DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 377TH AIR BASE WING (AFMC)

JAN 3 2012

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Mr. Thomas Berardinelli
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2000 Wyoming Blvd SE
Kirtland AFB NM 87117-5606

Mr. John Kieling, Manager
RCRA Permits Management Program
Hazardous Waste Bureau (HWB)
New Mexico Environment Department (NMED)
2905 Rodeo Park Road
Santa Fe NM 87505

Dear Mr. Kieling

Kirtland Air Force Base (KAFB) is submitting the KAFB Indoor Air Evaluation Work Plan, Bulk Fuels Facility Spill Solid Waste Management Units ST-106 and SS-111, November 2011 and the revised Indoor Air Evaluation Work Plan Schedule (appendix B of work plan), as directed by the 22 October 2011 NMED HWB letter to KAFB, RE: *Kirtland Air Force Base Indoor Air Work Plan Schedule, September 2011, KAFB, EPA ID#NM9570024423, HWB-KAFB-MISC.* Upon NMED approval of work plan, see schedule in appendix B of work plan, and as stated in the work plan Executive Summary, sampling events will occur in January and June 2012.

Please contact Ms. Victoria R. Martinez at 505-846-6362 or Victoria.martinez@kirtland.af.mil, if you have any questions.

Sincerely

THOMAS F. BERARDINELLI
Director of Staff

Attachment:
KAFB Indoor Air Evaluation Work Plan, November 2011(Electronic)

cc:
NMED-HWB (Mr. Moats, Mr. McDonald, Mr. Salem, Mr. Brandwein), w/ atch
NMED-GWQB (Mr. Schoeppner), w/ atch
NMED-PSTB (Mr. Reuter), w/ atch
NMED-OGC (Mr. Barnhart), w/ atch
HQ AFMC/A7AQ (Mr. McCann) w/ atch
/A7A1 (Mr. Fort) w/ atch
AFCEE/CMSE (Mr. Oyelowo) w/o atch
/EXEC (Mr. Urrutia) w/o atch
EPA Region 6 (Ms. King) w/ atch
USACE Omaha (Mr. Zink) w/o atch
TLI Solutions (Mr. Swanson) w/o atch
Community College Montoya Campus w/ atch
Admin Record (AR/IR), w/ atch
File

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Indoor Air Evaluation Work Plan
Bulk Fuels Facility Spill
Solid Waste Management Units ST-106 and SS-111

January 2012

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

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

INDOOR AIR EVALUATION WORK PLAN
BULK FUELS FACILITY SPILL
SOLID WASTE MANAGEMENT UNIT SS-106 AND SS-111

January 2012

Prepared for
U.S. Army Corps of Engineers
Albuquerque District
Albuquerque, New Mexico 87109

USACE Contract No. W912DY-10-D-0014
Delivery Order 0002

Prepared by
Shaw Environmental & Infrastructure, Inc.
7604 Technology Way, Suite 300
Denver, Colorado 80237

NOTICE

This report was prepared for the U.S. Army Corps of Engineers by Shaw Environmental & Infrastructure, Inc. for the purpose of aiding in the implementation of a final remedial action plan under the U.S. Air Force Environmental Restoration Program (ERP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to a final decision on remedial action may be in the public's interest. The limited objectives of this report 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 report, since subsequent facts may become known which may make this report premature or inaccurate.

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This Indoor Air Evaluation Work Plan was developed in response to correspondence dated January 28, 2011, from the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) to the U.S. Air Force (Air Force). In this letter, the NMED HWB required the Air Force to develop and submit a work plan to perform direct measurement of indoor and ambient air at the Bulk Fuels Facility (BFF) Spill at Kirtland Air Force Base (AFB), Albuquerque, New Mexico. This work plan defines activities and requirements for performing air sampling, both indoor and outdoor/ambient, at Kirtland AFB Buildings 1026, 1032, 1033, and 1049 as part of phase-separated hydrocarbon remediation at the BFF Spill site. It also summarizes previous investigations performed at the BFF Spill site. This work plan provides the rationale and scope of work to implement two sampling events, one in January 2012 and one in June 2012. The air sampling is intended to provide a data set that may be used to evaluate the potential risk to building occupants of inhalation exposure to chemicals . Once data are collected and evaluated, a letter report will be prepared and submitted to Kirtland AFB and the NMED HWB.

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40 CFR 270.11
DOCUMENT CERTIFICATION
NOVEMBER 2011

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 assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

JOHN C. KUBINEC, Colonel, USAF
Commander

This document has been approved for public release.

KIRTLAND AIR FORCE BASE
377 ABW Public Affairs

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PREFACE

This Indoor Air Evaluation Work Plan was prepared by Shaw Environmental & Infrastructure, Inc. (Shaw) for the U.S. Army Corps of Engineers (USACE), Albuquerque District, under Contract No. W912DY-10-D-0014, Delivery Order 0002. It pertains to interim measure activities associated with the Kirtland Air Force Base (AFB) Bulk Fuels Facility (BFF) Spill, Solid Waste Management Units ST-106 and SS-111, located in Albuquerque, New Mexico. This work plan was prepared in accordance with all applicable federal, state, and local laws and regulations, including the New Mexico Hazardous Waste Act; New Mexico Statutes Annotated 1978; New Mexico Hazardous Waste Management Regulations; Resource Conservation and Recovery Act ; regulatory correspondence between the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) and the U.S. Air Force, dated January 28, 2011, August 18, 2011, and October 11, 2011; and ongoing Tiger Team meetings between NMED HWB, Shaw, and Kirtland AFB representatives.

This work plan defines activities and requirements for performing air sampling, both indoor and outdoor/ambient, at Kirtland AFB Buildings 1026, 1032, 1033, and 1049 as part of phase-separated hydrocarbon remediation at the BFF Spill site. It also summarizes previous investigations performed at the BFF Spill site. This work plan provides the rationale and scope of work to implement two sampling events, one in January 2012 and one in June 2012.

The air sampling is intended to provide a data set that may be used to evaluate the potential risk to building occupants of inhalation exposure to chemicals. Once data are collected and evaluated, a letter report will be prepared and submitted to Kirtland AFB and the NMED HWB.

This work was performed under the authority of the USACE, Contract No. W912DY-10-D-0014, Delivery Order 0002. All work was conducted in October and November 2011. Mr. Walter Migdal is the Project Manager for the USACE, Albuquerque District. Mr. Wayne Bitner, Jr. is the Kirtland AFB Restoration Section Chief, and Mr. Thomas Cooper is the Shaw Project Manager. This plan was prepared by Ms. Kimberly Jones and Ms. Diane Agnew.

Thomas Cooper, PG, PMP
Shaw Environmental & Infrastructure, Inc.
Project Manager

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ACRONYMS AND ABBREVIATIONS

$\mu g/m^3$	micrograms per cubic meter
AFB	Air Force Base
Air Force	U.S. Air Force
AST	aboveground storage tank
AvGas	aviation gasoline
BFF	Bulk Fuels Facility
bgs	below ground surface
CFR	Code of Federal Regulations
COPC	chemical of potential concern
DCA	dichloroethane
DCB	dichlorobenzene
DCE	dichloroethene
DoD	U.S. Department of Defense
DQCR	daily quality control summary reports
DTIC	Defense Technical Information Center
EDB	ethylene dibromide
EIMS	Environmental Information Management System
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
ERPIMS	Environmental Resources Program Information Management System
ft	feet
ft/day	ft per day
Hg	mercury
HI	hazard index
HWB	Hazardous Waste Bureau
JP-4	Jet Propellant-4 fuel
JP-8	Jet Propellant-8 fuel
MTBE	methyl-tert-butyl ether
ND	not detected
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission regulations
NRC	National Research Council
ppbv	parts per billion by volume
PPE	personal protective equipment

ACRONYMS AND ABBREVIATIONS (Concluded)

QAPjP	Quality Assurance Project Plan
QC	quality control
QSM	*Quality Systems Manual for Environmental Laboratories*
RSL	Regional Screening Level
Shaw	Shaw Environmental & Infrastructure, Inc.
TCA	trichloroethane
TCE	trichloroethene
TetraTech	TetraTech, Inc.
USACE	U.S. Army Corps of Engineers

EXECUTIVE SUMMARY

This Indoor Air Evaluation Work Plan is being submitted in response to correspondence dated January 28, 2011, from the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) to the U.S. Air Force (Air Force). In this letter, the NMED HWB required the Air Force to develop and submit a work plan to perform direct measurement of indoor and ambient air at the Bulk Fuels Facility (BFF) Spill at Kirtland Air Force Base (AFB), New Mexico. The Work Plan was developed during Tiger Team meetings between Kirtland AFB, Shaw Environmental & Infrastructure, Inc., and NMED HWB representatives.

This work plan defines activities and requirements for performing air sampling, both indoor and outdoor/ambient, at Kirtland AFB Buildings 1026, 1032, 1033, and 1049. It also summarizes previous investigations performed at the BFF Spill site. This work plan presents the rationale and scope of work to implement two sampling events, one in January 2012 and one in June 2012.

The air sampling is intended to provide a data set that may be used to evaluate the potential risk to building occupants of inhalation exposure to chemicals . Once data are collected and evaluated, a letter report will be prepared and submitted to Kirtland AFB and the NMED HWB.

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1. INTRODUCTION

1.1 Scope of Activities

This Indoor Air Evaluation Work Plan was prepared by Shaw Environmental & Infrastructure, Inc. (Shaw) for the U.S. Army Corps of Engineers (USACE), Albuquerque District, under contract W912DY-10-D-0014, Delivery Order 0002. This work plan defines the activities and requirements related to performing indoor air and outdoor air/ambient sampling at Buildings 1026, 1032, 1033, and 1049, located at the Bulk Fuels Facility (BFF), Kirtland Air Force Base (AFB), Albuquerque, New Mexico. Two collections of indoor air samples and concurrent outdoor air/ambient samples will be performed in January and June 2012 to represent both winter and summer environments. The results of the outdoor air/ambient samples will be used to evaluate the potential for indoor sources or other sources.

This work plan was prepared in accordance with regulatory correspondence from the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) to the U.S. Air Force (Air Force) on January 28, August 18, and October 11, 2011 (Appendix A, Attachments 1, 2, and 3). The scope of work was defined during the ongoing Tiger Team meetings between Kirtland AFB, Shaw, and NMED HWB representatives.

1.2 Relevant Requirements

In a letter to Kirtland AFB, dated January 28, 2011 (Appendix A, Attachment 1), the NMED HWB requested submittal of an indoor air evaluation work plan for petroleum hydrocarbon fuel compounds in subslab soil vapor. As described in the NMED letter, Kirtland AFB will conduct an Indoor Air Evaluation on buildings within 100 feet (ft) horizontally from or vertically above documented subsurface contamination. The NMED chose Kirtland AFB Buildings 1026, 1032, 1033, and 1049, located within the BFF, to be sampled for indoor air quality and this was communicated to Shaw during the Tiger Team meeting held on September 22, 2010.

On August 18, 2011, the NMED requested a schedule outlining the date by which Kirtland AFB will submit the work plan (Appendix A, Attachment 2). The schedule for the Indoor Air Evaluation Work Plan is included as Appendix B.

On October 11, 2011, the NMED agreed to expedite review of the work plan to allow for the first indoor air sampling event to be conducted in January 2012 (Appendix A, Attachment 3).

1.3 Work Plan Organization

This work plan is organized as follows. Section 1 discusses the scope of activities and applicable requirements and regulatory criteria to be followed. Section 2 addresses project management and personnel. Section 3 describes the site and operational history. The environmental setting and previous investigations are discussed in Section 4. Section 5 presents the descriptions of the buildings to be sampled and the sampling approach for each. Section 6 provides the sampling procedure for indoor and outdoor/ambient air sampling. Section 7 details the field documentation processes that will be followed. Section 8 addresses quality assurance and quality control (QC), and Section 9 discusses the personal protective equipment (PPE) required for this project. Section 10 discusses the future reporting of the results. Section 11 presents the Data Management Plan. Tables and figures are provided under separate tabs following the body of this work plan.

Appendices to this work plan include Appendix A, which contains January 28, August 18, and October 11, 2011 regulatory correspondence from the NMED HWB to the Air Force. Appendix B presents the schedule for the Indoor Air Evaluation Work Plan. Appendix C contains the Kirtland AFB BFF Quality Assurance Project Plan (QAPjP) (Shaw, 2011a). Appendix D provides the floor plans for the four Kirtland AFB buildings that were chosen to be sampled. Appendix E contains photos from the site visit conducted on October 18, 2011. Appendix F contains field forms that will be used for field documentation.

2. PROJECT MANAGEMENT

2.1 Project Scheduling and Reporting Requirements

Shaw is responsible for planning, scheduling, and performing the project activities and fieldwork, as well as documenting and reporting project activities on a daily basis. Shaw is also responsible for compliance with the applicable QC requirements; overall project safety; the safety and health of workers under its direction; and performance of field activities according to the work plan, regulatory requirements, and this contract.

2.2 Project Organization and Resource Management

Mr. Thomas Cooper is the Shaw Project Manager for all investigations and remedial work at the BFF Spill at Kirtland AFB, New Mexico. Mr. Cooper will have overall responsibility for safety and quality on all projects. He will manage and integrate team members and will oversee cost and schedule monitoring and control. All project activities will be coordinated through the USACE Project Manager, Mr. Walt Migdal. Mr. Migdal will have direct communication with the Kirtland AFB Chief of Environmental Restoration, Mr. Wayne Bitner, Jr.

The project team will include corporate, managerial, and technical positions. Personnel at the work site will vary in number, depending on the particular task being completed. According to the established chain of command, Shaw subcontractors will report to Shaw, and Shaw will report to the USACE Project Manager. All Shaw personnel and Shaw subcontractors are required to have current hazardous waste training as defined by Title 29, Code of Federal Regulations (CFR), Section 1910.120. Shaw will directly supervise subcontractors performing fieldwork at all times, and Shaw is responsible for the work performance of all subcontractors under its supervision.

2.3 Project Coordination

During field investigation activities, daily QC reports (DQCRs) will be completed by the Field Team Manager and provided to the Project Manager, client designee(s), and. DQCRs summarize field activities and QC activities that occurred during the day.

Upon planning document approval, mobilization to the site will begin, as soon as practical based on schedule and weather, of field staff (management, technical, subcontractors), equipment (vehicles, computers, global positioning systems equipment, etc.), and materials (e.g., safety supplies).

3. BACKGROUND INFORMATION

3.1 Site Description

Kirtland AFB is located in Bernalillo County, in central New Mexico, southeast of and adjacent to the City of Albuquerque and the Albuquerque International Sunport (Figure 3-1). The approximate area of the base is 52,287 acres. The Kirtland AFB BFF Spill site is located in the northwestern portion of Kirtland AFB (Figure 3-1).

3.2 Operational History

Historical aerial photography has revealed that the Kirtland AFB BFF Spill area was used for fuel storage and processing as early as 1951 (CH2M Hill, 2001). At that time, the fueling area was separated into a distinct tank holding area, where bulk shipments of fuel were received, and a separate fuel loading area, where individual fuels trucks were filled.

Subsequent aerial photographs indicate that construction of the facility and associated infrastructure took place from 1951 until 1953. Once completed, the facility operated until it was removed from service in 1999, as a result of below-grade line leakage along the offloading rack. Bulk storage for Jet Propellant-8 fuel (JP-8), diesel fuel, and aviation gasoline (AvGas) was managed in the eastern portion of the facility. The three types of fuel handled by the BFF were aviation fuel (AvGas; high-octane gasoline), Jet Propellant-4 fuel (JP-4), and JP-8. The use of AvGas and JP-4 at Kirtland AFB was phased out in 1975 and 1993, respectively. JP-8 was handled through the Former Fuel Offloading Rack until the leak was discovered in 1999. A 250-gallon underground storage tank was located near the Building 1033 Pump House (CH2M Hill, 2001).

The exact history of releases is unknown. Conceptually, releases could have occurred when fuel was transferred from railcars, through the Former Fuel Offloading Rack, to the pump house, and then to the bulk fuel storage containers at the southern end of the site (aboveground storage tanks [ASTs] 2420 and 2422). Fuel transfer from the railcars to the pump house was done under vacuum transfers. Transfer of fuel from the pump house to the bulk storage containers was performed under pressurized conditions. Fuel transfer infrastructure for vacuum transfers was exempt from pressure testing, whereas fuel infrastructure for pressurized transfer did undergo regular pressure testing. Only when the vacuum portion of the fuel system underwent pressure testing in 1999 was any problem noted in the fueling system.

In November 1999, three known discharges occurred from the lines that transfer fuel from the JP-8 offloading rack to the pump house at the facility. The discharges included failure of one of the 14-inch-diameter transfer pipelines during a hydrostatic pressure test, a failure of a cam-lock coupling during pressure test of the second 14-inch-diameter transfer pipeline, and failure on the second 14-inch-diameter transfer pipeline itself during a hydrostatic pressure test after the cam-lock problem had been corrected. The first 14-inch-diameter pipeline had been in a state of failure previous to the test for an unknown duration; thus the total amount of fuel released is unknown. The other two discharges were estimated to be approximately 200 to 400 and 30 gallons, respectively. The extent of the contamination from the documented release in 1999 was determined during an investigation required by the NMED, in accordance with New Mexico Water Quality Control Commission regulations (NMWQCC). Contamination exceeding NMWQCC standards was detected in the subsurface soil to a depth of 300 ft below ground surface (bgs) with an aerial extent of 6 to 7 acres. Contamination was detected in the groundwater beneath the site at a depth of 480 ft bgs, 180 ft below the vertical extent of the contamination in the vadose zone, which also exceeds NMWQCC standards. Groundwater contamination was caused by downward diffusion of the soil gas to the water table (Holmes, 2002). Leaks in the transfer piping identified during integrity testing in November 1999 prompted a cessation of the use of the offloading rack in 2000 and its dismantling in 2002.

At present, jet fuel is stored in two ASTs (2.1- and 4.2-million gallons); diesel fuel is stored in two ASTs (one 5,000-gallon and one 10,000-gallon); and unleaded gasoline is stored in one 10,000-gallon AST. The site currently has two offloading pumps located in the southwestern corner of the facility, west of the fuel loading structure (Building 2404).

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4. SITE CONDITIONS

The following sections present a detailed discussion of Kirtland AFB history, geology, and known extent of contamination.

4.1 Geology

4.1.1 Regional Geology

The geology of the Kirtland AFB area varies in accordance with the regional geology. The eastern portion of the base is mountainous, with elevations reaching 7,900 ft above mean sea level. These mountains are composed of Precambrian metamorphic and crystalline rock (primarily granite) and Paleozoic sedimentary rock (primarily marine carbonates). The western portion of the base (which includes the BFF) lies within the Albuquerque Basin. Geologic features in this area of the basin include travertine and unconsolidated and semiconsolidated piedmont deposits, as well as aeolian, lacustrine, and stream channel deposits.

In general, the surficial geology is characterized by recent deposits (i.e., mixtures of sandy silt and silty sand with minor amounts of clay and gravel); Ortiz gravel (i.e., alluvial piedmont sand and gravel deposits); and the Santa Fe Group (i.e., a mixture of sand, silt, clay, gravel, cobbles, and boulders). Generally, the northern and western portions of Kirtland AFB are dominated by unconsolidated geologic units; consolidated units predominate within the eastern half of the base.

Kirtland AFB lies within the eastern portion of the Albuquerque structural basin, which contains the through-flowing Rio Grande. The basin is approximately 90 miles long and 30 miles wide. The deposits within the Albuquerque Basin consist of interbedded gravel, sand, silt, and clay. The presence of clay has significant implications for bulk hydrocarbon migration in the vadose zone. The thickness of basin-fill deposits in most of the basin exceeds 3,000 ft, though the thickness varies considerably because of the large amount of faulting in the basin.

Geologic materials of primary importance within the basin are the Santa Fe Group and the piedmont slope deposits. The Santa Fe Group consists of beds of unconsolidated to loosely consolidated sediments and interbedded volcanic rocks. The materials range from boulders to clay and from well-sorted stream channel deposits to poorly sorted slope wash deposits. Coalescing alluvial fans of eroded materials from the surrounding mountains were deposited unconformably over the Santa Fe Group, extending westward from the base of the Sandia and Manzano mountains to the eastern edge of the Rio Grande floodplain. The fan sediments range from poorly sorted mud flow material to well sorted stream gravel; the beds consist of channel fill and interchannel deposits. The fan deposits range in thickness from 0 to 200 ft and thicken toward the mountains.

4.1.2 Site-Specific Geology

The lithology consists of younger deposits overlaying the Santa Fe Group; a system of unconsolidated Tertiary-aged fluvial (ancestral Rio Grande lithofacies); and alluvial deposits from the Middle Rio Grande Basin. The top 100 to 150 ft consists primarily of silt and silty sand with interbedded clay and poorly graded sand layers. Generally, this silty unit thickens eastward with the silt and clay layers varying from a few feet to 170 ft in thickness. Sand deposits within this unit consist of silty, well graded, and poorly graded sand intervals that range in thickness from 0 to 60 ft.

Presumably, the discontinuous silt and clay layers are zones of low permeability and therefore are likely to impede downward flow of water and contamination, whereas the higher permeability sandy layers could provide pathways for water and contamination to easily migrate downward within the upper depositional unit. Underlying the silty upper unit is the Santa Fe Group. This unconsolidated depositional unit is observed in the subsurface geology at the BFF Spill site and appears to be a highly permeable unit.

This unit is present at depths greater than 100 ft bgs and primarily consists of sand and gravel layers that extend to depths greater than 500 ft bgs.

The sand is generally poorly to well graded and ranges in thickness from 1 to 250 ft. Discontinuous gravel lenses, likely channel deposits, are approximately 50 ft in thickness within some regions, particularly to the north, and are of unknown lateral extent. (Shaw, 2011b)

4.2 Hydrogeology

The groundwater system at Kirtland AFB and in the Albuquerque area lies within the Albuquerque Basin, also referred to as the Middle Rio Grande Basin. The basin is part of the Rio Grande Rift. As the Rio Grande Rift spread, the Albuquerque Basin filled with sediments several miles thick, most of which are referred to as the Santa Fe Group. The unit consists of unconsolidated sediments that thin toward the basin boundary. Edges of the basin are marked by normal faults. Overlying the Santa Fe Group are the Pliocene Ortiz gravel and Rio Grande fluvial deposits.

Generally, the upper unit of the Santa Fe Group contains the most productive portion of the regional aquifer that supplies groundwater to the City of Albuquerque and Kirtland AFB. The unit is characterized by piedmont slope, river, and floodplain deposits. The ancestral Rio Grande formed a large aggradational plain in the central basin, depositing a mix of coarse- to fine-grained sands, silts, and clays with variable bed thicknesses.

Basin-fill deposits comprise the aquifer in the Albuquerque Basin. Hydraulic conductivity values range from 0.25 ft per day (ft/day) to 50.0 ft/day because of large variations in the lithology of the basin-fill deposits. Clay layers have relatively low hydraulic conductivity, whereas gravel and cobble deposits have relatively high hydraulic conductivity. Deposits of interbedded gravel, sand, silt, and clay have intermediate hydraulic conductivity.

This principal aquifer underlies Kirtland AFB, with the basin fill in this area consisting of unconsolidated and semiconsolidated sands, gravels, silts, and clays of the Santa Fe Group; alluvial fan deposits associated with erosion of upland areas; and valley alluvium associated with stream development. The alluvium varies in thickness from a few feet near the mountains on the east side of the base to greater than 2,100 ft at a location 5 miles southwest of the airfield (TetraTech, Inc. [TetraTech], 2004).

4.3 Geochemistry

Geochemical conditions are one factor that influences the transport and transformation of chemical compounds in the environment. Biodegradation often is a major transformation process for petroleum hydrocarbons and related compounds and in general requires sufficient electron acceptors for microbial metabolism of petroleum hydrocarbons. In the presence of a carbon source (including fuel-related aromatic and aliphatic hydrocarbons), naturally occurring bacteria can use the fuel as food for growth and numerous naturally occurring compounds—nitrate, iron, manganese, sulfate, carbon dioxide, etc.—as electron acceptors, producing carbon dioxide, methane, and water (National Research Council [NRC], 2000).

4.4 Previous Investigations

The previous vapor intrusion investigation was conducted by CH2M Hill, and the results are provided in *Screening-Level Risk Evaluation for Petroleum Hydrocarbon Fuel Compounds in Subslab Soil Vapor – Bulk Fuels Facility, Kirtland Air Force Base* (CH2M Hill, 2009). The conclusions of this report are summarized in this section. In the report, the samples were compared with the U.S. Environmental Protection Agency (EPA) chemical-specific regional screening levels (RSLs) for industrial air.

Subslab soil vapor samples were collected in Kirtland AFB Buildings 1032 and 1048. Building 1032 is located in the vicinity of the vadose zone contamination, and Building 1048 is within the area of phase-separated hydrocarbons on the groundwater. The vapor probe in Building 1032 was installed through the concrete floor in the garage on the west side of the building. The vapor probe in Building 1048 was installed in the interior janitor's closet. Building 1032 was sampled twice in July 2009, and Building 1048 was sampled once in July 2009.

Petroleum hydrocarbon fuel compounds were detected in the subslab soil vapor samples from both Buildings 1032 and 1048 (Table 4-1). The detected fuel compound concentrations are below screening levels for the industrial use scenario except for benzene in Building 1048. Based on cumulative carcinogenic risk estimates and noncarcinogenic hazard index (HI) estimates, the results of the data are at the low end or below the EPA's acceptable ranges (CH2M Hill, 2009).

4.5 Identification of Potential Chemicals of Concern

Petroleum contamination associated with the BFF Spill has been identified in subsurface soil, soil gas, and groundwater. Contamination appears to be a result of various releases that have occurred over the operational history of the facility. Information is available on some of the releases, whereas other releases are not well documented and are inferred to have been ongoing for unknown periods of time. All chemicals of potential concern (COPCs) in groundwater, soil, and sediment at the BFF Spill site are constituents of refined petroleum products and include, but are not limited to, the following: benzene, toluene, ethylbenzene, and xylene; ethylene dibromide (EDB); and lead.

The EPA RSLs for resident air are presented in the *Regional Screening Level (RSL) Resident Air Supporting Table June 2011* (EPA, 2011). Residential RSLs for the petroleum-related compounds (in units of micrograms per cubic meter [$\mu g/m^3$]) are as follows:

	Carcinogenic Target Risk	Noncancer HI
• Benzene	0.31 µg/m^3	31.0 µg/m^3
• Toluene	------------	5,200 µg/m^3
• Ethylbenzene	0.97 µg/m^3	1,000 µg/m^3
• Total xylenes	------------	100 µg/m^3
• 1,2-EDB	0.0041 µg/m^3	9.4 µg/m^3

4.6 Potential Receptors and Exposure Scenarios

The potential receptors of contamination caused by the inhalation of chemicals consist of the occupants of Kirtland AFB Building 1032. This space contains an office, bathroom, shower room, and conference room and is used daily by military and civilian workers. Kirtland AFB Building 1026 is used for storage, and the indoor room of Kirtland AFB Building 1033 is used to house the pump controls and electrical system for the pump house. Neither of these buildings have any regular occupants.

Potential inhalation exposure in the buildings will be evaluated using a standard commercial-industrial exposure scenario (EPA, 1989). The residential air RSLs (EPA, 2011) are based on default exposure parameters, including an exposure time (ET) of 8 hours per day.

5. BUILDING DESCRIPTIONS AND SAMPLING APPROACH

5.1 Building Descriptions

The Kirtland AFB Buildings 1026, 1032, 1033, and 1049, located within the BFF Spill site, were originally selected to be sampled for indoor air quality. The NMED chose these buildings and communicated this information to Shaw representatives during the Tiger Team meeting held on September 22, 2011. On October 18, 2011, a site visit was conducted to further characterize each building, interview employees about the occupancy in each building, and locate potential sampling points.

5.1.1 Building 1026

Kirtland AFB Building 1026 is located approximately 500 ft south of Randolph Avenue Southeast and is situated 100 ft north of Building 1032. The building has a raised foundation for loading and unloading of trucks. The foundation rests on compacted dirt. Two rooms located inside the building are separated by a sliding metal door, which is in the closed position. This building is used for storage and is occupied only a few hours each month. No offices, bathrooms, or showers are present in the building that would suggest a long-term working environment. During the site walk, Shaw personnel noticed a strong odor throughout the building that could be indicative of hydrocarbon contamination.

5.1.2 Building 1032

Kirtland AFB Building 1032 is located approximately 100 ft south of Building 1026 and is situated 200 ft southeast of Building 1033. This building is comprised of office space, a hallway, a bathroom with adjoining shower room, a conference room, and a garage. Doors separate these spaces from each other. Within the office space, which is located on the east side of the building, there is a door to the outside that is open during the day. The tenants of Building 1032 occupy all the rooms except the garage on a daily basis.

5.1.3 Building 1033

Kirtland AFB Building 1033, also known as the “Pump House,” is located 200 ft west of Building 1026 and is situated 200 ft northwest of Building 1032. This building is divided into two areas, the indoor room, which houses the pump controls, and the outside space, which is used for fuel lines. The outside space has a roof but no walls. The Pump House also contains a basement area that is exposed by a large grate that covers the entire ceiling. The basement was determined to be a confined space, and access was not possible during the site visit. The indoor room of the Pump House contains no office space, bathroom, shower room, or conference room.

5.1.4 Building 1049

Kirtland AFB Building 1049 is located 150 ft south of Randolph Avenue Southeast and is situated 200 ft southeast of Building 1025. From the building floor plans, there appears to be a large work space on the west side of the building and an office space and bathroom on the east side of the building. Access to Building 1049 was denied during the site visit due to the sensitive nature of the work conducted within the building. To obtain access for a short site visit, Shaw personnel must contact Maurice Katko and schedule an escort. No pictures or notes would be allowed during the visit. Based on a discussion with Jessie Dugan, access to Building 1049 for future sampling events is highly unlikely due to security concerns. Therefore, this work plan includes only Buildings 1026, 1032, and 1033.

5.2 Sampling Approach

Sampling events will take place in January and June 2012 to characterize both winter and summer indoor air conditions. One indoor sample and one outdoor air/ambient sample will be collected for buildings 1026 and 1033 during each event. Two indoor samples and one outdoor air/ambient sample will be collected for building 1032 during each event. The exact locations will be determined upon approval of this work plan.

The potential sampling locations for indoor air are representative of inhalation exposure point concentrations for occupants. They are also placed strategically to differentiate indoor sources (e.g., dry erase markers, cleaning products, paint, carpet and linoleum adhesive). Composite indoor air samples will be collected over an 8-hour period at the breathing zone elevation of 5-to-6 ft above floor level. Detailed sampling procedures are presented in Section 6.0.

The outdoor air/ambient samples will be collected to compare indoor and outdoor air concentrations. Outdoor air/ambient samples will be collected concurrently with indoor air sample collection, although the outdoor air/ambient samples will start a half-hour before the indoor samples because of make-up air processing in the indoor air concentrations. The outdoor air/ambient samples will be collected from upwind locations at a distance equal to twice the height of the building walls on the east side of each building, as the most common wind direction is toward the west within the area of the BFF Spill.

The timing of air sample collection will be coordinated with Kirtland AFB and the building occupants. The goal will be to perform the sampling of all the buildings on the same day, but this is contingent on Kirtland AFB access requirements . Air samples will be analyzed using the modified EPA TO-15 low-level method for compounds to obtain low reporting limits. The chemical concentrations will be reported in units of parts per billion by volume (ppbv) and $\mu g/m^3$.

5.2.1 Building 1026

The indoor air sample for Building 1026 will be collected in the east room a few feet away from the sliding metal door (Figure 5-1). The west room of Building 1026 contains two drums of unknown material that could potentially contribute to concentrations of contaminants. The proposed sampling location is also situated away from a series of metal lockers labeled “Lab Supplies” in the east room. During the site visit, these lockers were closed with padlocks and their contents are unknown. No significant drains or pipes lead from the ground to the inside of the building.

5.2.2 Building 1032

The indoor air sampling for Building 1032 will be collected in the office space and in the shower room close to the shower drain and the drain for the entire room (Figure 5-2). The garage was eliminated as a possible sampling location because of its low occupancy during the day. The conference room located in the middle of the building is also used less regularly than the office and bathroom spaces. The office space is most commonly used by the building occupants. One of the indoor samples will be taken from this room near the southeast corner. The other indoor sample will be taken from the bathroom and shower room close to the open drains.

5.2.3 Building 1033

The indoor air sample for Building 1033 will be collected in the northeastern corner of the indoor room near several pipes leading to electrical utilities and pump controls (Figure 5-3). A box of paint cans stored in the northwestern corner of the indoor room could potentially contribute to concentrations of contaminants.

6. SAMPLING PROCEDURE

The air samples are to be collected in certified-clean, 6-liter, passivated, steel SUMMA® canisters within an 8-hour period at all three building locations. For the time-integrated air samples, a sample of air is drawn through a sampling train of components that regulate the rate and duration of sampling into a pre-evacuated, specially prepared passivated canister. The canisters are stainless steel containers that are supplied under negative pressure. Once received from the laboratory, a pre-evacuated SUMMA® canister can hold a high vacuum (i.e., greater than 30 inches of mercury [Hg]) for up to 30 days.

The most common size of SUMMA® canisters is 6 liters for a time-integrated sample collection. Depending on the laboratory selected to conduct the analyses, smaller sample containers (e.g. 1-liter SUMMA® canisters) may be used for sample collection.

Each pre-evacuated canister received from the laboratory is to be equipped with a brass plug, vacuum gauge, and flow controller. The brass plug ensures that no loss of vacuum occurs due to a valve accidentally opening during shipment. The plug also prevents dust from contacting the valve. A vacuum gauge will be used to measure the initial and final vacuum of the canister and to monitor the canister when collecting an integrated sample. A flow controller (critical orifice) is used when collecting an integrated sample over time. Prior to shipment, the laboratory is to confirm the flow rates for each orifice.

When the canisters are requested from the laboratory, the sampling duration will be specified so that the laboratory can pre-set the flow controller rates. The flow rate is to be set at the laboratory using a pressure of 30 inches Hg to ambient air. A fixed-flow controller is set to collect 5 liters of sample over the time interval so that a net negative pressure is maintained in the canister.

On the day of sampling, the sampling technician will note conditions that might affect the interpretation of the results under which the sample is collected. These conditions include weather conditions, indoor and outdoor air temperature and relative humidity, barometric pressure, wind speed, and any ventilation present.

6.1 Sampling Protocol

When placing canisters for sampling locations in the field, a photoionization detector will be used to complete a field check for potential indoor sources (e.g., source attributed to home construction or household chemical use) in the area to be sampled.

The specific operating protocol for all air samples is provided as follows:

1. Unpack the canisters from the shipping container. Verify that all equipment components are present and the canister valve is closed.
2. Mark each canister with a discrete sample number. Indicate the sample number and the flow controller and SUMMA canister serial numbers on the chain-of-custody form.
3. Remove the brass plug from the canister valve and attach the vacuum gauge tightly. If using a gauge with a "Tee" fitting, cap the side arm of the Tee with the brass plug.
4. Open and close the canister valve. The gauge will register the level of vacuum present. Record this value on the chain-of-custody form for the canister. The initial vacuum of the canister should be greater than 25 inches Hg. If the canister vacuum is less than 25 inches Hg, do not use it and arrange for a replacement canister.
5. Verify that the canister valve is closed. Remove the vacuum gauge and replace the brass plug on the canister valve.
6. Remove the brass plug from the canister valve and attach the flow controller to the canister valve.
7. Place the canister at the sampling location at an approximate breathing zone elevation of 5 ft above the ground surface. In general, the material of the canister is thermal-resistant, but the canisters should be kept out of direct sunlight during sampling.
8. Start the ambient air sampling one-half hour before the indoor air sampling. For each canister, open the valve and record the sampling time.

9. At the end of the sampling period, close the valve and record the time, temperature, and final canister pressure.

10. Remove the flow controller and attach the vacuum gauge. Open and close the canister valve. The gauge will register the level of vacuum present at the conclusion of sampling. Record this value on the chain-of-custody form for the canister. The final pressure of a 6-liter canister should range between 4 and 8 inches Hg. If the vacuum is greater than 8 inches Hg, the sample was collected at a lower flow rate. The laboratory will need to apply a greater dilution factor to the sample, resulting in elevated detection limits. If the final vacuum is less than 4 inches Hg, either the flow rate was too high or the pressure difference across the flow controller diaphragm was too low. Either condition means that the sample is skewed toward the initial sampling interval. This is a nonlinear sample, but it may still be considered valid. If the final pressure is near ambient (less than 1inch Hg), it must be considered an invalid integrated sample.

11. Remove the vacuum gauge. Place the brass plug on the canister valve and tighten. It is essential that all the connections between the canister and flow controller be tight and immobile by hand. A leak in any one of these connections means that some ambient air will be pulled in through the leak and not through the flow controller. A final pressure near ambient is one indication that there may have been a leak.

12. Repackage the sampling hardware in the original shipping materials. Complete the chain-of-custody form and ensure that air samples are properly labeled.

13. Ship samples to the selected project-specific laboratory for analysis. The subcontractor laboratory will maintain a current U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) certification to perform the Modified EPA TO-15 analysis. Sample analysis holding time will be 30 days from sample collection. The potential laboratory reporting limits for the modified EPA TO-15 low-level method are provided in Table 6-1.

6.2 Field Quality Control Samples

Field QC samples for indoor and outdoor air sampling will consist of field duplicate samples collected at one per each sampling event. Field QC samples will be analyzed in the same manner and for the same list of analytes as the associated field samples. Specific details for field QC samples are discussed in the QAPjP for the BFF Spill (Solid Waste Management Units ST-106 and SS-111 [Shaw, 2011a]), which is provided in Appendix C.

6.3 Equipment Decontamination

Equipment decontamination will not be required for this project. The equipment used to collect the indoor and outdoor air samples will be pre-cleaned and certified at the laboratory prior to shipping to the field for use in sample collection.

7. FIELD DOCUMENTATION

Field documentation consists of sample collection and sample handling records associated with the field activities. The documentation for the indoor air evaluation will comply with those procedures specified in the Kirtland AFB BFF QAPjP (Appendix C) for field logs, sample collection logs, equipment calibration logs, sample numbering, labeling, chain-of-custody records, sample packaging, and sample shipping.

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8. QUALITY ASSURANCE/QUALITY CONTROL

A comprehensive QAPjP was developed for the Kirtland AFB BFF Spill project to be implemented in support of sampling and analysis activities (Shaw, 2011a). The processes specified for the soil vapor EPA TO-15 Method will also apply for the low-level TO-15 sampling and analysis required in support of the indoor air evaluation. The QAPjP is provided in Appendix C.

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9. PERSONAL PROTECTIVE EQUIPMENT

Personnel directly involved in air sampling shall wear appropriate PPE as specified in the Site Safety and Health Plan (Shaw, 2010). Appropriate PPE will be selected based on the level of contamination present or suspected at a sampling location. Care will be taken to ensure that the selected PPE will protect workers from unnecessary contact with contamination. The minimum PPE required to perform sampling activities will be steel-toe boots and safety vests, which must be worn at all times within the BFF Spill site. No eating, smoking, drinking, chewing, or any hand-to-mouth contact is permitted during sampling operations. The use of Sharpie markers is also prohibited since this can affect sampling results.

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10. REPORTING

Upon completion of the January 2012 sampling event and receipt of analytical data from the laboratory, a data table of the validated sampling results will be provided to the USACE, Kirtland AFB, and NMED HWB. After the conclusion of the June 2012 sampling event, a letter report will be prepared for submittal to the USACE, Kirtland AFB, and NMED HWB, which will include the following information:

- A summary of the air sampling process
- The results of analyses for both January and June 2012 sampling events
- A figure showing the sampling locations and posting of significant results
- Interpretation of the data, including comparing indoor concentrations to outdoor concentrations and to relevant risk-based criteria for the sampled compounds
- A table listing the analytical results for the air samples

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11. DATA MANAGEMENT PLAN

Environmental laboratory services will be provided only by laboratories compliant with the *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2* (DoD, 2010) and that hold a current DoD ELAP certification for the required analytical methods. All generated analytical data will be uploaded into the Air Force data repository via the Environmental Resources Program Information Management System (ERPIMS).

Analytical data generated in support of the Kirtland AFB BFF Spill project will undergo an EPA Level III data review by the Project Chemist or designee. The data review will be performed using the QC criteria specified in the DoD QSM, Modified EPA TO-15 low-level method, and laboratory-specific standard operating procedures.

The following QC elements will be included in the EPA Level III data review:

- Laboratory method blanks
- Sample analysis holding times
- Surrogate spike recoveries
- Laboratory control sample/laboratory control sample duplicate recoveries
- Relative percent difference for duplicate samples
- Initial calibrations
- Continuing calibrations
- Trip blank data
- Field duplicate samples

Due to laboratory information system limitations, laboratories may not be able to provide initial and continuing calibration results in the required deliverables. In this case, the Project Chemist will manually review the calibration data and document review findings in both a database and data review worksheets.

Data will be validated and flagged with the following data qualifiers as applicable:

- ***J+ qualifier*** denotes the analyte was positively identified, but the associated numerical value is estimated with a potential high bias.
- ***J- qualifier*** denotes the analyte was positively identified, but the associated numerical value is estimated with a potential low bias.
- ***U qualifier*** denotes the analyte was analyzed for, but was not detected.
- ***R qualifier*** denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria and data quality objectives.

As a result of the Level III data review process, EPA qualifiers will be electronically generated and assigned to the sampling results that are outside of established control criteria. The qualified data will then be exported to a contractor database to generate report tables and prepare figures. EPA Level III data review findings will be summarized and documented with each of the sampling event reports.

An Oracle-based Environmental Information Management System (EIMS) will be used for sample planning, data loading, data management, and data reporting. This system supports all aspects of the project from the planning stages throughout the project life cycle and ultimately data archiving, and thus maintains the integrity of all project-related data. Each step of the data management process will be performed in accordance with the Kirtland AFB BFF QAPjP (Appendix C) and applicable *Base-Wide Plans for Investigation under the Environmental Restoration Program, 2004 Update,* Kirtland AFB, New Mexico (TetraTech, 2004). All associated field measurement data will be uploaded into the contractor EIMS and linked with validated analytical results to generate output files that will be used to generate the ERPIMS submittal. ERPIMS data submittals will be reviewed for accuracy and completeness before submittal. ERPIMS submittals will be provided to the Air Force every six months at a minimum or as appropriate for data generation for uploading to the Air Force data repository. ERPIMS submittals will be deemed complete upon receipt of the insertion letter from the Air Force. No data will be released to project stakeholders without the approval of the USACE.

All project-related data will be maintained and archived in the electronic project files on the corporate server and will be made available to the government as necessary. All data generated in support of this project will be maintained in accordance with the contract requirements.

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FIGURES

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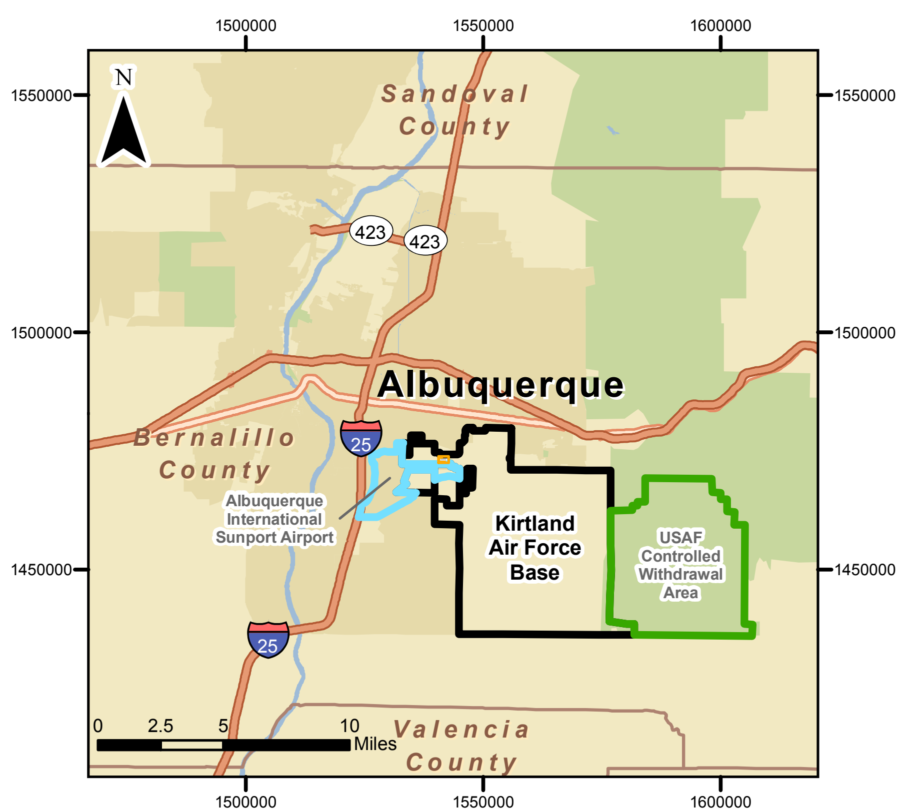
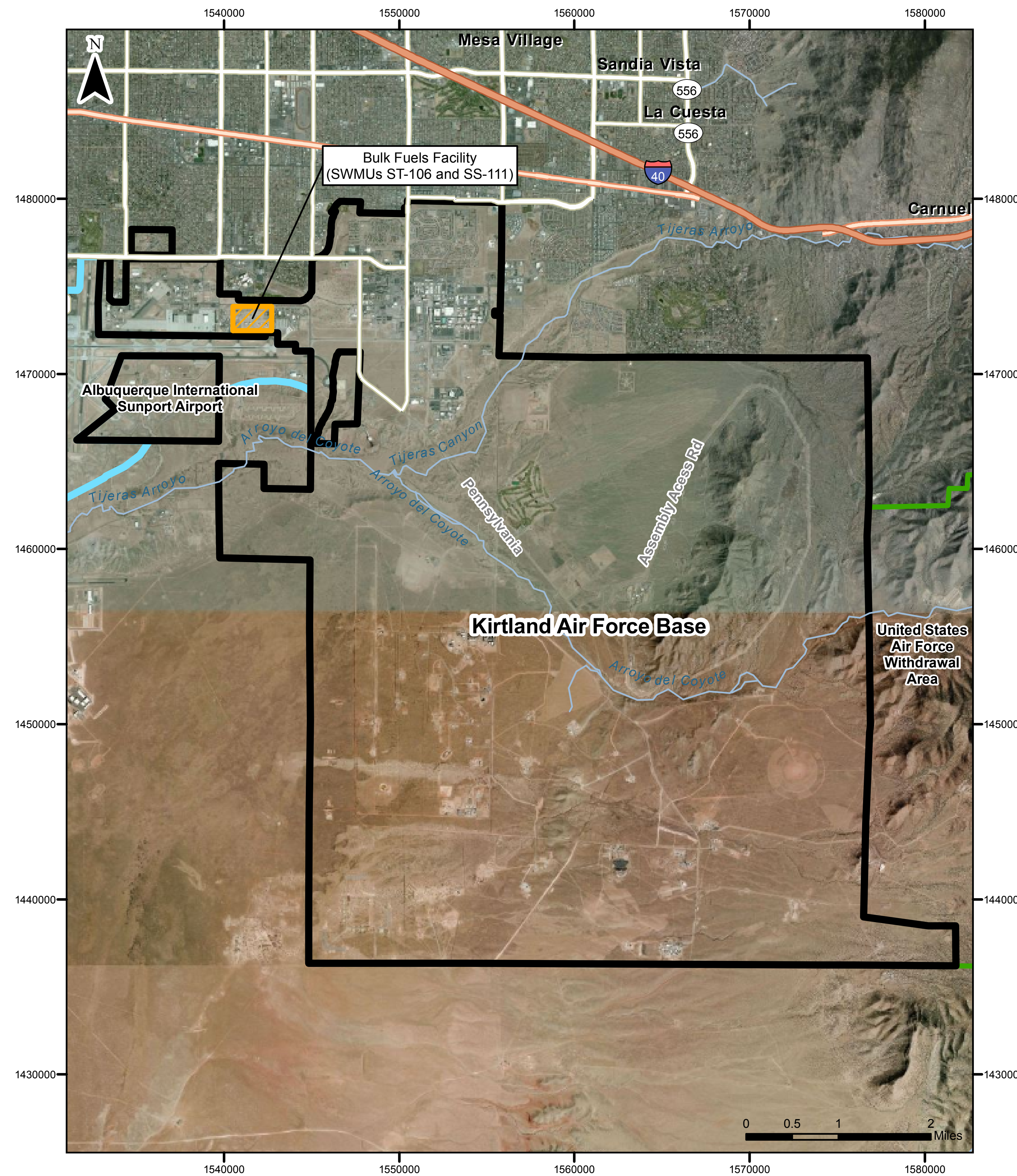
State Map



Local Area Map



Kirtland AFB Area Map

Legend

- Major Highways
- Highways
- Major Roads
- Rivers
- Bulk Fuels Facility (SWMUs ST-106 and SS-111)
- Installation Location
- Kirtland Air Force Base Installation Boundary
- Albuquerque International Sunport Airport
- United States Air Force Withdrawal Area

Projection : NAD_1983_StatePlane_New_Mexico_Central_FIPS_3002_Feet

INTERIM MEASURES WORK PLAN
BULK FUELS FACILITY SPILL
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 3-1

SITE LOCATION MAP

Project Number: 140705 Generated By: MDH Date: 11/09/11 File Path:H:\Kirtland_AFB\GIS_Documents\Project_Maps\2001AB_Site_Plans\Indoor_Air_Quality_WP\KAFB_001_Fig3-1_IndoorAirQual_WP.mxd

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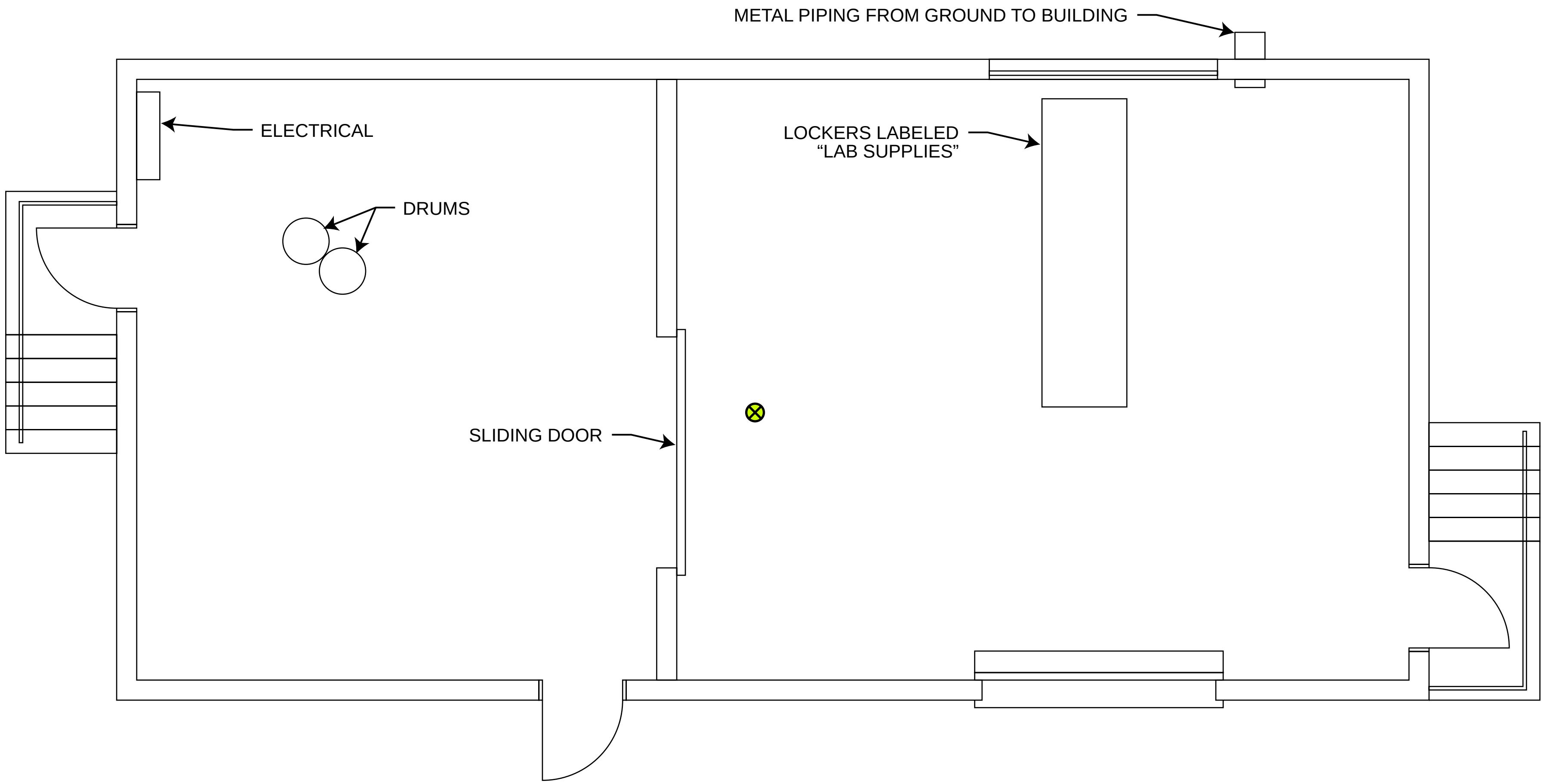

N

NOT TO SCALE

LEGEND

⊗ Proposed Sampling Location

INDOOR AIR QUALITY WORK PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 5-1
BUILDING 1026 FLOOR PLAN AND
PROPOSED SAMPLING LOCATION

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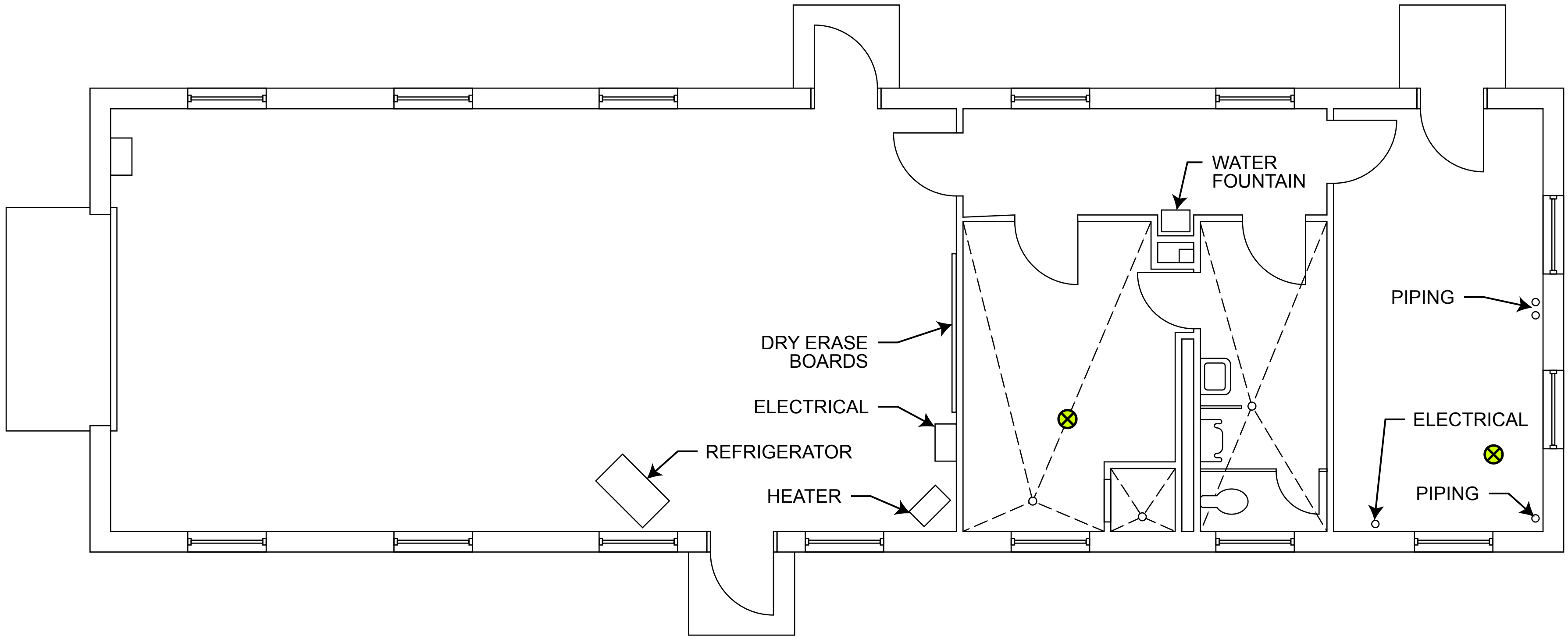

LEGEND

⊗ Proposed Sampling Location

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INDOOR AIR QUALITY WORK PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 5-2
BUILDING 1032 FLOOR PLAN AND
PROPOSED SAMPLING LOCATION

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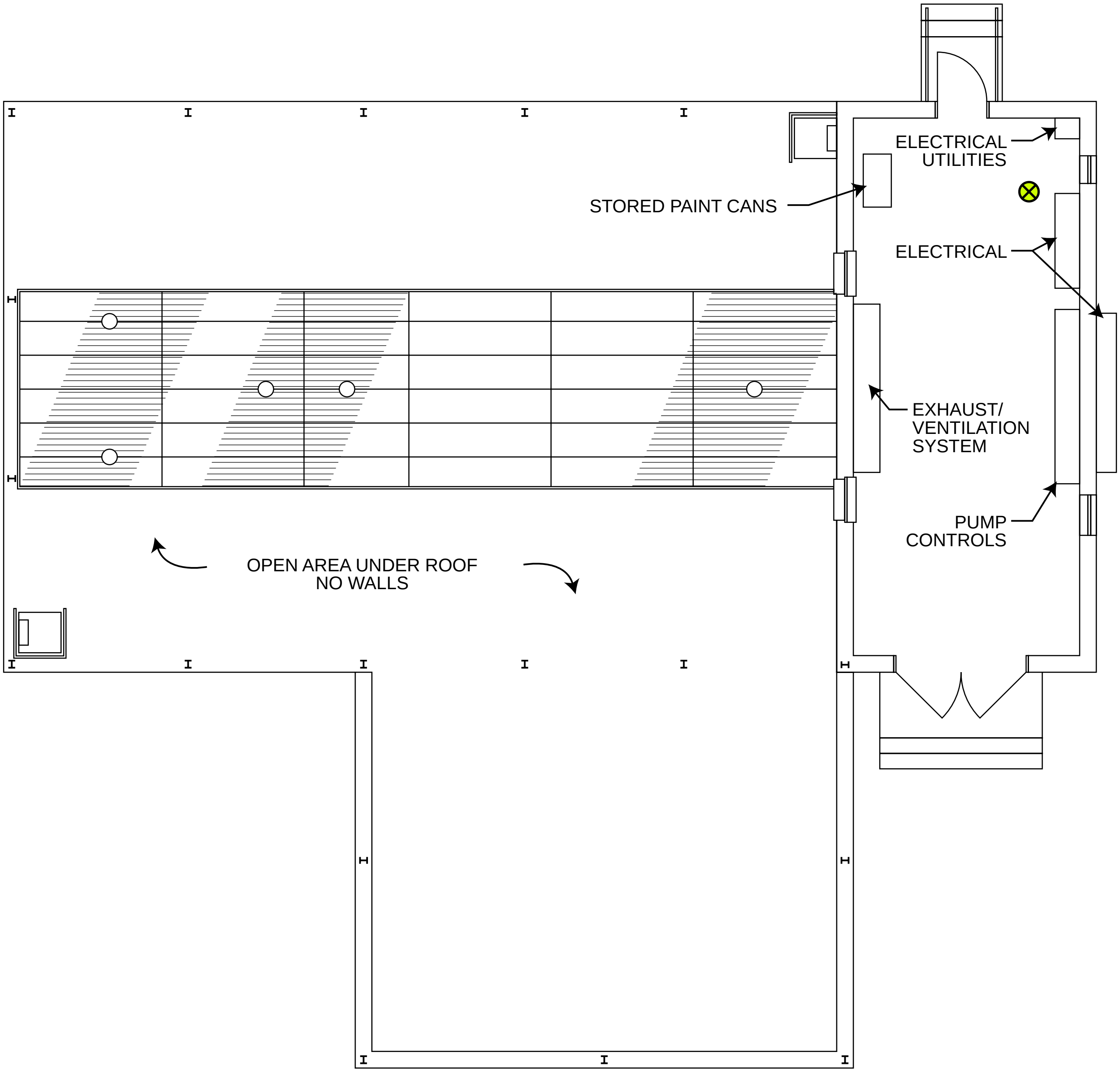

LEGEND

⊗ Proposed Sampling Location

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INDOOR AIR QUALITY WORK PLAN
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 5-3
BUILDING 1033 FLOOR PLAN AND
PROPOSED SAMPLING LOCATION

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TABLES

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Table 4-1. Soil Gas Cumulative Cancer Risk and Noncancer Hazard Index CH2M Hill, 2009

Field ID	Analyte	Result (µg/m^3)	Result Modified for Attenuation Factor (µg/m^3)	Carcinogenic Residential Air RSL (µg/m^3)	Noncancer Residential Air RSL (µg/m^3)	Residential Risk	Residential HI
Bldg-1032	Ethylbenzene	1.39	0.14	0.97	1,000	1.4 E-07	1.4 E-04
Bldg-1032	Styrene	1.35	0.13		1,000		1.3 E-04
Bldg-1032	cis-1,3-Dichloropropene	ND		0.61	21		
Bldg-1032	trans-1,3-Dichloropropene	ND		0.61	21		
Bldg-1032	1,4-DCB	3.31	0.33	0.22	830	1.5 E-06	4.0 E-04
Bldg-1032	1,2-EDB	ND		0.0041	9.4		
Bldg-1032	1,2-DCA	ND		0.094	2,500		
Bldg-1032	m,p-xylene	3.51	0.35		730		4.8 E-04
Bldg-1032	1,3,5-Trimethylbenzene	ND			6.3		
Bldg-1032	Toluene	80.52	8.05		5,200		0.002
Bldg-1032	Chlorobenzene	ND			52		
Bldg-1032	1,2,4-Trichlorobenzene	ND			4.2		
Bldg-1032	Tetrachloroethylene	ND		0.41	280		
Bldg-1032	cis-1,2-DCE	ND					
Bldg-1032	MTBE	3.03	0.3	9.4	3,100	3.2 E-08	9.8 E-05
Bldg-1032	1,3-DCB	ND		0.22	830		
Bldg-1032	Carbon tetrachloride	ND		0.16	200		
Bldg-1032	Acetone	61.44	6.14		32,000		1.9 E-04
Bldg-1032	Chloroform	ND		0.11	100		
Bldg-1032	Benzene	8.23	0.82	0.31	31	2.7 E-06	0.03
Bldg-1032	1,1,1-TCA	ND			5,200		
Bldg-1032	Bromomethane	ND			5.2		
Bldg-1032	Chloromethane	1.01	0.1		94		0.001
Bldg-1032	Chloroethane	ND			10,000		
Bldg-1032	Vinyl chloride	ND		0.16	100		
Bldg-1032	Methylene chloride	9.8	0.98	5.2	1,100	1.9 E-07	8.9 E-04
Bldg-1032	1,1-DCA	ND		1.5			
Bldg-1032	1,1-DCE	ND			210		
Bldg-1032	Trichlorofluoromethane	1.4	0.14		730		1.9 E-04
Bldg-1032	Dichlorodifluoromethane	2.52	0.25		210		0.001
Bldg-1032	1,1,2-Trichloro-1,2,2-trifluoroethane	1.84	0.18		31,000		5.9 E-06
Bldg-1032	1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND					

Table 4-1. Soil Gas Cumulative Cancer Risk and Noncancer Hazard Index CH2M Hill, 2009 (Continued)

Field ID	Analyte	Result (µg/m³)	Result Modified for Attenuation Factor (µg/m³)	Carcinogenic Residential Air RSL (µg/m³)	Noncancer Residential Air RSL (µg/m³)	Residential Risk	Residential HI
Bldg-1032	1,2-Dichloropropane	1.43	0.14	0.24	4.2	6.0 E-07	0.03
Bldg-1032	MEK (2-Butanone)	12.5	1.25		5,200		2.4 E-04
Bldg-1032	1,1,2-TCA	ND		0.15			
Bldg-1032	TCE	3.24	0.32	1.2		2.7 E-07	
Bldg-1032	1,1,2,2-Tetrachloroethane	ND		0.042			
Bldg-1032	Hexachlorobutadiene	ND		0.11			
Bldg-1032	o-xylene	1.39	0.14		730		1.9 E-04
Bldg-1032	1,2-DCB	ND			210		
Bldg-1032	1,2,4-Trimethylbenzene	ND			7.3		
					Bldg-1032 Cumulative Risk and HI:	**5.0 E-06**	**0.07**
Bldg-1048	Ethylbenzene	1.39	0.139	0.97	1,000	1.4 E-07	1.4 E-04
Bldg-1048	Styrene	2.49	0.249		1,000		2.5 E-04
Bldg-1048	cis-1,3-Dichloropropene	ND		0.61	21		
Bldg-1048	trans-1,3-Dichloropropene	ND		0.61	21		
Bldg-1048	1,4-DCB	2.7	0.27	0.22	830	1.2 E-06	3.3 E-04
Bldg-1048	1,2-EDB	ND		0.0041	9.4		
Bldg-1048	1,2-DCA	ND		0.094	2,500		
Bldg-1048	m,p-xylene	3.15	0.315		730		4.3 E-04
Bldg-1048	1,3,5-Trimethylbenzene	ND			6.3		
Bldg-1048	Toluene	7.07	0.707		5,200		1.4 E-04
Bldg-1048	Chlorobenzene	ND			52		
Bldg-1048	1,2,4-Trichlorobenzene	ND			4.2		
Bldg-1048	Tetrachloroethylene	3.27	0.327	0.41	280	8.0 E-07	0.001
Bldg-1048	cis-1,2-DCE	ND					
Bldg-1048	MTBE	ND		9.4	3,100		
Bldg-1048	1,3-DCB	ND		0.22	830		
Bldg-1048	Carbon tetrachloride	ND		0.16	200		
Bldg-1048	Acetone	69.51	6.951		32,000		2.2 E-04
Bldg-1048	Chloroform	ND		0.11	100		
Bldg-1048	Benzene	20.64	2.064	0.31	31	8.7 E-06	0.07
Bldg-1048	1,1,1-TCA	1.97	0.197		5,200		3.8 E-05
Bldg-1048	Bromomethane	ND			5.2		
Bldg-1048	Chloromethane	ND			94		
Bldg-1048	Chloroethane	ND			10,000		

Table 4-1. Soil Gas Cumulative Cancer Risk and Noncancer Hazard Index CH2M Hill, 2009 (Continued)

Field ID	Analyte	Result (µg/m^3)	Result Modified for Attenuation Factor (µg/m^3)	Carcinogenic Residential Air RSL (µg/m^3)	Noncancer Residential Air RSL (µg/m^3)	Residential Risk	Residential HI
Bldg-1048	Vinyl chloride	ND		0.16	100		
Bldg-1048	Methylene chloride	3.62	0.362	5.2	1,100	7.0 E-08	3.3 E-04
Bldg-1048	1,1-DCA	ND		1.5			
Bldg-1048	1,1-DCE	ND			210		
Bldg-1048	Trichlorofluoromethane	154.5	15.45		730		0.02
Bldg-1048	Dichlorodifluoromethane	954.45	95.445		210		0.5
Bldg-1048	1,1,2-Trichloro-1,2,2-trifluoroethane	ND			31,000		
Bldg-1048	1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND					
Bldg-1048	1,2-Dichloropropane	ND		0.24	4.2		
Bldg-1048	MEK (2-Butanone)	7.82	0.782		5,200		1.5 E-04
Bldg-1048	1,1,2-TCA	ND		0.15			
Bldg-1048	TCE	1.7	0.17	1.2		1.4 E-07	
Bldg-1048	1,1,2,2-Tetrachloroethane	ND		0.042			
Bldg-1048	Hexachlorobutadiene	ND		0.11			
Bldg-1048	o-xylene	1.57	0.157		730		2.2 E-04
Bldg-1048	1,2-DCB	ND			210		
Bldg-1048	1,2,4-Trimethylbenzene	ND			7.3		
					Bldg-1048 Cumulative Risk and HI:	**9.0 E-06**	**0.5**
Bldg-1032-2	Ethylbenzene	0.72	0.07	0.97	1,000	7.4 E-08	7.2 E-05
Bldg-1032-2	Styrene	ND			1,000		
Bldg-1032-2	cis-1,3-Dichloropropene	ND		0.61	21		
Bldg-1032-2	trans-1,3-Dichloropropene	ND		0.61	21		
Bldg-1032-2	1,4-DCB	1.41	0.14	0.22	830	6.4 E-07	1.7 E-04
Bldg-1032-2	1,2-EDB	ND		0.0041	9.4		
Bldg-1032-2	1,2-DCA	ND		0.094	2,500		
Bldg-1032-2	m,p-xylene	1.89	0.19		730		2.6 E-04
Bldg-1032-2	1,3,5-Trimethylbenzene	ND			6.3		
Bldg-1032-2	Toluene	1.24	0.124		5,200		2.4 E-05
Bldg-1032-2	Chlorobenzene	ND			52		
Bldg-1032-2	1,2,4-Trichlorobenzene	ND			4.2		
Bldg-1032-2	Tetrachloroethylene	ND		0.41	280		
Bldg-1032-2	cis-1,2-DCE	ND					

Table 4-1. Soil Gas Cumulative Cancer Risk and Noncancer Hazard Index CH2M Hill, 2009 (Concluded)

Field ID	Analyte	Result (µg/m^3)	Result Modified for Attenuation Factor (µg/m^3)	Carcinogenic Residential Air RSL (µg/m^3)	Noncancer Residential Air RSL (µg/m^3)	Residential Risk	Residential HI
Bldg-1032-2	MTBE	ND		9.4	3,100		
Bldg-1032-2	1,3-DCB	ND		0.22	830		
Bldg-1032-2	Carbon tetrachloride	ND		0.16	200		
Bldg-1032-2	Acetone	22.37	2.24		32,000		7.0 E-05
Bldg-1032-2	Chloroform	ND		0.11	100		
Bldg-1032-2	Benzene	1.63	0.16	0.31	31	5.2 E-07	0.005
Bldg-1032-2	1,1,1-TCA	ND			5,200		
Bldg-1032-2	Bromomethane	ND			5.2		
Bldg-1032-2	Chloromethane	1.61	0.16		94		0.001
Bldg-1032-2	Chloroethane	ND			10,000		
Bldg-1032-2	Vinyl chloride	ND		0.16	100		
Bldg-1032-2	Methylene chloride	3.13	0.31	5.2	1,100	6.0 E-08	2.8 E-04
Bldg-1032-2	1,1-DCA	ND		1.5			
Bldg-1032-2	1,1-DCE	ND			210		
Bldg-1032-2	Trichlorofluoromethane	1.4	0.14		730		1.9 E-04
Bldg-1032-2	Dichlorodifluoromethane	2.57	0.26		210		0.001
Bldg-1032-2	1,1,2-Trichloro-1,2,2-trifluoroethane	ND			31,000		
Bldg-1032-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane	ND					
Bldg-1032-2	1,2-Dichloropropane	ND		0.24	4.2		
Bldg-1032-2	MEK (2-Butanone)	11.24	1.12		5,200		2.2 E-04
Bldg-1032-2	1,1,2-TCA	ND		0.15			
Bldg-1032-2	TCE	1.97	0.2	1.2		1.6 E-07	
Bldg-1032-2	1,1,2,2-Tetrachloroethane	ND		0.042			
Bldg-1032-2	Hexachlorobutadiene	1.6	0.16	0.11		1.5 E-06	
Bldg-1032-2	o-xylene	ND			730		
Bldg-1032-2	1,2-DCB	ND			210		
Bldg-1032-2	1,2,4-Trimethylbenzene	ND			7.3		
Bldg-1032-2 Cumulative Risk and HI:						**3.0 E-06**	**0.009**

Table 6-1. Potential Modified EPA TO-15 Low-Level Method Reporting Limits

Compound	Reporting Limit (ppbv)	Reporting Limit (µg/m^3)
Freon 12	0.10	0.49
Freon 114	0.10	0.7
Chloromethane	0.10	0.21
Vinyl Chloride	0.10	0.26
1,3-Butadiene	0.10	0.22
Bromomethane	0.10	0.39
Chloroethane	0.50	1.3
Freon 11	0.10	0.56
Ethanol	0.50	0.94
Freon 113	0.10	0.77
1,1-Dichloroethene	0.10	0.4
Actone	0.50	1.2
2-Propanol	0.50	1.2
Carbon Disulfide	0.50	1.6
3-Chloropropene	0.50	1.6
Methylene Chloride	0.20	0.69
MTBE	0.10	0.36
trans-1,2-Dichloroethene	0.10	0.4
Hexane	0.10	0.35
1,1-Dichloroethane	0.10	0.4
2-Butanone (Methyl Ethyl Ketone)	0.50	1.5
cis-1,2-Dichloroethene	0.10	0.4
Tetrahydrofuran	0.50	1.5
Chloroform	0.10	0.49
1,1,1-Trichloroethane	0.10	0.54
Cyclohexane	0.10	0.34
Carbon Tetrachloride	0.10	0.63
2,2,4-Trimethylpentane	0.50	2.3
Benzene	0.10	0.32
1,2-Dichloroethane	0.10	0.4
Heptane	0.10	0.41
Trichloroethene	0.10	0.54
1,2-Dichloropropane	0.10	0.46
1,4-Dioxane	0.10	0.36
Bromodichloromethane	0.10	0.67
cis-1,3-Dichloropropene	0.10	0.45
4-Methyl-2-pentanone	0.10	0.41
Toluene	0.10	0.38
trans-1,3-Dichloropropene	0.10	0.45
1,1,2-Trichloroethane	0.10	0.54
Tetrachloroethene	0.10	0.68
2-Hexane	0.50	2
Dibromochloromethane	0.10	0.85
1,2-Dibromoethane (EDB)	0.10	0.77
Chlorobenzene	0.10	0.46
Ethyl Benzene	0.10	0.43
m,p-Xylene	0.10	0.43
o-Xylene	0.10	0.43
Styrene	0.10	0.42
Bromoform	0.10	1
Cumene	0.10	0.49
1,1,2,2-Tetrachlrorethane	0.10	0.69
Propylbenzene	0.10	0.49

Table 6-1. Potential Modified EPA TO-15
Low-Level Method Reporting Limits (Concluded)

Compound	Reporting Limit (ppbv)	Reporting Limit (μg/m^3)
4-Ethyltoluene	0.10	0.49
1,3,5-Trimethylbenzene	0.10	0.49
1,2,4-Trimethylbenzene	0.10	0.49
1,3-Dichlorobenzene	0.10	0.6
1,4-Dichlorobenzene	0.10	0.6
alpha-Chlorotoluene	0.10	0.52
1,2-Dichlorobenzene	0.10	0.6
1,2,4-Trichlorobenzene	0.50	3.7
Hexachlorobutadiene	0.50	5.3
Surrogate		
1,2-Dichloroethane-d4	70-130	70-130
Toluene-d8	70-130	70-130
4-Bromofluorobenzene	70-130	70-130

APPENDIX A

2011 Regulatory Correspondence between NMED HWB and the Air Force

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ATTACHMENT 1

January 28, 2011 Correspondence from NMED HWB to Colonel Robert L. Maness, Base Commander, 377 ABW/CC, and Mr. John Pike, Director of Environmental Management Section, 377 MSG/CEANR

Re: Screening-Level Risk Evaluation for Petroleum Hydrocarbon Fuel Compounds in Subslab Soil Vapor

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ATTACHMENT 2

August 18, 2011 Correspondence from NMED HWB to Colonel Robert L. Maness, Base Commander, 377 ABW/CC, and Mr. John Pike, Director of Environmental Management Section, 377 MSG/CEANR

Re: Submittal of Indoor Air Risk Evaluation Work Plan for Petroleum Hydrocarbon Fuel Compounds in Subslab Soil Vapor

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ATTACHMENT 3

October 11, 2011 Correspondence from NMED HWB to Colonel David J. Hornyak, Base Commander, 377 ABW/CC, and Mr. John Pike, Director of Environmental Management Section, 377 MSG/CEANR

Re: Kirtland Air Force Base Indoor Air Work Plan Schedule, September 2011

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APPENDIX B

Work Plan Schedule

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APPENDIX C

Quality Assurance Project Plan
Bulk Fuels Facility Spill
Solid Waste Management Units ST-106 and SS-111
(April 2011)

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APPENDIX D

Floor Plans

Building 1026

Building 1032

Building 1033

Building 1049

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APPENDIX E

Photos from Site Visit on October 18, 2011

Building 1026

Building 1032

Building 1033

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APPENDIX F

Field Forms

Form 1: Field Activity Daily Log

Form 2: Analytical Request/Chain-of-Custody Form

Form 3: Test Equipment and Calibration Log

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