dichloroethane	0.25
	Methyl tert-Butyl Ether	0.28
	Vinyl Acetate	0.28
	2-Butanone (MEK)	0.34
	cis-1,2-Dichloroethene	0.25
	n-Hexane	0.28
	Chloroform	0.20
	1,2-Dichloroethane	0.25
	1,1,1-Trichloroethane	0.18
	Benzene	0.31
	Carbon Tetrachloride	0.16
	1,2-Dichloropropane	0.22
	Bromodichloromethane	0.15
	Trichloroethene	0.19
	1,4-Dioxane	0.28
	Epichlorohydrin	0.26
	cis-1,3-Dichloropropene	0.22
	4-Methyl-2-pentanone	0.24
	trans-1,3-Dichloropropene	0.22
	1,1,2-Trichloroethane	0.18
	Toluene	0.27
	2-Hexanone	0.24
	Dibromochloromethane	0.12
	1,2-Dibromoethane	0.13
	n-Butyl Acetate	0.21
	Tetrachloroethene	0.15

Notes:
[a] Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, (EPA, January 1999) EPA/625/R-96/010b.
[b] Reporting and method detection limits from Columbia Analytical Services, Inc. of Simi Valley, California.
[c] This is the complete TO-15 analyte list; final analyte list will be limited to project specific analytes.
ppbV = parts per billion by volume

Table B1-29. Volatile Organic Compound Analysis in Ambient Air by Gas Chromatography/Mass Spectrometry – EPA Method TO-15, 4-Bromofluorobenzene (BFB) Mass Intensity Criteria

Mass	Required Intensity (relative abundance)
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base peak, 100% relative abundance
96	5 to 9% of mass 95
173	Less than 2% of mass 174
174	Greater than 50% of mass 95
175	5 to 9% of mass 174
176	Greater than 95%, but less than 101% of mass 174
177	5 to 9% of mass 176

Notes:
Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, (EPA, January 1999) EPA/625/R-96/010b.

APPENDIX C
LITHOLOGIC LOGGING FORM

MWH

Field Boring Log

Facility/Project Name _____
Location _____

Boring No. _____
Project No. _____

Drilling Co _____
Driller's Name _____
Drill Rig _____
Drill Method _____
_____
Logged By _____
Water Level Below TOC (ft): _____ Date Measured: _____

Northing: _____ Easting: _____
Ground Surface Elevation (ft): _____
Measuring Point elevation (ft): _____
(top of PVC casing)
Borehole Diameter: _____
Borehole Depth: _____

Depth (feet)	Grain Size			Blows (6 inches)	Sample Type	Sample Recovery	USCS/ASTM Classification	Lith. Code (ERPIMS)	Lithologic Description
	% Gravel	% Sand	% Fines						
0									
5									
10									
15									
20									
25									
30									
35									
40									
45									