# KIRTLAND AIR FORCE BASE
# ALBUQUERQUE, NEW MEXICO

## Interim Measures Work Plan

### Bulk Fuels Facility Spill
### Solid Waste Management Units ST-106 and SS-111

**March 2011**


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

**KIRTLAND AIR FORCE BASE**
**ALBUQUERQUE, NEW MEXICO**

# INTERIM MEASURES WORK PLAN

# BULK FUELS FACILITY SPILL
# SOLID WASTE MANAGEMENT UNITS ST-106 AND SS-111

**March 2011**

***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***
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This Interim Measures Work Plan describes immediate actions that Kirtland Air Force Base (AFB) is taking to characterize and remediate shallow soil at Solid Waste Management Units ST-106 and SS-111, collectively known as the Bulk Fuels Facility Spill (BFF Spill). It describes investigation activities, including excavation of contaminated soil at the Former Fuel Offloading Rack; PneuLog testing at nine well locations, along with baildown; and radius of influence testing. As part of this work plan, an approach for notifying communities impacted by BFF Spill interim measures will be identified and included in an updated Community Relations Plan, being prepared under separate cover. Information from this interim measures investigation and from concurrent groundwater and vadose zone investigations, will be used to develop and design a soil-vapor extraction interim measure to effectively remediate light non-aqueous phase liquid (LNAPL) in the vadose zone and at the water table. Information from this effort, as well as the vadose zone and groundwater investigations, will provide the data necessary to develop an investigation report that identifies all of the risks associated with the fuel contamination. Submittal of this work plan demonstrates the Air Force's commitment to addressing fuels contamination resulting from past practices and events at the Kirtland AFB BFF Spill.

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COLONEL ROBERT L. MANESS
Commander

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# PREFACE

This Interim Measures Work Plan, describes the immediate actions Kirtland Air Force Base (AFB) will take to remediate the Light Non-Aqueous Phase Liquid (LNAPL) plume resulting from past operations at Solid Waste Management Units ST-106 and SS-111, collectively called the Bulk Fuel Facility Spill, at Kirtland AFB, New Mexico. In order to prioritize field activities to meet the outlined aggressive schedule, Conceptual Site Model Data, including geologic, hydrogeologic, and contaminant conditions will be included as a separate section of the Quarterly Remedial and Site Investigation Report. The site model will encompass the source area(s), fuel percolation area, the LNAPL plume floating on groundwater, and the dissolved-phase contaminant plume.

This Interim Measures Work Plan describes actions that will be taken to reduce or prevent the migration of contaminants, or reduce or prevent exposure to contaminants while long-term remedies are being evaluated. This work plan outlines interim measures for remediating LNAPL floating on groundwater, as well as removing LNAPL from the source, and fuel percolation in areas within the vadose zone for immediate implementation.

This work is being performed under the authority of the U.S. Army Corps of Engineers (USACE), Contract No. W912DY-10-D-0014, Delivery Order 0002. All work was conducted in October and November 2010 and final revisions were made in March 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. Tom Cooper is the Shaw Environmental & Infrastructure, Inc. Project Manager. This plan was prepared by Ms. Sarah Brester, Ms. Melissa Halick, and Ms. Diane Agnew.

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| $^{o}$C | degrees Celsius |
| $^{o}$F | degrees Fahrenheit |
| | |
| ABCWUA | Albuquerque Bernalillo County Water Utility Authority |
| ADR | automated data review |
| AFB | Air Force Base |
| AmBe-241 | americium-beryllium-241 |
| ARCH | air-rotary casing hammer |
| API | American Petroleum Institute |
| ASDE | after-survey depth error |
| AST | aboveground storage tank |
| ASTM | ASTM International |
| AvGas | aviation gasoline |
| | |
| BFF | Bulk Fuels Facility |
| bgs | below ground surface |
| BTEX | benzene, toluene, ethylbenzene, and xylene |
| | |
| CFR | Code of Federal Regulations |
| CGWP | Certified Groundwater Professional |
| CHMM | Certified Hazardous Materials Manager |
| CHP | Certified Health Physicist |
| CIH | Certified Industrial Hygienist |
| COC | Contaminant of Concern |
| COPC | contaminant of potential concern |
| CRP | Community Relations Plan |
| CSM | conceptual site model |
| CSP | Certified Safety Professional |
| | |
| DoD | U.S. Department of Defense |
| DPT | direct-push technology |
| DTIC | Defense Technical Information Center |
| | |
| EDB | ethylene dibromide |
| EIMS | Environmental Information Management System |
| ELAP | Environmental Laboratory Accreditation Program |
| EM | Electromagnetic |
| EM | Engineer Manual |
| EPA | U.S. Environmental Protection Agency |
| EPH | extractable petroleum hydrocarbon |
| ERP | Environmental Restoration Program |
| ERPIMS | Environmental Resources Program Information Management System |
| | |
| FFOR | Former Fuel Offloading Rack |
| ft | foot/feet |
| ft/day | feet per day |
| | |
| GIS | geographic information system |

# ACRONYMS AND ABBREVIATIONS (continued)

| | |
|---|---|
| GPS | global positioning system |
| He-3 | helium-3 |
| HWB | Hazardous Waste Bureau (NMED) |
| ICE | internal combustion engine |
| IDW | investigation-derived waste |
| JP-4 | Jet Propellant Fuel-4 |
| JP-8 | Jet Propellant Fuel-8 |
| LNAPL | light non-aqueous phase liquid |
| MA DEP | Massachusetts Department of Environmental Protection |
| MCL | maximum contaminant level |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| mm | millimeters |
| NAD83 | North American Datum, 1983 |
| NMAC | New Mexico Administrative Code |
| NMED | New Mexico Environment Department |
| NOD | Notice of Disapproval |
| NRC | National Research Council |
| NTIS | National Technical Information Service |
| O.D. | outside diameter |
| OSRTI | Office of Superfund Remediation and Technology Innovation |
| OSWER | Office of Solid Waste and Emergency Response |
| PE | Registered Professional Engineer |
| PG | Professional Geologist |
| PGP | Professional Geophysicist |
| PID | photoionization detector |
| PM | Project Manager |
| PMP | Project Management Professional |
| PPE | personal protective equipment |
| ppm | parts per million |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| QAPjP | BFF Spill Quality Assurance Project Plan |
| QC | quality control |
| RCRA | Resource Conservation and Recovery Act |
| ROI | radius of influence |

# ACRONYMS AND ABBREVIATIONS (concluded)

| | |
|---|---|
| SEDD | Staged Electronic Data Deliverable |
| Shaw | Shaw Environmental & Infrastructure, Inc. |
| SOP | Standard Operating Procedure |
| SPR | standard penetration resistance |
| SPT | standard penetration test |
| SSHP | Site Safety and Health Plan |
| SSL | soil screening level |
| SVE | soil-vapor extraction |
| SVOC | semivolatile organic compound |
| SWMU | Solid Waste Management Unit |
| | |
| TCLP | toxicity characteristic leaching procedure |
| TPH | total petroleum hydrocarbon |
| | |
| USCS | Unified Soil Classification System |
| USACE | U.S. Army Corps of Engineers |
| USF | Santa Fe Group member |
| UTM | Universal Transverse Mercator |
| | |
| VOC | volatile organic compound |
| VPH | volatile petroleum hydrocarbon |
| | |
| wt% | percent by weight |

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# EXECUTIVE SUMMARY

This Interim Measures Work Plan, together with the Vadose Zone Investigation Work Plan, the Groundwater Investigation Work Plan, and the Light Non-Aqueous Phase Liquid (LNAPL) Containment Interim Measure Work Plan, are being developed in response to April 2 and August 6, 2010, regulatory correspondence from the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) to the U.S. Air Force (Air Force). In these letters, the NMED HWB required development and submittal of three separate work plans to address soil and groundwater contamination at Solid Waste Management Units ST-106 and SS-111 at Kirtland Air Force Base (AFB), New Mexico, collectively known as the Bulk Fuels Facility (BFF) Spill. An additional work plan is also being developed to address installation of an LNAPL containment system. The LNAPL containment system will provide physical containment of the LNAPL plume and isolate the dissolved-phase plume from the LNAPL source. This LNAPL containment interim measure will meet the NMED requirement for an immediate action to reduce or prevent the migration of contaminants. The four work plans will be implemented concurrently to expedite completion of each task. Submittal of these work plans demonstrates the Air Force's commitment to remediating fuel contamination resulting from past practices and events at the BFF Spill.

The Interim Measures Work Plan, presented in this document, describes immediate actions that Kirtland AFB is taking to begin remediation at the BFF Spill. This work plan describes investigation requirements of the August 6, 2010, NMED letter (Appendix A, Attachment 2), which includes excavation of contaminated soil at the Former Fuel Offloading Rack (FFOR), PneuLog testing at nine well locations, as well as baildown and radius of influence (ROI) testing.

The Quarterly Remedial and Site Investigation Report (Quarterly Monitoring Report) will provide a comprehensive, site-specific, Conceptual Site Model (CSM) using regional and site-specific information from the previous investigations. A current understanding of the sources, contaminants, and media impacted by activities at the BFF Spill will be provided in the updated CSM, with particular emphasis on LNAPL migration and transport.

Using existing data and NMED comments, a set of interim remediation measures were developed to begin addressing the LNAPL plume present beneath the BFF Spill. The focus of these interim remediation measures is mitigation of LNAPL migration in the subsurface to limit further impact to the regional aquifer that supplies drinking water for the Albuquerque Bernalillo County Water Utility Authority. The Air Force has adopted a strategy to halt and prevent further migration of LNAPL in the capillary and saturated zone of the aquifer. The primary mechanism for preventing further LNAPL migration is the removal of LNAPL mass, both through soil-vapor extraction (SVE) and groundwater/LNAPL extraction, from the subsurface to the extent practicable during these interim measures.

The specific remediation measures described in this work plan are:

- A shallow soil boring program using Geoprobe® technology will be employed at the FFOR to establish the location of shallow soil that requires interim remediation (i.e., shallow soil that exceeds the NMED soil screening levels for hazardous constituents [NMED, 2009]);
- Analytical testing of the soil at the FFOR to determine the extents of contamination at the FFOR for excavation activities;
- Excavation of all contaminated soil along the former pipeline at the FFOR; and

- PneuLog vertical profiling of newly installed vadose zone wells, baildown testing, and ROI testing to determine the most favorable locations and depths for soil SVE to remediate LNAPL in the unsaturated LNAPL source zone at the water table and throughout the vadose zone.

Information from this interim measure, combined with information from the groundwater and vadose zone investigations, will be used to develop and design an SVE interim measure to effectively remediate LNAPL in the vadose zone and at the water table. In addition, information from this effort, as well as the vadose zone and groundwater investigations, will provide the data necessary to develop an investigation report that identifies all of the risks associated with the fuel contamination.

# 1. INTRODUCTION

## 1.1 Overview

This Interim Measures Work Plan was prepared by Shaw Environmental and Infrastructure, Inc. (Shaw) for the U.S. Army Corps of Engineers (USACE) under contract W912DY-10-D-0014, Delivery Order 0002. This work plan pertains to interim measures associated with the Kirtland Air Force Base (AFB) Bulk Fuels Facility (BFF) Spill, Solid Waste Management Units (SWMUs) ST-106 and SS-111 (collectively known as the "BFF Spill"). The BFF Spill site is located in Albuquerque, New Mexico (Figure 1-1). 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, 20.4.1 New Mexico Administrative Code (NMAC);
- Resource Conservation and Recovery Act (RCRA);
- April 2 and August 6, 2010, regulatory correspondence between the New Mexico Environment Department (NMED) and the U.S. Air Force (Air Force) regarding the BFF Spill at Kirtland AFB (Appendix A); and
- Kirtland *AFB Base-Wide Plans for Investigation under the Environmental Restoration Program* (Tetra Tech, 2004).

The Interim Measures Work Plan describes the technical approach for addressing the two major requirements of the NMED's letter, dated April 2, 2010 (Appendix A, Attachment 1), to adequately characterize and remediate shallow soil at the BFF Spill and to incorporate additional comments and associated requirements as outlined in the August 6, 2010, NMED Notice of Disapproval (NOD) letter (Appendix A, Attachment 2) for the Kirtland AFB BFF Spill light non-aqueous phase liquid (LNAPL) plume.

## 1.2 Scope of Activities

This Interim Measures Work Plan describes field investigation activities and investigation activities regarding the nature and extent of contamination. In addition, an interim measure soil-vapor extraction (SVE) design report will be prepared detailing the requirements for implementation of an SVE interim measure for the vadose zone.

The Interim Measures Work Plan, presented in this document, describes the immediate actions that Kirtland AFB is taking to begin the remediation at SWMUs ST-106 and SS-111, collectively called the BFF Spill, at Kirtland AFB. This work plan describes investigation requirements of the August 6, 2010, NMED letter (Appendix A, Attachment 2), which includes excavation of contaminated soil at the Former Fuel Offloading Rack (FFOR); PneuLog testing at nine well locations, as well as baildown and radius of influence (ROI) testing.

As part of the Interim Measures Work Plan revision, an approach for notifying communities that will be impacted by the BFF Spill interim measures efforts will be created and is outlined in the Community Relations Plan (CRP), which will be issued under separate cover. This notification approach will include

information obtained during the CRP update to prepare and conduct appropriate notification activities through the methods and channels identified by the community.

In order to prioritize field activities to meet the outlined aggressive schedule, the Quarterly Remedial and Site Investigation Report (Quarterly Monitoring Report) will provide a comprehensive, site-specific conceptual site model (CSM) using regional and site-specific information from previous investigations. This report will contain all CSM data, including geologic, hydrologic, and contaminant conditions. The site model will encompass the source area(s), fuel percolation area, the LNAPL plume floating on groundwater, and the dissolved-phase contaminant plume. In this report, a current understanding of the sources, contaminants, and media that have been impacted by the activities at the BFF will be provided in the updated CSM, with particular emphasis on LNAPL migration and transport.

## 1.3 Approach and Implementation

Data developed during the past several years have revealed that there is a substantial LNAPL plume emanating from the BFF Spill and that immediate action can mitigate the impact of the LNAPL plume. This work plan defines interim measures that will be performed for the FFOR at the BFF that, in conjunction with the LNAPL containment system interim measure, will mitigate the potential endangerment to the regional aquifer that provides drinking water for the Albuquerque Bernalillo County Water Utility Authority (ABCWUA). The LNAPL containment system will provide physical containment of the LNAPL plume and isolate the dissolved-phase plume from the LNAPL source. This LNAPL containment interim measure will meet the NMED requirement for an immediate action to reduce or prevent the migration of contaminants.

Implementation of this work plan will be performed in conjunction with the Vadose Zone Investigation Work Plan, Groundwater Investigation Work Plan, and LNAPL Containment Interim Measure Work Plan prepared for the BFF. Intrusive investigations will determine the extent of soil contamination at the BFF Spill and will provide insight into the chemical makeup and distribution of contaminants within the vadose zone. Simultaneously focused investigations and pilot tests, described in this work plan, will be performed to develop final designs of interim measures that will remediate LNAPL.

## 1.4 Data Gaps

Following previous investigations at the BFF Spill, data gaps related to the nature of the fuels contamination and the extent of contaminations resulting from past operational history at the BFF Spill were identified. In addition to describing the immediate actions being taken to start remediation, the intent of the Interim Measures Work Plan is to also address major data gaps and to provide data of sufficient quality to in order to completely characterize the nature and extent of fuels-related soil and soil-vapor contamination (Table 1-1). Specifically, these data gaps include:

1. Characterize the vadose-zone hydrology and its relationship to the water table (Section 4.2.11, Table 4-2, and Figure 4-1 of the Vadose Zone Investigation Work Plan; Sections 4.6.2 and 4.6.11 of the Interim Measures Work Plan).

2. Determine the nature and extent of soil contamination along former and existing pipelines connecting the FFOR to Building 1033 and from Building 1033 to Jet Fuel Storage Tank 2420 and 2422 (Sections 4.5.2.1 and 4.5.2.2 of the Interim Measures Work Plan).

3. Characterize the soil-vapor distribution, soil permeability relative to LNAPL, and contaminant concentrations profiles within the vadose zone (Sections 4.2.10 and 4.2.11 of the Vadose Zone Investigation Work Plan; Sections 4.6.2, 4.6.10, and 4.6.11 of the Interim Measures Work Plan).

4. Identify the potential source of the LNAPL plume and extent of contamination (Sections 4.6.2 and 4.6.3 of the Interim Measures Work Plan).

5. Determine the aquifer conductivity relative to LNAPL and recoverability at the water table/LNAPL interface (Section 4.6.10 of the Interim Measures Work Plan).

6. Determine the radius of influence of future and proposed soil-vapor extraction units for optimization of remedy design (Section 4.6.11 of the Interim Measures Work Plan ).

## 1.5 Regulatory Requirements

In a letter to Kirtland AFB dated April 2, 2010, the NMED required Kirtland AFB to submit an "Interim Measures (IM) Plan that describes the immediate actions it will take to remediate and stop the migration of the LNAPL plume." This action is to be performed on an interim basis prior to performing a Corrective Measures Evaluation or Corrective Measures Implementation to mitigate the endangerment of the regional aquifer that provides drinking water for ABCWUA (Appendix A, Attachment 1). The interim measures that the NMED has required are focused on removal of LNAPL, which acts as a source of dissolved fuel upgradient of the ABCWUA groundwater supply wells.

On August 6, 2010, the NMED determined that the draft work planning documents submitted in response to the April 2, 2010, letter were deficient and issued an NOD instructing Kirtland AFB to correct NMED identified deficiencies. This Interim Measures Work Plan, in conjunction with the Vadose Zone Investigation Work Plan, Groundwater Investigation Work Plan, and LNAPL Containment Interim Measure Work Plan, addresses the deficiencies as outlined in the August 6, 2010, NOD (Appendix A, Attachment 2).

## 1.6 Work Plan Organization

This Interim Measures Work Plan is organized into the following 12 major sections:

- Section 1: Introduction
- Section 2: Site Setting and Background
- Section 3: Site Conditions
- Section 4: Methods and Approach
- Section 5: Monitoring and Sampling
- Section 6: Project Schedule
- Section 7: Organizational Plan
- Section 8: Data Management Plan
- Section 9: Quality Assurance (QA)/Quality Control (QC)
- Section 10: Waste Management
- Section 11: Accident Prevention Plan/Site Safety and Health Plan (SSHP)
- Section 12: Community Relations Plan

Figures and tables are provided in separate tabs following the body of the report.

Appendices to this work plan include:

- Appendix A: 2010 Regulatory Correspondence between the NMED Hazardous Waste Bureau (HWB) and the Air Force regarding the Kirtland AFB BFF Spill

- Appendix B: Project Schedule

- Appendix C: Waste Management Plan
- Appendix D: Field Forms
- Appendix E BFF Spill Quality Assurance Project Plan (QAPjP)
- Appendix F PneuLog Test Standard Operating Procedure (SOP)

# 2. SITE SETTING AND BACKGROUND

## 2.1 Site Description

Kirtland AFB is located in southeast Albuquerque, Bernalillo County, New Mexico, and occupies 51,558 acres. Kirtland AFB is bounded to the north and west by the City of Albuquerque, to the south by the Pueblo of Isleta, and to the east by the Cibola National Forest. The installation is adjacent to the City of Albuquerque airport, named the Albuquerque International Sunport.

A detailed discussion of base history, geology, and climate is included in Section 3 of the *Base-Wide Plans for Investigation under the Environmental Restoration Program* (Tetra Tech, 2004). The following sections provide a synopsis of relevant information.

## 2.2 Operational History

The Kirtland AFB BFF Spill is located in the western part of Kirtland AFB (Figure 2-1). Historical aerial photography has revealed that the area was utilized 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 (near the location of existing well KAFB-1066) and a separate fuel loading area where individual fuels trucks were filled. The truck loading area appears to have been approximately 250 feet (ft) north of the tank area.

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

The exact history of releases is unknown. Conceptually, releases could have occurred when fuel was transferred from railcars, through the FFOR, to the pump house and then to the bulk fuel storage containers at the south end of the site (Tanks 2420 and 2422). The probable release points have been investigated and are summarized in subsequent sections. The fuel transfer from the railcars to the pump house was done under vacuum. The 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 that was not required in 1999 was any problem noted in the fueling system.

At present, jet fuel is stored in two aboveground storage tanks (ASTs) (2.1- and 4.2-million gallons). Diesel fuel is stored in two ASTs (5,000- and 10,000-gallon), and unleaded gasoline is stored in one 10,000-gallon AST. The site currently has one temporary JP-8 offloading rack located in the southwestern corner of the facility, west of the fuel loading structure (Building 2404). This rack was placed into service following the piping failure at the FFOR (SWMU ST-106). A second small offloading rack (Building 2401) is used for the delivery of diesel and unleaded gasoline motor vehicle fuels.

The fuel delivered to the temporary JP-8 offloading rack is conveyed to the pump house (Building 1033) via subsurface transfer lines. The fuel is then pumped to the JP-8 ASTs via piping of varying sizes that

runs above the ground for approximately 750 ft, and below the ground for approximately 300 ft. Figure 2-1 shows the infrastructure present within the eastern portion of the BFF.

# 3. SITE CONDITIONS

This section describes site conditions, including regional and site-specific geology, hydrogeology, and geochemistry. In addition, it presents the known extent of contamination, summarizes previous investigative results, and describes contaminants of potential concern (COPCs).

## 3.1 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, igneous (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 semi-consolidated 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 in 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 (CH2M HILL, 2008).

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. The Santa Fe Group (USF) under the BFF is further broken down into two depositional facies called the USF-1 and USF-2 (Hawley et al., 1995). As shown on Table 3-1, USF-1 is present from ground surface to approximately 86 ft below ground surface (bgs), then a transition occurs where USF-1 and USF-2 are interfingered to a depth of 117 ft bgs, under which USF-2 is present to a depth of greater than 500 ft bgs (CH2M HILL, 2008).

## 3.2 Site-Specific Geology

Soil types at the BFF range from lean clays, silts, and sands to minor silty or sandy gravels. These can be correlated into several litho-stratigraphic zones discussed below.

- From the surface to approximately 85 ft bgs, the soil primarily consists of thick, discontinuous intervals of silt and silty or sandy clays.

- From approximately 86 to 144 ft bgs, two 3- to 25-ft-thick units of poorly graded fine-grain sands alternate with two silty, sandy, and lean clay units that are up to 25 ft in thickness.
- From approximately 144 to 270 ft bgs poorly graded fine-grained sands combine with well-graded fine- to coarse-grained sands.
- A significant 15-ft-thick clay zone occurs within the lower sandy zone at about 270 ft bgs.

Soil at the BFF ranges from wet to dry. The finer-grained upper soil is generally moist while the coarser-grained deeper soil could be either moist or dry. Several minor perched water-bearing zones are present in the vadose zone above the regional water table at the BFF. None of these water-bearing zones is substantial enough to merit the installation of a groundwater monitoring well. Some of these water-bearing zones below 400 ft bgs probably represent remnants of the regional aquifer that have remained as the water table has dropped. The regional water table is present at approximately 485 ft bgs as indicated by wet, gravelly, sand drill cuttings (CH2M HILL, 2001).

## 3.3 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 thickness.

Basin-fill deposits make up 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 (Tetra Tech, 2004).

This principal aquifer underlies Kirtland AFB, with the basin fill in this area consisting of unconsolidated and semi-consolidated 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 (Tetra Tech, 2004).

## 3.4 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). Microbial testing for soil performed in 2009 found that significant microbial action was detected at the location with high fuel contamination (CH2M HILL, 2009).

## 3.5 Nature and Extent of Contamination

### 3.5.1 Contaminant Sources

In November 1999, three known discharges occurred as a result of pressure testing of the lines that transfer fuel from the JP-8 offloading rack (Building 2405) to the pump house at the facility (Figure 2-1):

- Failure of one of the 14-inch-diameter belowground transfer pipelines (pipeline #22) during a hydrostatic pressure test,
- Failure of a cam-lock coupling during pressure test of the second belowground transfer pipeline (pipeline #23), and
- Failure of the second belowground transfer pipeline (pipeline #23) during a hydrostatic pressure test after the cam-lock coupling problem had been corrected.

Testing revealed that the primary belowground transfer pipeline (pipeline #22) had been in a state of failure for an unknown duration; therefore, the total amount of fuel released is unknown. The volumes of the second two discharges were estimated to be approximately 200 to 400 gallons and 30 gallons, respectively. For all discharges documented in November 1999, the product released was JP-8. However, because of the presence of multiple types of fuel contamination on the water table and the size of the LNAPL plume, it is likely that the primary pipeline had been in a state of failure for many years. The presence of LNAPL fuel hydrocarbons on the water table also indicates that substantial releases have occurred and that a range of fuel types may have been released. Fuel types include AvGas, diesel, JP-4, and JP-8 (Tetra Tech, 2004).

In 1951, the U. S. Government specified JP-4 (for jet propellant) as a 50-50 kerosene-unleaded gasoline blend (MIL-J-5624E). JP-4 was the primary Air Force jet fuel between 1951 and 1995 (Tetra Tech, 2004). JP-4 is a mixture of aliphatic and aromatic hydrocarbons with a low flash point (0° Fahrenheit [°F]/-18° Celsius [°C]); if a lit match is dropped into JP-4, ignition does not occur.

JP-8 was specified by the U. S. Government in 1990 as a lower volatility replacement for JP-4. JP-8 is kerosene-based and has been used in nearly all jet aircraft, tactical ground vehicles, and electrical generators since 1996. Based on historical Air Force fuel usage, AvGas would have been in use from approximately the 1940s to 1975. Ethylene dibromide (EDB) was added to the fuel as a lead scavenger and serves as a useful tracer of time frames. Likewise, the transition from JP-4 to JP-8 in 1993 serves as another potential marker.

Over the past several years, potential sources in addition to the offloading rack have been evaluated as possible contributors to LNAPL on the water table. These previously investigated potential sources include the pump house, a fueling island, underground piping, an evaporation pond, and areas where water from the bottom water holding tanks was released. The bulk fuel ASTs will be investigated following the demolition of the standing ASTs. Demolition in this area is anticipated to be complete in the second quarter of 2011 (Tetra Tech, 2004).

### 3.5.2 Previous Investigative Results

As discussed in Section 3.5.1, in November 1999, three known discharges occurred as a result of pressure testing of the lines that transfer fuel from the JP-8 offloading rack (Building 2405) to the pump house (Building 1033) at the facility. Subsequent investigations were conducted, and the results are provided in the following reports:

- *Stage 1 Abatement Plan Report for the Bulk Fuels Facility (ST-106),* Kirtland Air Force Base, New Mexico (CH2M HILL, 2001)
- *Stage 2 Abatement Plan Report for the Soil Vapor Extraction and Treatment System, Bulk Fuels Facility (ST-106*), Kirtland AFB, New Mexico (CH2M HILL, 2006a)
- *Stage 1 Abatement Plan Report, East Side of the Kirtland AFB Bulk Fuels Facility,* Kirtland Air Force Base, New Mexico (CH2M HILL, 2006b)
- *Semi-Annual Summary and Performance Report for the Bulk Fuels Facility, October 2007 through March 2008,* Kirtland AFB, New Mexico (CH2M HILL, 2008)
- *Remediation and Site Investigation Report for the Bulk Fuels Facility, April 2009–September 2009,* Kirtland Air Force Base, New Mexico (CH2M HILL, 2009)

The conclusions of these reports are summarized in the following sections. In the reports, the soil data collected during the BFF investigations are compared with the NMED's total petroleum hydrocarbon (TPH) screening guidelines to aid in defining the extent of contamination (NMED, 2006). The petroleum product subgroup containing kerosene and jet fuel was selected as applicable for the BFF site. The TPH toxicity for jet fuel is based on the weighted sum of the toxicity of the hydrocarbon fractions, which is reported as 30 percent for C11-C22 aromatics and 70 percent for C9-C18 aliphatics. Based on this assumed composition, the documented TPH screening guideline for potable water industrial direct exposure for jet fuel is 1,810 milligrams per kilogram (mg/kg). The TPH screening guideline for vapor migration and inhalation of groundwater industrial direct exposure is 2,350 mg/kg.

**Stage 1 Abatement Plan Report (CH2M HILL, 2001)**

In the soil investigations initiated immediately after the 1999 discovery of the fuel line leak, contamination was detected along the JP-8 offloading rack that supplies the 300-ft-long belowground pipeline. The horizontal extent of shallow contamination less than 40 ft bgs was delineated during the June 2000 direct-push technology (DPT) investigation portion of the Phase 1 investigation. This contamination appeared to be limited to within 50 ft lateral to the location where the pipelines went belowground.

The site investigations conducted during 2000 also included soil characterization at depth, extending downward to the water table at select locations. Contamination was identified in two deep soil borings (SB-25 and SB-26) installed during July 2000 using hollow-stem auger drilling. These two borings were located on the eastern and western ends of the offloading rack. The maximum concentration of TPH detected in the soil from boring SB-25 was 81,000 parts per million (ppm) in the sample from 105 ft bgs, which is just below the Transition Zone between USF-1 and USF-2. The maximum concentration of TPH detected in boring SB-26 was 114,000 ppm in the sample from 270 ft bgs, which is just above the Clay Zone that divides the USF-2 hydrostratigraphic unit.

Additional borings were installed to determine the horizontal extent of the soil that contains TPH concentrations greater than 100 mg/kg. Based on data from the additional borings, soil contamination that exceeds the NMED TPH Screening Guidelines (NMED, 2006) is limited to within approximately 310 ft of the surface, and within the area 65 ft south (SB-29A), 280 ft north (SB-34), 400 ft east (SB-32), and 175 ft west (SB-33) of the FFOR. The total area of soil affected by the petroleum hydrocarbon contamination is estimated to be 6.5 acres with depths of contamination extending to 310 ft bgs.

**Stage 2 Abatement Plan Report (CH2M HILL, 2006a)**

Additional borings were advanced in 2003 as part of a pilot test for SVE. All four soil-vapor monitoring wells included both soil and vapor sampling capabilities and were completed to depths of approximately 450 ft bgs. In addition to the anticipated intervals of petroleum-related contamination, two locations were found to have detections at the lowest sampling depth of 60 ft bgs.

**Stage 1 Abatement Plan Report, East Side of the Kirtland AFB Bulk Fuels Facility (CH2M HILL, 2006b)**

In 2005, a shallow soil investigation of potential source areas on the east side of the BFF was conducted. Soil samples were collected from the following areas:

- Former Wash Rack Drainfield
- Three Fuel-Storage ASTs
- Former Fuel/Water Evaporation Pond
- Recovered Liquid Fuel Collector Tank
- Primary Fuel-Storage ASTs and Tank Bottom Water-Holding Tanks

The investigation included excavating test pits (TP-07, TP-08, and TP-09) and advancing a DPT borehole (SB-04) to 50 ft bgs. Additionally, a temporary soil-vapor monitoring point was installed in the DPT borehole and monitored for TPH concentrations with field monitoring equipment for several quarters. Based on visual observations, analysis of soil samples from the test pit and shallow soil sampling at this location, and analysis of soil-vapor samples, no substantial hydrocarbon impacts were identified in the interval from the ground surface to 50 ft bgs. The only area where soil exceeded the NMED TPH guideline was located in the vicinity of the primary fuel storage ASTs and tank bottom water-holding tanks. The maximum TPH concentration was 2,400 mg/kg detected in the sample from 15 ft bgs. None of the detections indicates the area was contributing to the soil-vapor profile at the BFF Spill.

**Semi-Annual Summary and Performance Report (CH2M HILL, 2008)**

In 2007, groundwater monitoring well KAFB-1066 was installed in the general vicinity of the east side of the BFF. This monitoring well was installed between the presumed area of the storage tank associated with the 1951 rack operations and the location of the filling rack itself where tanker trucks would have been fueled. Well KAFB-1066 is roughly 75 ft north of the storage tank area associated with 1951 operations. Additionally, 15 groundwater monitoring wells were installed between 2007 and 2008. These monitoring well installations are reported on the Semi-Annual Summary and Performance Reports. Soil sampling was conducted at 20-ft intervals during advancement of the KAFB-1066 borehole, from 20 to 480 ft bgs. Soil sample results did not suggest the presence of a large surface release of fuel in this area. However, there were detections of limited petroleum hydrocarbon concentrations (< 100 mg/kg) throughout much of the borehole length, and isolated, higher concentration detections of other fuel compounds, such as toluene, benzene, xylenes, etc., at individual shallower depths of 40 and 140 ft bgs in the borehole. While the individual fuel-related detections in the borehole were not extremely high, the

pattern of detections may be indicative of a predominantly stair-step lateral and vertical migration of near surface releases of fuel through the vadose zone.

**Remediation and Site Investigation Report (CH2M HILL, 2009)**

In 2009, soil boring investigations were conducted, and four additional groundwater monitoring wells were installed at the BFF Spill to further evaluate other potential source areas. The soil data are consistent with previous sampling results and verify the effectiveness of the SVE system. LNAPL was not detected in samples collected from any of the newly installed wells.

### 3.5.3 Identification of Contaminants of Potential 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 COPCs at the BFF Spill are constituents of refined petroleum products and include, but are not limited to, the following: benzene, toluene, ethylbenzene, naphthalene, xylenes, EDB, and lead.

Compound-specific groundwater maximum contaminant levels (MCLs), developed for the protection of human health, are presented in NMAC, Title 20 - Environmental Protection, Chapter 6, Water Quality, Part 2 - Ground and Surface Water Protection.

Section 3.5.3 is a preliminary assessment of COPCs for the project site. A final list of COPCs will be determined in the Risk Assessment and presented in the final report.

MCLs for petroleum-related compounds are as follows:

- Benzene 0.01 milligrams/liter (mg/L)
- Toluene 0.75 mg/L
- Ethylbenzene 0.75 mg/L
- Total xylenes 0.62 mg/L
- EDB 0.0001 mg/L

### 3.5.4 Light Non-Aqueous Phase Liquid Distribution

The greatest thickness of LNAPL occurs in the area to the east of the FFOR. LNAPL thickness is consistent with vadose zone migration of bulk LNAPL by following the water table toward the north and east. On October 4, 2010, measurements of LNAPL were obtained in monitoring wells that have historically had or potentially have measurable thickness of LNAPL (CH2M HILL, 2011). The currently known extent of the LNAPL plume is shown on Figure 2-1.

LNAPL was detected in the following wells on October 10, 2010 (CH2M HILL, 2011):

- KAFB-1065 1.54-ft SVE
- KAFB-1066 1.04-ft SVE
- KAFB-1068 1.24-ft SVE
- KAFB-1069 1.10-ft
- KAFB-10610 0.15-ft
- KAFB 10614 0.21-ft
- KAFB-10628 0.22-ft

Measured thicknesses are greater at monitoring wells where active SVE is ongoing, possibly producing a mounding effect. The LNAPL plume extends approximately 2,600 ft long and is approximately 1,000 ft wide, trending along the groundwater flow direction.

### 3.5.5 Dissolved-Phase COPC Distribution

The distribution of dissolved-phase COPCs forms a halo around the LNAPL plume. As expected, concentrations of dissolved COPCs are detected at high concentrations very close to the LNAPL plume due to the dissolution of petroleum products into the groundwater and lower concentrations further from the LNAPL plume. The dissolved-phase plume as it is currently understood extends approximately 4,500 ft along the axis of the plume, trending along the groundwater flow direction. EDB is the most widely distributed COPC. The footprint of the dissolved-phase plume downgradient is elongated as the more mobile contaminants, such as benzene and EDB, are more quickly transported along with groundwater movement downgradient. The current known extent of the dissolved-phase plume is shown on Figure 2-1.

### 3.5.6 Site-Specific Fate and Transport

(To be included in the Quarterly Monitoring Report.)

### 3.5.7 Potential Receptors

(To be included in the Quarterly Monitoring Report.)

### 3.5.8 Site-Specific Conceptual Model

The specific CSM will be included in the Quarterly Monitoring Report, which will also address data gaps as applicable. The CSM will include an in-depth discussion of the site geology; it will encompass the source areas, fuel percolation area, LNAPL plume floating on groundwater, and the dissolved-phase contaminant plume in groundwater. The applicable models will be illustrated through the liberal use of detailed, accurate, scaled geologic cross-sections; maps in plan view; and other figures to clearly and accurately show geologic features, hydrologic features, and contamination levels.

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# 4. METHODS AND APPROACH

This section describes the approach, methods, and operational procedures to be used during the remediation actions planned at Kirtland AFB. The purpose of the interim measures and field activities described in this work plan is to better define hazardous constituent contamination around the FFOR, complete an interim removal action for impacted soil at the FFOR, and confirm levels of residual contamination. The installation of the pneumatic wells and subsequent testing are intended to provide necessary information for determination and design of additional interim measures.

## 4.1 Field Activities

Preliminary activities will include site mobilization and site-specific training of project personnel and equipment.

## 4.2 Project Organization

Mr. Tom Cooper is the Shaw Project Manager (PM) for the groundwater remediation effort to remediate the LNAPL plume resulting from past operations at SWMUs ST-106 and SS-111, collectively called the BFF Spill, at Kirtland AFB, New Mexico.

Mr. Cooper will have overall responsibility for safety and quality on all project tasks. The PM will manage and integrate team members and will oversee cost and schedule monitoring and control. All project activities will be coordinated through the USACE PM, Mr. Walter Migdal, who will have direct communication with the Kirtland AFB Chief of Environmental Restoration, Mr. Wayne Bitner, Jr.

The project team will include the following corporate, managerial, and technical positions:

- Senior Vice President of Operations Management: Alan Solow, CHP
- Program Manager: Stephen Moran, PG, PMP
- Contracts Manager: Joyce Becker
- Project Manager: Tom Cooper, PG, PMP
- Certified Industrial Hygienist: James Joice, CIH, CHMM, CSP
- Community Relations Specialist: Lisa Stahl
- Environmental Regulatory Specialist: Jan Martin, PE
- Risk Assessor: Mark Weisberg, CHMM
- Senior Scientist/Engineer-SVE: David Cacciatore, PhD, PE, PMP
- Senior Scientist/Engineer-In Situ: Gary Hecox, PhD, PG, CGWP
- Senior Chemist: Pam Moss
- Senior Geophysicist: Tim Deignan, PGP
- Senior Scientist/Engineer-Bioremediation: Charles Schaefer, PhD

The project organizational chart is provided in Figure 4-1.

## 4.3 Mobilization

Following project planning document approval, mobilization of field staff (management, technical, subcontractors), equipment (vehicles, computers, GPS [global positioning system], etc.), and material (safety supplies, etc.) will begin immediately.

A temporary facilities area will be set up at a prescribed location at Kirtland AFB, which will contain an office trailer/s, lay-down area, and work crew facilities. An electrical subcontractor will be utilized for electricity hook-ups to the facilities as needed.

## 4.4 Site Preparation

The project site may require initial preparation activities prior to conducting interim measures operations. Those activities are described in the following sections.

### 4.4.1 Utilities Clearance

A utilities clearance shall be conducted to locate all underground and suspended utilities both on Kirtland AFB property and off base. On-base utilities clearance activities will be conducted as prescribed by and in accordance with the Kirtland AFB site representative policies and procedures. Utilities clearance activities at adjacent residential neighborhoods and City of Albuquerque right-of-ways shall be prescribed by and in accordance with State of New Mexico and City of Albuquerque utilities regulations.

All underground utilities shall be clearly marked prior to the start of any intrusive activities. All intrusive activities will take into account any existing utilities and will be located to avoid these utilities. The State of New Mexico's "New Mexico One Call" utility excavation clearance system will be utilized for all off-base drilling and excavation locations. Each well boring will be tested for utility clearance to 5 ft with a hand-auger or post-hole digger.

### 4.4.2 Waste Handling

All investigation-derived waste (IDW) generated during remediation activities will be properly characterized, contained, disposed of, and otherwise managed in accordance with all federal, state, and local laws and regulations. A description of the anticipated IDW management process is outlined in the Kirtland AFB BFF Spill Waste Management Plan, included as Appendix C to this Interim Measures Work Plan. All IDW will be contained in approved roll-off bins or 55-gallon drums. These drums and roll-off bins will be stored at a central location at Kirtland AFB for proper waste stream characterization and subsequent disposal.

### 4.4.3 Site Survey

Land surveying activities may occur before, during, and after all excavation activities, and after well installation activities. The survey will be conducted at locations on Kirtland AFB, in adjacent residential neighborhoods, and at City of Albuquerque right-of-ways. The survey will establish northings, eastings, and elevations at all locations. All survey points shall be verified, determined, marked, and documented in accordance with all requirements outlined in the Kirtland AFB Base-Wide SOPs. A State of New Mexico-registered professional land surveyor or licensed Professional Engineer will be utilized for well location verification and determination, excavation extents, temporary benchmarks as required for site controls, and as-built determination surveys, which are outlined as follows:

- Measuring point and ground surface at newly installed and existing monitoring, SVE, and extraction wells;
- Auger and DPT soil boring locations;
- Soil excavation areas;

- Building/treatment system locations;
- Geophysics survey lines;
- Pipelines; and
- Any other lines, points, and features requiring geographical control.

Elevations for each survey point will be determined to the nearest 0.01 ft. The horizontal coordinates of each survey point will be determined to the nearest 0.01 ft and referenced to the New Mexico State Plane Coordinates. Horizontal coordinates shall be based on the New Mexico State Plane Coordinate System, central zone (North American Datum, 1983 [NAD83]), as published by the National Geodetic Survey. Survey points will also be provided in Universal Transverse Mercator (UTM) coordinate system. Elevations will be determined to the nearest 0.01 ft and referenced to the 1988 National Geodetic Vertical Datum, as obtained from permanent benchmarks.

There will be two survey points for new and existing monitoring wells installed at the BFF Spill. The first survey point will be on the north side of the polyvinyl chloride (PVC) well casing. The second survey location will be on the ground surface adjacent to the steel protective casing or concrete well pad. Survey points at all other points, lines, and features will be have both horizontal and vertical control.

Daily reports shall consist of a tabulation of the location, identification, coordinates (both State Plane and UTM), and elevations of each point surveyed that day.

## 4.5 Former Fuel Offloading Rack Interim Measures

For the purposes of the interim measures, Kirtland AFB plans to remove the structures associated with the FFOR, as required. The belowground piping from the FFOR to the pump house has been removed. Removal of the FFOR structures is not a part of this work plan, but all excavation activities will be carried out in coordination with the removal of these structures. With respect to interim measures for soil contamination addressed in this work plan, the Air Force proposes to excavate soil near the FFOR and piping that contain hazardous constituents exceeding the NMED soil screening levels (SSLs) (NMED, 2009).

Removal of structures associated with FFOR will entail removal of the small amount of remaining aboveground components of the FFOR (most of the FFOR structure had been removed previously), as well as the belowground piping that extends from the FFOR to the pump house (Building 1033), where the piping was disconnected from the fuel distribution system. Additional subsurface piping extends from the pump house to a point where the pipeline “daylights” aboveground near the pump house (Building 1033) and existing ASTs. However, this latter piping run is still in use. Kirtland AFB has pressure-tested this line and it appears to be intact (CH2M HILL, 2010). In addition, Kirtland AFB personnel report that this line is scheduled to be taken out of service within the next 6 to 12 months.

In coordination with the removal of the FFOR structures, an investigation of the shallow soil will be performed to determine the extent of soil containing hazardous constituents at concentrations exceeding the NMED SSLs. As delineation is completed, soil with concentrations exceeding the NMED SSLs will be excavated to a depth of 20 ft bgs. A slide rail system to excavate the contaminated soil will be utilized; details are outlined in the following sections.

### 4.5.1 FFOR Interim Measure Objectives

The interim measure objective for collection of soil samples at the FFOR is to characterize potential contamination in the soil with respect to hazardous constituents. Samples will be collected from the soil removed during excavation, as well as from the sidewalls and base of excavations for confirmation soil sampling. Data from soil sampling will be used to characterize excavated soil for backfilling or disposal. Data from the confirmation soil sampling will be used to verify complete removal of impacted soil from the FFOR. The NMED SSLs for hazardous constituents will be used as excavation criteria for soil samples (NMED, 2009).

### 4.5.2 FFOR Soil Investigation and Sampling

Additional soil investigation of FFOR soil will be performed to better understand the location and distribution of contamination in shallow soil that may be associated with potential vapor intrusion pathways and that can be readily excavated. The proposed investigation methods include collection and evaluation of shallow soil samples using DPT along and near the FFOR.

#### *4.5.2.1 Pipeline from FFOR to Building 1033*

DPT borings will be drilled along the centerline and on each side of former pipelines that connected the FFOR to the pump house (Building 1033) (Figure 4-2). DPT borings will be advanced along a line oriented directly over what was once the centerline of the now-excavated pipelines, with 10-ft spacing between boring samples. In addition, DPT borings will be collected along two lines oriented parallel to the former pipe centerline with the two lines situated no further than 5 ft from and on opposite sides of the former pipe centerline (Figure 4-2). Samples will be collected from depths of 0, 5, 10, 15, and 20 ft bgs and submitted for TPH, VOCs, SVOCs, and lead analysis.

Historical aerial photographs and as-built diagrams were used to determine the location of the FFOR and associated pipelines, in order to measure and locate the three known pipeline leak locations that are located approximately 18, 150, and 200 ft from the west end of the FFOR (Figure 4-2). Samples will be collected directly beneath the three known leak locations and will also be included in the BFF Spill Quality Assurance Project Plan (QAPjP). At each of the three known pipeline leak locations, soil samples will be collected at grid nodes with 5-ft spacing. Samples will be collected from depths of 0, 5, 10, 15, and 20 ft bgs for TPH, VOCs, SVOCs, and lead.

All samples will be submitted to the off-site laboratory for analysis of volatile and extractable petroleum hydrocarbons (VPH/EPH), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and lead analyses by a U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP)-certified laboratory, using U.S. Environmental Protection Agency (EPA) (2007) and Massachusetts Department of Environmental Protection (MA DEP) (2004a,b) methods and in accordance with the QAPjP (Appendix E).

The results for the initial set of DPT boring soil samples will be reviewed to determine whether the extent of soil contamination exceeding the NMED SSLs has been fully delineated. Additional DPT borings will be drilled and soil samples collected in an iterative process until the full extent of soil contamination that exceeds the NMED SSLs associated with the FFOR has been determined. A “step-out” location will be sampled for each location that exceeds the NMED SSLs. Each step-out location will be situated 5 ft from the original location, perpendicular to the pipeline. Soil with contaminants of concern (COCs) exceeding the NMED SSLs will be excavated as described in Section 4.5.3.

#### *4.5.2.2 Pipeline from Building 1033 to Fuel Storage Tank*

DPT borings will also be collected along two lines oriented parallel to the pipe centerline that extends from the pump house (Building 1033) to the two storage fuel tanks located to the southwest of Building 1033. Soil samples will be collected with a 10-ft spacing interval that are no further than 5 ft from the pipe centerline (Figure 4-3). Boring samples will be collected from depths of 0, 5, 10, 15, and 20 ft bgs for TPH, VOCs, SVOCs, and lead analysis.

If detected COC concentrations are greater than the NMED SSLs, then additional sample location(s) will be stepped out to a new grid node location and samples will be collected at the same depth intervals to determine the extent of hazardous soil contamination. Each step-out location will be situated 5 ft from the original location, perpendicular to the pipeline. Soil with COCs exceeding the NMED SSLs will be excavated as described in Section 4.5.3.

#### *4.5.2.3 Direct-Push Technology Soil Sample Collection*

The methodology for DPT drilling and soil sampling will follow industry standard practices. The DPT equipment will advance a continuous 2-inch-diameter, split-spoon core barrel lined with an acetate liner for lithologic description and soil sample collection. Samples will be collected from depths of 0, 5, 10, 15, and 20 ft bgs for TPH, VOCs, SVOCs, and lead analysis. Sample collection methods for sampling from the DPT core are summarized in the following steps:

- Sampling equipment will be decontaminated prior to sampling activities at each borehole.

- Borehole drilling and sample collection will be conducted by advancing the sample barrel (with acetate liner) at 5-ft sampling intervals. Once the barrel has reached the desired sampling depth, the sample barrel will be pulled up quickly and smoothly. The acrylic liner will be removed from the sample barrel, Teflon® tape will be placed over the ends, and the barrel will be sealed with plastic caps until sampling is conducted.

- Shallow boring samples will be logged by a qualified geologist to any sample collection activities. The boring logs will be reviewed and approved by a Professional Geologist.

- The field geologist will collect samples from the stated depth intervals and submit the samples to the laboratory for TPH, VOCs, SVOCs, and lead analysis. Additionally, the associated headspace reading will recorded for each depth interval using a photoionization detector (PID) according to the methodology specified in the Kirtland AFB Base-Wide SOP B3.1 (Photoionization Detectors and Organic Vapor Analyzers). The samples will be obtained directly from the core tube. Efforts will be made to minimize the time the soil is exposed to air prior to placing the sample into the appropriate jar. QA/QC samples will be collected to monitor validity of the collection procedures. Field duplicates will be collected at the rate of 10 percent.

  - Headspace samples will be collected from the sampler. Soil from the core will be used to fill a clean glass jar half-way, the top will be covered with one or two sheets of clean aluminum foil, and the screw caps will be used to tightly seal the jars. The jar will be set aside for a minimum of 10 minutes and no longer than 4 hours, after which the lid will be removed. The foil seal will be punctured with the PID instrument to collect the headspace measurement.

  - Samples for VOCs and VPH will be collected using EnCore (or similar type) samplers in accordance with EPA SW-846 Method 5035 and the NMED requirements. VOC and VPH samples will be collected before homogenization of the sample for other analyses. If conditions

exist that make the use of this type of sampler impractical (collection of samples from soil cuttings or dry or gravelly conditions), then discrete grab samples will be collected in a 4-ounce jar prior to homogenization with as little disturbance as possible.

- Samples for SVOCs, EPH, and lead analysis will then be collected as discrete grab samples from the native soil horizon with no compositing and placed into the clean sample container provided by the laboratory.

- A preprinted label and custody seal will be applied by the field geologist to each sample container.

#### *4.5.2.4 Soil Removal Criteria*

Laboratory analysis will be performed for all soil samples to determine concentrations of hazardous constituents in soil for the purpose of defining the final extent of all excavations, for risk assessment, and for waste determination.

Soil sampled with results that exceed the NMED SSLs will be removed as determined during sampling activities by excavating down to a maximum depth of 20 ft bgs. Coordination with the Air Force will be conducted in conjunction with the removal of the existing pipelines prior to beginning excavation activities.

### 4.5.3 Excavation of Soil at the FFOR

#### *4.5.3.1 Field Activities*

Prior to commencing the field activities for excavation, all extents of the excavated area will be defined as described in the sampling and soil removal criteria (Sections 4.5.2.3 and 4.5.2.4). All waste profiling and underground utility clearance will have been completed. All utilities will have been located and cleared prior to excavation activities. A staging area will have been set up for traffic flow during all activities.

#### *4.5.3.2 Waste Profiling*

Excavated soil will be characterized in place to determine whether the soil will be stockpiled for future backfilling (if soil is determined to be below SSLs) or whether it will be transported for disposal (if soil is determined to exceed the NMED SSLs) (see Sections 4.5.2.1 and 4.5.2.2 for sampling criteria). All boring samples will be analyzed for TPH, VOCs, SVOCs, and lead. If analytes detected are at concentrations greater than the NMED SSLs, soil will be removed and transported to a waste facility. If soil is determined to be hazardous based on the NMED SSLs, then additional sample location(s) will be stepped out to a new grid node location (5-ft space) and samples will be collected at the same depth intervals in order to determine the extent of soil contamination.

Soil with COC concentrations exceeding the NMED SSLs will be excavated and waste will be characterized using TPH concentrations to determine proper measures for disposal using the EPA guideline: Section 1.2 of Method 1311 (Waste Management Plan, Appendix C). If COC concentrations are below the NMED SSLs, then soil will be stockpiled and used as backfill.

Sampling soil in place will minimize the amount of stockpiled soil by obtaining pre-approval from the disposal facility to accept the excavated soil prior to initiating the removal action. The results from previous investigation of the FFOR will be submitted and, if necessary, additional samples will be collected for analyses requested by the disposal facility to adequately characterized the FFOR soil for

disposal. As described in the Waste Management Plan (Appendix C), the Kirtland AFB active on-site landfill (LF-268) will be used for disposal of solid non-hazardous wastes if specific waste criteria are met. Otherwise, soil will be disposed of at an off-site permitted landfill either as hazardous (characteristic and/or listed) or non-hazardous waste.

#### *4.5.3.3 Work Zones*

The work area will be delineated and divided into an exclusion zone, a contamination reduction zone, and a support zone. The exclusion zone will be maintained around the work area by placing signs, barricades, and/or yellow tape as necessary. The size and shape of the exclusion zone will be determined by the site conditions; it will be large enough to include the potentially hazardous zone around the sites.

#### *4.5.3.4 Excavation and Trenching Safety Requirements*

Because excavation activities are anticipated at the Kirtland AFB during the BFF Spill interim measure project to remove all contaminated soil as outlined in the previous sections, safety requirements for all excavation and trenching are outlined below.

Daily inspections of the excavation shall be made by a competent person as defined in Title 29 of the Code of Federal Regulations (CFR), Part 1926.650 (29 CFR §1926.650). All excavated materials will be placed at least 2 ft from the edge of the excavation. Perimeter protection shall be provided for unattended excavations as specified in Section 25.B of the USACE *Safety and Health Requirements Manual Engineer Manual (EM) 385-1-1* (USACE, 2008). The Site Safety and Health Officer will evaluate the exposure of the excavation to employees, the public, vehicles, and equipment. This evaluation will be used in determining the class of perimeter protection.

Appropriate personal protective equipment (PPE) will be worn by all field team members, according to the requirements outlined in the Kirtland AFB Spills BFF SSHP (Shaw, 2011) and all Kirtland AFB Base-Wide SOPs. All sampling equipment will be decontaminated and properly disposed of. All project personnel will participate in the site-specific training session and be instructed on the following requirements:

- Before commencing intrusive activities, the existence and location of underground pipes, electrical equipment, communication lines, gas lines, etc., will be determined and documented. Only hand digging will be permitted within 3 ft of underground high-voltage, product, or gas lines. Once the line is exposed, heavy equipment will be used but will remain at least 3 ft from the exposed line.

- Operations will be suspended, ignition sources eliminated, and the area ventilated if the concentration of flammable/combustible vapors reaches or exceeds 10 percent of the lower explosive limit. A combustible gas indicator will be used to make this determination when excavating in areas with a potential for flammable/combustible vapors to exist.

- If excavating equipment is being operated in the vicinity of Energized Overhead Electric Lines, the following table will be used to determine safe working distances.

**Excavation and Trenching Safety Requirements Relative to Electrical Utilities**

| Nominal System Voltage | Minimum Required Clearance |
|---|---|
| 0 to 50 kilovolts | 3 meters (10 feet) |
| 51 to 200 kilovolts | 4.5 meters (15 feet) |

**Excavation and Trenching Safety Requirements Relative to Electrical Utilities (concluded)**

| Nominal System Voltage | Minimum Required Clearance |
|---|---|
| 201 to 300 kilovolts | 6 meters (20 feet) |
| 301 to 500 kilovolts | 7.5 meters (25 feet) |
| 501 to 750 kilovolts | 10.5 meters (35 feet) |
| 750 to 1,000 kilovolts | 13.5 meters (45 feet) |

- Personnel entry into any excavation 5 ft deep or greater is permitted only if the necessary protective systems are in place. Employees shall wear a harness with a lifeline securely attached to it when entering excavations classified as confined spaces or that otherwise present the potential for emergency rescue.

- Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. If water is controlled or prevented from accumulating by the use of water removal equipment, the process shall be monitored by a competent person to ensure proper operation.

- Excavations greater than 4 ft in depth, which require personnel to enter, shall have sufficient means of entry and egress (e.g., stairs, ladders, and ramps). Ladders will be provided and secured as necessary. Ladders will extend at least 3 ft aboveground. Means of entry/egress shall not require personnel to travel laterally more than 25 ft.

#### *4.5.3.5 Excavation Activities*

A slide-rail shoring system will be used to enable excavation to total depth without risking cave-ins of the excavation sidewalls and to avoid the need for sloping. The excavations will commence by installing the slide-rail system on site. The individual system consists of two side panels and a center strut. Additional systems will be installed as needed and determined in the field. The strut can be assembled with different spreader lengths to conform to the excavation extents. The strut can be locked into place and the side panels can be moved independently.

Steel posts and panels will be advanced during initial excavation activities and will be advanced to depth as the excavation progresses. The size of each excavation will be minimized to all extents practical based on field conditions to allow for more accuracy of excavated volumes and better protection of subsurface utilities and site infrastructure.

The slide-rail system will be installed from the top of the excavation down and removed from the bottom of the excavation up. This reduces shoring system advancement beyond the targeted excavation. The slide-rail system will minimize the size of the excavation, all soil disturbances, and restoration time and cost. The slide-rail system will also reduce project risk.

#### *4.5.3.6 Confirmation Soil Sampling*

Confirmation samples will be collected from the excavation sidewalls, ahead of or behind temporary shoring as the excavation progresses. Sidewall samples will be obtained at 25-ft intervals along the length of the excavation at a depth below ground surface equal to half the depth of excavation. Results from the initial sample collection and step-out locations will define the extents of the excavation. Floor confirmation samples will be obtained from the base of excavation

### 4.5.4 Transportation and Disposal

Excavated soil will be sampled per the requirements outlined above and in the QAPjP (Appendix E). Soil will be sampled in place for characterization and disposal requirements. Excavated soil will be disposed of at the Kirtland AFB landfill or an approved off-site location. All waste will be properly characterized and disposed of and otherwise managed in accordance with all federal, state, and local laws and regulations. A description of the anticipated excavated soil disposal process is presented in the Waste Management Plan (Appendix C).

Clean soil (i.e., soil that has been removed and been confirmed as posing no threat to human health, the environment, or groundwater) will be stockpiled and reused for backfilling purposes.

### 4.5.5 Site Restoration

Following soil excavation, the trench will be backfilled in lifts and compacted. Backfill will consist of previously excavated and sampled soil that has been determined to pose no threat to human health, the environment, or groundwater, as well as additional, clean backfill soil transported to the site. If soil is brought in for backfilling, it will have similar properties to the native soil existing at the site.

Backfilling operations will include removal of the slide-rail system. Upon completion of backfill and soil compaction operations, site restoration will be conducted and include appropriate grading of the disturbed areas and surface revegetation as needed.

### 4.5.6 Former Fuel Offloading Rack Soil Investigation Report

Upon completion of FFOR interim measures, a soil investigation report for the FFOR will be prepared and submitted that describes all activities and findings. A Draft, Draft Final, and Final FFOR Soil Investigation Report will be provided.

The reports are intended to document the implementation of the vadose zone interim measures. All field work will be fully documented in order to evaluate and interpret data to support remedial alternative decisions and interim actions. The following will be included in the report to demonstrate that all of the objectives of the Shallow Vadose Zone interim measures have been achieved:

- Summary of field activities
- Analytical results/data review
- Soil excavation information
- Field data forms and documentation

## 4.6 Vadose Zone Interim Measures Evaluation

To date, characterization activities performed at the site have not identified substantial amounts of residual or migrating LNAPL in the vadose zone (i.e., within the 500-ft soil column above the water table). In complexly heterogeneous soil, determination of locations and depths with migrating LNAPL is difficult by standard investigation methods. The goal of identifying LNAPL in the vadose zone can be met by collecting and correlating detailed soil permeability and contaminant concentration logs or profiles. Relatively new investigative techniques, such as vertical profiling by pneumatic logging, have been developed that can provide this level of detail. At Kirtland AFB, these logs or profiles will be most useful at locations where past migration of LNAPL from near-surface sources is known to have occurred.

Kirtland AFB will perform a focused and detailed characterization of the deep vadose zone in the vicinity of the past migration pathway from the FFOR to the main body of LNAPL currently located at the water table. Nine PneuLog well clusters will be installed; each cluster will consist of three separate wells. Vertical profiling will be performed in each of the wells using PneuLog, a proprietary pneumatic well logging technique (Praxis Environmental Technologies, 1999), hydrocarbon baildown testing, and zone or ROI testing. Characterization will be sufficient to determine whether there is a need for LNAPL remediation in the fuel percolation zone as part of these interim measures. Vadose zone interim measures will be implemented if data collected during the PneuLog profiling, supplemented by results of the concurrent vadose zone investigation, identify the presence of LNAPL within the fuel percolation zone.

The results of the PneuLog tests, including recommendations for SVE well installations, will be submitted to the NMED for review and comment.

### 4.6.1 Vadose Zone Interim Measure Objectives

***Borehole Logging and Geophysics Objectives***

The objectives for borehole and geophysics logging are to characterize the formation around the boring, including porosity, permeability, measurement of fractures, joints, or other discontinuities, and water, clay, or other mineral. The logging will aid in the identification of the presence of silt and clay layers that affect the migration of the LNAPL from the source area to the water table. The deepest well in each cluster will be geophysically logged. Data from the geophysics will be used to refine the locations for the pneumatic well clusters planned for installation. The delineation of the distribution of localized storage units (i.e., clay lenses, silty sands) within the vadose zone will aid in the design of the interim measure wells and testing.

### 4.6.2 PneuLog Testing/Evaluation

A vadose zone treatability study will be conducted using a proprietary pneumatic well logging technique. Through new well installations, detailed soil permeability and contaminant concentration profiles, as a function of depth, will be obtained to be used in vadose zone LNAPL interim measure design. Through this logging technique, residual LNAPL will be detected if it is present in soil. Elevated concentrations may represent migrating masses and past migration pathways and will be identified to aid in confirmation of the LNAPL release areas.

The detailed characterization of the vadose zone will be focused in the vicinity of the likely release, at the FFOR, and will extend to the main body of LNAPL at the water table. This data will be used to identify the location of LNAPL that can contribute to the LNAPL plume or impact groundwater.

PneuLog testing accomplishes vertical profiling by simultaneously measuring cumulative gas flow and contaminant concentrations along the length of a vent well screen during SVE (Praxis Environmental Technologies, 1999). Pneumatic logging is conducted using a downhole, gas-velocity sensor that is first lowered into the well and then is raised at a steady rate from the bottom to the top of the well screen while gas is being extracted from the well. A special wellhead assembly enables obtaining these measurements without interfering with the application of vacuum to the well.

Relatively thin LNAPL pools at high saturation and LNAPL mass can be entrapped by permeability and capillary contrasts within the vadose zone. The PneuLog technique may allow identification of strata containing a large LNAPL mass because it allows measurement of sustained concentrations of soil gas that is collected from distances extending well away from the SVE well. Discrete soil-gas samples only collect soil gas from a small area around the well measured in cubic inches to cubic feet. However, SVE

draws soil gas from much larger distances away from the well, allowing "sampling" of hundreds of cubic feet of the formation. Thus, by performing SVE and monitoring the mass production rate at each depth within the soil column, it may be possible to identify entrapped pools of LNAPL that can be remediated using SVE.

Proper use of PneuLog information allows the SVE practitioner to optimize the location of vent wells and optimize screen placement to target the contaminant-producing soil layer. During vertical profiling of flow from the vent well, the change in cumulative gas flow measured by the velocity sensor as it travels from one depth interval to another is equal to the gas flow emanating from that soil interval. The gas permeability value for each interval is then determined from Darcy's Law. The technique is analogous to techniques applied in water wells to identify preferential pathways for groundwater. The correlations between flow rates and contaminant concentrations allow for identification of zones where high levels of contamination are located and where preferred pathways exist. Air permeability can be estimated from this data to refine the ROI and optimize the remedial strategy.

PneuLog testing is performed during the vapor extraction, with a vacuum applied to the test well to extract vapors from the well. At the BFF Spill, PneuLog testing will be performed at each well. Because the vapor concentrations from the PneuLog test wells are expected to be very high, it is likely that the most effective equipment for performing the temporary vapor extraction will be internal combustion engines (ICE), similar to those currently in use at the site. An ICE will be temporarily mobilized to the location of the PneuLog test wells, plumbed to the wells, and then operated according to the Kirtland AFB existing SVE protocols for the duration of the testing (expected to be between two and four weeks). If permitting of the ICE system for this temporary application is problematic, then a suitable thermal oxidization unit will be temporarily mobilized to the site to treat the SVE off-gas.

The PneuLog testing requires new wells to be installed. Therefore, nine PneuLog well clusters, consisting of three wells each, will be installed in the fuel percolation area, east of the FFOR. This area is currently believed to constitute the core of the contamination in the vadose zone and represents the place where fuel presumably migrated to groundwater. Nine new PneuLog wells will be installed and drilled to the water table (approximately 500 ft bgs) in order to significantly improve characterization of the entire contaminated area. The data gained from the PneuLog, Hydrocarbon Baildown, and ROI testing will be critical in understanding the amount of fuel contamination in the vadose zone that must be remediated. Figure 4-4 presents the PneuLog well locations. The PneuLog testing SOP is provided in Appendix F.

Initially, only three PneuLog well clusters, shown in Figure 4-4, will be installed. The initial well clusters will be located along the westernmost edge of the percolation area in order to constrain the LNAPL and clay layer extent along the pipeline. The locations for the remaining six well clusters will be dependent on the results for samples from the first three so that the new cluster locations better define the fuel percolation area where fuel may have migrated to groundwater. If LNAPL is detected in a given well cluster, the next cluster to be installed will be moved outward toward the east, north, or south so that the edge of the percolation area is defined. Similarly, if no LNAPL is detected in a given well cluster, the next cluster to be installed will be moved inward towards the center of the percolation area. Figure 4-4 illustrates where the first three well clusters will be installed, as well as where it is estimated that the additional six clusters will be placed. By following the step-out approach to well cluster placement of the PneuLog wells, the lateral extent and concentration of LNAPL in the percolation area will be better defined. This approach also allows for the correlation of LNAPL to the presence or absence of low-permeability clay layers in the subsurface.

#### *4.6.2.1 PneuLog Well Installation, Drilling, Soil Sampling, and Geophysical Logging*

Nine new PneuLog well clusters, comprised of three wells with screens intervals positioned at different depths, will be installed. Locations of each of the PneuLog well clusters are shown on Figure 4-4. Soil samples will be collected from each boring, visually logged, and screened for contamination with a PID or similar device. Electromagnetic (EM) induction, neutron, and gamma geophysical logging on the deepest well of each cluster will be performed. The geophysical logging will help characterize the formation around the boring, including porosity, permeability, measurement of fractures, joints, or other discontinuities, and water, clay, or other mineral content.

Each PneuLog well will consist of a single borehole drilled to the water table (approximately 500 ft bgs), with each borehole containing three installed well casings. The deepest well casing will be 3 inches in diameter, in order to accommodate the logging instrumentation (Figure 4-5), flush-threaded, Schedule 80 PVC casing. Each well will contain three screen intervals at 500 to 355, 350 to 205, and 200 to 25 ft bgs utilizing factory-slotted PVC 0.010 slot screen. These screen intervals should screen the entire vadose zone from 25 to 500 ft bgs. Figure 4-5 provides a schematic of the PneuLog well construction.

Each well boring will be tested for utility clearance to 5 ft with a hand-auger or post-hole digger. Borehole advancement (drilling) will be performed using the air-rotary casing hammer (ARCH) method. The ARCH method uses steel insulator casing, advanced with a drill bit/rod, to prevent borehole collapse. Each borehole will be drilled using an 11-¾-inch outside diameter (O.D.) drive casing to a depth of 150 ft bgs. A 9-⅝-inch O.D. casing will be used to complete the borehole to the final depth.

#### *4.6.2.2 Borehole Logging*

Each boring will be fully described on a boring log similar or equivalent to that shown in Appendix D, Form 1 and in accordance with ASTM International (ASTM) D5434-09 *(Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock*).

Soil samples will be collected using split-spoon samplers at 10-ft intervals to 50 ft bgs. Beyond that depth, samples will be collected at 50-ft intervals and at changes in lithology to the total depth. In addition to visual logging, each sample will be screened for VOCs with a PID or similar device.

The rig geologist will log the boring as it is being drilled by recording relevant data, listed below, on the appropriate boring log. Data that will be included in the logs, when applicable, are:

- The identifying number and location of each boring will be noted.
- All measurements will be accurate to one-tenth of a foot.
- Drilling logs and other scaled drawings will be drawn at a scale of 1 inch = 1 ft. For wells deeper than 200 ft bgs, the scale of 1 inch = 5 ft will be used. In addition, if sampling intervals are greater than 10 ft apart, the log can be represented with breaks in order to skip unlogged intervals).
- Soil types will be classified in accordance with the Unified Soil Classification System (USCS). These classifications will be prepared in the field by the geologist and will be subject to revision based on laboratory tests or subsequent review.
- A full description of soil samples will be provided. For split-spoon, thin-wall, soil-core, or otherwise intact samples, the description will include but not be limited to the USCS two-letter classification,

plus a more complete verbal description of color, consistency, soil moisture, grain size, and size distribution.

- Depth limits and the type and number of each sample obtained will be indicated. All samples will be numbered consecutively.
- The number of blows required for each 6-inch penetration of split-spoon sampler and for each 12-inch penetration of casing will be indicated, as well as hammer weight and length of fall for split-spoon or driven samplers, and hydraulic pressure used to push thin-wall tubes. If thin-wall tubes are pushed manually, that will be indicated.
- Depth to water as first encountered during drilling, along with the method of determination, will be noted. Any distinct water-bearing zones below the first zone also will be noted. Other observations during drilling will be noted, such as bit chatter, rod binding, rod drops, flowing or heaving sands, bit pressure, rod rotations per minute, and water pressure.
- If drilling fluid is used, the fluid losses, interval over which they occur, and quantity lost will be recorded.
- A general description of the drilling equipment used will be provided. This description, including such information as rod size, bit type, pump type, rig manufacturer, and model, may be provided in a general legend.
- Dates and times of start and completion of boring will be indicated.
- The names of the contractor, driller, and rig geologist will be noted.
- The size and length of casing or auger used in each borehole will be noted.
- Observations of visible contamination for each sample or from cuttings that appear contaminated will be made.
- Field instrument readings will be noted.

As the boring is drilled, the rig geologist will evaluate adjacent samples recovered, together with observation of the drill cuttings, wash water (if any), and drill performance, to determine appropriate stratigraphic definitions or distinctions within the soil column. Such contacts or breaks between strata must be determined by the rig geologist and indicated on the boring log. In general, a stratigraphic unit contains only similar soil that can be classified within the same two-letter USCS classification category symbol. In some cases, significant differences in soil color, grain size distribution, or strength, would be sufficient to classify soil having the same two-letter USCS classification category symbol into two or more distinct strata.

After the rig geologist has indicated the appropriate stratigraphic breaks on the log, he/she will develop and record an appropriate description for each defined stratigraphic unit. Each description will contain information about the color, grain size distribution, consistency, moisture, etc., and the appropriate two-letter USCS classification category symbol.

### *Classification of Soil Types*

All classification data will be written directly on the boring log. The method of deriving the classification will be described or reference to this guideline or other manuals should be made. Handling of samples during soil classification will be coordinated with chemical sampling activities, if appropriate.

### *USCS Classification*

Soil types are to be classified according to the USCS (ASTM D2488-09a, *Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]*). This method of classification is detailed in Appendix D, Form 2. This classification method identifies soil types on the basis of grain size and liquid limits, and categorizes them by two-letter symbols.

In the USCS system, fine-grained soil, or fines, are classified as those that will pass through a No. 200 U.S. standard sieve (0.074 millimeter [mm]) and are of two types: silt "M" and clay "C." Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors only. Organic material "O" is a common component of soil but has no size range and is recognized by its composition.

Gravely soil is identified by a "G" as the first letter in the two-letter symbol, whereas sandy soil is identified with an "S." The term, "rock fragments," will be used to indicate granular materials resulting from the breakup of rock. These materials are typically angular, indicating little or no transport from their source. When the term, "rock fragments," is used, it will be followed by a size designation, such as ¼ to ½ diameter or "coarse-sand size," either immediately after the entry or in the remarks column. The USCS classification will not be affected by this variation in terms.

The second letter in the two-letter USCS symbol provides information about the grain size distribution of granular soil, or the plasticity characteristics of fine-grained soil. These second-letter modifiers are "P" well sorted, "W" well graded/poorly sorted, "C" clayey, "M" silty, "L" low plasticity, or "H" high plasticity. Note that the term, "poorly graded," implies a uniform grain size distribution and is the same as "well sorted."

### *Color*

Soil colors will be described using a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil sample could therefore be referred to as "gray" or "light gray" or "blue-gray." Because color can be used in correlating units between sampling locations, it is important that color descriptions be kept consistent throughout field operations.

Colors must be described while the sample is still moist. Soil samples will be broken or split vertically to describe colors. Soil sampling devices tend to smear the sample surface creating color differences between the sample interior and exterior. In accordance with ASTM D1535-08e1 (*Standard Practice for Specifying Color by the Munsell System*), Munsell color charts or equivalent must be used based on project requirements.

### *Relative Density and Consistency*

To classify the relative density and/or consistency of a soil, the geologist must first identify the soil type. Granular soil contains predominantly sands and gravels and is generally non-cohesive (particles do not adhere well when compressed). Finer-grained soil (silts and clays) is cohesive (particles will adhere together when compressed).

The density of non-cohesive, granular soil is classified according to standard penetration resistances obtained from split-spoon sampling methods that are in accordance with ASTM D1586-08a (*Standard Test Method for Standard Penetration Test [SPT] and Split-Barrel Sampling of Soils*).

These designations are as follows:

| Standard Penetration Resistance (SPR) | |
|---|---|
| **Designation** | **Blows per ft** |
| Very Loose | 0 to 4 |
| Loose | 5 to 10 |
| Medium Dense | 11 to 30 |
| Dense | 31 to 50 |
| Very Dense | Over 50 |

SPR represents the number of blows required to drive a split-barrel sampler with a 2-inch O.D. casing 12 inches into the material using a 140-pound hammer falling freely through 30 inches. The sampler is driven through an 18- or 24-inch sampling interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soil is obtained by adding the number of blows required to penetrate the second and third 6 inches of each sampling interval. In cases where gravel or rock fragments are broken by the sampler or where rock fragments are logged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This will be noted on the log and referenced to the sample number.

The consistency of cohesive soil is determined by performing field tests and identifying the consistency as shown in Appendix D, Form 2. It is determined either by blow counts or most accurately by a pocket penetrometer or field Torvane device in accordance with ASTM D2573-08 (*Standard Test Method for Field Vane Sheer Text in Cohesive Soil*). The SPR can be applied to cohesive soil as follows:

| Designation | SPR (blows per ft) |
|---|---|
| Very soft | <2 |
| Soft | 2-4 |
| Medium Soft | 4-8 |
| Stiff | 8-15 |
| Hard | >30 |

The pocket penetrometer method is conducted on a selected sample of the soil, preferably the lowest 0.5 ft of the sample in the split-spoon sampler. The sample should be broken in half, and the penetrometer pushed into the end of the sample to determine the consistency. Consistency cannot be determined by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft, decomposed rock fragment rather than a hard soil. The pocket penetrometer or Torvane may be used in conjunction with blow counts to determine cohesive soil consistency.

*Soil Component*

In nature, soil is comprised of particles of varying size and shape and represents combinations of the various soil types. Appendix D, Form 2 lists grain size classifications to be used in describing soil types or rocks. The following terms are useful in the description of soil components:

| The Identifying Proportion of the Component Defining Range of Percentages by Weight | |
|---|---|
| Trace | 0-10 percent |
| Little | 11-20 percent |
| Some | 21-35 percent |
| Most | 36-50 percent |

*Moisture*

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual‘s judgment. A suggested parameter for judging this in a fine-grained soil would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling project. Laboratory tests in accordance with ASTM D2216-10 (*Standard Test Methods for Laboratory Determination of Water [Moisture] Content of Soil and Rock by Mass*) or field tests for water content should be performed if the natural water content is important.

*Stratification*

Stratification can only be determined after the split-spoon sampler is opened. The stratification or bedding thickness for soil and rock is dependent on grain size and composition. The classification to be used for stratification description is described below:

**Thickness Approximate English(Metric) Equivalent Classification**

| Metric | English | Classification |
|---|---|---|
| >1 meter | > 3.3 ft | Very thick |
| 30 cm -1 meter | 1.0 ft -3.3 ft | Thick bedded |
| 10 cm-30 cm | 4.0 in -1.0 ft | Medium bedded |
| 3 cm -10 cm | 1.0 in -4 in | Thin bedded |
| 1 cm -3 cm | 2/5 in -1 in | Very thin bedded |
| 3 mm -1 cm | 1/8 in -2/5 in | Laminated |
| 1 mm -3 mm | 1/32 in -1/8 in | Thinly laminated |
| <1 mm | <1/32 in | Micro laminated |

#### *4.6.2.3 Borehole and Well Abandonment*

If needed, all well and borehole abandonment procedures will be performed in accordance with all federal, state, and local regulations. Well abandonment will be supervised by a qualified geologist or hydrogeologist, and the details recorded on the Well/Borehole Abandonment Form, depicted in Appendix D, Form 3. Unless otherwise specified, monitoring wells will be abandoned as described below:

- Prior to abandonment, the borehole or well will be probed to determine the total open depth of the hole or well casing, respectively. Water level measurements will also be measured and recorded.

- All stainless-steel or steel existing well casings will be completely removed or drilled out to the total depth of the well to avoid groundwater contamination due to corrosion. PVC casings may remain in place.

- A plugging material consisting of one or a combination of the following materials will be used:

  – Neat cement with not more than 5 percent by weight (wt%) of bentonite,
  – Bentonite slurry (which can include polymers designed to retard swelling),
  – High solids grout, or
  – Pelletized medium grade or crushed bentonite.

- Cement and bentonite slurries will be pumped into place in a continuous operation with a grout pipe introducing the plugging material at the bottom of the well and moving the pipe progressively upward as the well is filled. This method will be repeated to within 2 ft bgs unless otherwise specified.

- The well casing will be severed at least 2 ft bgs, if not required to be completely removed, and a cement plug larger in diameter than the well bore will be constructed over the well bore and completed flush with the ground surface.

- When using pelletized or crushed bentonite, the bentonite will be poured down the hole in 3- to 5-ft lifts and hydrated using clean potable water between lifts. This method will be repeated to within 2 ft bgs, unless otherwise noted.

#### *4.6.2.4 PneuLog Well Installation Procedures*

PneuLog wells are specially designed and consist of a well nest comprised of three wells with long screen intervals. Together, all three wells are designed to screen the entire vadose zone from 25 to 500 ft bgs. An engineered filter pack will be installed in the annular space between the well casing/screen and the borehole from the bottom of the borehole to approximately 2 ft above the top of the screened interval, with a minimal amount, approximately 1 to 2 ft, of bentonite grout seal between each screen interval. The filter pack will be slurried with clean potable water and tremied into place to prevent bridging and to ensure continuous placement, while the temporary drill casing is slowly removed. A 10-ft hydrated bentonite seal will be emplaced above the sand filter pack incrementally hydrated with potable water in 1-ft lifts. After the final lift has been allowed to hydrate for 2 hours, a high solids (20 wt%) bentonite grout will be emplaced by tremie pipe to within 30 ft of the surface, and a cement/bentonite grout will be emplaced to within 1.5 ft of the surface.

The design and construction of each PneuLog well cluster shall comply with the guidelines established in various RCRA guidance documents, including, but not limited to:

- EPA, Office of Waste Programs Enforcement and Office of Solid Waste and Emergency Response (OSWER), *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1 (EPA, 1986); and

- EPA, *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*, EPA 600489034, (EPA, 1991).

PneuLog well installation procedures are detailed as follows:

- Appropriate PPE will be worn in accordance with the SSHP (Shaw, 2011).

- The borehole will be drilled to the total depth for the well to be installed using an ARCH rig. Temporary surface casing to the water table may be used to stabilize the upper portion of the drill hole, but casing must be removed as filter pack and bentonite-cement grout are installed.

- Well construction requires the installation of three separate wells that screen three intervals along the total length of the borehole. Each well will contain three screen intervals at 500 to 355, 350 to 205, and 200 to 25 ft bgs. Each well will be constructed with flush-threaded, Schedule 80 PVC casing with a PVC, 0.010-inch, slotted screen. The deepest well will have 3-inch diameter casing that can accommodate the geophysical logging equipment.

- If the boring is overdrilled beyond the bottom of the proposed sump elevation by more than 10 ft, the borehole will be backfilled with filter pack material to an elevation approximately 5 ft below the proposed bottom of sump elevation.

- While slowly removing the drill casing from the borehole, the borehole annular space will be backfilled from a maximum of 2 ft and a minimum of 0.5 ft below the bottom of the lowest well screen to 2 ft above the well screen with a filter pack (10/20 silica sand). A 1- to 2-ft layer of bentonite grout will be place directly above the filter pack. After allowing for the bentonite grout to set, the filter pack for the next well will be placed above the bentonite grout. The process will repeat until the final filter pack is placed around the shallowest well within the nest. Because of the special design of this well, this implies that filter packs will be placed from the bottom of the well to within 23 ft bgs.

- The filter pack will be placed using a tremie pipe to avoid bridging and ensure a continuous filter pack throughout the screened interval of the well. The well may be gently surged to break up bridging and ensure complete placement of the filter pack around the well screen.

- Next, a bentonite chip seal will be installed for a thickness of 10 ft. If placed above the water table (i.e., shallow wells), the bentonite chips will be hydrated with potable water for each 1-ft lift to ensure a competent seal. The bentonite seal will be a minimum thickness of 5 ft. Installation of a thicker bentonite seal is currently used for monitoring wells at the Kirtland AFB to ensure that there will be no intrusion of grout from above the seal into the filter pack material below the seal.

- A 20 percent, high-solids, bentonite grout mixture will be installed over the bentonite seal using a tremie pipe. The mixture will consist of 20 wt% sodium bentonite powder. The bentonite grout will be installed to within 30 to 50 ft of the surface. The high-solids bentonite grout is currently and successfully used for well installation at the base to inhibit intrusion of grout into the well's filter pack and screen.

- To the surface, a cement/bentonite grout mixture will be installed over the high-solids bentonite grout using a tremie pipe. The mixture will consist of 94 pounds of Portland cement to 7 gallons of approved water and 3 wt% sodium bentonite powder.

- Belowground surface completions will be within steel, flush-mounted protective covers (manholes) with gasketed, bolt-down covers. A concrete surface seal will be placed around the manhole and will extend from the cement/bentonite grout to ground surface. Protective posts will not be required on flush-finished wells.

- Aboveground surface completions will consist of a 9-inch by 5-ft, protective, round steel casing with a 3-ft "stick-up" and a 4-ft by 4-ft by 4-inch concrete pad mounded in such a way as to direct surface runoff from the casing. A 4-inch by 5-ft concrete-filled steel bollard will be installed around each well

on the outside of the concrete pad. A drain hole will be drilled in the protective casing above the concrete surface. In locations subject to freezing, the finished pad will be designed to resist damage caused by frost heaving.

The well will be equipped with a security lock. All locks will be keyed alike. The well will be tagged with a corrosion-resistant, identification stamped on the protective casing that identifies the well number, depth, date of installation, and the adjusted top-of-casing elevation. The well also will be clearly designated as a monitoring well. The casing will be coated with protective paint as required by the base.

#### *4.6.2.5 PneuLog Well Installation Documentation*

Well construction diagrams will be completed for each installed well. These diagrams will at a minimum document the following information:

- Project and site names, well number, and the total depth of the well;
- Depth of any grouting or sealing, the amount of cement and/or bentonite used, and the total depth of the boring;
- Depth and type of well casing;
- Static water (if present) level upon completion of the well and after well development;
- Installation date or dates, and name of the driller and the geologist installing the well. Each installation diagram will be signed by the preparer;
- All pertinent construction details of the monitoring wells, such as depth to and description of all backfill materials installed (such as gravel pack, bentonite, and grout); gradation of gravel pack; length, location, diameter, slot size, material, and manufacturer of well screen(s); and location of any blank pipe installed in the well;
- Description of surface completion, including protective steel casing, protective pipes, and concrete surface seal;
- A description of any difficulties encountered during well installation;
- Survey coordinates and the elevation of top of ground and top of well riser; and
- A brief stratigraphic log on the well installation diagram showing depths to and descriptions of major lithologic changes encountered in the boring.

All wells will be completed to include a T-coupling, which allows connection of the well to an SVE system. This coupling also allows the placement of a sensor and data logging device. This device will be used to monitor air flow and contaminant concentrations.

There will be two survey points for wells installed at the BFF Spill. The first survey point will be on the north side of the PVC well casing. The second survey location will be on the ground surface adjacent to the steel protective casing or concrete well pad. Survey points at all other points, lines, and features will have both horizontal and vertical control.

All well installations and completions shall be carried out per applicable ASTM standard ASTM D4750, the Kirtland AFB SOPs for Field Investigations, and as outlined above. Appropriate PPE will be worn as

outlined in the SSHP (Shaw, 2011). All equipment will be properly decontaminated between each borehole.

#### *4.6.2.6 PneuLog Borehole Geophysical Investigation*

Borehole geophysics, consisting of induction, neutron, and gamma logging, will be conducted on 29 existing monitoring wells and the nine Pneulog wells to be installed as described in this work plan. The deepest well installed at each of the nine Pneulog wells will be logged. Geophysical logging will aid in fully characterizing subsurface stratigraphy and the nature and extent of vadose zone and groundwater contamination. The ultimate goal of geophysical borehole logging investigations is to use the data to refine the CSM of the potential source location(s) and the extent of the LNAPL contamination, in order to optimize placement of remedial SVE and groundwater extraction wells and potential future monitoring wells. For this objective, it is expected that the top of the fine-grained clay and silt units in the vadose zone will need to be determined to a vertical precision of 1 ft using the geophysical logs. The specified precision requires that depth errors associated with the logging process will need to be closely monitored and meet the ASTM standard (less than or equal to 0.4 percent of the total depth logged). Additionally, the thickness of the lithologic units influences the shape of the log curve and therefore influences the ability to precisely define the top of the unit. In general, lithologic units whose thickness is less than approximately 1.5 to 2 times the borehole tool length may produce complex log responses that generally cannot be interpreted to a precision of 1 ft.

A general procedure for the information recorded for a borehole geophysics survey will include recording all information necessary to correctly interpret the log, including:

- Project number;
- Well identification number;
- Well completion information;
- Location of the zero-depth reference of the log, which will be the ground elevation for the final processed data (if any other reference is used, such as the top of casing, it will be noted in the log header);
- Location of the after-survey depth error (ASDE) reference point, which may be the top of the casing, ground level, or some other specified point;
- Height of the top of the casing above ground level;
- Depth of the bottom of the casing(s) and screen interval; and
- Total depth geophysically logged (the greatest log depth reached in the hole will also be recorded for comparison to the drilling depth).
- Total depth drilled
- Any additional pertinent information

Borehole logging will follow standard industry practices, such as those presented in:

- ASTM 5753-05(2010) (*Standard Guide for Planning and Conducting Borehole Geophysical Logging*),
- ASTM D6274-98(2004) (*Standard Guide for Conducting Borehole Geophysical Logging–Gamma*),
- ASTM D6727-01(2007) (*Standard Guide for Conducting Borehole Geophysical Logging–Neutron*), and
- ASTM D6726-01(2007) (*Standard Guide for Conducting Borehole Geophysical Logging–Electromagnetic Induction*).

### 4.6.3 Instrumentation

#### *4.6.3.1 Downhole Geophysical Logging*

Geophysical techniques have proven to be valuable tools in determining lithology, porosity, and moisture condition of various stratigraphic units. Downhole geophysical logging will be conducted using a suite of logs to include medium and deep induction, neutron, and natural gamma (large-crystal) tools.

The logs will be run from at or above the groundwater table (approximately 500 ft bgs) to ground surface through PVC well casing. Equipment will be decontaminated at each well location before conducting logging activities.

All logging equipment will be calibrated in accordance with manufacturer's specifications. "Shop" calibrations will be performed within 30 days of the logging event. During the initial mobilization, operations will be confined to KAFB and before and after calibrations will be conducted for each logging tool at each well. During the subsequent mobilizations, operations will occur in the neighborhoods surrounding KAFB. Due to the interferences anticipated in the neighborhoods (e.g., nulling the induction probe near large metal objects, power line interference, etc.) and safety factors associated with the neutron probe radioactive source, tool calibrations may be performed at a calibration site within the KAFB boundaries prior to and at the conclusion of each day's activities.

The induction probe will be run free in casing during logging activities, and the neutron probe will be "sidewalled" using a bow spring or mechanical arm. This information will be recorded on the Shaw wireline logging summary sheet for each well.

A minimum of 100 ft of repeat log will be performed after the initial logging effort and the initial and repeat logs will be provided to the Shaw representative in hardcopy form for review. After completion of the borehole, a paper copy of the strip logs will be provided to the Shaw representative for review and approval. Digital data files for all logs also will be provided by the logging contractor at the end of the field day.

Geophysical logs will show results of induction logging (medium and deep) in ohm meters, neutron logging in American Petroleum Institute (API) neutron units, and gamma logging in API-calibrated counts per second. The results of each method will be plotted versus depth from the surface to total depth of the borehole for which the log represents. The name of the borehole, location of the borehole, the date(s) that the borehole was completed, the drilling method, ASDE, and the elevation of the top of the borehole will also be noted in the boring log. Data will be provided to the Shaw representative in hard copy and in digital format.

The logs will be evaluated /interpreted along with soil boring logs, well construction reports, and previous geophysical logs acquired in the surrounding area.

#### *4.6.3.2 Induction Logging*

EM-induction logs record the electrical conductivity (inverse of resistivity) of the materials surrounding the borehole. The conductivity is dependent on the porosity, permeability, type of material, moisture content, and total dissolved-solids concentration of the water within the unconsolidated materials or rocks.

EM-induction logging provides detailed stratigraphic information from dry, cased (PVC), or uncased holes. A small transmitter coil or array in the borehole probe induces eddy currents in the surrounding geologic material. The eddy currents generate a secondary magnetic field in the geologic materials. The strength of the magnetic field is controlled by the electrical properties of both geologic materials and groundwater. A receiver coil or array measures the strength of the quadrature component of the secondary magnetic field, and electronics in the instrument console convert the magnetic field strength to values of conductivity.

The induction probe that will be used for the logging of the Pneulog wells is 1.7 inches in diameter and 9 ft in length, with receiver arrays at 22 inches and 33 inches. The system operates at 25.6-kilohertz frequency and provides two conductivity measurements corresponding to “medium” (22-inch spacing) and “deep” (33-inch spacing) radii of investigation. The medium induction component is most sensitive to material at a distance of approximately 3 to 12 inches from the center of the well, and the deep induction provides information at distances up to 20 to 30 inches (ASTM D 6726, Advanced Logging Technology DIL 45 Correction Charts, and Geonics EM39 Induction Manual). Consequently, borehole effects are minimized using the deep-induction component and the measured conductivity responds to the “true” formation conductivity. Drift and noise are typically less than 1 millisiemen per meter and conductivity changes of a few percent can be resolved.

#### *4.6.3.3 Gamma Logging*

Gamma logs detect the amount of natural gamma radiation emitted by the rocks surrounding the borehole. Naturally occurring radiation comes from three principal areas: potassium-40, which occurs with all potassium minerals; uranium-238; and thorium-232, which are associated primarily with biotite. Clayey and shaley rocks typically have higher gamma radiation due to their composition of the weathering products of potassium feldspar and mica. The natural gamma tool is used for general lithologic identification and stratigraphic correlation. The typical radius of investigation for the natural gamma log is approximately 10 to 12 inches from the borehole wall.

The natural gamma probe utilizes a sodium-iodide, thallium-activated crystal to measure gamma-ray emissions from soil or rock. The method can be used in uncased, steel-cased, or PVC-cased wells. The natural gamma crystal will be integrated with the induction and neutron probes for both mobilizations. A calibration certificate for the gamma will be provided by the logging contractor.

#### *4.6.3.4 Neutron Logging*

Neutron logging uses an active radioactive source to identify porous formations and lithology. The tool is also used to identify water saturation in vadose zones. An americium-241 (beryllium-activated, americium-beryllium-241 [AmBe-241]) neutron source emits high energy (fast) neutrons into the formation. These neutrons diffuse through the formation and collide with the atoms present. Collisions with atoms that have a similar mass of neutrons, such as hydrogen, result in an exchange of energy. Thus,

these neutrons are slowed down to thermal energies which can be detected by the helium-3 (He-3) detector. Since slowing is primarily due to collisions with hydrogen, neutron count rates represent the hydrogen content of the formation and can be interpreted in terms of porosity in water saturated formations.

The probe that will be used for the logging of the Pneulog wells is 1.7 inches in diameter and 6.9 ft in length.

The necessary containers and safeguards for the transportation, storage, and use of nuclear source(s) will be provided. The operator will be properly trained, certified, and maintain the required licenses to handle nuclear source(s). Work will complete with all federal and state requirements for the use of active-source tools.

#### *4.6.3.5 Logging System*

A Mount Sopris MGX digital logger (or equivalent) will be used. This facilitates interchanging probes as well as allowing the data to be collected on a DOS-based field notebook as the winch raises and lowers the probe. The logging system will be equipped with a 0.1- or 0.125-inch steel conductor cable long enough to log the wells of interest.

### 4.6.4 Pre-Logging Requirements

Pre-logging activities include drilling, as necessary, and mobilization of the logging unit by the logging contractor to the borehole locations. The following are basic pre-logging requirements:

- Boring logs will be prepared for each borehole during drilling for field comparison with the wireline logs. Zones of extensive circulation, lost circulation, suspected washouts, or drilling problems will be noted for anticipation of possible log response.
- Hole deviations will be recorded on the appropriate form(s) if directional surveys were run.
- A wireline logging summary will be filled out for each borehole. Information such as the tool, logging speed, repeat interval, depth reference, start and end time, calibration information, etc. will be recorded. A tool status report will be on site for all tools plus spares.
- All logging equipment will be properly decontaminated before arrival on site, between wells, and before leaving the site. The equipment will be decontaminated according to Section 5.4 of this work plan.
- For logging in cased holes, a “dummy” tool of the same dimensions may be used to ensure the working tool does not stick in the hole. This is especially useful for small-diameter PVC casing, which may flex when it is set in the borehole.

### 4.6.5 Logging Requirements

The general borehole geophysical logging process consists of the following:

1. After mobilization to the borehole and decontamination of the equipment, the contractor connects the first tool to the logging cable.

2. The contractor conducts the "before" logging calibration check at the well or another pre-approved location at the start of the day to ensure the instrumentation is functioning properly. The calibration results are checked to ensure that they meet the required tolerances.

3. The tool is placed in the hole and adjusted to "zero" depth at a pre-defined depth reference (e.g., top of casing). The contractor checks to ensure that all equipment is still functioning properly and then lowers the logging tool into the borehole.

4. While the tool is lowered to the bottom of the hole, the logging tool response is monitored by the logging engineer.

5. Once the tool is at the bottom of the hole, a final check is completed (instrument settings, logging scales, total depth, etc.). Logging is commenced up the hole at the proper speed (re: logging contractor SOPs) and data are digitally recorded. The logging speed and sample interval are documented on the wireline summary sheet and log header for each well.

6. Once the upwards logging run is completed, the tool is placed back in the hole at a specified interval to collect a repeat section for QC purposes.

7. Field copies of all logs are generated. The original and repeat log sections are checked for overall quality and repeatability.

8. Post-logging calibration checks are performed at the well site or at the end of the day.

9. If data are collected with another tool, the process above is repeated. If not, the logging unit and associated tools and equipment are decontaminated and prepared for transfer to the next borehole.

The following required items are necessary for effective implementation of the logging process and generation of useful logs of appropriate quality:

- The pullout strength of the cable socket, which connects the tool to the cable, will be known before entry into the hole.

- Calibration procedures, both in the shop and in the field, must be performed. The time and results of the last shop calibration for each tool will be documented.

- Field calibrations are performed prior to and after logging and recorded on the wireline logging summary sheet.

- When logging tools are run in combination, all curves are referenced to the same depth reference point (e.g., top of casing or ground level).

- Depth control will be used for each logging run. This is accomplished by placing the tool reference point at a known point (e.g., top of casing) and using that location as the "zero" reference for the logging run.

- The ASDE metric for the project will be 0.4 percent of the logged depth between the start and end of a logging run where the tool is referenced to a zero depth at a pre-defined point prior to and at the end of the logging sequence. The proposed ASDE is based on the current ASTM standards and will ensure the logging data are of sufficient quality to meet the project objectives. The ASDE is documented on the log header for each well.

- The geologist should ensure that the driller drills a rat hole deep enough so as to provide enough depth for the log's first valid readings to be in the sand or gravel at the bottom of the well.

- Repeat sections will be run for all logs. The repeat sections will be selected based on zones of interest and will be a minimum of 100 ft in length.

Attention to detail during borehole geophysical logging, including equipment setup, calibration, and monitoring, is required for obtaining accurate and reliable data. Borehole geophysical logs are subject to a number of potential tool problems and operational errors. A Shaw QC representative will be present during the entire logging operation to provide oversight of the logging process. The Shaw QC representative will independently document the logging activities to ensure the data are of sufficient quantity and quality to meet the project objectives. Any and all problems (including tool malfunction and significant downtime) and associated corrective actions will be recorded by the Shaw QC representative on the appropriate form(s) according to the project work plans.

Field copies of all logs will be provided to the Shaw QC representative at the end of each logging run. The QC representative will review the log and check the data for overall quality and repeatability (e.g., noise spikes, depth reference, drift of the EM log). Any potential quality issues will be brought to the attention of the contractor and resolved prior to demobilization from the site.

For the field logs (and final logs [see below]), all off-scale readings, drift adjustments, and first curve readings will be marked on the logs, and all curves identified and labeled. All post-logging field calibrations must be run for each tool and recorded on the log tails or headers. These will be checked with the pre-log calibrations, noting any changes.

A wireline logging summary sheet will be completed for each borehole. Header information will be thoroughly filled out, including equipment and calibration date. The type, temperature, and resistivity of any fluids and other associated measured parameters will be recorded, as applicable. Any unusual conditions, problems, or concerns regarding the logging run will be included in the remarks section. Logging speeds, time constants, and tool model will be correctly recorded. The digital data for the original, repeat, and tool calibrations will be digitally recorded and maintained as part of the official project record.

The logs will be completed to the satisfaction of the Shaw QC representative before the logging contractor is allowed to rig down. Final approval for acceptance of the quality of the log will rest with the QC representative and project manager.

### 4.6.6 Post-Logging Requirements

A predetermined number of final log prints will be provided within two weeks of completing the final logging run including the final composite logs. Any and all information required for entry on the field logs above will be included on the final log prints. In addition to the hardcopy logs, raw and final processed digital data will be delivered within two weeks of project completion.

### 4.6.7 Reporting

#### *4.6.7.1 Daily Field Reports*

Field records of the operation of site activities, including boreholes logged and support activities such as equipment decontamination, will be made available to the Site Supervisor at the completion of each day’s work. At a minimum, the following data shall be included in the daily reports:

- Dates and times of beginning and completion of work;
- A list of employees at the site and their work locations (borehole number);
- The number and location of boreholes logged, including depth or total logging footage performed;
- A list of major equipment on site and its location (borehole or equipment decontamination location); and
- Any problems encountered, including standby time recorded.

#### *4.6.7.2 Final Report*

Three copies of the paper strip logs and report and digital (MSWord [text], PDF [figures], ASCII [logging data]) copies on compact disc will be provided. Each log title block will include at a minimum the borehole number, probe type, module adjustments, logging speed, depth footage (vertical scale), horizontal units and scale, depth to groundwater, and calibration(s). The report shall include field and data processing procedures, figures representing the data, and an interpretation minimally identifying relatively more permeable zone, stratigraphy and structure as applicable.

### 4.6.8 Technical Review

All borehole geophysical logging plans, scopes-of-work, field procedures, field QC documentation, logs, and associated reports will undergo technical review by a geophysicist.

The technical review, at a minimum, will consider and evaluate the following pre-logging items:

- Data collection objectives and requirements
- Site geology
- Scope-of-work
- Vendor qualifications and equipment
- Field procedures

The post-logging technical review should consider and evaluate the following minimum items:

- Field documentation, including problems encountered and corrective actions taken
- Equipment calibration/certification
- Review and quality of the logs relative to the requirements in this SOP and the project work plans
- Calculations and data interpretation

Any issues raised during the pre-logging technical review should be resolved between the reviewer and staff planning the program before conducting the logging. Issues raised during the post-logging review shall be resolved before external submission of the results. The technical review comments and issues, and corresponding resolution, will be documented and filed with the project records.

### 4.6.9 Borehole Geophysics Equipment Decontamination

All downhole logging equipment and materials, including the cable and the probe, will require decontamination before use, between each borehole, and before demobilization. Equipment will be thoroughly decontaminated between boreholes. All equipment will be cleaned before mobilization.

### 4.6.10 Hydrocarbon Baildown Pilot Testing

A hydrocarbon baildown tests will be performed on six existing wells in order to determine the thickness and depth of free product in the well as it recovers. The following wells will be tested: KAFB-10628, KAFB-10614, KAFB-1069, KAFB-1068, KAFB-1066, and KAFB-1065. These well locations are shown on Figure 4-6. Baildown testing will be conducted to estimate the LNAPL transmissivity and recoverability at the water table/LNAPL interface. This test will be conducted by removing LNAPL from a test well and borehole with a pump and measuring the recovery rate of LNAPL.

This test will be completed specifically on wells exhibiting greater than 0.5 ft of free product thickness. Up to six existing wells will be tested (Figure 4-6). The calculated transmissivity values from these tests will be used to delineate the area of LNAPL with potential to migrate and to optimize the remediation well placement for the vadose zone interim measure design.

This information, along with the PneuLog data above will help to improve characterization of the contaminated area and allow for determination of the amount of fuel contamination in the vadose zone that must be remediated.

### 4.6.11 Radius of Influence Testing

ROI testing of the vadose zone will use SVE -W1 or -W6 well clusters (Figure 4-7) to aid in the design of the vadose zone interim measures that will be conducted. The ROI will be used to find the greatest distance from a well at which a sufficient vacuum and vapor flow can be induced to enhance volatilization and extraction of the contaminants in the soil. The results will be used for the SVE system design, whereby SVE wells will be distributed with an overlapping ROI to completely cover the area of contamination. ROI testing on existing SVE wells will be performed by placing a vacuum on the tested well using a mobile ICE unit while measuring pressure in adjacent SVE and PneuLog wells. Tests on individual wells will be conducted until pressure drops in adjacent wells stabilize, which may take hours to several days. A vacuum reading greater than or equal to 0.1 inches of water column vacuum will be used as an indication of vacuum influence. The data from the ROI testing will be contoured across the testing area. These results and those from the PneuLog testing will be used to determine future SVE well spacing.

### 4.6.12 Interim Measures and Vadose Zone Investigation Results

The interim measures and vadose zone investigation results will be presented upon completion of well installation, PneuLog testing, hydrocarbon baildown test, and ROI testing outlining all data, activities and findings. The results will be presented and are intended to document all acquired data for evaluation and proper understanding of the amount of fuel contamination in the vadose zone and determination of proper remediation of the plume. Raw data will be provided and processed data, with evaluation results and conclusions, will be presented in a subsequent Final FFOR Soil Investigation Report. All field work will also be fully documented in order to evaluate and interpret data to support remedial alternative decisions and interim actions.

## 4.7 Investigation-Derived Waste

All IDW will be handled in accordance with the project-specific Waste Management Plan, which is provided as Appendix C to this work plan. In general, all soil cuttings generated by the drilling of soil borings will be containerized in roll-off containers at the drilling location. Composite soil samples will be collected from each roll-off bin for waste disposal characterization. Water produced from well

development, testing, and sampling will be containerized and characterized for waste disposal. All PPE equipment (e.g., sampling gloves) will be disposed of with municipal waste.

## 4.8 Equipment Decontamination

The objective of field decontamination is to remove contaminants of concerns from sampling, drilling, testing, and other field equipment to concentrations that will not impact study objectives. Kirtland AFB Base-Wide SOP B.1-11 will be used by field personnel responsible for cleaning sampling or other equipment in the field.

Specification for decontamination materials include:

- Use a standard brand of phosphate-free laboratory detergent, either liquid or powder, preferably Liquinox® or (Alconox®).
- Use tap water from any municipal water treatment system or use bottled drinking water. Soap and tap water will remove the gross contamination from the sampling equipment.

### 4.8.1 Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated, thereby jeopardizing the validity of sample data. Containers will be constructed of proper materials to ensure their integrity. The following containers should be used for storing specified cleaning materials:

- Soap—Keep in clean containers until use. It should be poured directly from the container into the wash bucket or tub.
- Tap water—Keep in clean tanks, hand-pressure sprayers, or squeeze bottles, or apply directly from a hose.
- Deionized water—Store in clean containers that can be closed when not in use. It may be applied from squeeze bottles.

### 4.8.2 Decontamination of Large Equipment

The following procedure will be used to decontaminate large pieces of equipment, such as casings, auger flights, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casing, auger flights, pipe, or rods. This procedure shall also be employed for decontamination of heavy machinery, such as backhoes and excavators:

- Wash the external surfaces of equipment with high-pressure, hot water and Liquinox®, Alconox®, or an equivalent non-phosphate, laboratory-grade, detergent. If necessary, scrub until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The inside surfaces of equipment that come into direct contact with the media being sampled also will be washed as described above. Specific decontamination instructions will be included in project-specific addenda.
- Rinse with potable water.
- Perform this decontamination procedure before equipment is used and between each well or other sampling locations.

### 4.8.3 Decontamination of Sampling Equipment

The following procedure will be used to decontaminate devices, such as split spoons, bailers, sample trays, spatulas, spoons, and augers that come into direct contact with the sample media:

- Wash and scrub equipment using tap water and laboratory detergent. Wire or plastic bristle brushes can be used.
- Rinse with tap water, removing all visible dirt and soap residue.
- Rinse with deionized water.
- Place onto clean plastic sheeting and allow to completely air dry.
- If not used immediately, wrap in aluminum foil.

Decontamination of sampling equipment will be kept to a minimum in the field and, whenever possible, dedicated sampling equipment will be used. Decontamination fluids will be disposed as required by the project-specific Waste Management Plan (Appendix C). Personnel directly involved in equipment decontamination will wear appropriate PPE as specified in the SSHP (Shaw, 2011).

Whenever possible, decontamination pads provided by Kirtland AFB should be used to clean large equipment. In other instances, a decontamination pad may need to be constructed at the investigation site.

### 4.8.4 Construction of a Decontamination Pad

Decontamination pads constructed in the field should meet the minimum specifications described below:

- The pad should be constructed in an area known or believed to be free of surface contamination. A temporary pad should be lined with a water impermeable material with no seams within the pad. The material should be either easily replaced (disposable) or repairable.
- The location of the pad should be out of the work zone and situated so as not to interfere with other work in progress.
- The pad should not leak excessively. Any sump or pit should be lined.
- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above the ground surface to prevent equipment for being splashed and re-contaminated.
- Water collected on the pad will be containerized and disposed of according to the Waste Management Plan (Appendix C). Small amounts of water will be left to evaporate.

## 4.9 Personal Protective Equipment

Personnel directly involved in equipment decontamination shall wear appropriate PPE as specified in the SSHP (Shaw, 2011). Appropriate PPE will be selected based on the level of contamination present or suspected at a site. Care will be taken to ensure that the selected PPE will protect decontamination workers from unnecessary contact with soil or decontamination fluids. The following is a list of the minimum PPE required to perform decontamination activities:

- Safety glasses with splash shields or goggles and latex gloves will be worn during all cleaning operations. For decontamination activities involving large amounts of water, rain suits or aprons and rubber over-boots will also be worn.

- No eating, smoking, drinking, chewing, or any hand-to-mouth contact will be permitted during cleaning operations.

- Field equipment decontamination will be conducted in accordance with ASTM D5088-02(2008) (*Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Site*) requirements and ASTM D5608-10 (*Standard Practices for Decontamination of Field Equipment Used at Low Level Radioactive Waste Sites*) as applicable.

# 5. MONITORING AND SAMPLING

All soil, soil gas, and geophysical data collected during the interim measures will support delineation of the lateral and vertical distribution of LNAPL within the vadose zone and floating on top the water table. This information will be used to refine the CSM and to develop and design a SVE interim measure to effectively remediate LNAPL in the vadose zone and LNAPL at the water table. In addition, information from this effort, along with the vadose zone and groundwater investigations will provide the data necessary to develop an investigation report that identifies all of the risks associated with the fuel contamination.

The USACE will notify the NMED no less than 15 days prior to field sampling or other field activities and will provide the NMED the opportunity to collect split samples upon request. In addition, the NMED will be notified in writing a minimum of 15 days before implementation of this Interim Measures Work Plan.

## 5.1 ARCH Drilling Soil Sampling

Soil samples (drill cuttings) will be collected from the ARCH drill rig "cyclone" on representative 5-ft centers, and at changes in lithology/color, during advancement of each of the nine boreholes. A geologist will lithologically log the samples and field screen them for VOCs using a PID. Because the ARCH drilling method uses air to lift cuttings from the borehole and creates varying amounts of friction heat, some VOCs will be driven off before field screening. Therefore, PID readings will primarily be used for health and safety purposes. These readings may also distinguish areas of no/low contaminant concentrations from those of gross/higher concentrations on a qualitative basis, but will not be used in any decision-making process.

## 5.2 Geoprobe® Shallow Soil Investigation

Soil samples will be collected continuously to 20 ft bgs using the Geoprobe® Macrocore system along the entire length of the pipeline between the tank farm and the FFOR, regardless of whether the pipeline runs underground or on the surface (Figure 2-1). The borings will be spaced at intervals of 25 ft and are to be located on both sides of the pipeline. Soil samples from the shallow borings will be collected at depths of 0, 5, 10, 15, and 20 ft bgs. Shallow boring samples will be logged by a qualified geologist and reviewed and approved by a registered Professional Geologist as the logs are completed. The soil samples will be analyzed at an off-site laboratory by MA DEP methods for VPH/EPH (MA DEP, 2004a,b) and EPA methods for TPH, VOCs, SVOCs, and lead (EPA, 2007).

Additional step-out borings will be located in areas where soil concentrations exceed the NMED SSLs for hazardous constituents (NMED, 2009). This process will continue to fully delineate the boundaries of soil requiring excavation.

Analytical sampling types, analysis, and estimated quantities are provided in Table 5-1. Table 6-1 presents sample requirements for analytical testing of parameters for each matrix, including sample containers to be used, preservation required, and holding times.

## 5.3 PneuLog Soil Gas Sampling

PneuLog soil gas sampling will be performed at nine locations in the area of the BFF Spill that appear to contain residual LNAPL starting from the point(s) of release to the water table. The proposed locations for the nine PneuLog test locations are shown in Figure 4-4. The vertical profiles from these wells may

facilitate identification of large masses of vadose LNAPL (e.g., LNAPL "perched" on low permeability lenses) or significant contiguous zones of residual LNAPL in the vadose zone.

Proper use of PneuLog information allows the SVE practitioner to optimize the location of vent wells and optimize screen placement to target the contaminant-producing soil layer. During vertical profiling of flow from the vent well, the change in cumulative gas flow measured by the velocity sensor as it travels from one depth interval to another is equal to the gas flow emanating from that soil interval. The gas permeability value for each interval is then determined from Darcy's Law. Typical cumulative flow data appear similar to output from spinner testing in water wells and the data analysis is identical. The technique is analogous to techniques applied in water wells to identify preferential pathways for groundwater.

## 5.4 Field Quality Control

Field QC samples will be collected throughout field investigation activities to ensure the integrity and reproducibility of the soil investigation data. Field QC samples include duplicates, trip, and field blanks for VOC analysis (water only), and equipment blanks for non-dedicated sampling equipment. Field duplicates will be collected at a frequency of 10 percent of the total number of environmental samples or a minimum of one per each event. Trip blank samples will accompany each shipment of water samples to the laboratory for VOC analysis. One field bank will be collected per day for groundwater sampling. Sampling equipment rinse blanks will be collected for soil and groundwater at a rate of 5 percent of the total number of environmental samples, when non-dedicated sampling equipment is being utilized. A temperature blank will be included with each shipment of soil and water samples from the field to the off-site laboratory.

## 5.5 Sample Packaging and Shipping

Sample packaging and shipping requirements are designed to maintain sample integrity from the time a sample is collected until it is received at the analytical laboratory. All chain-of-custody forms, sample labels, custody seals, and other sample documents will be completed as specified in the QAPjP, provided in Appendix E. Specific procedures for packaging and shipping of environmental samples are presented as follows:

- A sample label, completed with indelible ink, will be attached to the sample bottle.
- A picnic cooler (e.g., Coleman or other sturdy cooler) will typically be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut so that no fluids, such as melted ice, will drain out of the cooler during shipment. A large plastic bag may be used as a liner for the cooler. Packing material, such as bubble wrap, or Styrofoam beads, will be placed in the bottom of the liner.
- The containers will be placed in the lined picnic cooler. Cardboard separators may be placed between the containers at the discretion of the shipper.
- All samples for chemical analysis must be shipped cooled to 4°C with ice. All samples will require icing before shipment.
- The liner will be taped closed, if used, and sufficient packing material will be used to prevent sample containers from making contact or rolling around during shipment.
- A copy of the chain-of-custody form will be placed inside the cooler.

- The cooler will be closed and taped shut with strapping tape (filament-type).
- Custody seals will be placed on the cooler. Clear tape will be placed over the custody seals to help prevent them from being accidentally torn or ripped off.
- The cooler of samples will be shipped via an overnight carrier. A standard air bill is necessary for shipping environmental samples.

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# 6. PROJECT SCHEDULE

The project schedule is provided in Appendix B to this work plan.

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# 7. ORGANIZATIONAL PLAN

## 7.1 Overall Project Organization

The organizational structure of the Shaw project team is shown in Figure 4-1.

Mr. Tom Cooper is the Shaw PM for all investigations and remedial work at SWMUs ST-106 and SS-111, collectively called 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. Walter Migdal, who 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 PM. Figure 4-1 and Table 7-1 specify Shaw personnel responsibilities and reporting lines. Communication pathways are also detailed in the QAPjP, provided in Appendix E. All Shaw personnel and Shaw subcontractors are required to have current hazardous waste training as defined by 29 CFR §1910.120. Shaw will directly supervise subcontractors performing field work at all times, and Shaw is responsible for the work performance of all subcontractors under its supervision.

## 7.2 Responsibilities, Qualifications, and Authority of Key Personnel

Table 7-1 summarizes roles and responsibilities, qualifications, and authorities of project team members.

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# 8. DATA MANAGEMENT PLAN

Environmental laboratory services will be provided only by laboratories compliant with the *DoD Quality Systems Manual for Environmental Laboratories, Version 4.1* (DoD, 2009) or the most recent version and that hold a current DoD ELAP accreditation for all appropriate analytical methods. Three laboratories will provide analytical results in support of the BFF Spill project. Each laboratory will provide electronic data in both Staged Electronic Data Deliverable (SEDD) and the Environmental Resources Program Information Management System (ERPIMS) format. The SEDD deliverable will be used for applying the electronic data review process. The ERPIMS deliverable will be validated for upload to the Air Force data repository. All analytical data generated in support of the BFF Spill remediation will be uploaded into the Air Force Data Repository Environmental Restoration Information System on a quarterly basis.

***EPA Level III Data Review***

Analytical data generated in support of the Kirtland BFF Spill project will undergo an EPA Level III data review by a project chemist. An automated data review (ADR) software developed by Laboratory Data Consultants Inc. will be used to perform a 100-percent EPA Level III data review. The data review will be performed for soil, groundwater, and soil-vapor analytical data obtained from each of the pre-remedy quarterly monitoring events. In addition, the project chemist will use the ADR software to conduct a 100-percent, EPA Level III data review of the analytical data collected during the vadose zone and groundwater investigation, and the interim measure field sampling activities. The data review will be performed using the QC procedures specified in the following documents:

- QAPjP (Appendix E);
- *DoD Quality Systems Manual for Environmental Laboratories, Version 4.1* (DoD, 2009);
- *Test Methods for Evaluating Solids Waste, SW846 Physical/Chemical Methods* (EPA, 2007 and updates);
- USACE, *Environmental Quality – Guidance for Evaluating Performance-Based Chemical Data,* Engineer Manual (EM) 200-1-10 (USACE, 2005);
- *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA, 2008); and
- *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2010).

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

- Laboratory method blanks,
- Sample extraction and analysis holding times,
- Surrogate spike recoveries,
- Laboratory control sample/laboratory control sample duplicate recoveries,
- Matrix spike/matrix spike duplicate recoveries,
- Relative percent difference for duplicate samples,
- Initial calibrations,
- Continuing calibrations,
- Trip and field blank data (water samples for VOCs only), and

- Field duplicate samples.

Note that because of laboratory information system limitations, laboratories may not be able to provide initial and continuing calibration results in SEDDs. In this case, the project chemist will manually review the calibration data and document review findings in a database and data review worksheets.

Data will be validated and qualified 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.

As a result of the ADR process, EPA qualifiers will be electronically generated and assigned to sampling results that are outside of established control criteria. The qualified data will then be exported to a contractor database for data users and for report tables and figure preparations. EPA Level III data review findings will be summarized and documented with each Quarterly Monitoring Report and in other reports containing analytical data.

An 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 lifecycle 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 QAPjP (Appendix E) and applicable *Base-Wide Plans for Investigations under the Environmental Restoration Program, 2004 Update, Kirtland AFB, New Mexico* (Tetra Tech, 2004). All quarterly monitoring field data, including but not limited to, water level data, survey data, boring logs, and well construction logs, will be uploaded into the contractor EIMS and linked with validated analytical results in order to generate output files that will be used to populate Environmental Restoration Program Tools and generate ERPIMS Version 5.0 submittals. ERPIMS data submittals will be reviewed for accuracy and completeness before submittal. ERPIMS submittals will be provided to the Air Force, at a minimum, every six months or as appropriate for data generation for uploading into the Air Force data repository. ERPIMS submittals will be deemed complete upon receipt of the insertion letter from the Air Force.

Site characterization data will be mapped using a geographic information system (GIS). The GIS dataset will be accompanied by metadata conforming to the Federal Geographic Data Committee's Content Standard for Digital Geospatial Metadata and the Army Installation Geospatial Information and Services Metadata Standard, v1, which is compliant with Spatial Data Standards for Facilities, Infrastructure, and Environment v2.6. The horizontal accuracy of GIS data will be tested in accordance with the National Standard for Spatial Data Accuracy and results will be recorded in the metadata. All data will be provided in the UTM projection in the appropriate zone, and will have a datum of NAD83. The GIS effort will involve preparation, analysis, processing, and interpretation of data acquired from soil sampling and analysis, geophysical logging, and intrusive investigations. The GIS coordinator will register and process all survey and field data such that it can easily be incorporated into the Kirtland AFB and Army Mapper database. Contractor GIS analysts will prepare maps depicting site-specific attributes for continuous

updates to be provided to project stakeholders. 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 Shaw 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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# 9. QUALITY ASSURANCE/QUALITY CONTROL

A comprehensive QAPjP document has been developed and will be implemented in support of sampling and analysis activities for the BFF Spill (Appendix E).

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# 10. WASTE MANAGEMENT

All wastes generated during implementation of this work plan will be handled and disposed of according to the requirements presented in the Waste Management Plan (Appendix C). Soil will be sampled in place for characterization and for disposal requirements. Soil that is excavated will be transported for disposal to the on-site Kirtland AFB landfill, as described in Appendix C. Appendix C discusses containerization, sampling, and disposal requirements relevant to this project.

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# 11. ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN

The Accident Prevention Plan, including the SSHP (Attachment 10) for the Kirtland AFB BFF Spill investigation work, has been submitted under separate cover (Shaw, 2011).

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# 12. COMMUNITY RELATIONS PLAN

A Community Relations Plan (CRP) is being developed and submitted under separate cover in accordance with contract No. W912DY-10-D-0014, Delivery Order 0002 and the Kirtland AFB Base-Wide Community Relations Plan. Community information meetings, including community outreach as well as presentations at neighborhood association meetings, are provided upon request. Below is a general approach to supporting community relations. For details, see the CRP being submitted under separate cover.

The CRP identifies activities designed to aid information sharing between the project and local community in understanding the bulk fuels contamination associated with the Kirtland AFB BFF Spill. The CRP also outlines the types of information to be provided and how that information will be distributed to surrounding communities and other interested stakeholders. The CRP includes the following information:

- Project background and history;
- Local demographic, site historical, and technical data; and
- Proactive communication strategies based on the compiled data.

The outreach strategy developed meets current regulatory standards and Air Force communication needs and requirements. This strategy will also respond to community's needs and desire for information about the ongoing remediation field activities associated with the BFF Spill. Community relations work will be conducted in accordance with the appropriate regulatory guidance, including EPA's *RCRA Public Participation Manual, 1996 Edition,* OSWER-9950.1. (EPA, 1996), and *Superfund Community Involvement Handbook, EPA 540-K-05-003* (EPA, 2005).

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# FIGURES

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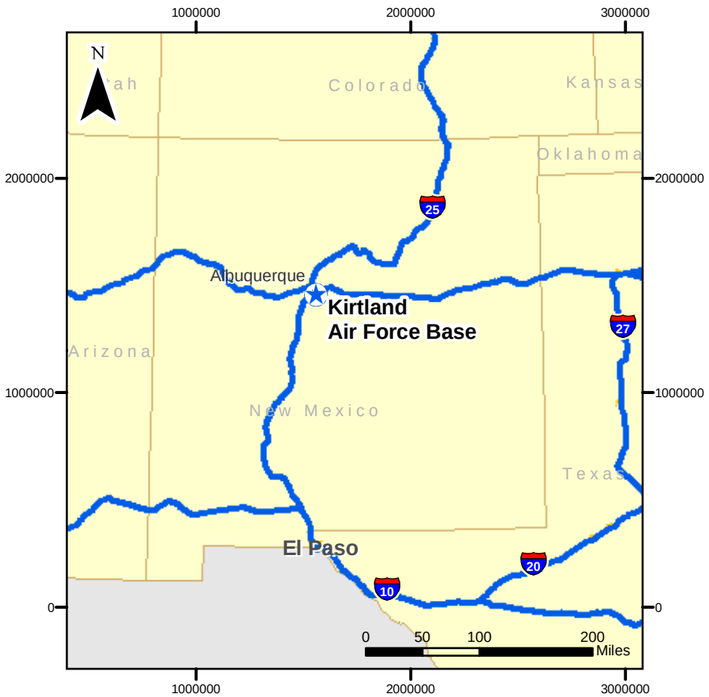
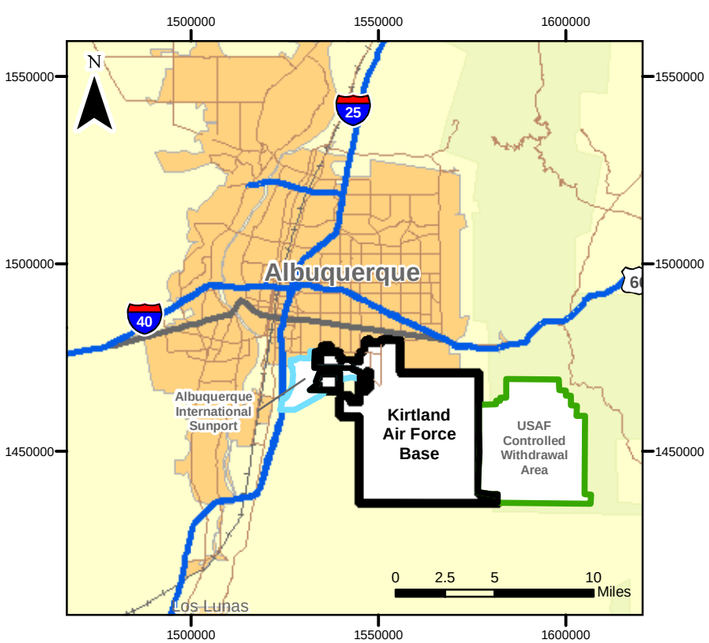
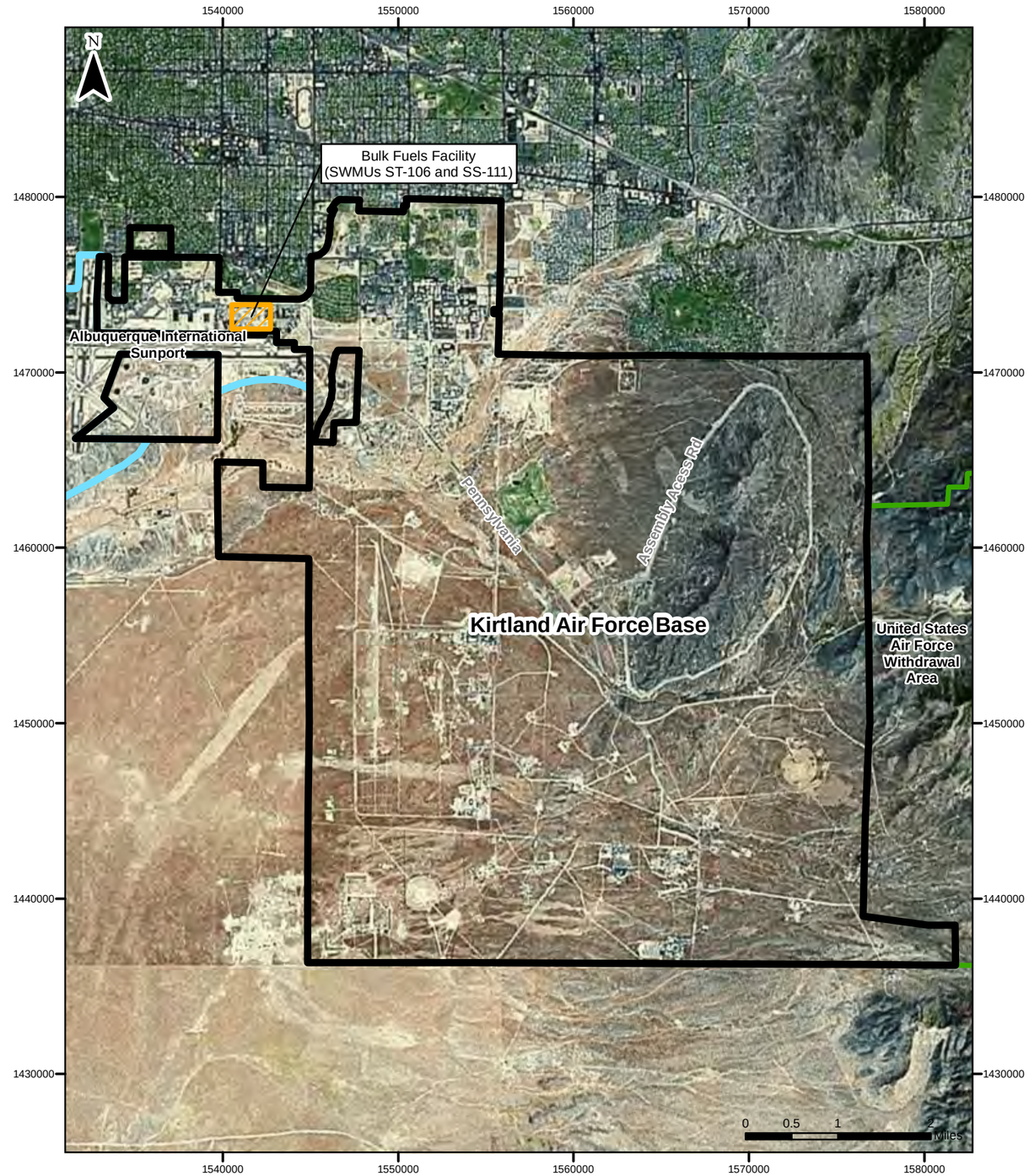



## State Map




## Local Area Map




## Kirtland AFB Area Map

- Bulk Fuels Facility (SWMUs ST-106 and SS-111)
- State Boundary
- Urban Area
- Installation Location
- Kirtland Air Force Base Installation Boundary
- Albuquerque_Intl_Sunport
- United States Air Force Withdrawal Area
- Limited Access
- Highway
- Major Road

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 1-1

SITE LOCATION MAP

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Project Number: 140705

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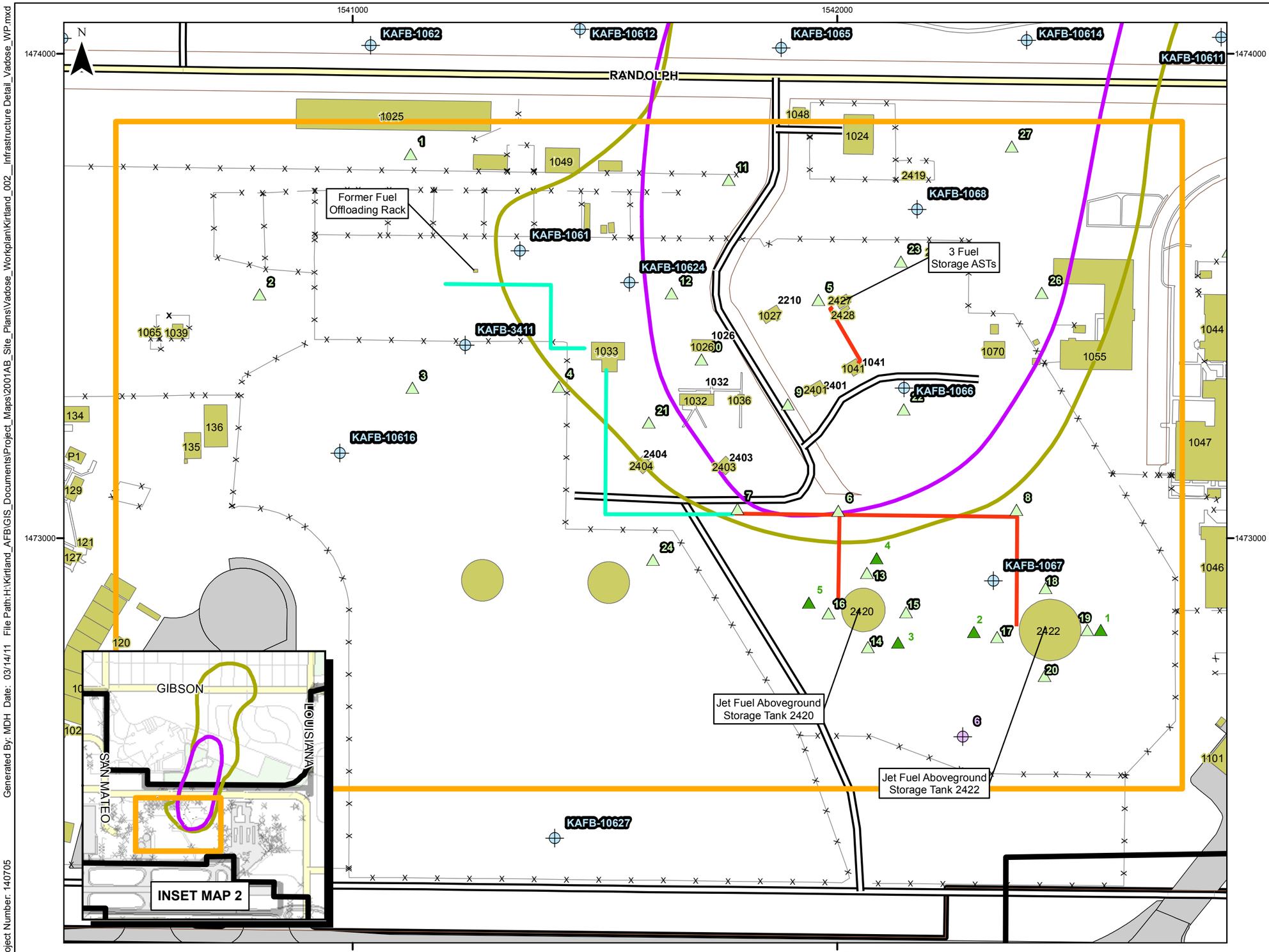


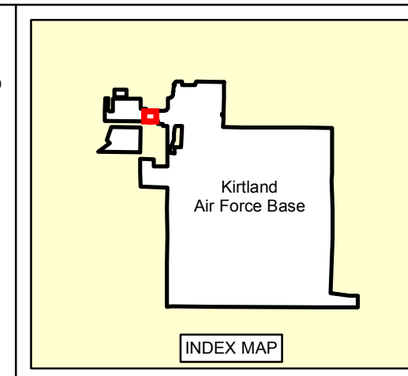


- Borehole Locations for Soil Sampling and for Conversion to Soil-Vapor Monitoring Wells (Labeled with ID provided by NMED)
- Locations for Shallow Soil Borings in Tank Farm Area (Labeled with ID provided by NMED)
- Proposed Soil-Gas Monitoring Wells (Labeled with ID provided by NMED)
- Existing Monitoring Well
- Aboveground Fuel Transfer Lines
- Underground Fuel Transfer Lines
- Bulk Fuels Facility (SWMUs ST-106 and SS-111)
- Estimated Extent of LNAPL
- Estimated Extent of Dissolved Phase Contaminant Plume
- Installation Boundary
- Fence
- Interstate
- Major Road
- Road
- Parcels
- Structure
- Structure (other)
- Runway
- Bridge
- Sidewalk
- *Park
- Installation Boundary

0 100 200 Feet

1 Inch = 200 ft

Projection : NAD_1983_StatePlane_New_Mexico_Central_FIPS_3002_Feet

BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-1

SOURCE AREA AND INFRASTRUCTURE

Generated By: MDH Date: 03/14/11 File Path:H:\Kirtland_AFB\GIS_Documents\Project_Maps\2001AB_Site_Plans\Vadose_Workplan\Kirtland_002__Infrastructure Detail_Vadose_WP.mxd

Project Number: 140705

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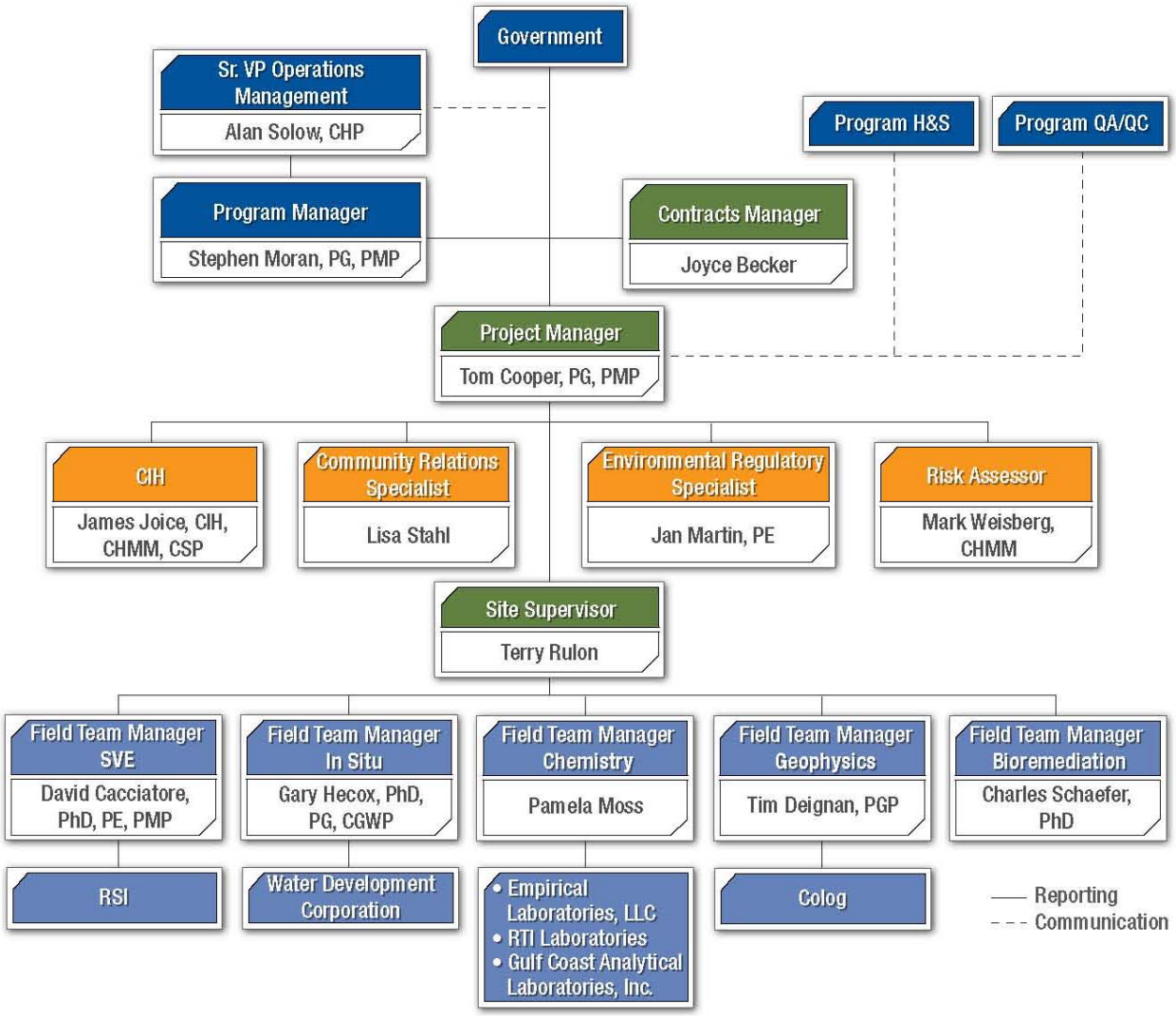
**Figure 4-1. Project Organization**



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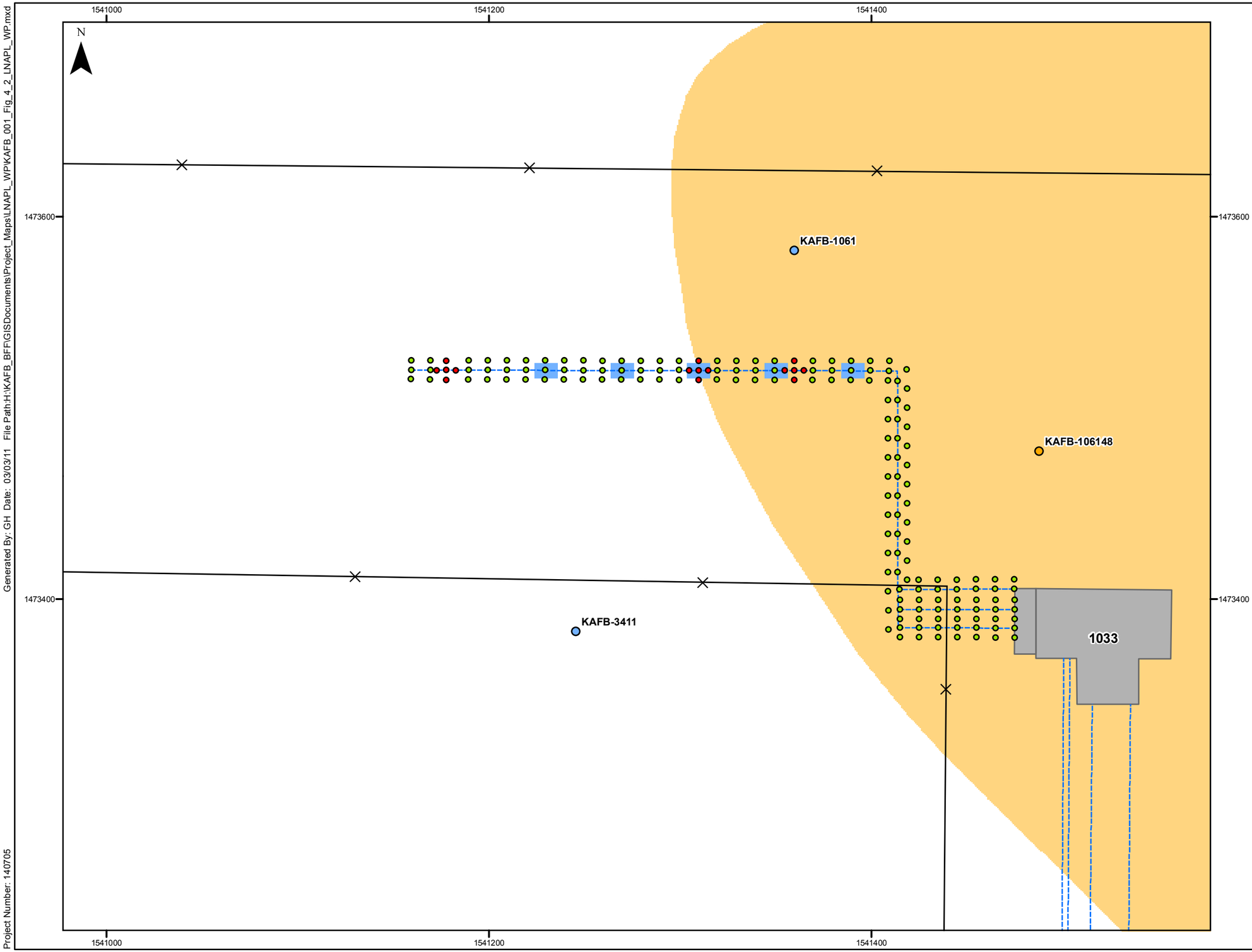


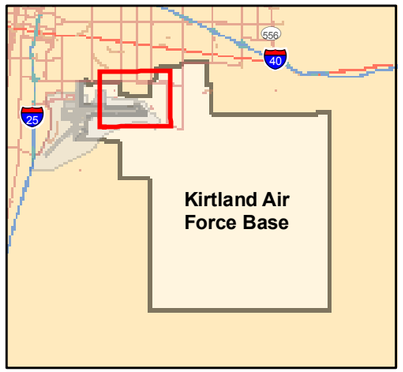


- Suspected Leak Location Samples - 5 ft nodes
- Proposed Soil Sample Locations - 10 ft spacing
- Pneulog Well Location
- Existing Groundwater Monitoring Well
- Fence
- Former Fuel Transfer Lines
- Structures
- Former Fuel Transfer Stations
- Estimated Extent of Dissolved Phase Contaminant Plume

*Note:*
*169 soil samples total.*

0 50 100 Feet
1 Inch = 50 ft
Projection : NAD_1983_StatePlane_New_Mexico_Central_FIPS_3002_Feet

BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-2

FORMER FUEL OFFLOADING RACK TO PUMP HOUSE SOIL INVESTIGATION AREAS

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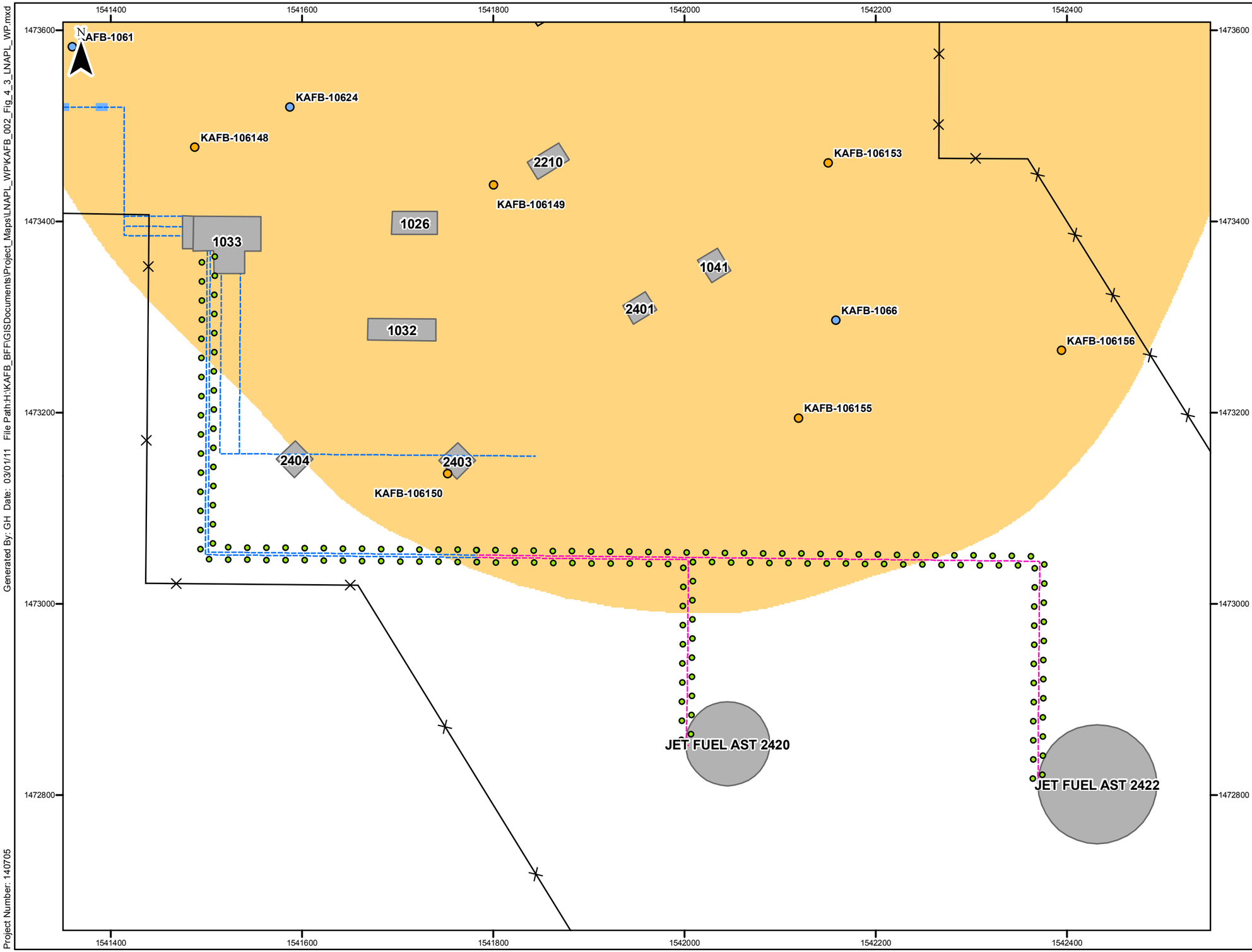


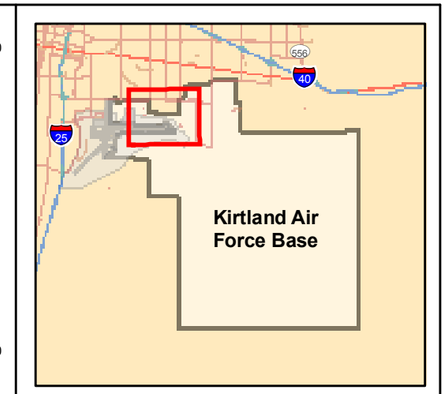


Proposed Soil Sample Locations - 20 ft spacing

Existing Groundwater Monitoring Well

Pneulog Well Location

Fence

Fuel Transfer Lines

Aboveground Fuel Transfer Lines

Structures

Fuel Transfer Stations

Estimated Extent of Dissolved Phase Contaminant Plume

*Note:*
*164 soil samples total.*

0 100 200 Feet

1 Inch = 50 ft

Projection : NAD_1983_StatePlane_New_Mexico_Central_FIPS_3002_Feet

BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-3

PUMP HOUSE AND UNDERGROUND PIPE SOIL INVESTIGATION AREAS

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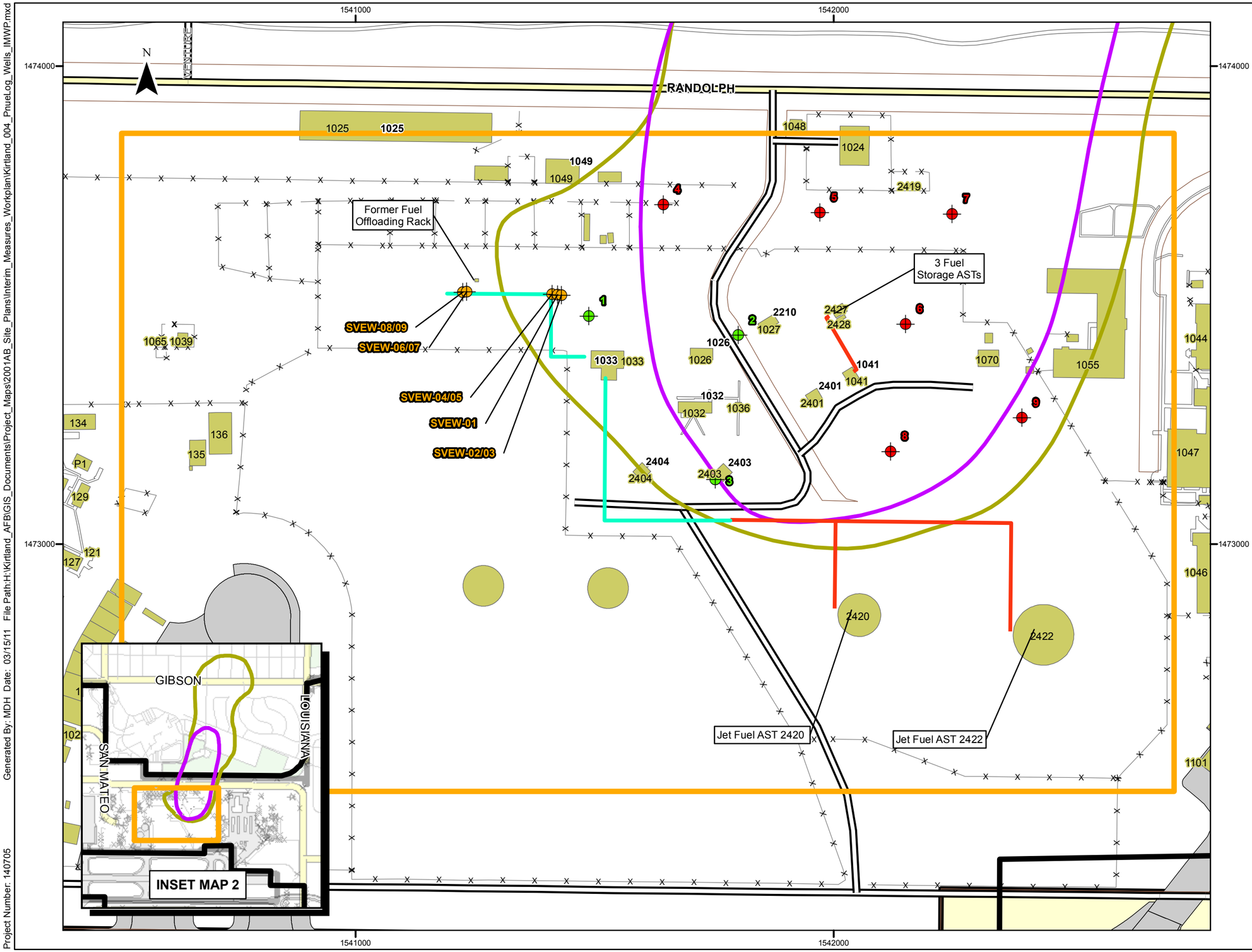


INTERIM MEASURES WORK PLAN
BULK FUELS FACILITY SPILL
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-4

LOCATION OF PNEULOG WELLS

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Project Number: 140705

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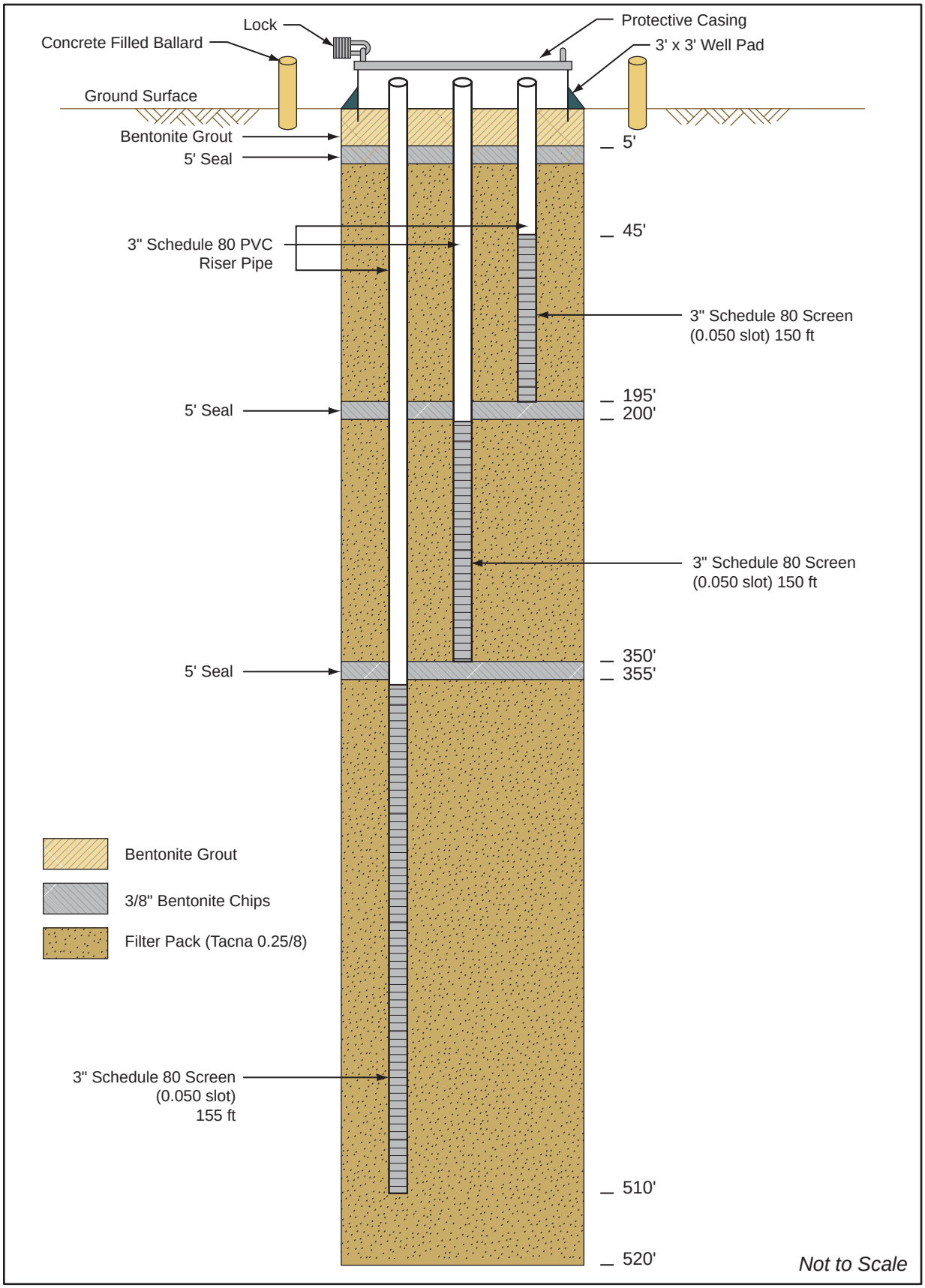


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**Figure 4-5**
**Schematic of PneuLog Well Cluster Construction**

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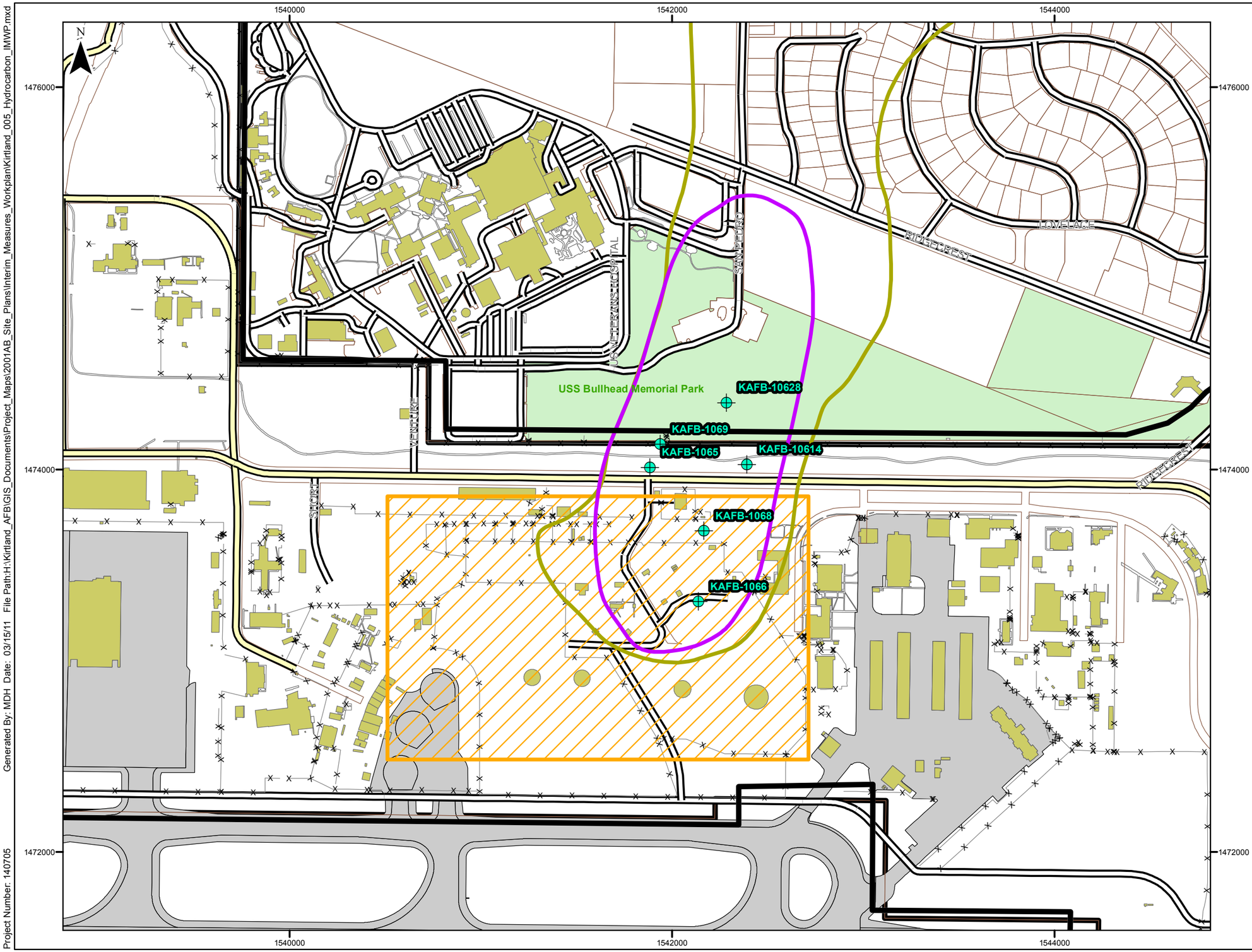


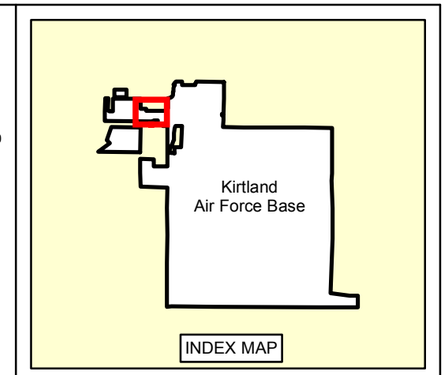


- Hydrocarbon Baildown Monitoring Well Testing Locations
- Installation Boundary
- Estimated Extent of LNAPL
- Estimated Extent of Dissolved Phase Contaminant Plume
- Bulk Fuels Facility (SWMUs ST-106 and SS-111)
- Fence
- Interstate
- Major Road
- Road
- Parcels
- Structure
- Structure (other)
- Runway
- Bridge
- Sidewalk
- *Park
- Installation Boundary

0 500 1,000 Feet

1 Inch = 500 ft

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 4-6

HYDROCARBON BAILDOWN
TESTING LOCATIONS

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Project Number: 140705

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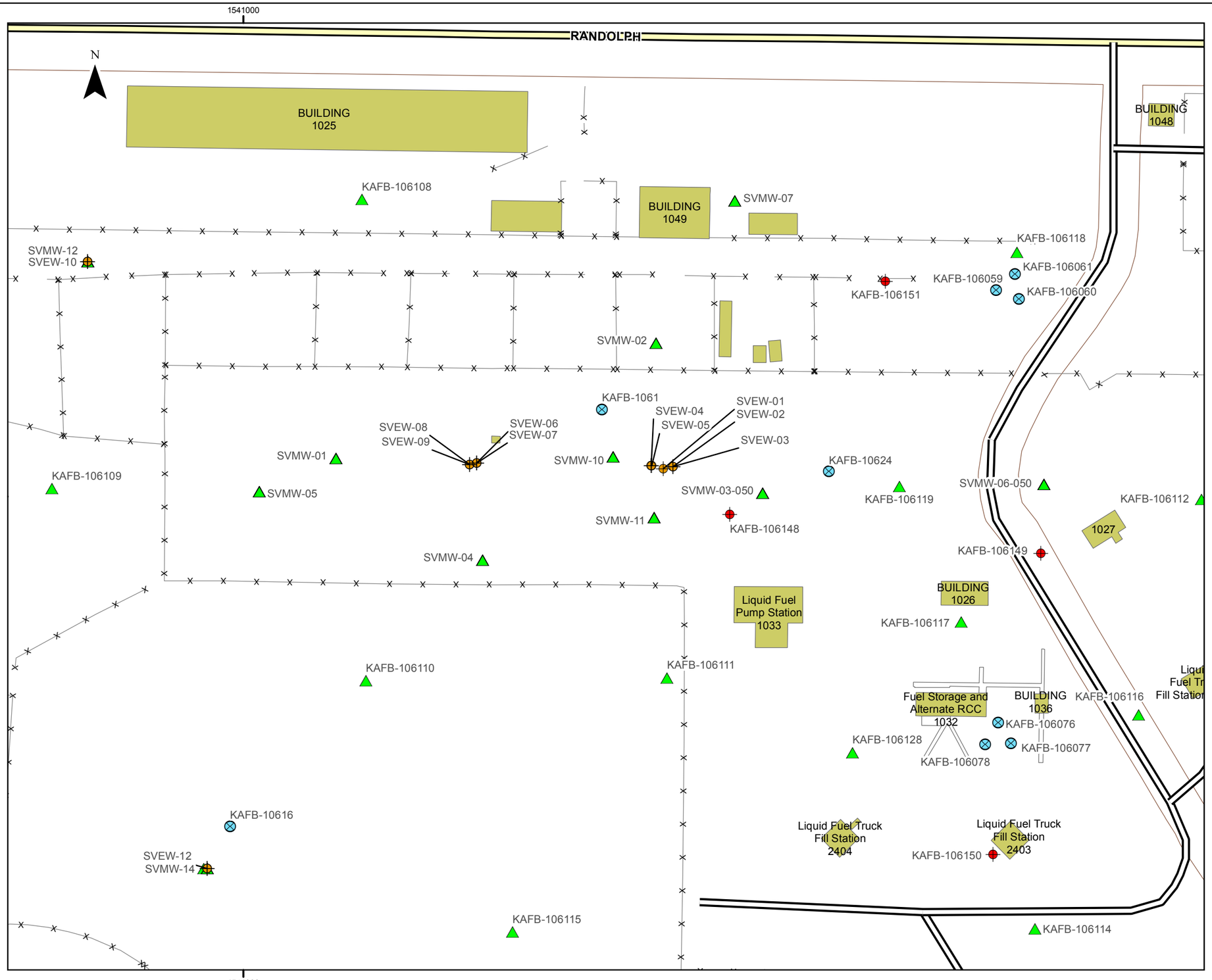


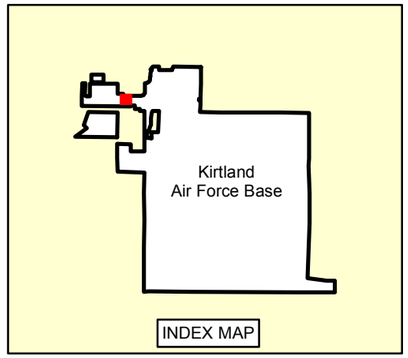


- Monitor Well
- Pneu Log
- SVE Extraction Well
- SVE Monitor Well
- Fence
- Parcels
- Structure
- Sidewalk
- Installation Boundary
- Major Road
- Road

0 50 100 Feet

1 Inch = 100 ft

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 4-7

POTENTIAL RADIUS OF INFLUENCE TEST WELLS

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# TABLES

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## Table 1-1. Data Gaps Summary

| No. | Data Gap | Work Plan | Section |
|---|---|---|---|
| 1 | Characterize the vadose zone hydrology and its relationship to the water table. | Vadose Zone Investigation | Section 4.2.11 |
| | | Interim Measures | Sections 4.6.2 and 4.6.11 |
| 2 | Determine the nature and extent of soil contamination along former and existing pipelines connecting the Former Fuel Offloading Rack to Building 1033 and from Building 1033 to Jet Fuel Storage Tank 2420 and 2422. | Interim Measures | Sections 4.5.2.1 and 4.5.2.2 |
| 3 | Characterize the soil vapor distribution, soil permeability relative to light non-aqueous phase liquid (LNAPL), and contaminant concentrations profiles within the vadose zone. | Vadose Zone Investigation | Sections 4.2.10 and 4.2.11 |
| | | Interim Measures | Sections 4.6.2, 4.6.3, and 4.6.11 |
| 4 | Identify the potential source of the LNAPL plume and extent of contamination. | Interim Measures | Sections 4.6.2 and 4.6.3 |
| 5 | Determine the aquifer conductivity relative to LNAPL and recoverability at the water table/LNAPL interface. | Interim Measures | Section 4.6.10 |
| 6 | Determine the radius of influence of future and proposed soil vapor extraction units for optimization of remedy design. | Interim Measures | Section 4.6.11 |

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## Table 3-1. Hydrostratigraphic Units and Correspondence to Site-Specific Units

| Regional Unit (Depositional Facies) | Site-Specific Zones | Description | Thickness | Approximate Depth Interval | SVMW Screened Intervals |
|---|---|---|---|---|---|
| **USF-1** (Distal alluvial piedmont fan deposits from the Sandia uplift) | | Thick discontinuous intervals of silt (ML) and silty or sandy clays (CL) w/minor lean clays (CL) | 74’ to 94’ | Surface to ≈86’ bgs | 50’ to 52.5’ bgs |
| **Transition Zone** (Inter-tongued USF-1 and USF-2) | Upper transition sands (USF-2) | Poorly graded sand (SP) buff colored, fine-grained | 15’ to 25’ | ≈86’ bgs to ≈107’ bgs | 97’ to 102.5’ bgs |
| | Upper transition fines (USF-1) | Primarily silty, sandy, and lean clays (CL) with minor silt (ML) zones | 13’ to 25’ | ≈107’ bgs to ≈125’ bgs | |
| | Lower transition sands (USF-2) | Poorly graded sand (SP) buff colored, fine-grained | 3’ to 15’ | ≈125’ bgs to ≈140’ bgs | |
| | Lower transition fines (USF-1) | Primarily silty, sandy, and lean clays (CL) | 0’ to 10’ | ≈140’ bgs to ≈144’ bgs | |
| **USF-2** (Stacked sequence of braided river-channel deposits [Ancestral Rio Grande] and inter-bedded fine- to medium-grained sediments of diverse origin) | Upper Ancestral Rio Grande deposits | Poorly graded fine-grained sands (SP) and well-graded fine- to coarse-grained sands (SW) buff colored, w/trace of gravels. | 117’ to 140’ | ≈144’ bgs to ≈270’ bgs | 147’ to 152.5’ bgs, 229’ to 231’ bgs, 250’ to 252.5 bgs |
| | Clay Zone | Lean clay (CL) brown, moist to wet, very stiff w/minor sandy and silty clay (CL) | 0’ to 15’ | ≈270’ bgs to ≈280’ bgs | |
| | Lower Ancestral Rio Grande deposits | Poorly graded fine-grained sands (SP) and well-graded fine- to coarse-grained sands (SW) buff colored, w/higher fraction of gravel (GW) and fine-grained (GM) zones | >137’ | ≈280’ bgs to >517’ bgs | 287.5’ to 305’ bgs |

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## Table 5-1. Field Sampling and Quality Control Sample Summary

| Matrix | Analytical Group | No. of Primary Sampling Locations | No. of Field Samples | No. of Field Duplicates | No. of MS/MSDs | No. of Field Blanks | No. of Equipment Rinsates | No. of Trip Blanks | Total No. of Samples to Laboratory |
|---|---|---|---|---|---|---|---|---|---|
| FFOR Soil Sampling | | | | | | | | | |
| Soil | VOCs – SW846 8260B | 80 | 400 | 40 | 20 | 0 | 20 | 0 | 480 |
| Soil | VPH/EPH – MA DEP | 80 | 400 | 40 | 20 | 0 | 20 | 0 | 480 |
| Soil | SVOCs – SW846 8270D | 80 | 400 | 40 | 20 | 0 | 20 | 0 | 480 |
| Soil | Lead – SW846 6010C | 80 | 400 | 40 | 20 | 0 | 20 | 0 | 480 |
| Soil IDW Sampling | | | | | | | | | |
| Soil | Ignitability, Corrosivity, Reactivity – 40 CFR 261 | 30 | 30 | 0 | 0 | 0 | 0 | 0 | 30 |
| Soil | TCLP VOCs – SW846 1311/8260B | 30 | 30 | 0 | 0 | 0 | 0 | 0 | 30 |
| Soil | TCLP SVOCs – SW846 1311/8270D | 30 | 30 | | 0 | 0 | 0 | 0 | 30 |
| Soil | TCLP Pesticides – SW846 1311/8081B | 30 | 30 | 0 | 0 | 0 | 0 | 0 | 30 |
| Soil | TCLP Herbicides – SW846 1311/8151A | 30 | 30 | 0 | 0 | 0 | 0 | 0 | 30 |
| Soil | TCLP Metals – SW846 1311/6010C/7470A | 30 | 30 | 0 | 0 | 0 | 0 | 0 | 30 |
| Soil | BTEX – SW846 8260B/8021B | 30 | 30 | 0 | 0 | 0 | 0 | 0 | 30 |
| Soil | TPH gas/diesel – SW846 8015C | 30 | 30 | 0 | 0 | 0 | 0 | 0 | 30 |

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## Table 6-1. Sample Requirements for Analytical Testing

| Low-Concentration Samples | | | | | |
|---|---|---|---|---|---|
| | | | | Maximum Holding Times[4] | |
| **Matrix** | **Parameter[1]** | **Container[2, 3]** | **Preservation[3]** | **Extraction** | **Analysis** |
| Water | Volatiles | 2 x 40-mL[5] G, Septa Vial | Ice to 4°C<br>4 drops concentrated hydrochloric acid (HCl) or sodium bisulfate ($NaHSO_4$) to pH<2 | — | 14 days |
| Water | SVOCs | 2 x 1-L[5, 6] amber G | Ice to 4°C | 7 days | 40 days |
| Water | Metals[7] | 1 x 1-L P | Nitric acid ($HNO_3$) to pH<2 | | 6 months[7] |
| Water | TPH-gas<br>TPH-diesel | 2 x 40-mL[6] G, Septa Vial<br>2 x 1-L G | Ice to 4°C | | 14 days |
| Water | Common parameters | 1 x 1- L[5] G | Ice to 4°C | | 28 days[8] |
| Soils/Sediments | Volatiles | 3- to 5-gram Encore | Ice to 4°C | | 48 hr, 14 days frozen |
| Soils/Sediments | SVOCs, PCBs, pesticides | 1 x 8-oz G | Ice to 4°C | 14 days | 40 days |
| Soils/Sediments | Metals, cyanide, TPH | 1 x 8-oz G<br>5-gram Encore for TPH-gas | Ice to 4°C | | 6 months,[7] 14 days, 48 hr, 14 days frozen |
| **Medium-Concentration Samples** | | | | | |
| Water/Liquid | Volatiles | 2 x 40-mL G | Ice to 4°C[8] | | 14 days |
| Water/Liquid | SVOCs[6] | 2 x 32-oz wide-mouth jars, G | Ice to 4°C[8] | 7 days | 40 days |
| Water/Liquid | PCBs[5], pesticides | 2 x 32-oz wide-mouth jar G | Ice to 4°C[8] | 7 days | 40 days |
| Water/Liquid | Metals | 1 x 16-oz wide-mouth jar, G | $HNO_3$ to pH<2 | | 6 months[7] |
| Water/Liquid | Explosives | 2 x 1-L amber G | Ice to 4°C | 7 days | 40 days |
| Water/Liquid | Cyanide | 1 x 1-L P | Sodium hydroxide (NaOH) to pH>12<br>Ice to 4°C | | 14 days |
| Soils/Sediments | Volatiles | 3- to 5-gram Encore for TPH-gas | Ice to 4°C | | 48 hr, 14 days frozen |
| Soils/Sediments | SVOCs, PCBs, pesticides | 1 x 8-oz wide-mouth jar, G | Ice to 4°C | 14 days | 40 days |
| Soils/Sediments | Metals, cyanide, TPH | 1 x 8-oz wide-mouth jar, G<br>5-gram Encore for TPH-gas | Ice to 4°C | | 6 months,[7] 14 days, 48 hr, 14 days frozen |
| Liquid | All organic and inorganic analyses | 1 x 8-oz wide-mouth jar, G | | See comment 9 | |
| Solids | All organic and inorganic analyses | 2 x 8-oz wide-mouth jars, G | | See comment 9 | |

## Table 6-1. Sample Requirements for Analytical Testing (concluded)

1 SVOC = semivolatile organic compounds, TPH = total petroleum hydrocarbon, and PCB = polychlorinated biphenyl.

2 All containers must have Teflon®-lined seals (Teflon®-lined septa for volatile organic analysis [VOA] vials).

3 L = liter; G = glass; P = high-density polyethylene. Sample preservation will be done in the field immediately upon sample collection. If water samples are filtered in the field, differential pressure methods using 45-micron filters will be used, and preservatives added after filtration. VOA samples should never be filtered.

4 When only one holding time is given, it implies total holding time from sampling until analysis.

5 Samples with residual chlorine present will be dechlorinated with sodium thiosulfate as specified in SW-846 (third edition).

6 Three bottles are required on at least 5-10 percent (but at least one) sample so that the laboratory can perform all method QC checks for SW-846 method.

7 Total recoverable metals for water samples. Holding time for mercury is 28 days in glass; for hexavalent chromium is 24 hours.

8 Chlorine, bromine, fluorine, nitrate, nitrite, phosphate, sulfate; 1 L for each method; orthophosphate requires filtration. Holding time for extraction is 48 hours for nitrate, nitrite, and phosphate if not preserved with sulfuric acid to pH<2.

9 Holding times for medium-concentration samples are the same as those specified for low concentration samples.

## Table 7-1. Project Team Member's Qualifications, Responsibilities, and Authorities

| Position | Qualifications | Duties and Responsibilities | Authority Level |
|---|---|---|---|
| **Project Manager** | • Tom Cooper, PG, PMP<br>• Mr. Cooper is a Professional Geologist (PG) and Project Management Professional (PMP) with 11 years of experience as a hydrogeologist on complex groundwater remediation projects and 5 years of experience as a project manager for firm-fixed-price, performance-based acquisition (PBA) projects including hybrid PBAs with options. He has expert knowledge of groundwater and soil sample collection/data evaluation and has extensive experience working proactively with clients and regulators to determine the best technologies to reach remedial performance objectives.<br>• Mr. Cooper has served as the project manager for DoD projects at Former Air Force Plant PJKS, Pueblo Chemical Depot, and Vandenberg AFB. For these projects, he has established a strong and cooperative working relationship with his clients as well as the state and EPA regulators. At PJKS, he successfully negotiated with the regulators to implement an environmental covenant and technical impracticability waiver as opposed to a pump-and-treat system. The environmental covenant saved the Air Force millions of dollars. At Pueblo, Mr. Cooper developed ten remedy-specific work plans that were approved within the first year of the project. He and his team then completed installation of eight in situ bioremediation systems within the second year of the project. | • Manages task order (TO) deliverables, schedules, and budgets<br>• Implements procedures to eliminate conflicts, errors, and omissions and ensure the accuracy of all output<br>• Establishes and maintains close communication and coordination with the USACE for the duration of the project<br>• Assigns scientists, engineers, and select subcontractors<br>• Procures services, equipment, and supplies as needed<br>• Ensures personnel follow approved work plans/specs<br>• Tracks materials and resources and justify change orders<br>• Coordinates subcontractors' work to ensure compliance with safety and health, quality, and contract procedures | • Full responsibility and authority to execute TOs<br>• Approves subcontractor invoices, project charges, and deliverables<br>• Implements corrective action<br>• Stops work for non-compliance/safety violation |
| **Site Supervisor** | • Terry Rulon<br>• Mr. Rulon has over 22 years as a site supervisor on restoration, remediation, demolition, and hazardous waste sites. His role has been primarily bid preparation, estimating, overall site management, and field work on numerous complex environmental projects throughout the U.S.<br>• Mr. Rulon's experience includes, but is not limited to, management of contaminated soil remediation, in situ bioremediation of groundwater for chlorinated compounds, shock sensitive chemical packaging, and emergency response actions. | • Tracks progress of daily well installation production and soil excavation<br>• Schedules manpower and balancing project resources<br>• Schedules use of equipment<br>• Manages sampling of environmental media and IDW, handling of IDW, and coordination of IDW disposal.<br>• Manages operation and maintenance of all equipment<br>• Addresses field issues to keep project on schedule<br>• Communicates daily with project manager to keep project on schedule | • Supervises field TO engineering and design staff<br>• Manages subcontractors<br>• Implements corrective action<br>• Stops work for non-compliance/safety violation |

## Table 7-1. Project Team Member's Qualifications, Responsibilities, and Authorities (continued)

| Position | Qualifications | Duties and Responsibilities | Authority Level |
|---|---|---|---|
| **Field Team Manager - SVE** | • David Cacciatore, PhD, PE, PMP<br>• Dr. Cacciatore is a registered Professional Engineer (PE) and PMP with 7 years of experience designing and implementing SVE/bioremediation systems for environmental remediation projects. He has designed and implemented a wide range of bioremediation technologies, including monitored natural attenuation (MNA). Dr. Cacciatore has served as the Designer of Record on plans and reports for several high-profile projects at sites including Hunters Point Naval Shipyard and Treasure Island in California. He has played an integral role in supporting negotiations with regulators to gain approval of the remedies and cleanup goals for these projects. Dr. Cacciatore has authored/co-authored 11 technical papers/ presentations at industry conferences on the design and implementation of bioremediation and other remedial methods. | • Identifies, trains, mentors, and assigns qualified engineering staff to tasks/projects<br>• Ensures compliance and consistency of engineering and technical program execution across all TOs<br>• Provides professional engineering certification of drawings, specifications, and documents as necessary<br>• Ensures compliance with all applicable engineering and design codes, standards, and guidance | • Supervises field TO engineering and design staff<br>• Defines qualifications and requirements of engineering and technical staff at TO level<br>• Evaluates performance of engineering staff and provides feedback, including recommendations, to project manager<br>• Stops work for non-compliance/safety violation |
| **Field Team Manager – In Situ** | • Gary Hecox, PhD, PG, CGWP<br>• Dr. Hecox is a PG and certified groundwater professional (CGWP) with 32 years of experience in hydrogeology, GIS development and application, contaminant investigations, risk analysis, and remediation. He is a technical expert in non-aqueous phase liquid (NAPL) assessment and remediation, groundwater modeling, geostatistics, statistics, and error analysis.<br>• Dr. Hecox has served as Shaw's senior scientist/engineer for federal remediation projects dealing with in excess of 5 million gallons of LNAPL contamination. He specializes in designing and implementing process treatment systems such as the chemical stabilization of soils and groundwater. He has provided technical input and strategy support in RCRA site remediation negotiations and technical impracticability waivers for various federal sites. Dr. Hecox has also developed and deployed new technologies and applications of GIS for hydrogeologic assessments. | • Prepares groundwater modeling to assist with the design of remediation systems<br>• Executes the MNA evaluation study<br>• Evaluates and documents all hydrogeologic data to confirm LNAPL and plume containment | • Supervises field TO design staff<br>• Defines qualifications and requirements of technical staff at TO level<br>• Evaluates performance of technical staff and provides feedback, including recommendations, to project manager<br>• Stops work for non-compliance/safety violation |

## Table 7-1. Project Team Member's Qualifications, Responsibilities, and Authorities (continued)

| Position | Qualifications | Duties and Responsibilities | Authority Level |
|---|---|---|---|
| **Field Team Manager – Bioremediation** | • Charles Schaefer, PhD<br>• Dr. Schaefer has 14 years of experience with assessing the fate and transport of organic contaminants in soil and groundwater systems. His work has included design and performance of laboratory scale experiments, mathematical and numerical modeling, and conceptual design and evaluation of field-scale bioremediation systems. He has taught graduate-level courses in contaminant hydrogeology, and has been successful in attaining research funding from the EPA, DoD, and the U.S. Department of Energy (DOE). Dr. Schaefer's research has included development of experimental methods to evaluate new and emerging technologies including EDB degradation in Shaw's treatability study laboratories located in Lawrenceville, NJ and Knoxville, TN. As a result of his research, he has developed and published several conceptual and mathematical models that have been used to better understand, interpret, and predict contaminant fate and transport.<br>• Dr. Schaefer has been the lead engineer and/or technical manager on several field projects, many of which have used innovative investigation and treatment technologies. His key contributions include the conceptual design and performance evaluation of an air sparging/soil vapor extraction Superfund site in New Jersey; development of a transport model to evaluate contaminant biodegradation in an engineered biocell at a Superfund site in Delaware; and development and implementation of an innovative cosolvent technology for investigation of dense, non-aqueous phase liquid (DNAPL) in bedrock. | • Identifies, trains, mentors, and assigns qualified engineering staff to tasks/projects<br>• Ensures compliance and consistency of engineering and technical program execution across all TOs<br>• Provides professional engineering certification of drawings, specifications, and documents as necessary<br>• Ensures compliance with all applicable engineering and design codes, standards, and guidance | • Supervises field TO engineering and design staff<br>• Defines qualifications and requirements of engineering and technical staff at TO level<br>• Evaluates performance of engineering staff and provides feedback, including recommendations, to project manager<br>• Stops work for non-compliance/safety violation |

## Table 7-1. Project Team Member's Qualifications, Responsibilities, and Authorities (continued)

| Position | Qualifications | Duties and Responsibilities | Authority Level |
|---|---|---|---|
| **Field Team Manager – Chemistry** | • Pamela Moss<br>• Ms. Moss has 32 years of experience in chemical QC, analytical chemistry, and project management in support of federal contracts. Ms. Moss has supported projects at Kirtland AFB from 1996 to 2010. During this time, she managed in excess of $5 million in analytical lab services. She has also participated in RCRA site investigations, remedial actions, long-term groundwater monitoring, compliance monitoring and sampling programs, which include hazardous wastes and routine and non-routine analytical parameters for groundwater, drinking water, soil, and air.<br>• Ms. Moss has 14 years of experience at Kirtland participating in regular communications and negotiating with the NMED to ensure compliance with all applicable regulations. Ms. Moss also has extensive knowledge and experience implementing federal programs in accordance with the USACE; DoD Quality Systems Manual; and EPA requirements, protocols, and analytical methodologies. | • Approves project-specific DQOs that will meet the project-specific performance standards<br>• Determines appropriateness of sampling procedures, analytical methods, and laboratory quality systems<br>• Approves the final QAPP<br>• Verifies the selection of appropriately qualified laboratories<br>• Coordinates field and laboratory quality assurance surveillance per contract specifications<br>• Notifies the project manager of any problems or nonconformance issues<br>• Directs the performance of data review per contract specifications<br>• Oversees data management and ERPIMS submittals | • Supervises field scientists and technical staff<br>• Defines qualifications, requirements, and assigns engineering and technical staff at TO level<br>• Evaluates performance of technical staff and provides feedback, including recommendations, to project manager<br>• Stops work for non-compliance/safety violation |
| **Field Team Manager – Geophysics** | • Tim Deignan, PGP<br>• Mr. Deignan is a registered PGP with more than 21 years of experience, which include executing multiple projects at Kirtland AFB. As a recognized subject matter expert, Mr. Deignan has also donated his time to serve as an archeological expert for efforts at Kirtland AFB. His experience includes design and management of integrated geophysical programs to investigate and assess sites and geotechnical, geologic, hydrogeologic, and cultural resource features. He specializes in high-resolution, integrated geophysical programs for environmental remediation and munitions investigations.<br>• Mr. Deignan works with numerous state and federal agencies to increase the usability of results for geophysical and statistical sampling data, and is integral in developing more adequate and innovative sampling approaches. He is a two-time recipient of the Industry Recognition Award from the Interstate Technology and Regulatory Council. | • Functions in lead technical role for efforts requiring expert level support<br>• Identifies, trains, mentors, and assigns qualified technical staff to tasks/projects<br>• Ensures compliance and consistency of technical program execution<br>• Ensures compliance with all applicable federal, state, and local regulations<br>• Serves as the project geophysicist of record | • Supervises field scientists and technical staff<br>• Defines qualifications, requirements, and assigns engineering and technical staff<br>• Evaluates performance of technical staff and provides feedback, including recommendations, to project manager<br>• Stops work for non-compliance/safety violation |

## Table 7-1. Project Team Member's Qualifications, Responsibilities, and Authorities (continued)

| Position | Qualifications | Duties and Responsibilities | Authority Level |
|---|---|---|---|
| **Environmental Regulatory Specialist** | • Jan Martin, PE<br>• Ms. Martin is a New Mexico-registered PE with more than 24 years of experience ensuring compliance on complex environmental investigation and remediation projects. Located in Shaw's Albuquerque office, Ms. Martin has executed a number of environmental remediation projects for DoD in New Mexico and other states, including active installations under the Installation Restoration Program at Wright-Patterson AFB, and Formerly Used Defense Sites (FUDS) at the Former Walker AFB in Roswell, New Mexico and at a FUDS adjacent to Kirtland.<br>• She has worked with DoD clients, EPA regulators, and private and tribal stakeholders to ensure compliance on projects conducted under RCRA as well as various DoD programs, state statutes, and regulations. Ms. Martin has prepared remedial investigation, engineering evaluation/cost analyses, and feasibility study reports, various decision documents, land use control plans, Operating Properly and Successfully (OPS) documents, RCRA closure and corrective action documents, and design analysis documents including plans and specifications. | • Identifies regulatory requirements and oversees implementation of environmental regulatory requirements<br>• Supports project manager in regulatory interaction<br>• Works closely with the installation representatives to ensure that environmental policies and procedures are implemented<br>• Stops work for non-compliance/safety violation | • Reports regulatory updates to project manager<br>• Coordinates regulatory meeting in concert with project manager<br>• Maintains list of team personnel who have authority to contact regulatory agencies<br>• Stop-work authority |
| **Risk Assessor** | • Mark Weisberg, CHMM<br>• Mr. Weisberg, a Certified Hazardous Materials Manager (CHMM), has prepared hundreds of risk assessments at more than 25 Army/DoD facilities, including Former Walker AFB in Roswell, New Mexico. At Walker, he prepared NMED-approved screening-level environmental risk assessments for sites throughout the base. He has more than 20 years of experience in ecology and environmental assessment, where he has been responsible for supervising and conducting risk assessments and RCRA facility investigations at numerous hazardous, toxic, and radioactive waste sites for the Army, Air Force, and Navy. His areas of expertise include ecological and human health risk assessment; toxicology; statistical analysis; water quality; site assessment; and federal, state, and local permit preparation. | • Functions in lead technical role for efforts requiring expert level support<br>• Identifies, trains, mentors, and assigns qualified technical staff to tasks/projects<br>• Ensures compliance and consistency of technical program execution<br>• Ensures compliance with all applicable federal, state, and local regulations | • Supervises field scientists and technical staff<br>• Defines qualifications, requirements, and assigns engineering and technical staff<br>• Evaluates performance of technical staff and provides feedback, including recommendations, to project manager<br>• Stops work for non-compliance/safety violation |

## Table 7-1. Project Team Member's Qualifications, Responsibilities, and Authorities (continued)

| Position | Qualifications | Duties and Responsibilities | Authority Level |
|---|---|---|---|
| **Certified Industrial Hygienist (CIH)** | • James Joice, CIH, Certified Safety Professional (CSP), CHMM<br>• Mr. Joice, Shaw's CIH for the Huntsville Worldwide Environmental Remediation contract, has 30 years of experience managing the health and safety for projects and programs at hundreds of environmental remediation sites. He has extensive experience establishing and maintaining health and safety plans and procedures where EPA Levels A, B, and C PPE were required.<br>• He regularly supervises project safety personnel; monitors subcontractor activities; develops, implements, and enforces site-specific safety and health plans (SSHPs); audits sites for compliance with health and safety (H&S) program requirements; conducts personnel training, and verifies regulatory compliance. He has also prepared and implemented H&S programs for several PBA and firm-fixed-price contracts. | • Implements and oversees H&S program and plans<br>• Develops, implements, and oversees APPs inclusive of SSHPs and directs/approves any changes<br>• Notifies Contracting Officer of changes in the approved plan within 48 hours<br>• Interfaces with the USACE on H&S program requirements<br>• Assesses risk and ensures engineering controls and/or appropriate PPE are used for worker and public protection | • Approves APPs/SSHPs and all modifications before issuance to the USACE<br>• Manages H&S Program and directs training and required attendance<br>• Investigates safety concerns raised by staff<br>• Investigates any accidents<br>• Stops work for non-compliance/safety violation |
| **Community Relations Specialist** | • Lisa Stahl<br>• Ms. Stahl is a senior community relations specialist/anthropologist with 17 years professional experience that includes active participation on projects in New Mexico. Ms. Stahl provided public involvement and social science support for efforts at both the Los Alamos National Laboratory as well as Pueblo of Isleta.<br>• She has 17 years of experience working with a variety of assessment tools and information; establishing positive working relationships with multiple stakeholders; and preparing and distributing various bilingual outreach materials to a variety of end-users.<br>• Ms. Stahl specializes in identifying and facilitating community perspectives into program and policy processes through active involvement and regular communication with members of the community. She is also skilled at writing innovative public participation strategies tailored and targeted to the specific needs and concerns of the community.<br>• Her various experiences have included liaison activities between project staff and communities, conducting community assessments, evaluating various public programs, and providing community involvement support to a variety of government clients. | • Performs community outreach to facilitate offsite drilling program<br>• Establishes and maintains regular communication regarding project and field efforts with the all members of community<br>• Plans, organizes, and participates in public meetings regarding the project., including working with all applicable parties to prepare for public meetings<br>• Prepares and advertises public notices as necessary<br>• Prepares project fact sheets and facilitates distribution of fact sheets and other presentation materials<br>• Performs research and community interviews to gather needed information | • Reports updates to project manager<br>• Coordinates public meetings in concert with project manager<br>• Maintains list of team personnel who have authority to conduct community interviews<br>• Stops work for non-compliance/safety violation |

## Table 7-1. Project Team Member's Qualifications, Responsibilities, and Authorities (concluded)

| Role | Subcontractor | Duties and Responsibilities | Authority Level |
|---|---|---|---|
| **Driller** | Water Development Corporation | • Installs groundwater, soil vapor monitoring, and soil vapor extraction wells<br>• Uses direct push methods to advance soil borings<br>• Collects continuous soil samples<br>• Collects soil vapor samples | • Stops work for non-compliance/safety violation |
| **Laboratory** | Empirical Laboratories, LLC – groundwater sample analysis<br><br>Gulf Coast Analytical Laboratories, Inc. – soil sample analysis<br><br>RTI Laboratories – soil vapor sample analysis | • Conducts analytical services in accordance with the UFP-QAPP and DoD QSM<br>• Provides analytical data in electronic PDF format<br>• Provides ERPIMS-formatted deliverables | • Stops work for non-compliance/safety violation |
| **Transportation and Disposal** | Rhino | • Furnishes trucks, drivers, and all associated services required for transporting hazardous waste oil mixtures from Kirtland AFB to an offsite disposal facility<br>• Ensures compliance with federal, state, and local environmental regulations<br>• Provides all equipment and materials required for performing work at the disposal site | • Stops work for non-compliance/safety violation |

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# APPENDIX A

## 2010 Regulatory Correspondence between the NMED HWB and the Air Force regarding the Kirtland AFB BFF Spill

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# ATTACHMENT 1

## April 2, 2010 Correspondence from the NMED HWB to Colonel Michael S. Duvall, Base Commander, 377 ABW/CC Re: SWMUs ST-106 and SS-111, BFF Spill, Kirtland, AFB

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AR Doc # 3451

# NEW MEXICO ENVIRONMENT DEPARTMENT

## *Hazardous Waste Bureau*


BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

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RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary


**CERTIFIED MAIL - RETURN RECEIPT REQUESTED**

April 2, 2010

APR 19 2010

Colonel Michael S. Duvall
Base Commander
377 ABW/CC
2000 Wyoming Blvd. SE
Kirtland AFB, NM 87117-5606

Mr. John Pike
Director, Environmental Management Section
377 MSG/CEANR
2050 Wyoming Blvd., Suite 116
Kirtland AFB, NM 87117-5270

**RE: SOLID WASTE MANAGEMENT UNITS ST-106 AND SS-111, BULK FUELS FACILITY SPILL**
**KIRTLAND AIR FORCE BASE**
**EPA ID# NMD9570024423, HWB-KAFB-10-004**

Dear Colonel Duvall and Mr. Pike:

As you are aware, the U. S. Department of Defense Kirtland Air Force Base ("Permittee") is conducting an investigation of contaminated groundwater at the Bulk Fuels Facility Former Fuel Offloading Rack (Solid Waste Management Unit ["SWMU"] ST-106) and the associated Light Non-Aqueous Phase Liquid ("LNAPL") plume (SWMU SS-111, or Phase-Separated Hydrocarbon Bulk Fuels Facility Remediation) (collectively, the "Bulk Fuels Facility Spill"). Data submitted by the Permittee show that the contamination caused by the Bulk Fuels Facility Spill represents a significant threat to human health and the environment, particularly to well water in urban neighborhoods adjacent to Kirtland Air Force Base ("KAFB"). Despite the fact that this release of hazardous constituents was first discovered 10 years ago, the Permittee has not completely characterized the Bulk Fuels Facility Spill, nor conducted adequate remediation.

As stated in the New Mexico Environment Department ("Department") Ground Water Quality Bureau ("GWQB") letter enclosed with this letter, the GWQB has transferred oversight of the Bulk Fuels Facility Spill to the Hazardous Waste Bureau ("HWB"),

which will direct corrective action at the Bulk Fuels Facility Spill pursuant to the New Mexico Hazardous Waste Act ("HWA") NMSA 1978, §74-4-1 to 74-4-14 and the Hazardous Waste Management Regulations ("HWMR", 20.4.1 NMAC).

Releases of hazardous waste or hazardous constituents are subject to corrective action under Sections 3004(u) and (v) and 3008(h) of the Resource and Conservation Recovery Act "RCRA"; 42 U.S.C. §§ 6924(u) and (v) and 6928(h); Sections 74-4-4(A)(5)(h) and (i), 74-4-4.2(B), and 74-4-10(E) of the HWA; and the HWMR at 40 C.F.R. Part 264, Subpart F (incorporated by 20.4.1.500 NMAC).

Pursuant to 20.4.1 NMAC incorporating 40 CFR § 264.101(a), the Permittee must institute corrective action as necessary to protect human health and the environment for all releases of hazardous waste or constituents from any SWMU. Additionally, in accordance with 20.4.1 NMAC incorporating 40 CFR § 264.101(c), the Permittee must implement corrective actions beyond the facility boundary.

Section R.5 of the Hazardous and Solid Waste Amendments ("HSWA") Module IV of the Permittee's RCRA Permit states:

> The Permittee shall conduct those investigations of SWMUs previously identified with known or suspected releases of contamination as necessary to protect human health and the environment to: characterize the facility (Environmental Setting); define the source (Source Characterization); define the degree and extent of contamination (Contamination Characterization); and to identify actual or potential receptors.

Additionally, pursuant to Section R.5(b):

> The Permittee shall collect analytical data to completely characterize the waste and areas where waste have been placed, including: type, quantity, physical form, disposition (containment or nature of deposits), and the facility characteristics affecting releases.

And, in accordance with Section R.5(c):

> The Permittee shall collect analytical data on groundwater, soils, surface water, sediment, and subsurface gas contamination when necessary to characterize contamination from a SWMU. The data shall be sufficient to define the extent, origin, direction and rate of movement of the contaminant plumes.

Therefore, in accordance with Section K.1 of the HSWA Module IV of the Permittee's RCRA Permit, the Permittee is directed to immediately implement interim measures to remediate the LNAPL plume, to excavate and remove structures and contaminated soil in

the vadose zone at and in the vicinity of the Former Fuel Offloading Rack, to install additional wells, and continue operation of the existing soil-vapor extraction units as directed below. Additionally, pursuant to Section R.5 of Module IV of the Permit, the Permittee is directed to immediately complete characterization of contaminated soil and soil-gas in the vadose zone, and to immediately complete characterization of the dissolved-phase contamination in groundwater. Furthermore, in accordance with Section M.1 of Module IV of the Permit, the Permittee will be directed by NMED to conduct one or more Corrective Measures Evaluations. The Permittee shall comply with the detailed instructions specified below by the indicated deadlines.

## A. REQUIREMENT FOR COMPLETING CHARACTERIZATION OF CONTAMINATION IN THE VADOSE ZONE

The Department finds that contaminant characterization is inadequate at the tank farm, the piping extending from the tank farm to the Former Fuel Offloading Rack, and areas in the vicinity of the Former Fuel Offloading Rack. More specific details on this finding are presented in the next two paragraphs.

Based on information provided by the Permittee, only four soil borings have been completed at the fuel tanks and no borings have been completed along the ancillary piping leading from the fuel tanks to the Former Fuel Offloading Rack. The four soil borings at the tanks were completed to shallow depths ranging from 25-48 feet. Diesel Range Organics ("DRO") contamination was detected in all four boreholes, with the highest concentrations (1800-2400 mg/kg) found in borehole SB-09. A number of hazardous constituents were also detected in soil samples from SB-09 and SB-06. Despite these findings, the Permittee did not determine the extent of contamination near the tanks. The latter is particularly notable given that the Permittee's *Stage 1 Abatement Plan Report* (February 8, 2006) contains the following recommendation (in Section 4.4):

> It is recommended that additional field investigation at the east side of the Bulk Fuels Facility be conducted to determine the full extent of petroleum hydrocarbons in soil and soil vapor beneath Tank 2422...Additional investigation will also determine whether release(s) associated with this tank are the source of sorbed-phase and vapor-phase petroleum hydrocarbons previously indentified in distal monitoring wells SVMW-13 and SVMW-15.

To date, the Permittee has not conducted the additional field investigation to determine the full extent of petroleum hydrocarbons and hazardous constituents in soil and soil vapor around the Bulk Fuels Facility.

The Permittee has also not completed characterization of the contaminated soil in the vicinity of the Former Fuel Offloading Rack, as previous investigative efforts seem to have been arbitrarily terminated once Total Petroleum Hydrocarbons ("TPH") concentrations in soil were found to be less than 100 mg/kg. Additional soil borings should have been completed to investigate the full

extent of soil contamination above background levels regardless of the concentration levels of the contaminants. Similarly, characterization of soil-gas contamination near the Former Fuel Offloading Rack is inadequate; investigative efforts appear to have been terminated once TPH concentrations were found to be below 1000 ppmv in the area. Additional soil-gas monitoring wells should have been installed to investigate the full extent of soil-gas contamination from the surface to groundwater, even in areas where the contamination is less than 1000 ppmv.

Thus, the Permittee has not adequately characterized LNAPL contamination in the vadose zone. Characterization must be complete to design and implement an appropriate final remedy. Accordingly, pursuant to the deadlines established below, the Permittee must:

1. Determine the amount of fuel that exists within the vadose zone as sorbed or residual liquid, or as soil gas.
2. Identify the source of the LNAPL fuel plume.
3. Describe the vadose zone hydrology, its relationship to observed and potential to-be-discovered groundwater contamination, and the potential for continuing contamination of groundwater by vadose zone contamination sources.
4. Characterize the geology and extent of contamination in the soil and soil gas to determine distribution, fate, and migration of contaminants.

Therefore, on or before **June 7, 2010**, the Permittee must submit to the Department for its review and approval a Vadose Zone Investigation Plan that describes the additional actions the Permittee will take to investigate the vadose zone hydrology and geology of the affected area, to identify and characterize the source of the releases at the Bulk Fuel Facility, and to identify the extent of soil and soil-gas contamination in the vadose zone from the surface to groundwater. The area covered under this Vadose Zone Investigation Plan must include the tank farm and the ancillary piping between the farm and the Former Fuel Offloading Rack. The Vadose Zone Investigation Plan must describe in detail all research, locations, depths and methods of exploration, field procedures, sampling and analysis of soil and soil gas and related quality control procedures. The Vadose Zone Investigation Plan shall also describe the results and the means (for example, cross-sections, plan views) by which these results will be reported after the investigation is completed, and a schedule for implementation of the work that complies with the compliance schedule in Table 1 of this letter.

**Table 1. Compliance Schedule for Vadose Zone Investigation**

| Task | Date Due |
|---|---|
| Submit Vadose Zone Investigation Plan to the Department | June 7, 2010 |
| Complete all subsurface-soil sampling and installation of all soil-gas monitor wells | Within 12 months after Department approval of Vadose Zone Investigation Plan |

| | |
|---|---|
| Report results for subsurface-soil sampling | Within 15 months after Department approval of Vadose Zone Investigation Plan |
| Complete first four quarters of soil-gas sampling and analysis | Within 24 months after Department approval of Vadose Zone Investigation Plan |
| Soil-gas sampling | Quarterly after well installations completed |
| Submit quarterly soil-gas monitoring reports to the Department | 60 days after the quarter during which sampling occurred |

Furthermore, in addition to any other locations the Permittee identifies, the locations listed in Table 2 of this letter shall be included in the Vadose Zone Investigation Plan and must be sampled for contaminants in soil and soil gas (all coordinates in this table are State Plane Coordinates in feet, NAD83). Soil samples shall be collected at a frequency of at least one sample every 10 feet for the first 50 feet, and at least one sample thereafter every 50 feet to total depth, and at least one sample at total depth in each boring. Each boring at each location shall be drilled from the surface to the water table, and each boring shall be completed as a permanent soil-gas monitoring well. All of the soil-gas monitoring wells shall be capable of yielding discrete samples of soil gas recovered from depths of 25, 50, 150, 250, 350, and 450 feet below the ground surface. While the Permittee shall continue to analyze samples for TPH and hazardous constituents, the investigation shall not be limited to only those areas containing or suspected to contain TPH at concentrations of greater than 100 mg/kg (100 ppm) in soil or 1000 ppmv in soil gas. Instead, investigation of the Bulk Fuels Facility Spill shall be designed to determine the full extent of contamination above background levels regardless of contaminant concentration levels.

**Table 2. Borehole locations for soil sampling and for conversion to soil-gas monitoring wells.**

| Location # | Easting | Northing | Characterization Purpose |
|---|---|---|---|
| 1 | 1541119 | 1473793 | Step out from Fuel Offloading Rack beyond 100 mg/kg contaminated zone |
| 2 | 1540808 | 1473503 | Step out from Fuel Offloading Rack |
| 3 | 1541123 | 1473310 | Step out from Fuel Offloading Rack |
| 4 | 1541425 | 1473313 | Step out from Fuel Offloading Rack |
| 5 | 1541961 | 1473492 | Path from Fuel Offloading Rack to LNAPL Plume |
| 6 | 1542002 | 1473057 | Piping |
| 7 | 1541794 | 1473061 | Piping |
| 8 | 1542370 | 1473058 | Piping |
| 9 | 1541898 | 1473276 | Path from Fuel Offloading Rack to LNAPL Plume |
| 10 | 1541720 | 1473369 | Step out from Fuel Offloading Rack |

| | | | |
|---|---|---|---|
| 11 | 1541776 | 1473740 | Step out from Fuel Offloading Rack |
| 12 | 1541658 | 1473505 | Path from Fuel Offloading Rack to LNAPL Plume |
| 13 | 1542061 | 1472928 | Fuel tanks |
| 14 | 1542063 | 1472775 | Fuel tanks |
| 15 | 1542142 | 1472847 | Fuel tanks |
| 16 | 1541982 | 1472845 | Fuel tanks |
| 17 | 1542330 | 1472796 | Fuel tanks |
| 18 | 1542430 | 1472897 | Fuel tanks |
| 19 | 1542516 | 1472810 | Fuel tanks |
| 20 | 1542428 | 1472716 | Fuel tanks |
| 21 | 1541611 | 1473238 | Piping |

In addition to any other location identified by the Permittee, the locations listed in Table 3 of this letter shall also be included in the Vadose Zone Investigation Plan to be sampled for contaminants in soil gas (all coordinates in this table are State Plane Coordinates in feet, NAD83). Each boring at each location listed in Table 3 shall be completed as a permanent soil-gas monitoring well. All of the soil-gas monitoring wells shall be capable of yielding discrete samples of soil gas recovered from depths of 25, 50, 150, 250, 350, and 450 feet below the ground surface.

**Table 3. Locations for soil-gas monitoring wells.**

| Location # | Easting | Northing | Characterization Purpose |
|---|---|---|---|
| 1 | 1543058 | 1474093 | Characterize outside of LNAPL Plume |
| 2 | 1543194 | 1474680 | Characterize outside of LNAPL Plume |
| 3 | 1542306 | 1474093 | Characterize within LNAPL Plume |
| 4 | 1541555 | 1475049 | Characterize outside of LNAPL Plume |
| 5 | 1541248 | 1474141 | Characterize outside of LNAPL Plume |
| 6 | 1542259 | 1472591 | Characterize outside of LNAPL Plume |
| 7 | 1540667 | 1472823 | Characterize outside of LNAPL Plume |
| 8 | 1542525 | 1475459 | Characterize within LNAPL Plume |
| 9 | 1542436 | 1474878 | Characterize within LNAPL Plume |

## B. REQUIREMENT FOR COMPLETING CHARACTERIZATION OF DISSOLVED-PHASED CONTAMINANTS IN GROUNDWATER

The Permittee has not adequately characterized the dissolved-phase contamination in the groundwater and has not analyzed groundwater samples from wells located in the LNAPL plume area. The final remedy for the Bulk Fuels Facility Spill cannot be determined until this characterization work has been completed. Additionally, the Permittee has not installed any groundwater monitoring wells to investigate the vertical extent of the dissolved-phase groundwater contamination, the effects of vertical gradients, and the geology of the aquifer at any appreciable depth below the water table. The dissolved-phase plume is approaching one or more

Water Utility Authority well fields. Given that the pumping of water supply wells is known to induce vertical gradients in groundwater and can cause significant components of vertical flow in the vicinity of such wells, vertical characterization of groundwater quality and geology is required.

The leading edge and the eastern and western margins of the plume are undefined, and the nature and concentrations of contaminants in the core of the plume are poorly characterized because existing wells are located too far apart (generally at distances greater than 500 feet). Additionally, only one upgradient well has been installed that may yield groundwater samples that are free from contamination. Given the magnitude of this spill, several upgradient wells should be installed that are screened at different depths at and below the water table to ensure that all areas of contaminated groundwater have been located, and that the background wells are truly monitoring background water quality.

Therefore, on or before **July 7, 2010**, the Permittee must submit to the Department for its review and approval a Groundwater Investigation Plan that describes the additional actions the Permittee will take to characterize the nature, horizontal and vertical extent, and the fate and rate of migration of the groundwater contamination. The Groundwater Investigation Plan shall include construction details and the locations and depths of the groundwater monitoring wells to be installed, actions to characterize the geology and hydrogeology at and below the water table, and the groundwater flow direction and velocity. The plan shall also present details on field procedures, and the sampling and analysis of groundwater and related quality control. The Groundwater Investigation Plan shall describe the results, the means (*e.g.*, cross-sections, plan views) by which these results will be reported after the investigation is completed, and a schedule for implementation of the work that complies with the compliance schedule in Table 4 of this letter.

**Table 4. Compliance Schedule for Groundwater Investigation**

| Task | Date Due |
|---|---|
| Submit Groundwater Investigation Plan to the Department | July 7, 2010 |
| Complete installation of all wells | Within 12 months after Department approval of Groundwater Investigation Plan |
| Submit well installation report to the Department | Within 15 months after Department approval of Groundwater Investigation Plan |
| Complete first eight quarters of groundwater sampling and analysis | Within 36 months after Department approval of Groundwater Investigation Plan |

| | |
|---|---|
| Groundwater Sampling | Quarterly after well installations completed |
| Submit quarterly groundwater monitoring reports to the Department | 60 days after the quarter during which sampling occurred |

In addition to any locations the Permittee identifies, the Groundwater Investigation Plan shall also include a description of the installation of groundwater monitoring wells at the locations listed in Table 5 of this letter (all coordinates in this table are State Plane Coordinates in feet, NAD83). Three groundwater monitoring wells shall be installed at each of the cluster well locations listed in Table 5. The screen depths shown in Table 5 are distances (in feet) that the top of the screens shall be set below the water table. Screen lengths for wells shall not exceed 15 feet, with the exception that wells screened across the water table (those with screen depths of zero in Table 5) shall have screens 20 feet long, with no more than 15 feet of said screen length situated below the water table.

In addition to any other tools the Permittee identifies, the Groundwater Investigation Plan shall also include details describing the geophysical logging of all existing and new wells using induction (deep), neutron, and gamma (large crystal) tools. Geophysical logging at the cluster well locations listed in Table 5 is required in only the well at each location having the deepest screened interval.

**Table 5. Cluster well locations and screen depths relative to the water table.**

| Location # | Easting | Northing | Screen Depths | Characterization Purpose |
|---|---|---|---|---|
| 1 | 1542189 | 1476725 | 0, 15, 40 | Plume margin |
| 2 | 1541984 | 1476042 | 0, 15, 40 | Plume margin |
| 3 | 1543703 | 1476600 | 0, 15, 40 | Plume margin |
| 4 | 1543372 | 1475065 | 0, 15, 40 | Plume margin |
| 5 | 1543643 | 1477939 | 0, 15, 85 | Leading edge and deep characterization |
| 6 | 1541430 | 1472370 | 0, 15, 40 | Background water quality |
| 7 | 1542812 | 1473601 | 0, 15, 40 | Plume margin |
| 8 | 1542722 | 1477726 | 0, 15, 40 | Leading edge |
| 9 | 1543054 | 1477788 | 0, 15, 40 | Leading edge |
| 10 | 1543774 | 1477304 | 0, 15, 40 | Leading edge |
| 11 | 1541774 | 1473718 | 0, 15, 85 | Plume core, deep delineation |
| 12 | 1542362 | 1473801 | 0, 15, 85 | Plume core, deep characterization |
| 13 | 1542305 | 1474340 | 0, 15, 85 | Plume core, deep characterization |
| 14 | 1542736 | 1474715 | 0, 15, 85 | Plume core, deep characterization |
| 15 | 1542860 | 1475860 | 0, 15, 85 | Plume core, deep characterization |
| 16 | 1542189 | 1475207 | 0, 15, 85 | Plume core, deep characterization |
| 17 | 1541891 | 1473151 | 0, 15, 85 | Plume core, deep characterization |
| 18 | 1542203 | 1474071 | 0, 15, 85 | Plume core, deep |

| | | | | |
|---|---|---|---|---|
| | | | | characterization |
| 19 | 1542653 | 1475338 | 0, 15, 85 | Plume core, deep characterization |
| 20 | 1542535 | 1475975 | 0, 15, 85 | Plume core, deep characterization |
| 21 | 1543199 | 1475767 | 0, 15, 85 | Plume core, deep characterization |
| 22 | 1543068 | 1476494 | 0, 15, 85 | Plume core, deep characterization |

## C. REQUIREMENT FOR INTERIM MEASURES

In its October 28, 2009 letter, the GWQB wrote:

> The New Mexico Environment Department (NMED) has determined, based on information generated by Kirtland Air Force Base (KAFB) during its investigations, that the scale and observed impact of the Light Non-Aqueous Phase Liquid (LNLAP) hydrocarbon contamination of groundwater associated with the SS-111 Bulk Fuels Facility constituting the majority of the KAFB ST-106 LNAPL plume has been largely defined. This plume of LNAPL hydrocarbons has been found to have contaminated groundwater over a substantial area that is the source of drinking water supplies for the City of Albuquerque and is also located in the vicinity of several public water supply wells. The volume of LNAPL hydrocarbons on groundwater, which has been estimated by KAFB to be in the millions of gallons, will take a substantial period of time to remediate. Currently, the majority of the LNAPL hydrocarbon plume is located off of KAFB property and is not being actively remediated.

The Permittee's records indicate that the LNAPL and dissolved-phase plumes have migrated horizontally a distance of about 0.5 mile and 0.9 miles, respectively, from the area of the Former Fuel Offloading Rack.

Interim measures are required to reduce or prevent the migration of contaminants, or to reduce or prevent human or environmental exposure to contaminants while long-term corrective action remedies are evaluated and implemented. Section K.1 of the HSWA Module IV of the Permit states:

> If during the course of any activity initiated under this module, the Administrative Authority determines that a release or potential release of hazardous constituents from a SWMU poses a threat to human health and the environment, the Administrative Authority may specify interim measures. The Administrative Authority will determine the specific measure, including potential permit modifications, and the schedule for implementing the required measures.

Additionally, Section K.2 of Module IV of the Permit states:

The following factors may be considered by the Administrative Authority in determining the need for interim measures.

1. Time required to develop and implement a final remedy;
2. Actual and potential exposure to human and environmental receptors; and
3. The potential for the further degradation of the medium absent interim measures.

The Department has determined that the Bulk Fuel Facility Spill poses a threat to human health and the environment, and furthermore, endangers the groundwater resource – including water supply wells – relied upon by the Albuquerque Bernalillo County Water Utility Authority for delivery of safe drinking water to its customers. The contamination also threatens KAFB water supply wells, and those that supply the Veterans Administration ("VA") Hospital. The large size of the LNAPL plume and its proximity to these water supply wells requires that urgent action be taken to prevent the LNAPL plume from contaminating more of Albuquerque's drinking-water supply.

The Permittee has estimated the volume of fuel released from the Bulk Fuels Facility to range from about 1-2 million gallons, but the actual volume could be considerably larger because characterization of the vadose zone is inadequate. For example, the Department has estimated the volume of sorbed fuel at or greater than 100 ppm in soil to be about 4.8 million gallons; this does not include fuel in soil gas, fuel dissolved in groundwater, and floating fuel forming the LNAPL plume. The Department has estimated the fuel included in the LNAPL plume to be approximately 3 million gallons, giving a total volume of fuel sorbed to soil and that contained within the LNAPL plume at nearly 8 million gallons. The Permittee's records indicate that it has installed and is operating "interim ICE SVE" units on the Permittee's property; however, these four soil-vapor extraction (SVE) units are not an adequate interim measure to address the existing ground water contamination, including the LNAPL plume that has migrated beyond the facility boundary. From April 2003 to September 2009, these SVE units have extracted an estimated 286,600 gallons of fuel. From April through September 2009, the average extraction rate has declined by 25 per cent. The average extraction rate for each SVE unit is about 2,975 gallons per month.

At the rate of extraction achieved so far by the existing SVE units, the operation of these units would take over 14 years to remove 2 million gallons of fuel. This length of time is unacceptable because additional groundwater within the capture zone of Water Utility Authority water supply wells could become contaminated before the remediation could be completed. Furthermore, should the Department's calculations prove to be more accurate than the Permittee's estimated volume of fuel, it would take over 56 years for the remediation of the fuel to be completed.

Additionally, although the Permittee knows that considerable volumes of fuel have leaked from the Former Fuel Offloading Rack, the Permittee has not removed all of the

structures associated with the Former Fuel Offloading Rack (mostly the underground portions of the original structures), and has not excavated and removed contaminated soil around the Former Fuel Offloading Rack. The Permittee has instead abandoned the structures and contaminated soil in place. Soil containing considerable amounts of sorbed fuel, thus containing high concentrations of hazardous constituents, must exist at the Former Fuel Offloading Rack at shallow depths, posing a continuing source of contamination and threat to the groundwater resource.

Therefore, on or before **June 7, 2010,** the Permittee must submit to the Department for its review and approval an Interim Measures ("IM") Plan that describes what immediate actions it will take to remediate and stop the migration of the LNAPL plume. The IM Plan must also describe excavation and removal of all structures of the Former Fuel Offloading Rack, including the underground components, and the excavation and removal of contaminated soil at and in the vicinity of the Former Fuel Offloading Rack to a depth of at least 20 feet. The IM Plan must also include an implementation schedule showing that remediation of the LNAPL plume will be completed within five years of the Department's approval of the IM Plan, and that excavation and removal of structures and contaminated soil at and in the vicinity of the Former Fuel Offloading Rack will be completed within one year of the Department's approval.

Furthermore, on March 16, 2010, the Permittee sent a *Stage 2 Abatement Plan Modification Addendum* (dated March 16, 2010) concerning the proposed installation of three additional offsite groundwater monitoring wells. The March 16 submittal does not address the deficiencies identified by the GWQB in its letters of June 23 and October 28, 2009. This plan would not adequately characterize the LNAPL plume, the dissolved-phase groundwater contamination, or contaminated soil and soil gas at the Bulk Fuels Facility. However, given the urgency to complete characterization and implement an effective remedy, the NMED nevertheless approves the March 16, 2010, submittal as a second and separate interim measure, subject to the modifications described herein:

1. The March 16 plan proposes that well screens are to be constructed with lengths of 25 feet or more. Screen lengths for the wells shall not exceed 20 feet, with 15 feet of screen situated below the water table, and 5 feet of screen constructed above the water table.
2. The March 16 plan proposes that wells completed in the area of the LNAPL plume will not be developed after installation, and proposes that groundwater samples will not be acquired for laboratory analysis from wells located within the area of the LNAPL plume. Although existing wells within the area of LNAPL plume have in the past served only as sampling points to measure LNAPL thickness and as soil-vapor extraction points, these wells must now also be available to sample groundwater below the floating LNAPL so that concentrations of dissolved-phase contaminants can be assessed in this area. This same requirement will also apply to all future wells installed to address the Bulk Fuels Facility Spill, including the wells required under this letter. Thus, all wells that address the Bulk Fuels Facility Spill, including those located within the LNAPL

plume area, shall be properly developed to reduce turbidity and to remove residual drilling fluids (if any).

3. Groundwater at all wells within the LNAPL plume shall be sampled for laboratory analysis of hazardous constituents (volatile and semi-volatile organic compounds) and TPH after the wells are developed.
4. Proposed wells KAFB-10626 and KAFB-10628 shall be installed across the water table at the locations proposed in the March 16 plan. These two wells correspond to locations #5 and 13, respectively, in Table 5 above.
5. Proposed well KAFB-10627 shall be installed at location #6 listed in Table 5 above, which is a different location than that proposed by the Permittee in the March 16 submittal.
6. A tremie pipe shall be used to install the filter pack and seal for each well, and to place grout.
7. Grout shall be placed in lifts, with the first lift no greater than 100 feet in length and subsequent lifts no greater than approximately 200 feet. All lifts shall be allowed to dry until stable before the next lift is placed.
8. The March 16 plan does not contain a schedule for implementation. The March 16, 2010, plan shall be implemented **within two weeks** of approval from the City of Albuquerque to access the City property (e.g., Bullhead Park), to the extent access from the City is required for well installation. The Permittee shall otherwise implement the submittal **immediately**. All work shall be completed no later than **July 6, 2010**, or **90 days** after required access from the City is granted, whichever is later. Completion includes development of all new and existing wells that have not been previously developed, and the sampling of all wells within the LNAPL plume.
9. Sampling results (from item #3) above shall be reported to the NMED in writing on October 5, 2010, or 120 days after required access from the City is granted, whichever is later.

**Table 6. Compliance Schedule for Interim Measures**

| Task | Date Due |
|---|---|
| Submit Interim Measures Plan to the Department | June 7, 2010 |
| Complete excavation and removal of structures and soil at Former Fuel Offloading Rack | Within one year of approval of Interim Measures Plan |
| Complete remediation of LNAPL plume | Within five years of approval of Interim Measures Plan |

| | |
|---|---|
| Implement March 16, 2010 Stage 2 Abatement Plan Modification Addendum with required modifications | Immediately, except within two weeks of gaining permission for that portion of the March 16 Plan that requires access to City property. |
| Submit report to the Department on well installations conducted under March 16 Plan | July 6, 2010, or 90 days after required access from the City is granted, whichever is later |
| Submit report to the Department on groundwater sampling results conducted under March 16 Plan | October 5, 2010, or 120 days after required access from the City is granted, whichever is later |

Until such time that the IM Plan is approved by the NMED, the Permittee shall continue to operate the four SVE units already in service 24 hours per day, 7 days a week, except when necessary to perform maintenance or repairs. If maintenance or repairs are necessary, the maintenance or repairs shall be completed as quickly as practicable, and the unit returned to service immediately after maintenance or repairs are completed. Any maintenance or repairs that will take more than 3 calendar days shall be reported in writing to the Department within 24 hours of discovery that the maintenance or repairs will take more than 3 days. The Permittee shall explain in the report why the maintenance or repairs will take more than 3 calendar days and why the delay is beyond the control of the Permittee.

## D. REQUIREMENT TO CONDUCT A CORRECTIVE MEASURES EVALUATION

In accordance with Section M.1 of HSWA Module IV of the Permit, if the Administrative Authority has reason to believe that a SWMU has released concentrations of hazardous constituents, or if the Administrative Authority determines that contaminants present a threat to human health and the environment given site-specific exposure conditions, the Administrative Authority may require a Corrective Measures Study (herein referred to a Corrective Measures Evaluation, or "CME"). With this letter, the Department hereby notifies the Permittee that it is required to conduct a CME for the Bulk Fuels Facility Spill. The CME shall be conducted to develop remedial alternatives that, if implemented, would be appropriate to effectively arrest and remediate contamination in the vadose zone, the LNAPL plume, and the dissolved-phase groundwater contamination in a reasonable period of time. A CME Report shall be prepared that describes in detail the results of the CME. The CME Report shall be submitted to the Department within 180 days after the Department notifies the Permittee that characterization of the Bulk Fuels Facility Spill has been completed and approved by the Department. The CME and CME Report shall also be completed in accordance with Sections O and S of HSWA Module IV of the Permit.

## E. REPORTING REQUIREMENTS

The investigation plans required under this letter shall include relevant maps and cross-sections that show concentration data for contaminants and other relevant information with supporting data posted on the maps and cross-sections in a legible manner, and clearly showing which borings/wells contributed data towards construction of the maps and cross-sections and which did not. Tables including all existing soil borings, soil-gas monitoring wells, and groundwater monitoring wells, listing their surveyed location, sampling points and maximum depth of exploration shall also be included in the reports and plans. For soil-gas monitoring wells, tables and graphs shall also be included providing trends of TPH concentrations versus time for the depths below ground surface of 25, 50, 150, 250, 350, and 450 feet.

## F. CONCLUSIONS

The requirements in this letter to conduct corrective action at the Bulk Fuel Facility Spill are mandatory. If the Permittee fails to comply with the directives of this letter, the Department may take the following actions, or some combination of the following actions, to enforce these requirements: 1) issue a compliance order under section 74-4-10 of the HWA seeking injunctive relief or civil penalties for noncompliance; 2) file a civil action under sections 74-4-10 and 74-4-10.1(E) of the HWA or section 7002(a) of RCRA, 42 U.S.C. § 6972(a), seeking injunctive relief or civil penalties; or 3) file an action seeking criminal penalties under section 74-4-11 of the HWA. This list of authorities is not exhaustive and NMED reserves its rights to take any action authorized by law to enforce the requirements of the HWA and the HWMR.

The Permittee shall respond directly to my attention, with copy to Mr. Bill Olson of the GWQB, and Mr. William Moats (NMED HWB, 5500 San Antonio NE, Albuquerque, NM 87109), on all correspondence and required plans and reports related to the Bulk Fuels Facility Spill upon receipt of this letter, unless otherwise directed by HWB. All submittals and correspondence must be submitted in hardcopy and electronic format. Assessment of fees for the submittal of corrective action documents pursuant to 20.4.2. NMAC shall be made under separate cover.

If you have any questions or comments concerning the technical matters in this letter, you may contact William McDonald or Sid Brandwein of my staff at (505) 222-9582 and (505) 222-9504, respectively. If you have other questions or comments, I may be contacted directly at 505-476-6000.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: M. Leavitt, Director, NMED WWMD
J. Kieling, NMED HWB
W. Moats, NMED HWB
B. McDonald, NMED HWB
S. Brandwein, NMED HWB
B. Olson, Chief, NMED GWQB
A. Puglisi, NMED GWQB
B. Swanson, NMED GWQB
L. Barnhart, NMED OGC
B. Gallegos, AEHD
B. Gastian, ABCWUA
L. King, EPA-Region 6

File: Reading and KAFB 2010

APR 19 2010

# ATTACHMENT 2

## August 6, 2010 Correspondence from the NMED HWB to Colonel Robert L. Maness, Base Commander, 377 ABW/CC Re: SWMUs ST-106 and SS-111, BFF Spill, Kirtland, AFB

## Directive for Conducting Interim Measures and Notice of Disapproval, Interim Measures Work Plan, June 2010 Vadose Zone Work Plan, June 2010 Groundwater Investigation Work Plan, June 2010

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# NEW MEXICO ENVIRONMENT DEPARTMENT

## *Hazardous Waste Bureau*

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Governor

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Lieutenant Governor

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RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary


**CERTIFIED MAIL - RETURN RECEIPT REQUESTED**

August 6, 2010

Colonel Robert L. Maness
Base Commander
377 ABW/CC
2000 Wyoming Blvd. SE
Kirtland AFB, NM 87117-5606

Mr. John Pike
Director, Environmental Management Section
377 MSG/CEANR
2050 Wyoming Blvd., Suite 116
Kirtland AFB, NM 87117-5270

**RE: BULK FUELS FACILITY SPILL, SWMUS ST-106 AND SS-111**
**DIRECTIVE FOR CONDUCTING INTERIM MEASURES AND NOTICE OF DISAPPROVAL**
**INTERIM MEASURES WORK PLAN, JUNE 2010;**
**VADOSE ZONE WORK PLAN, JUNE 2010;**
**GROUNDWATER INVESTIGATION WORK PLAN, JUNE 2010**
**KIRTLAND AIR FORCE BASE, EPA ID# NM9570024423**
**HWB-KAFB-10-015, HWB-KAFB-10-016, HWB-KAFB-10-019**

Dear Col. Maness and Mr. Pike:

The contamination caused by the Bulk Fuels Facility Spill at Kirtland Air Force Base (KAFB) represents a significant threat to human health and the environment, particularly to well water that supplies drinking water to portions of Albuquerque, KAFB, and the Veterans' Administration Hospital. Even though this release was first discovered 10 years ago, the U. S. Air Force (Permittee) has not characterized the nature and extent of Bulk Fuels Facility Spill, nor conducted adequate remediation. The threat posed by this release demands immediate and aggressive action as called for in the New Mexico Environment Department's (NMED's) April 2, 2010 letter.

The NMED has reviewed the Interim Measures Work Plan (June 2010), Vadose Zone Work Plan (June 2010), and Groundwater Investigation Work Plan (June 2010) regarding the KAFB Bulk Fuels Facility Spill, Solid Waste Management Units (SWMUs) ST-106 and SS-111. The plans were submitted in response to the NMED's letter of April 2, 2010, which concerned the need for

additional site characterization and interim measures to remediate contamination in groundwater, source areas, and fuel floating on the water table.

NMED finds that all three plans are deficient. This Notice of Disapproval (NOD) is issued to the Permittee with the intent that the Permittee correct the deficiencies identified herein. This NOD includes general comments that apply to all three documents, and general and specific comments concerning deficiencies found in each of the individual plans. These comments comprise Part 1 of this letter.

Due to the urgent need to accelerate certain aspects of remediation and characterization, the Permittee is also directed herein to implement interim measures in the form of additional soil vapor extraction and to take various other actions including establishing sentry groundwater monitoring wells and providing NMED certain critical information. This direction comprises Part 2 of this letter, and also sets forth requirements related to well construction, sampling of environmental media, field and laboratory quality assurance, and reporting.

# PART 1

## A. Deficiencies Common to All Three Plans

***1. Appendix A of the Vadose Zone and Interim Measures Work Plans and Appendix D of the Groundwater Investigation Work Plan –*** Appendix A and Appendix D are exactly the same plan (about 500 pages, dated April 2004), appended to and occupying 80% or more (by number of pages) of the Vadose Zone, Interim Measures, and Groundwater Investigation Work Plans. Although the plan presented in Appendices A and D is voluminous, it is only a general plan that lays out the Permittee's internal requirements for conducting corrective action for the entire base. Furthermore, the copies of this plan provided to the NMED are missing figures (Figure 3-4), have their own appendices that are noted as "to be provided at a later date", and, in places, have outdated information (Table B7.2-1, page B-177 of Appendix B of Appendix A).

Because Appendices A and D are not specific to the Bulk Fuels Facility Spill, they do not describe in sufficient detail how, for example, project organization, data management, and quality assurance will be implemented under the Vadose Zone, Groundwater Investigation, and Interim Measures Work Plans. For example, under the project management plan, the organizational chart only shows KAFB management. The field sampling plan discusses the various types of field quality control (QC) samples that could be utilized during an investigation, but does not set forth the specific types of QC samples that should be prepared or collected for the Bulk Fuels Facility Project. Furthermore, because it is only a general plan for the entire base, the plan does not commit to the collection of QC samples for any project.

Appendices A and D must be deleted from the Vadose Zone, Groundwater Investigation, and Interim Measures Work Plans. They have little value because they do not contain the appropriate level of detail for characterization and clean up of the Bulk Fuels Facility Spill and do not

commit the Permittee to do anything. The Permittee shall revise the Vadose Zone, Groundwater Investigation, and Interim Measures Work Plans to include the appropriate level of detail and commitment on project organization, data management, and field and laboratory quality assurance.

***2. Appendix B of the Vadose Zone and Interim Measures Work Plans and Appendix A of the Groundwater Investigation Work Plan –*** These appendices include only a 2006 NMED guidance document. The guidance is outdated and adds little, if any, value to the Vadose Zone, Interim Measures, and Groundwater Investigation Work Plans, and thus, must be deleted from all three plans. NMED guidance documents may be cited, if necessary, in future submittals.
***3. Community Relations -*** The community relations plan is not included in Appendix A of the Vadose Zone and Interim Measures Work Plans and Appendix D of the Groundwater Investigation Work Plan. Instead, the appendices state "*Appendix I, Community Relations Plan, (to be provided at a later date)*". The Permittee shall revise the Vadose Zone, Interim Measures, and Groundwater Investigation Work Plans to include a community relations plan specific to the Bulk Fuels Facility spill. The plan must specify how the Permittee will inform the public, including the Albuquerque Bernalillo County Water Utility Authority (WUA), the City of Albuquerque, and the Veterans Administration of progress made on characterization and clean up of the Bulk Fuels Facility spill.

***4. Schedules –*** Characterization and clean up of the Bulk Fuels Facility Spill is expected to be a large, complex, and interactive project with many deadlines that will have to be met by the Permittee. The Gantt charts provided in the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans do not contain sufficient detail and are unacceptable because they over simplify field work on the schedules as only a few tasks. A Gantt chart showing all major tasks, their dependency if any on other tasks, and their early/late starts, early/late completions and critical paths must be provided in each of the plans. NMED expects that charts of sufficient detail would likely require presentation on sheets larger than 11" x 17".

The Permittee must also submit to the NMED a Gantt chart that integrates all of the work to be done under the three plans. This Gantt chart must be submitted with the Vadose Zone Work Plan.

***5. Organization -*** The organization plans in the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans only include mention of a project manager and a field team manager, and again reference the general site plan under Appendix A of the Vadose Zone and Interim Measures Work Plans and Appendix D of the Groundwater Investigation Work Plan. NMED notes that there are personnel mentioned by name under the Project Management Plan of Appendix A and Appendix D that have not worked for the Permittee at KAFB for the last several years.

It is likely that more than a project manager and a field team manager will be required to manage and execute a project of this size and complexity. Furthermore, it is unclear if there will be a separate field team manager for different tasks, such as conducting geophysical logging, drilling

and installation of wells, operating and maintaining soil vapor extraction (SVE) units, and sampling of environmental media. Also, the plans do not include details on the responsibilities and the qualifications of the personnel (by position) that will be involved.

Simply stating that a kick off meeting " ...will outline roles and responsibilities of all participants..." is not acceptable. It must be clearly understood in writing prior to project start who (by position) will be responsible for overseeing and conducting the myriad of events that need to happen such as field work, interpretation and management of various data, data validation, updating of the conceptual site model, communicating and reporting, and so forth. The Permittee must revise the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans to correct these deficiencies.

***6. Data Management*** - The Data Management Plan provided in Appendix D of Appendix A of the Vadose Zone and Interim Measures Work Plans and Appendix D of Appendix D in the Groundwater Investigation Work Plan is a general plan for entire base (see Comment #1 of Section A, Part 1) and, thus, is not specific to the Bulk Fuels Facility Spill. The plan specifically fails to provide detail concerning the types of data that are to be managed, schedules for data submittals and entries into the database, how accuracy and completeness of the data will be ensured, and data availability to the NMED. The Permittee must revise the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans to correct these deficiencies.

***7. Identification of and Approach to Addressing Data Gaps*** - Section 1.2 of each of the plans states "following previous investigations at the BFF, data gaps were identified...". Because these work plans are meant at a minimum to address data gaps identified in NMED's letter of April 2, 1010, the Permittee must list the data gaps that apply to each of the three plans, as appropriate for the topic of the plan, and indicate where in each of the plans the data gaps are addressed. The Permittee must revise the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans to include a description of the data gaps identified by the NMED and point specifically to where in each the document these data gaps are addressed.

***8. Extent of Contamination and Clean Up Criteria*** – The extent of contamination in the various media (soil, soil vapor, groundwater) shall be based upon determining at what locations hazardous constituents occur at levels that exceed approved background concentrations. This was stated in the NMED's letter of April 2, 2010, and applies to all RCRA facilities in New Mexico that must conduct correction action.

Regarding clean up criteria, any soil contamination left in place within 20 feet of the surface must meet NMED's risk requirements for an acceptable level of risk for all hazardous constituents ($10^{-5}$ for carcinogens and Hazards Index < 1 for noncarcinogens under a residential land-use scenario). Any soil contamination left in place at any depth must also have sufficiently low concentrations of hazardous constituents to be protective of groundwater. The Permittee may use the NMED's Soil Screening Levels in lieu of conducting a baseline risk assessment to determine the risk of contaminants.

While the use of total petroleum hydrocarbons (TPH) as an indicator of contamination is convenient for field screening, the risk to human health and the environment must be assessed through the use of laboratory analysis of hazardous constituents (e.g., benzene, toluene, ethylene dibromide (EDB), naphthalene, xylenes). The Permittee must revise the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans accordingly.

***9. Site Specific Conceptual Model*** - The plans continue to provide what appears to be an outdated conceptual model of geologic, hydrologic, and contaminant conditions. However, regardless of the use of current data or the lack thereof, graphical representations of the conceptual model are of poor quality because the graphics are not always legible, are often too small to convey details, don't present sufficient numbers of cross-sections, and rely too much on the presentation of cartoons in lieu of detailed and accurate drawings (for example, Figures 2-8 and 2-9 in the Groundwater Investigation Work Plan).

NMED expected more in the discussion of site specific geology, as what was provided is similar to that presented in reports for the last 8 years or so. A site conceptual model encompassing the source area(s), the fuel percolation area, the light non-aqueous phased liquid (LNAPL) plume floating on groundwater, and the dissolved-phase contaminant plume in groundwater must be included in each of the plans. The model should be illustrated through the liberal use of detailed, accurate, and scaled geologic cross-sections, maps in plan view, and any other necessary graphical representations to clearly and accurately show geologic and hydrologic features, and contaminant levels.

NMED suggests that the geophysical logs, especially the electric logs, for KAFB-0115, KAFB-10624, KAFB-16 and Ridgecrest-3 wells would be useful for assisting in the interpretation of the stratigraphy of the area of interest, as these logs clearly show certain stratigraphic horizons in the vadose zone that are distinctive and widespread units ("marker beds"). The site-specific conceptual model in the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans must be revised to correct the above noted deficiencies.

***10. Failure to Provide Graphics and Data Submittals*** – Section E of NMED's April 2, 2010 letter states "The investigation plans required under this letter shall include relevant maps and cross-sections that show concentration data for contaminants and other relevant information with supporting data posted on the maps and cross-sections in a ***legible*** (emphasis added) manner, and clearly showing which borings/wells contributed data towards construction of the maps and cross-sections and which did not. Tables including all existing soil borings, soil-gas monitoring wells, and groundwater monitoring wells, listing their surveyed location, sampling points and maximum depth of exploration shall also be included in the reports and plans. For soil-gas monitoring wells, tables and graphs shall also be included providing trends of TPH concentration versus time for the depths below ground surface of 25, 50, 150, 250, 350, and 450 feet."

Many of the figures in the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans are illegible and the required tables and graphs were not included, or were not provided in the format required. These tables and graphs are necessary to assess the adequacy of proposed

locations of borings/wells/SVE units. These tables and graphs of the required types, formats, and in legible form must be included in the revised Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans.

***11. Quality Assurance (QA)/Quality Control (QC) plan*** - The Quality Assurance Plan provided in Appendix D of Appendix A (or Appendix D of Appendix D in the GW Plan) is a general plan for the entire base (see Comment #1, Section A, Part 1 of this letter) and is not specific to the Bulk Fuels Spill Project. The Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans must specify exactly what field and laboratory quality control samples are to be prepared or collected, as appropriate, and other aspects about quality control that are important to the Bulk Fuels Facility project, including the quality control targets that will be considered acceptable for each of the analytes of concern for each given media. The Permittee must revise the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans to correct these deficiencies.

***12. Certification Statements*** - The Vadose Zone, Interim Measures, and Groundwater Investigation Work Plans and associated transmittal letters do not contain the required signed certification statement under RCRA and the New Mexico Hazardous Waste Act. Pursuant to 20.4.1.900 NMAC, incorporating 40 C.F.R. § 270.1 1 (d)(1), all plans and reports shall include a certification, signed by a chief or senior executive officer of the Facility stating:

> 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 fine and imprisonment for knowing violations.

The revised Vadose Zone, Interim Measures, and Groundwater Investigation Work Plans or associated transmittal letters must include this signed certification.

***13. Waste Management*** - The Waste Management Plan provided in Appendix E of Appendix A of the Vadose Zone and Interim Measures Work Plan, and Appendix E of Appendix D in the Groundwater Investigation Work Plan) is a general plan for entire base (see Comment #1, Section A, Part 1 of this letter) and is not specific to the Bulk Fuels Facility Spill project.

Investigation Derived Waste (IDW) includes, but is not limited to, general refuse, drill cuttings, excess sample material, water (e.g., decontamination, development, purge), spent materials, and used disposable equipment generated during the course of investigation, corrective action, or monitoring activities. All IDW shall be properly characterized and disposed of, and otherwise

managed in accordance with all federal, state, and local laws and regulations. The Permittee shall include a description of the anticipated IDW management process as a revision to the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans.

## B. Interim Measures Work Plan

### *1. General Comments on Interim Measures Work Plan*

The Interim Measures Work Plan was to address two major requirements of NMED's letter of April 2, 2010: 1) remove the Fuel Offloading Rack and excavate to a depth of 20 feet contaminated soil surrounding the Fuel Offloading Rack; and 2) conduct interim measures to remediate the LNAPL plume within five years. This Part (Part 1) of this letter addresses the deficiencies on addressing the first requirement; Part 2 addresses the second requirement to immediately take action to remediate the LNAPL plume floating on the groundwater. Rather than complying with NMED's April 2, 2010 direction to take immediate action vis à vis LNAPL remediation, the Permittee proposes characterization of the vadose zone for some unspecified time period, followed later by SVE. More specifically, the Interim Measures Work Plan includes: testing six wells to determine LNAPL transmissivity (Tn); conducting air sparging and multi-phase extraction pilot tests, and conducting characterization studies using PneuLog tests.

NMED emphasizes that interim measures are actions quickly taken to reduce or prevent the migration of contaminants, or reduce or prevent exposure to contaminants while long-term remedies are evaluated. While characterization studies may be useful for improving remediation efforts, or for proposing and designing a final remedy, interim measures for remediating LNAPL floating on groundwater need to be implemented immediately. Any effort to successfully remove LNAPL floating on groundwater must also involve the removal of LNAPL from the source(s) and fuel percolation areas within the vadose zone.

### *2. Specific Comments on Interim Measures Work Plan*

*1. Page 2-10, Section 2.4* – This section of the plan indicates that the Permittee is preparing a report on indoor air quality, and that the report is currently in draft. A copy of the final indoor air quality report must be provided to the NMED by **October 6, 2010**, and as indicated in the Compliance Schedule of Table 5 of this letter.
*2. Page 3-1, Section 3* - Throughout Section 3 (for example, Sections 3.2, 3.2.2, 3.4.1, 3.4.2, 3.5) the Permittee states its intent to characterize and excavate only soils with "mobile LNAPL", and to leave any other contaminated soil for later remediation under the Corrective Measures Implementation Plan (CMI), which the Permittee referred to as a Corrective Measures Evaluation (CME). The term "mobile LNAPL" was coined by the Permittee and apparently means soil containing such a high concentration of fuel contamination that the soil is dripping wet with fuel.

The reasons given by the Permittee not to excavate other contaminated soils (soil without mobile LNAPL) is that a risk assessment would have to be developed separately for such soils, and the Permittee expresses its desire to delay excavation of such soils until long-term corrective actions

are initiated for the site. Due to the urgent need for action at this site, such an approach is not acceptable. The Permittee can rapidly develop target clean up goals based on NMED's risk requirements noted above, or simply use NMED's soil screening levels for hazardous constituents. Soils do not need to be dripping wet with fuel to pose a risk to human health or the environment. NMED estimates that a Corrective Measures Implementation Plan will not be approved for at least several years because of the inadequate state of site characterization today. Leaving contaminated soil in the ground that poses a significant risk to human health or the environment for what will likely be a fairly long time period before long-term corrective actions are initiated is unacceptable. As indicated in Comment #8 in Section A of Part 1 of this letter, all contaminated soil to a depth of 20 feet that represents an unacceptable risk to human health or the environment shall be excavated and removed from the Fuel Offloading Rack area.

As mentioned above, due to the urgent need to accelerate remediation, the Permittee is directed in Part 2 of this letter to implement interim measures, which includes removal of the remaining components of the Fuel Offloading Rack and excavation of contaminated soil. This work shall be completed in accordance with the Interim Measures Work Plan as modified by the requirements of this letter and in accordance with the Compliance Schedule in Table 5 of this letter.

*3. Page 3-2, Section 3.2.2* – This section indicates that soil samples will be analyzed in the laboratory only if samples do not respond to a field test kit. This is an unacceptable approach. The Permittee shall use laboratory analysis all soil samples in shallow borings for TPH, VOCs, SVOCs, and lead.

*4. Page 3-4, Section 3.4.2* – This section indicates that a detailed excavation plan for the Fuel Offloading Rack will be submitted to the NMED at a later date. NMED's April 2, 2010 letter intended for the Interim Measure Work Plan to be the detailed plan.

The excavation of contaminated soil and removal of structures at the Fuel Offloading Rack is a relatively simple "dig and haul" operation, and represents by far the easiest of the two major interim measures that the Permittee was directed to accomplish in NMED's letter of April 2, 2010. NMED requires the Permittee to begin excavation and removal of structures at the Fuel Offloading Rack immediately (see Section A of Part 2 of this letter).

*5. Page 4-1, Section 4.2* – In part, this section states "Kirtland AFB proposes to install an IRM to remove, to the extent practicable within five years of work plan approval, mobile LNAPL present at the water table that has the potential to migrate along the water table and potentially further endanger the regional aquifer that provides drinking water for ABCWUA. Immobile LANPL and sorbed and dissolved fuel contamination in groundwater will be addressed by the future CME."

The NMED finds several unacceptable concepts related to these statements. First, as previously mentioned, NMED does not agree with the Permittee-coined terms "mobile LNAPL" and "immobile LNAPL." The point of the interim measure is to clean up contamination (LNAPL)

that poses a threat to groundwater, regardless of contaminant concentrations. Even LNAPL that is not migrating along the water table has the potential to contaminate groundwater with concentrations of hazardous constituents that are at unsafe levels for human consumption. Second, the phrase "to the extent practicable" suggests that the Permittee has already admitted defeat without even attempting to clean up the groundwater and the floating LNAPL. Third, the LNAPL floating on the water table endangers water supply wells in addition to those operated by the WUA. Lastly, like the cleaning up of contaminated soil around the Fuel Offloading Rack, the Permittee is stating its desire to delay clean up for at least several years while a final remedy through an approved CMI Plan is implemented, which is unacceptable. The Permittee must revise the Interim Measures Work Plan to remove the above-noted deficiencies.

6. *Page 4-4, Section 4.6* - In the last paragraph the Permittee states that "Routine system optimization will be performed … to maintain the highest mass extraction rate…"

The Permittee shall revise this section to explain in detail how the system will be optimized.

7. *Page 5-1, Section 5* - The Permittee states: "Vadose zone interim remedial measures will be implemented if data collected during the PneuLog profiling, supplemented by results of the concurrent vadose zone investigation, identify the presence of potentially mobile LNAPL within the vadose zone."

As mentioned above, the NMED does not agree with the Permittee-coined terms "mobile LNAPL" and "immobile LNAPL." It should be inarguable that fuel infiltrated from near or at the ground surface and has percolated through the vadose zone to groundwater. Some fuel is likely still draining to groundwater. However, hazardous constituents can still migrate to groundwater as vapor even in areas where the draining of liquid fuel to groundwater has stopped or never took place. The Permittee must revise the Interim Measures Work Plan to indicate that remediation of the vadose zone will be conducted to accomplish clean up of LNAPL floating on the groundwater, regardless of whether fuel-saturated conditions exist in the vadose zone in a given area.

8. *Page 5-2, Section 5.2* - The fourth paragraph states: "PneuLog will be performed at three locations…starting from the point(s) of release to the water table."

Figure 5-1 shows the proposed locations for PneuLog testing about 750 feet northeast of the Fuel Offloading Rack and approximately 750 feet north of the southern extent of the LNAPL plume that is floating on groundwater. According to the conceptual model provided in the Interim Measures Work Plan, the proposed locations for PneuLog testing could lead to missing the path of percolation that the fuel took to groundwater.

The Permittee must revise the Interim Measures Work Plan to include some PneuLog testing in the fuel percolation area. See Comment #4 in Section C of Part 1 of this letter for information on the area NMED has identified as the fuel percolation area. Indicate also in the Interim Measures Work Plan the significance of using three locations for PneuLog testing and explain in more

detail how the air flow potential of the geologic units will be assessed and used in the design to optimize SVE.

The Interim Measures Work Plan shall also be revised to indicate that geologic and geophysical (induction, gamma, and neutron) logs will be made for the boreholes used for PneuLog testing.

*9. Figures.* Figures 2-2 through 2-5 are very difficult, and in some cases impossible to read. Cross-section A-A' is not the view seen in Figure 2-8.

The Permittee shall revise the Interim Measures Work Plan to include corrected and legible figures.

## C. Vadose Zone Work Plan

### *1. General Comments on Vadose Zone Work Plan*

In NMED's letter of April 2, 2010, the Permittee was directed to submit a Vadose Zone Investigation Plan that describes the additional actions the Permittee will take to investigate vadose zone hydrology and geology, to identify and characterize the source of the releases at the Bulk Fuel Facility, and to identify the extent of soil and soil-gas contamination in the vadose zone from the surface to groundwater. The Vadose Zone Plan was to describe in detail all research, locations, depths and methods of exploration, field procedures, sampling and analysis of soil and soil gas and related quality control procedures, the results and the means by which the results are to be reported, and a schedule of the work.

The Vadose Zone Work Plan that has been submitted is inadequate to accomplish the objectives established in NMED's letter of April 2, 2010. A major reason is that the proposed borings and soil-vapor wells are located too far apart to characterize in adequate detail the contaminant and geologic conditions in the vadose zone. NMED therefore directs herein a general increase in the number of sampling points. The Permittee shall revise the Vadose Zone Work Plan to include all of the soil borings and soil-vapor well installations required by this letter.

For the convenience of providing further discussion in this letter, NMED has divided the vadose zone into five principal areas: the tank farm, pipeline, Fuel Offloading Rack, fuel percolation area, and the far field area of the soil-vapor plume. Each of these areas is discussed below.

*1. Tank Farm* – Contamination is known to occur from the surface to deep levels at the Tank Farm. In its letter of April 2, 2010, NMED directed that nine deep soil borings/soil-vapor wells be completed in the tank farm area; the Permittee proposed only three. Through its direction in it April 2, 2010 letter, NMED was hoping to avoid the time-consuming process of "dickering" with the Permittee on numbers of borings (and wells, to be discussed later). Nevertheless, in the interest of comity and upon further consideration, NMED agrees that by adjusting locations and completing some shallow borings, the tank farm area could be covered at least initially by five deep soil borings/soil-vapor wells and five shallow soil borings. Depending on what is found,

additional soil borings/soil-vapor wells may be needed, and NMED reserves its rights to require such additional borings, wells, or both in the future.

The Permittee shall complete the soil borings/soil-vapor wells at locations #16, 17, 19 and 20; and the soil vapor well at location #6 that are listed in Tables 1 and 2 of this letter, respectively, and shown on Figure 1 enclosed with this letter. The Permittee shall also complete shallow soil borings to a depth of at least 20 feet at locations #1 through 5, which are listed in Table 3 of this letter and shown also on Figure 1. Soil samples from the shallow borings shall be collected at depths of 0, 5, 10, 15, and 20 feet and shall be analyzed for TPH, VOCs, SVOCs, and lead.

2. *Pipeline* – The Permittee has not investigated the pipeline that runs between the tank farm, the pump house, and the Fuel Offloading Rack. In NMED's letter of April 2, 2010, the Permittee was directed to complete four deep soil borings/soil-vapor wells along the buried and exposed portions of the pipeline. The Permittee proposed none.

In lieu of completing deep soil borings/soil-vapor wells, the Permittee proposed to complete shallow borings along the buried portion of the pipeline extending south of the pump house. However, the Vadose Zone Work Plan is unclear as to the number of shallow boreholes that would be completed. Additionally, the proposed plan is inadequate because the entire length of pipeline between the tank farm and the Fuel Offloading Rack is not included in the investigation.

The Permittee shall complete the deep soil borings/soil-vapor wells at locations #4, 6, 7, 8, and 24 that are listed in Table 1 of this letter and shown on Figure 1. The Permittee shall also complete shallow borings along the entire length of the pipeline between the tank farm and the Fuel Offloading Rack, regardless of whether the pipeline runs underground or on the surface. The borings shall be spaced at intervals not to exceed 25 feet and are to be located on both sides of the pipeline. Soil samples from the shallow borings shall be collected at depths of 0, 5, 10, 15, and 20 feet. The soil samples from deep and shallow borings shall be analyzed for TPH, VOCs, SVOCs, and lead. Depending on the results, NMED may require further investigation of this area, including more and deeper borings.

3. *Fuel Offloading Rack* – The Fuel Offloading Rack is supposedly the main source of the fuel spill, but it has not been adequately characterized since discovery of the fuel leak 10 years ago. Previous investigative efforts appear to have been arbitrarily terminated once TPH concentrations were found to be less than 100 mg/kg in soil and below 100 ppmv in soil vapor. In NMED's letter of April 2, 2010, the Permittee was directed to complete a ***minimum*** of six deep soil sampling/vapor wells at the Fuel Offloading Rack to determine the full extent of contamination; the Permittee proposed four. NMED reaffirms its previous direction. The Permittee shall complete the soil borings/soil-vapor wells at locations #1, 2, 3, 4, 11, and 12 that are listed in Table 1 of this letter and shown in Figure 1.

4. *Fuel percolation area* – This area, east of the Fuel Offloading Rack, is currently believed to constitute the core of the contamination in the vadose zone, and represents the place where fuel presumably migrated to groundwater. In NMED's letter of April 2, 2010, the Permittee was

directed to complete a ***minimum*** of six deep soil sampling/vapor wells in order to significantly improve characterization of this area. This is critical to understanding the amount of fuel contamination in the vadose zone that must be remediated. The Permittee proposed to complete only two of the deep soil sampling/vapor wells that the NMED specified.

The Permittee did, however, propose an additional 3 deep soil sampling/vapor wells at locations further to the east. NMED agrees that these latter locations are necessary to properly characterize this area. Thus, to improve the understanding of the amount of fuel contamination in the vadose zone that must be remediated, the Permittee shall complete the soil borings/soil-vapor wells at locations #5, 9, 10, 21, 22, 23, 25, 26, and 27 listed in Table 1 and shown on Figure 1.

*5. Far field area of Soil-Vapor plume* – In its letter of April 2, 2010, NMED directed the Permittee to install six soil-vapor wells at locations north of the Fuel Offloading Rack and fuel percolation area to investigate the concentrations of hazardous constituents in soil gas that overlies groundwater in these areas. The Permittee shall complete the soil-vapor wells at locations #1, 2, 4, 3, 5, 6, 8, and 9; and the soil boring/soil-vapor well at location #24, that are listed in Tables 2 and 1, respectively, and shown on Figure 1.

*6. Sampling Requirements Applicable to all Five Vadose Zone Areas* - Soil samples from the deep borings shall be collected at a frequency of at least one sample every 10 feet for the first 50 feet, and at least one sample thereafter every 50 feet to total depth, and at least one sample at total depth in each boring. Each deep boring at each location shall be drilled from the surface to the water table, and each deep boring shall be completed as a permanent soil-gas monitoring well. The soil-gas monitoring wells shall be capable of yielding discrete samples of soil gas recovered from depths of 25, 50, 150, 250, 350, and 450 feet below the ground surface.

All boreholes that will have soil-vapor monitoring wells constructed in them shall be logged using induction (medium and deep), neutron, and gamma tools. Geologic logs shall also be prepared for these boreholes showing the geologic conditions from the surface to the total depth of each borehole.

The coordinates in Tables 1-3 are State Plane Coordinates in feet, NAD83. All boring/soil vapor well locations are also shown on Figure 1 enclosed with this letter.

**Table 1. Borehole Locations for Soil Sampling and for Conversion to Soil-Vapor Monitoring Wells.**

| Location # | Easting | Northing | Characterization Purpose |
|---|---|---|---|
| 1 | 1541119 | 1473793 | Step out from Fuel Offloading Rack |
| 2 | 1540808 | 1473503 | Step out from Fuel Offloading Rack |
| 3 | 1541123 | 1473310 | Step out from Fuel Offloading Rack |
| 4 | 1541425 | 1473313 | Step out from Fuel Offloading Rack and piping |

| | | | |
|---|---|---|---|
| 5 | 1541961 | 1473492 | Fuel percolation area |
| 6 | 1542002 | 1473057 | Piping |
| 7 | 1541794 | 1473061 | Piping |
| 8 | 1542370 | 1473058 | Piping |
| 9 | 1541898 | 1473276 | Fuel percolation area |
| 10 | 1541720 | 1473369 | Fuel percolation area |
| 11 | 1541776 | 1473740 | Step out from Fuel Offloading Rack |
| 12 | 1541658 | 1473505 | Fuel percolation area and Fuel Offloading Rack |
| 16 | 1541992 | 1472768 | Fuel tanks |
| 17 | 1542229 | 1472916 | Fuel tanks |
| 19 | 1542485 | 1472911 | Fuel tanks |
| 20 | 1542428 | 1472716 | Fuel tanks |
| 21 | 1541611 | 1473238 | Fuel percolation area |
| 22 | 1542137 | 1473266 | Fuel percolation area |
| 23 | 1542131 | 1473571 | Fuel percolation area |
| 24 | 1541620 | 1472955 | Far Field and piping |
| 25 | 1542807 | 1473592 | Fuel percolation area |
| 26 | 1542422 | 1473506 | Fuel percolation area |
| 27 | 1542360 | 1473808 | Fuel percolation area |

**Table 2. Locations for Soil-Gas Monitoring Wells.**

| Location # | Easting | Northing | Characterization Purpose |
|---|---|---|---|
| 1 | 1542900 | 1474092 | Far Field |
| 2 | 1543194 | 1474680 | Far Field |
| 3 | 1542306 | 1474093 | Far Field |
| 4 | 1541555 | 1475049 | Far Field |
| 5 | 1541248 | 1474141 | Far Field |
| 6 | 1542259 | 1472591 | Far Field and fuel tanks |
| 8 | 1542504 | 1475414 | Far Field |
| 9 | 1542436 | 1474878 | Far Field |

**Table 3. Locations for Shallow Soil Borings in Tank Farm Area.**

| Location # | Easting | Northing |
|---|---|---|
| 1 | 1542544 | 1472810 |
| 2 | 1542282 | 1472806 |
| 3 | 1542125 | 1472784 |
| 4 | 1542081 | 1472959 |
| 5 | 1541941 | 1472867 |

The Permittee shall revise the Vadose Zone Work Plan to incorporate the general comments and correct the deficiencies noted above.

***2. Specific Comments on Vadose Zone Work Plan***

*1. Downhole Geophysical Logging* - Section 3.2.1.1, Table 3-1, Topic 3, states "If proposed vapor monitoring points are screened in zones determined to be fine grained lithologic units adjust the screen location vapor monitoring points up or down to the nearest coarser grained unit."

Because individual fine grained or coarse grained beds do not necessarily extend laterally for any significant distances, any geophysical logs used to adjust screen locations must be generated for that particular borehole.

The Permittee must revise the Vadose Zone Work Plan to indicate the maximum distance that screened zones are to be adjusted from the required screen depths should adjustment be necessary. For screens that are to be set 100 feet apart as directed under this letter, the Permittee may adjust screens by no more than 25 feet. For screens that are to be set 25 feet apart, the Permittee may adjust screens by no more than 5 feet.
*2. Seismic Refraction, Section 3.2.1.2* - NMED encourages the use of geophysical techniques; however, NMED is doubtful that seismic refraction will prove useful in this case. NMED is concerned that refraction will only detect shallow loose material near the surface, somewhat more dense subsurface material, and saturated material beginning at the water table. Although KAFB is free to conduct the refraction survey, the NMED will not allow such survey to delay completion of other work required for characterizing and cleaning up the Bulk Fuels Facility Spill.

If the Permittee proceeds with conducting the refraction survey, the following issues must be addressed in the revised work plan.

A. Explain why seismic refraction was chosen and not shallow reflection.

B. Explain how seismic refraction is expected to identify the difference between a fine-grained unit and a coarse-grained unit above the saturated zone at depths of 450-500 feet (see DQO step 5 for topic 1 on Table 3-1). Table 3-1, DQO step 6, topic 1 implies that refraction will be able to define a unit within 1-foot depth at a depth of 500 feet. These Data Quality Objectives cannot likely be achieved.

C. If the 1-foot depth is actually referring to the location of geophones, specify what the QC targets are for the seismic survey (for example, how close should the interpreted seismic interface be to the actual depth to water). Specify the site-specific conceptual model of the seismic layering. Indicate the expected thicknesses versus depth of units to be detected.

D. Explain what seismic source is planned to be used in this "noisy" environment that can carry an off-the-end shot for the 1500 foot line. Conceptually, specify how many shot points and what locations are planned per line.

E. Figure 3-1 shows 13 seismic lines that are all oriented in an east-west direction. Section 3.2.1.2 discusses orthogonal lines. Clarify how many lines are planned. Specify how the orthogonal lines will be placed, and show them on a corrected Figure 3-1. Explain why the proposed seismic lines are shown crossing buildings.

*3. Resistivity, Section 3.2.1.3* – Like the refraction survey discussed in the proceeding comment, the NMED is doubtful that the IP/RES techniques will prove useful in this case. Although KAFB is free to conduct the resistivity survey, the NMED will not allow such a survey to delay completion of other work required for characterizing and cleaning up the Bulk Fuels Facility Spill.

If the Permittee proceeds with conducting the survey, the following issues must be addressed in the revised work plan.

A. As described in Section 3.2.1.3 of the plan, 56 stakes are proposed to be situated along 1,850 feet transects. This amounts to an electrode separation of about 30 feet, which would yield a shallowest apparent resistivity of the upper nominal 30 feet, with a value every 30 feet horizontally. Explain how the resistivity survey is expected to provide good results with all the surface interferences, cultural conditions, pipelines, surface topography changes, utilities, and other conditions known to be present at the site. Explain how close, for example, does the interpreted depth to groundwater need to be to meet the "Specify Limits on Decision Errors" concept on Table 3-1. Specify the QC procedures to be performed, such as calibrating to a known resistance and reciprocity tests.

B. Explain why the proposed resistivity lines are shown crossing buildings.

C. Indicate whether the geophysical parameters measured in the Sunbelt Geophysics report were taken into account in planning the resistivity investigation.

D. Specify what size transmitter is to be used to be able to measure the appropriate parameters with appropriate detail at large depths, and what electrode arrays are to be used.

E. Indicate if an analysis has been conducted modeling what MN, AB, and AB-MN spacings seem plausible based upon site-specific resistivities (estimated from resistivity or induction logs) and equipment specifications.

F. F. Indicate and explain the computer model by which the data are to be interpreted.

*4. Page 3-5, Section 3.2.3* – Substitute semi-volatile organic compounds (SVOCs) for polycyclic aromatic hydrocarbons (PAHs) and add lead to the parameters to be analyzed for in soil. The Permittee must revise the Vadose Zone Work Plan accordingly.

*5. Page 3-6, Section 3.2.3* – The first paragraph on this page says that soil samples containing LNAPL will not be sent to the laboratory for chemical analysis. All soil samples, including those containing LNAPL, must be sent to a laboratory and analyzed for TPH, VOCs, SVOCs, and lead. The Permittee must revise the Vadose Zone Work Plan accordingly.

*6. Page 3-6, Section 3.2.4* – This section states that screens on soil-vapor monitoring wells will be set to "anticipated depths" of 25, 50, 150, 250, 350, and 450 feet. The Permittee must revise the Vadose Zone Work Plan to indicate the maximum distance that screened zones are to be adjusted from the required screen depths, should adjustment be necessary. For screens that are to be set 100 feet apart as directed under this letter, the Permittee may adjust screens by no more than 25 feet. For screens that are to be set 25 feet apart, the Permittee may adjust screens by no more than 5 feet. The Permittee must revise the Vadose Zone Work Plan accordingly.

*7. Cross-section "A-A"* - Cross-section A-A' location shown on Figures 2-2 through 2-5 does not correspond to Cross-Section A-A' shown in Figure 2-8. Supply the intended cross-section A-A' with data shown clearly and legibly, and with appropriate data.

## D. Groundwater Investigation Work Plan

***General Comments on Groundwater Investigation Work Plan***

In NMED's letter of April 2, 2010, the Permittee was directed to submit a Groundwater Investigation Work Plan that describes the additional actions the Permittee will take to characterize the nature, horizontal and vertical extent, and the fate and rate of migration of the groundwater contamination. The Groundwater Investigation Work Plan was also to include construction details and the locations and depths of the groundwater monitoring wells to be installed, actions to characterize the geology and hydrogeology at and below the water table,

groundwater flow direction and velocity, field procedures, and the sampling and analysis of groundwater and related quality control. The Groundwater Investigation Work Plan was also to describe the means *(e.g.,* cross-sections, plan views) by which results would be reported after the investigation and include a schedule to complete the work.

The leading (northern) edge and the eastern and western margins of the dissolved-phase and LNAPL plumes are as yet undefined, and the nature and concentrations of contaminants in the core of each of the plumes are poorly characterized because existing wells are located too far apart (generally at distances greater than 500 feet), vertical characterization information is nonexistent, and water quality beneath the LNAPL plume has not been assessed. Additionally, the vertical extent of contaminated groundwater, key aspects of the hydrology of the groundwater (hydraulic conductivity, velocity), and the geology (horizontal and vertical characteristics) of the saturated zone are poorly defined or are unknown.

In general, the Groundwater Investigation Work Plan proposes too few wells, both in a vertical and horizontal sense, than is needed to adequately characterize the geology, hydrology, and the nature and extent of contamination over such a large area of groundwater contamination. As mentioned earlier, NMED was hoping to avoid the time-consuming process of "dickering" with the Permittee on numbers of borings and wells by providing clear and specific direction in its April 2, 2010 letter. Nevertheless, in the interest of comity and upon further consideration, NMED agrees that by adjusting locations some well locations directed in NMED's April 2, 2010 letter can be replaced with some proposed by the Permittee in the Groundwater Investigation Work Plan. NMED nonetheless directs an increase in the number of sampling points over that proposed by the Permittee, with the goal of achieving adequate site characterization more quickly to address the urgent matter of cleaning up the Bulk Fuels Facility Spill. Depending on what is found, additional wells may be needed, and NMED reserves its rights to require such additional borings, wells, or both in the future. The Permittee shall revise the Groundwater Investigation Work Plan to include all of the well installations required by this letter.

NMED has identified several other general deficiencies with the Groundwater Investigation Work Plan, which includes issues related to background water quality, vertical characterization, water quality beneath the LNPAL plume, rate of contaminant migration, cluster/nested wells, and characterization of plume cores and margins. These general deficiencies are discussed below.

*1. Background Water Quality* - Only two upgradient wells have been installed that potentially may yield groundwater samples that are free from contamination. Both of these wells were only recently completed; none is screened appreciably below the water table to provide vertical characterization of water quality, geology, and hydrologic conditions. The Permittee must complete the background cluster/nested wells at location #6 listed in Table 4 of this letter and shown on Figure 2 (enclosed).

*2. Vertical Characterization* – The plan identifies proposed wells that are to be screened at various depths below the water table as "B" and "C" wells, with the "C" wells the deepest screened well at a given cluster/nested well location. Due to urgency of this matter, the NMED

does not approve of "C" well installation being contingent on "B" well results. Given that the pumping of water supply wells is known to induce vertical gradients in groundwater, can cause significant components of vertical flow in the vicinity of such wells, and draws water preferentially from productive zones that may be deeper than the water table, vertical characterization of groundwater quality, hydrology, and geology is required for all well installations specified by this letter.

*3. Water Quality Beneath the LNAPL Plume* - Although the lack of water quality information was identified specifically by the NMED as a data gap, the Groundwater Investigation Work Plan states that groundwater at well locations within the boundaries of the LNAPL plume will not be sampled and analyzed. This is an unacceptable approach. Knowledge of water quality beneath the LNAPL plume is crucial to understand the full extent and magnitude of the groundwater contamination.

*4. Rate of Contaminant Migration* - Although a critical question to be answered, it was not clear in the Groundwater Investigation Work Plan if the Permittee has a plan to address the rate of migration of either the dissolved-phase or LNAPL contaminant plumes, and in particular, the time it would take for the dissolved-phase plume to reach surrounding well fields. The Permittee must clarify this point.

*5. Cluster versus Nested Wells* – The NMED has no objections to the use of nested wells instead of cluster wells, provided the nested wells are properly constructed. However, in this case the NMED will not accept wells that are constructed with 3-inch diameter casing and screens. Three-inch diameter casing and screens are inappropriate for constructing groundwater monitoring wells that will be installed to depths of 500 feet or more. The Permittee shall design wells to be constructed in cluster or nested configurations using casing and screen that are no smaller than 5 inches in diameter. The borehole surrounding the well casing for a nested or cluster well must be of sufficient diameter to allow for an adequate annular space between the borehole and well casing and screen. The annular space must be of sufficient size to allow for proper construction of filter packs and seals, and for the installation of grouting (see the groundwater monitoring well construction requirements set forth in Part 2 of this letter).

*6. Characterization of Plume Cores* – The dissolved-phase and LNAPL plumes extend off base to nearly 0.9 to 0.5 miles, respectively from the presumed source, yet a total of only eight wells currently exist off-base to characterize the cores of both plumes. Of these eight wells, this includes two wells where groundwater has not been sampled for water quality in the past and one well that was only very recently installed at Bullhead Park for which no water quality data has been submitted to the NMED.

In NMED's letter of April 2, 2010, the Permittee was directed to install groundwater monitoring wells at a ***minimum*** of eight additional locations to characterize the concentrations of contaminants, and the geologic and hydrologic conditions that exist off-base in the plume cores; instead, the Permittee proposed only four.

To achieve the objective of providing initial plume-core characterization, the Permittee shall install the groundwater monitoring wells at locations #11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, and 23 listed in Table 4 and shown on Figure 2.

*7. Characterization of Plume Margins* – Only five existing wells define the edge of the plume off-base (including one well recently installed). In NMED's letter of April 2, 2010, the Permittee was directed to install groundwater monitoring wells at a ***minimum*** of eight additional locations to characterize the concentrations of contaminants, and the geologic and hydrologic conditions that exist off base along the plume margins; instead, the Permittee proposed five.

To adequately provide initial plume-edge characterization, the Permittee shall install the groundwater monitoring wells at locations #1, 2, 3, 4, 5, 7, 8, 9, 10, 24, 25, 26, 27, and 28 that are listed in Table 4 and shown on Figure 2.

Three groundwater monitoring wells shall be installed at different depths at each of the well locations listed in Table 4. The screen depths shown in Table 4 are distances (in feet) that the top of the screens shall be set below the water table, except wells screened across the water table (those with screen depths of zero in Table 4) may have screens that extend above the water table. Screen lengths for wells shall not exceed 15 feet, with the exception that wells screened across the water table shall have screens 20 feet long, with no more than 15 feet of screen length situated below the water table.

The geologic conditions encountered from the surface to the total depth of the borings at each well location shall be logged. Boreholes completed for well installations at all locations shall also be logged using induction (medium and deep), neutron, and gamma (large crystal) tools. Geophysical and geologic logging at a given cluster well location is required only in the well at the location having the deepest screened interval.

Coordinates in Table 4 are State Plane Coordinates in feet, NAD83. All of the locations listed in Table 4 are also shown on Figure 2 enclosed with this letter.

**Table 4. Well locations and screen depths relative to the water table.**

| Location # | Easting | Northing | Screen Depths | Characterization Purpose |
|---|---|---|---|---|
| 1 | 1542189 | 1476725 | 0, 15, 40 | Plume margin, deep characterization |
| 2 | 1541984 | 1476042 | 0, 15, 40 | Plume margin, deep characterization |
| 3 | 1543703 | 1476600 | 0, 15, 40 | Plume margin, deep characterization |
| 4 | 1543372 | 1475065 | 0, 15, 40 | Plume margin, deep characterization |
| 5 | 1543643 | 1477939 | 0, 15, 85 | Plume margin, deep characterization |
| 6 | 1541430 | 1472370 | 15, 40* | Background water quality, deep characterization |

| | | | | |
|---|---|---|---|---|
| 7 | 1542812 | 1473601 | 0, 15, 40 | Plume margin, deep characterization |
| 8 | 1542722 | 1477726 | 0, 15, 40 | Plume margin, deep characterization |
| 9 | 1543054 | 1477788 | 0, 15, 40 | Plume margin, deep characterization |
| 10 | 1543774 | 1477304 | 0, 15, 40 | Plume margin, deep characterization |
| 11 | 1541774 | 1473718 | 0, 15, 85 | Plume core, deep characterization |
| 12 | 1542362 | 1473801 | 0, 15, 85 | Plume core, deep characterization |
| 13 | 1542305 | 1474340 | 15, 85* | Plume core, deep characterization |
| 14 | 1542736 | 1474715 | 0, 15, 85 | Plume core, deep characterization |
| 15 | 1542860 | 1475860 | 0, 15, 85 | Plume core, deep characterization |
| 16 | 1542189 | 1475207 | 0, 15, 85 | Plume core, deep characterization |
| 17 | 1541731 | 1473291 | 0, 15, 85 | Plume core, deep characterization |
| 18 | 1542203 | 1474071 | 0, 15, 85 | Plume core, deep characterization |
| 19 | 1542565 | 1475360 | 0, 15, 85 | Plume core, deep characterization |
| 20 | 1542535 | 1475975 | 0, 15, 85 | Plume core, deep characterization |
| 21 | 1543199 | 1475767 | 0, 15, 85 | Plume core, deep characterization |
| 22 | 1543068 | 1476494 | 0, 15, 85 | Plume core, deep characterization |
| 23 | 1541968 | 1474648 | 0, 15, 85 | Plume core, deep characterization |
| 24 | 1541682 | 1474703 | 15, 40* | Plume margin, deep characterization |
| 25 | 1541025 | 1474360 | 15, 40* | Plume margin, deep characterization |
| 26 | 1540407 | 1474016 | 15, 40* | Plume margin, deep characterization |
| 27 | 1543712 | 1475683 | 15, 40* | Plume margin, deep characterization |
| 28 | 1543364 | 1477684 | 0, 15, 40 | Plume margin, deep characterization |

* - water table well already exists

The Permittee shall revise the Groundwater Investigation Work Plan to incorporate the general comments and correct the deficiencies noted above.

***Specific Comments on Groundwater Investigation Work Plan***

*1. Page 3-6, Section 3.3.4 and Figure 3-3* – Well construction details are missing, as the wrong figure was submitted for a well construction diagram in the Work Plan. The Permittee shall revise the Groundwater Investigation Work Plan to correct the deficiency noted above.

2. *Page 3-4, Section 3.3.2* – This section states that "NMED will be notified regarding any deviations in well constructions per Section 4.0." Aside from the fact that there is no Section 4.0, well construction and any changes thereto must be approved in advance by the NMED. E-mail or telephone approval may suffice to facilitate in-field decision-making. The Permittee shall revise the Groundwater Investigation Work Plan accordingly.

3. *Page 3-5, Section 3.3.3* – Soil samples shall be collected at well locations #11, 12, 17, and 18 listed in Table 4 from the deepest borehole at each location. The samples shall be collected at a frequency of at least one sample every 10 feet for the first 50 feet of the borehole, then at least one sample every 50 feet to the bottom of the borehole, and at total depth of the borehole. The soil samples must be analyzed in the laboratory for TPH, VOCs, SVOCs, and lead. The Permittee shall revise the Groundwater Investigation Work Plan accordingly.

4. *Page 3-7, Section 3.3.5* – This section indicates that wells screened below the water table will be considered by the Permittee to be "piezometers" (normally for measuring only hydraulic head). Groundwater samples must be collected from all wells, regardless if the wells are screened at the water table or deeper, and all samples must be analyzed for TPH and hazardous constituents. The Permittee shall revise the Groundwater Investigation Work Plan accordingly.

5. *Page 3-7, Section 3.3.5* – This section states that wells located within the area of the floating LNAPL will not be developed. All wells, including those within the LNAPL plume, shall be properly developed to provide representative water samples. The Permittee shall revise the Groundwater Investigation Work Plan accordingly.

6. *Page 3-7, Section 3.3.6* – This section states that groundwater at wells located within the area of the floating LNAPL will not be sampled. Groundwater in all wells will be sampled, including those within the LNAPL plume. The Permittee shall revise the Groundwater Investigation Work Plan accordingly.

7. *Page 3-7, Section 3.3.6* – For analysis of groundwater samples, add lead and substitute SVOCs for PAHs, and dissolved iron and dissolved manganese for iron and manganese, respectively. Samples must not be filtered, except for sample fractions for dissolved iron and dissolved manganese.

Add alkalinity and pH to the list of field parameters.

The Permittee shall revise the Groundwater Investigation Work Plan accordingly.

8. *Page 3-6, Section 3.3.4* - It is not clear how many wells are actually proposed because wells KAFB-10629, KAFB-10630, and KAFB-10638 are not listed on Table 3-2 of the Groundwater Investigation Work Plan. The Permittee must clarify or resolve this discrepancy in a revision to the Groundwater Investigation Work Plan.

9. *Page 3-1, Section 3.1.1* - Indicate what geophysical logs will be run and at what stage of the borehole/well installation process. The discussion should be included in Section 3.3 instead of Section 3.1.1. The Permittee shall revise the Groundwater Investigation Work Plan accordingly.

10. *Page 3-2, Section 3.3.1* - See specific Comments #2 and 3 for the Vadose Zone Work Plan regarding surface geophysical surveys.

# PART 2

## A. Direction to Conduct Interim Measures and Other Actions

In NMED's letter of April 2, 2010, the Permittee was informed that the NMED has determined that the Bulk Fuel Facility Spill poses a threat to human health and the environment, and furthermore, endangers the groundwater resource – including water supply wells – relied upon by the WUA for delivery of safe drinking water to its customers. The contamination also threatens KAFB and the Veterans Administration ("VA") Hospital water-supply wells. The large extent of this contamination and its proximity to water supply wells requires that urgent action be taken.

The NMED has estimated that nearly 8 million gallons of fuel have been released at the Bulk Fuels Facility. The Permittee is operating four SVE units on the Permittee's property; however, these soil-vapor extraction units will not clean up the contamination thus far known to occur from the Bulk Fuels Facility Spill in a reasonable time frame. Because the Permittee's Interim Measures Work Plan does not contain any interim measures that could be implemented immediately, the NMED herein is directing the Permittee to:

1. conduct additional soil vapor extraction,
2. improve the Operation and Maintenance Plan for the SVE units,
3. begin immediate excavation of contaminated soil at the Fuel Offloading Rack,
4. provide an estimate of the contaminant migration rate,
5. install sentry wells,
6. log existing wells, including using geophysical methods,
7. submit critical data to the NMED, and
8. provide adequate funding to the WUA for sampling and analysis of well water.

SVE and these other actions must be initiated or completed, as appropriate, by the deadlines indicated in this letter and in the Compliance Schedule in Table 5. Additionally, this letter specifies minimum requirements that the Permittee must meet regarding well installations, well development, sampling, geophysical logging, preparing geologic logs, notification of activities, field and laboratory quality control, and reporting.

*1. Soil Vapor Extraction*

a. The Permittee has demonstrated that SVE has worked to remove contaminate vapors from the vadose zone. The Permittee shall install and operate additional SVE units at the following locations:

i. No later than **October 6, 2010** (Table 5) at existing groundwater monitoring wells KAFB-3411, KAFB-10614, and KAFB-10624, which are located in the core of the vadose zone contamination.
ii. No later than **November 8, 2010** (Table 5) at soil boring/soil-vapor monitoring well locations #4, 5, 9, 10, 11, 12, and 21 that are listed in Table 1 of this letter. These wells, to be located in the core of contamination, should be designed to serve both as vapor extraction wells and as soil-vapor monitoring wells. The Permittee must also conduct geologic logging and borehole geophysical logging at each location. The Permittee shall comply with the collection and analysis of soil samples as specified in Part 1 of this letter for well installations.
iii. No later than **October 6, 2010** (Table 5) or 60 days after required access is granted, which ever is later, at existing groundwater monitoring wells KAFB-10617 and 10618 which are located at the northern extent of the LNAPL plume.
iv. No later than **November 8, 2010** (Table 5) or 60 days after required access is granted, which ever is later, at existing groundwater monitoring wells KAFB-10610 which is located at the northern extent of the 1-foot thick layer of LNAPL plume.
v. No later than **November 8, 2010** (Table 5) or 60 days after required access is granted, which ever is later, locations #3, 8 and 9 on Table 2 of this letter shall be made ready for conducting future soil vapor extraction by completing soil-vapor monitoring/extraction wells at this location. The Permittee must conduct geologic logging and borehole geophysical logging at this location and shall comply with the collection and analysis of soil samples as specified in Part 1 of this letter for well installations.

b. The Permittee shall continue to operate SVE units at the locations of the four existing SVE units (located at the Fuel Offloading Rack, KAFB-1065, KAFB-1066, and KAFB-1068).

Until such time that the interim measures plan is approved by the NMED, the Permittee shall continue to operate all SVE units 24 hours per day, 7 days a week, except when necessary to perform maintenance or repairs. If maintenance or repairs are necessary, the maintenance or repairs shall be completed as quickly as practicable, and the unit returned to service immediately after maintenance or repairs are completed. Any maintenance or repairs that will take more than 3 calendar days shall be reported in writing to the NMED within 24 hours of discovery that the maintenance or repairs will take more than 3 days. The Permittee shall explain in the report why the maintenance or repairs will take more than 3 calendar days and why the delay is beyond the control of the Permittee.

The SVE units shall be similar to those currently in use for the Bulk Fuels Facility Spill and shall be capable of extracting soil vapor at a minimum flow rate of 27 SCFM. The SVE units shall also average over a period of 12 months an operating efficiency (operating time relative to down time) of no less than 85%. The SVE units shall meet the regulatory requirements for air emissions enforced by the City of Albuquerque Environmental Health Department. The Permittee is responsible for obtaining all necessary permissions and permits to construct and operate the SVE units.

If the City of Albuquerque Environmental Health Department will not issue an air permit to operate the SVE units specified by this letter, the Permittee shall immediately notify the NMED in writing and shall substitute a different technology for conducting SVE and treating emissions that will meet the regulatory requirements enforced by the City of Albuquerque Environmental Health Department and the deadlines set forth in this letter in the Compliance Schedule shown in Table 5.

***2. Operation and Maintenance (O&M) Plan***

The Permittee shall modify its O&M Plan to reduce down time of SVE units by maintaining in inventory commonly-needed spare parts for maintenance and repairs, and keeping a spare engine available for SVE units that suffer catastrophic engine failures. The spare parts and engine shall be maintained by the Permittee in inventory by **September 7, 2010**. The Permittee shall provide NMED with a written list of the spare parts and spare engine kept in inventory by **October 6, 2010** (Table 5).

***3. Excavation of Soil and Removal of Fuel Offloading Rack***

The Permittee shall by **October 6, 2010** (Table 5) begin removal of the remaining components of the Fuel Offloading Rack and excavation of contaminated soil to 20 feet. The excavation of soil and removal of the Fuel Offloading Rack shall be completed by **October 6, 2011** (Table 5), and a report on completion of the work submitted to the NMED by **January 15, 2012** (Table 5). Any soil contamination left in place must meet NMED's requirements for clean up (see Comment # 8 of Section A of Part 1 of this letter). The Permittee may use direct push sampling and field analysis to help determine which soils require excavation. However, laboratory analysis shall be conducted to determine the concentrations of hazardous constituents in soil for the purpose of defining the final extent of excavation, for risk assessment, and for waste determinations.

Soil shall be sampled to determine whether all contaminated soil that poses an unacceptable risk to human health or the environment has been removed to a depth of at least 20 feet. Soil samples shall be analyzed in the laboratory for TPH, VOCs, SVOCs, and lead, and collected on all sides and the bottom of the excavation at a spacing not to exceed 25 feet.

### *4. Estimates of Contaminant Migration Rate*

The Permittee must provide NMED by **September 7, 2010** (Table 5) with calculations showing the estimated velocity of and the travel time for the dissolved-phase contaminant plume to first reach the closest well in the Ridgecrest well field, the Veteran Administration (VA) Hospital Well, and KAFB production wells KAFB-3, KAFB-15, and KAFB-16. The calculations shall consider the direction and gradient of groundwater flow, and the geologic and hydrologic properties of the aquifer under a worse-case scenario. The Permittee shall provide the source of all information used to support the required calculations.

### *5. Installation of Sentry Wells*

a. The Permittee must install groundwater monitoring wells (water table, intermediate, and deep wells referred to as A, B, and C wells) at location #28 of Table 4 of this letter, north of the leading edge of the dissolved-phase contaminant plume, by no later than **November 8, 2010** (Table 5) or 90 days after required access is granted, which ever is later. These wells will serve as sentry wells for the northern extent of the dissolved-phase plume.
b. The Permittee must install B and C groundwater monitoring wells at existing well locations KAFB-10613 and KAFB-1064, near the V.A. Hospital, by no later than **November 8, 2010** (Table 5) or 90 days after required access is granted, which ever is later. These wells will serve as sentry wells for the V.A. Hospital.
c. The Permittee must install A, B, and C groundwater monitoring wells at location #3 listed in Table 4 of this letter, on the east edge of the dissolved-phase contaminant plume, by no later than **November 8, 2010** (Table 5) or 90 days after required access is granted, which ever is later. These wells will serve as sentry wells for the northeastern extent of the dissolved-phase plume.
d. The Permittee must install A, B, and C groundwater monitoring wells at location #1 listed in Table 4 of this letter, on the west edge of the dissolved-phase contaminant plume no later than **November 8, 2010** (Table 5) or 90 days after required access is granted, which ever is later. These wells will serve as sentry wells for the northwestern extent of the dissolved-phase plume.
e. The Permittee must also conduct geologic and borehole geophysical logging of each well discussed in paragraphs a-d of this section. Geologic logging must be completed during the drilling of the boreholes; geophysical logging must be completed within 30 days of well completion (Table 5). Copies of the geologic and geophysical logs must be provided to the NMED by the submittal dates for quarterly reports specified in NMED's letter of June 4, 2010.

Wells constructed in cluster or nested configuration must meet the requirements set forth in Comment # 5 of Section D of Part 1 of this letter. Groundwater samples shall be collected and analyzed in a laboratory at a quarterly frequency from each sentry well in accordance with the direction in NMED's letter of June 4, 2010, and directions under this letter.

*6. Geophysical logging of Existing Wells*

The Permittee must conduct borehole geophysical logging (medium and deep induction, gamma, and neutron) at all existing groundwater monitoring wells. Copies of the geophysical logs must be provided to the NMED by **October 6, 2010** (Table 5).

*7. Submitting Critical Data to NMED*

The Permittee failed to provide certain critical information required in NMED's April 2, 2010 letter. The Permittee must provide the following information to the NMED by **September 7, 2010** (Table 5):

i. tables in electronic format (Excel™) showing the locations (x, y, z), sampling points, and maximum depths of all soil borings and vapor and groundwater monitoring wells;
ii. Survey plats for all wells.
iii. tabulated data in electronic format (Excel™) and graphs showing hydrocarbons (HC) and trends of major hazardous constituent (such as benzene, toluene, ethylene dibromide, xylenes, naphthalene, ethylbenzene, and lead) concentrations versus time for soil vapor for each extraction and each soil-vapor and groundwater monitoring well, as applicable.
iv. tabulated data in electronic format (Excel™) and graphs showing trends of TPH and major hazardous constituent (such as benzene, toluene, ethylene dibromide, xylenes, naphthalene, ethylbenzene, and lead) concentrations versus time for groundwater for each groundwater monitoring well.
v. Cross-sections showing the geology of the site drawn to a horizontal scale of 1 inch equals 50 feet, a vertical scale of 1 inch = 50 feet, and along the orientations A-A', B-B', C-C', and D-D' as shown on Figure 3 enclosed with this letter.
vi. Cross-sections showing the geology of the site drawn to a horizontal scale of 1 inch equals 300 feet, a vertical scale of 1 inch = 50 feet, and along the orientations A-A', B-B', C-C', and D-D' as shown on Figure 4 enclosed with this letter.
vii. Cross-sections showing concentrations of major hazardous constituents in soil, drawn to a horizontal scale of 1 inch equals 50 feet, a vertical scale of 1 inch = 50 feet, and along the orientations A-A', B-B', C-C', and D-D' as shown on Figure 3 enclosed with this letter.
viii. Cross-sections showing concentrations of major hazardous constituents in soil vapor, drawn to a horizontal scale of 1 inch equals 50 feet, a vertical scale of 1 inch = 50 feet, and along the orientations A-A', B-B', C-C', and D-D' as shown on Figure 3 enclosed with this letter.
ix. Cross-sections showing concentrations of major hazardous constituents in groundwater, drawn to a horizontal scale of 1 inch equals 300 feet, a vertical scale of 1 inch = 50 feet, and along the orientations A-A', B-B', C-C', and D-D' as shown on Figure 4 enclosed with this letter.

***8. Sampling and Analysis of Water Production Wells***

NMED understands that the Permittee is providing funding to the WUA to analyze groundwater samples from WUA water-supply wells threatened by contamination originating from the Bulk Fuels Facility Spill. NMED has also become aware that the analytical method used by the WUA to test for ethylene dibromide (EDB) is 524.2 rather than Method 504.1, the latter which is normally used for purposes of determining compliance with Safe Drinking Water Act.

NMED does not consider analysis by Method 524.2 to be sufficiently sensitive to provide adequate early-warning protection for the WUA wells. The Permittee shall continue to collaborate with the WUA to ensure that water quality is safe for human consumption, but will also ensure the samples are analyzed by Method 504.1. The Permittee shall provide copies of the laboratory results to the NMED in quarterly reports in accordance with the reporting requirements of NMED's letter of June 4, 2010.

## B. Technical Requirements for Conducting Interim Measures

***1. Notification of Sampling and other Field Activities***

The Permittee shall notify the NMED in writing of field sampling or other field activities undertaken in accordance with the requirements of this letter, and shall provide the NMED the opportunity to collect split samples upon request by the NMED. For such sampling or other field activities, the Permittee shall provide the NMED with as much advance notice as is practicable, but no less than 15 days prior to the conduct of such sampling. The Permittee shall notify the NMED in writing a minimum of 15 days prior to the implementation of the Interim Measures, Groundwater Investigation and Vadose Zone Work Plans. Notification of sampling or other field activities may be made by email, fax, or letter.

***2. Soil-Vapor Well Construction***

Soil-vapor monitoring wells shall be designed and constructed in a manner that will yield high-quality samples. Soil vapor wells shall not be installed with the use of any fluids. Soil vapor wells may be completed by backfilling with native materials. The Permittee shall not sample the well before the expiration of the 24-hour equilibration period following completion of installation. Information on the design and construction of soil-vapor monitoring wells shall be recorded as for groundwater monitoring wells.

***3. Groundwater Monitoring Well Construction***

Groundwater monitoring wells shall be designed and constructed in a manner that will yield high quality samples, ensure that the well will last the duration of the project, and ensure that the well will not serve as a conduit for hazardous constituents to migrate between different stratigraphic

units or aquifers. The design and construction of groundwater monitoring wells shall comply with the guidelines established in various RCRA guidance, including, but not limited to:

EPA, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1, September, 1986; and

Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034, 1989.

*1. Drilling Methods*

The Permittee shall abide by the following conditions:

1. Drilling shall be performed in a manner that minimizes impacts to the natural properties of the subsurface materials;
2. Drilling shall be performed in a manner that contamination and cross-contamination of groundwater and aquifer materials is avoided;

1. The drilling method shall allow for the collection of representative samples of rock, unconsolidated sediment, and soil;
2. The drilling method shall allow the Permittee to determine when the appropriate location for the screened interval(s) has been encountered;
3. The drilling method shall allow for the proper placement of a filter pack and annular sealant for each monitored zone, and the borehole diameter shall be at least four inches larger in diameter than the nominal diameter of the well casing and screen to allow adequate space for emplacement of the filter pack and annular sealants;
4. The drilling method shall also allow for the collection of representative groundwater samples; and
5. Drilling fluids, including air, shall be used only when minimal impact to the surrounding formation and groundwater can be ensured.

All drilling equipment shall be in good working condition and capable of performing the planned tasks. Drilling rigs and equipment shall be operated by properly trained crews. Drilling equipment shall be properly decontaminated before initiation of drilling for each boring. Precautions shall be taken to prevent the migration of contaminants between geologic, hydrologic, or other identifiable zones during drilling and well installation activities.
The drilling and sampling shall be conducted under the direction of a qualified engineer or geologist. Known site features and/or site survey grid markers shall be used as references to locate each boring prior to surveying the location.

*2. Well Construction Materials*

When selecting construction materials, the primary concern shall be selecting well construction materials that will not contribute to or remove hazardous waste or constituents from groundwater

samples. Other factors to be considered include the tensile strength, compressive strength, and collapse strength of the materials; the length of time the monitoring well will be in service; and the material's resistance to chemical and microbiological corrosion.

*3. Design and Construction of Screens and Filter Packs*

Screens and filter packs shall be designed to allow accurate sampling of the saturated zone that the well is intended to sample, minimize the passage of formation materials (turbidity) into the well, and ensure sufficient structural integrity to prevent the collapse of the intake structure. The filter pack shall be installed in a manner that prevents bridging and particle-size segregation. Filter packs shall be installed by the tremie pipe method. At least two inches of filter pack material shall be installed between the screen and the borehole wall, and two feet of filter pack material shall extend above the top of the screen. A minimum of six inches and a maximum of two feet of filter pack material shall also be placed under the bottom of the screen. The precise volume of filter pack material required shall be calculated and recorded before placement, and the actual volume used shall be determined and recorded during construction. Any significant discrepancy between the calculated and actual volume shall be explained. Prior to installing the filter pack annular seal, a one to two-foot layer of chemically inert fine sand shall be placed over the filter pack to prevent the intrusion of annular sealants into the filter pack.

*4. Design and Construction of Annular Seals*

The annular space between the casing and the borehole wall shall be properly sealed to prevent cross-contamination. The materials used for annular sealants shall be chemically inert with respect to the highest anticipated concentration of chemical constituents expected in the groundwater. The precise volume of annular sealant required shall be calculated and recorded before placement, and the actual volume shall be determined and recorded during construction. Any significant discrepancy between the calculated volume and the actual volume shall be explained.

During construction, an annular seal shall be placed on top of the filter pack. This seal shall normally consist of a high solids (10 to 30 percent) bentonite material in the form of bentonite pellets, granular bentonite, or bentonite chips. The seal shall be placed in the annulus through a tremie pipe. A tamping device shall be used to ensure that the seal is emplaced at the proper depth. The bentonite seal shall be placed above the filter pack with a minimum of two-foot vertical thickness. The bentonite seal shall be allowed to completely hydrate in conformance with the manufacturer's specifications prior to installing the overlying annular grout seal. A grout seal shall be installed on top of the filter pack seal. The grout shall be placed into the annular space by the tremie pipe method, from the top of the filter pack annular seal to within a few feet of the ground surface; however, the grout shall be installed at intervals necessary to allow it time to cure and not damage the filter pack or filter pack annular seal during installation of the grout. The grout seal shall be allowed to cure for a minimum of 24 hours before the concrete surface pad is installed. All grouts shall be prepared in accordance with the manufacturer's specifications.

*5. Surface Completion Methods*

Monitoring wells may be completed either as flush-mounted wells, or as above-ground completions. A surface seal shall be installed over the grout seal and extended vertically up the well annulus to the land surface. The lower end of the surface seal shall extend a minimum of one foot below the frost line to prevent damage from frost heaving. The composition of the surface seal shall be neat cement or concrete. In above-ground completions wherein the well casing rises or sticks up above ground level, a three-foot square by four-inch thick concrete surface pad shall be installed around the well immediately after the protective casing is installed. The surface pad shall be sloped so that drainage will be off the pad and away from the protective casing. In addition, a minimum of one inch of the finished pad shall be below grade or ground elevation to prevent washing and undermining by soil erosion.

Protective casing with a locking cover shall be installed around the well casing (stickup or riser) to prevent damage or unauthorized entry. The protective casing shall be anchored in the concrete surface pad below the frost line and extend at least several inches above the casing stickup. A weep hole shall be drilled into the protective casing just above the top of the concrete surface pad to prevent water from accumulating and freezing inside the protective casing. A cap shall be placed on the well riser to prevent the entry of foreign materials into the well, and a lock shall be installed on the cover of the protective casing to provide security against tampering. If a well is located in an area that receives vehicular traffic, a minimum of three bumper guards consisting of steel pipes three to four inches in diameter and a minimum of five-feet in length shall be installed next to the concrete surface pad. The bumper guards shall be installed to a minimum depth of two feet below the ground surface in a concrete footing and extend a minimum of three feet above ground surface. The pipes that form the bumper guards shall be filled with concrete to provide additional strength, and shall be painted a bright color to make them readily visible.
If flush-mounted completions are required (e.g., in active roadway areas), a protective structure such as a traffic-rated utility vault or meter box shall be installed around the casing. In addition, measures should be taken to prevent the accumulation of surface water in the protective structure and around the well intake. These measures shall include outfitting the protective structure with a steel lid or manhole cover that has a rubber seal or gasket, and ensuring that the bond between the cement surface seal and the protective structure is watertight. A lock shall be installed on the lid or cover of the protective structure to prevent unauthorized access to the well.

*6. Well Development Methods*

All monitoring wells shall be developed to create an effective filter pack around the screen, correct damage to the formation caused by drilling, remove residual drilling mud or other drilling additives, if present, and fine particles from the formation near the borehole, and assist in restoring the original water quality of the aquifer in the vicinity of the well. Monitoring wells shall be developed until the column of water in each well is free of visible sediment, and the pH, temperature, turbidity, and specific conductance have stabilized to within 10%. If a well is pumped dry, the water level shall be allowed to sufficiently recover before the next development period is initiated.

If water is introduced to a borehole during drilling and completion, then at minimum the same volume of water shall be removed from the well during development. In addition, the volume of water withdrawn from or introduced into a well during development shall be recorded. Well development must be completed within 30 days of installation.

***4. Surveying Requirements for Groundwater Monitoring and Soil-Vapor Wells***

The horizontal and vertical coordinates of the measuring point at the top of each monitoring well casing and the ground surface elevation at each monitoring well location shall be determined by a registered New Mexico professional land surveyor or licensed Professional Engineer. Horizontal coordinates shall be measured in accordance with the State Plane Coordinate System. Horizontal positions shall be measured to the nearest 0.1 foot, and vertical elevations shall be measured to the nearest 0.01 foot.

***5. Well Completion Reports***

For each monitoring well, the Permittee shall submit to the NMED a completion summary report which shall include a well construction log and diagram, a geologic log, and a well development log. The report for each well shall be submitted in accordance with the quarterly schedule set forth in NMED's letter of June 4, 2010.

***6. Well Construction Diagrams and Logs***

Information on the design, construction, and development of each monitoring well shall be recorded. Construction diagrams and logs shall include the following information:

1. Well, boring name/number;
2. Date/time of construction;
3. Borehole diameter and casing diameter;
4. Surveyed location coordinates;
5. Total depth, expressed both as depth below ground surface and elevation above sea level;
6. Name of drilling contractor;
7. Casing length;
8. Casing materials;
9. Casing and screen joint type;
10. Screened intervals, expressed both as depth(s) below ground surface and elevation(s) above sea level;
11. Screen materials;
12. Screen slot size and design;
13. Filter-pack material and size;
14. Filter-pack volume (calculated and actual);
15. Filter-pack placement method;

16. Filter-pack interval(s), expressed both as depth(s) below ground surface and elevation(s) above sea level;
17. Annular sealant composition;
18. Annular sealant placement method;
19. Annular sealant volume (calculated and actual);
20. Annular sealant interval, expressed both as depth below ground surface and elevation above sea level;
21. Surface sealant composition;
22. Surface seal placement method;
23. Surface sealant volume (calculated and actual);
24. Surface sealant interval, expressed both as depth below ground surface and elevation above sea level;
25. Surface seal and well apron design and construction;
26. Development procedure and turbidity measurements;
27. Well development purge volume(s) and stabilization parameter measurements;
28. Type, design, and construction of protective casing;
29. Type of cap and lock;
30. Ground surface elevation above sea level;
31. Survey reference point elevation above sea level on well casing;
32. Top of casing elevation above sea level;
33. Top of protective steel casing elevation above sea level;
34. Drilling method(s); and
35. Types, quantities, and dates/times that additives were introduced, if any.

***7. Measurement of Groundwater Levels***

Groundwater levels shall be measured in all monitoring wells associated with the Bulk Fuels Facility Spill within 72 hours from the start of monitoring the water level in the first well. Groundwater levels shall be obtained prior to purging for any sampling event. Measurement data and the date and time of each measurement shall be recorded on a field log. The depth to groundwater shall be measured to the nearest 0.01 foot. The depth to groundwater shall be recorded relative to the surveyed well casing rim.

***8. Sampling of Environmental Media***

Sampling of environmental media (groundwater, soil, and soil vapor) shall comply with the requirements set forth in NMED's letter of June 4, 2010, and in accordance with the additional requirements provided herein.

*1. Soil Sampling Requirements*

Relatively undisturbed discrete soil and rock samples shall be obtained during the advancement of each boring for the purpose of logging and analytical testing. A split-barrel sampler lined with brass sleeves, a coring device, or other method approved in advance by the NMED shall be used to obtain samples during the drilling of each boring.

Soil samples are subject to the same field quality assurance, laboratory quality assurance, data validation, and reporting requirements as for groundwater and soil-vapor samples; including requirements to collect or prepare, as appropriate, and analyze field quality control samples. Soil samples collected for the purpose of analyzing for VOCs and SVOCs shall not be mixed to homogenize samples for any reason.

*2. Groundwater Sample Collection*

Groundwater samples shall be obtained within eight hours of the completion of well purging. Groundwater in monitoring wells with low recharge rates and that purge dry shall be sampled when the water level in the well has recovered sufficiently to collect the required samples. Sample collection methods shall be documented in field monitoring logs. Samples shall be placed into appropriate clean containers. Decontamination procedures shall be established and, implemented, for nondedicated water sampling equipment.

The Permittee shall obtain groundwater samples for dissolved metals analysis using disposable in-line filters with a 0.45 micron mesh size.

***9. Field Quality Control***

Field duplicates shall consist of two samples collected sequentially. Field duplicate samples shall be collected and analyzed at a frequency of at least 10 percent of the total number of environmental samples submitted for analysis. At a minimum, one duplicate sample per sampling event shall always be collected and analyzed.

Field blanks shall be prepared and analyzed at a frequency of no less than one per day. Field blanks shall be generated by filling sample containers in the field with deionized water and submitting the field blank, along with the groundwater samples, to an analytical laboratory.

Equipment blanks shall be prepared and analyzed at a rate of at least five percent of the total number of environmental samples submitted for analysis, but no less than one equipment blank per sampling day. Equipment blanks shall be generated by rinsing decontaminated sampling equipment with deionized water, and capturing the rinsate water in an appropriate clean container. The equipment blank then shall be submitted with the groundwater samples to the analytical laboratory for the same analyses as the environmental samples.

Trip blanks shall be prepared using deionized water. Trip blanks shall be managed exactly the same as environmental samples. Trip blanks shall accompany sampling personnel into the field

throughout sampling activities, and then shall be placed into a shipping container with environmental samples for shipment to the analytical laboratory. Trip blanks shall be analyzed at a frequency of one for each shipping container holding samples for VOC analysis.

***10. Laboratory Quality Assurance***

The Permittee shall ensure that contract analytical laboratories maintain internal quality assurance programs in accordance with EPA and industry-accepted practices and procedures. At a minimum, the laboratories shall use a combination of standards, blanks, surrogates, duplicates, matrix spike/matrix spike duplicates (MS/MSD), and other laboratory control samples to assess data quality. The laboratories shall establish control limits for individual chemicals or groups of chemicals based on the long-term performance of the test methods. In addition, the laboratories shall establish internal QA/QC procedures that meet EPA's laboratory certification requirements. Specific procedures to be completed are identified in the following sections. If a laboratory is unable or unwilling to meet the requirements of this Permit, the Permittee shall select a different laboratory that can and will meet the requirements.

*1. Laboratory Equipment Calibration Procedures*

The laboratories' equipment calibration procedures, calibration frequency, and calibration standards shall be in accordance with the EPA test method requirements and documented in quality assurance and standard operating procedures manuals. All instruments and equipment used by laboratories shall be operated, calibrated, and maintained according to manufacturers' guidelines and recommendations. Operation, calibration, and maintenance shall be performed by personnel who have been properly trained in these procedures. A routine schedule and record of instrument calibration and maintenance shall be kept on file at the laboratories.

*2. Laboratory QC Samples*

Analytical procedures shall be evaluated for quality by analyzing reagent blanks or method blanks, surrogates, MS/MSDs, and laboratory duplicates, as appropriate for each method. At a minimum, laboratories shall analyze laboratory blanks, MS/MSDs, and laboratory duplicates at a frequency of at least one in 20 for all batch runs requiring EPA test methods and at a frequency of at least one in 10 for non-EPA test methods. All laboratory quality control data reported with the Facility's sample analysis results must be related to the analysis of the Facility's samples.

***11. Data Validation***

The Permittee shall evaluate all sample data, and all field and laboratory QC results for acceptability. Each group of samples shall be evaluated using data validation guidelines contained in EPA guidance documents, the latest version of SW-846, and industry-accepted methods and procedures. Additionally, the Permittee shall evaluate all data for compliance with the following parameters:

1. Representativeness -- The Permittee shall implement procedures to assure representative samples are collected and analyzed, such as repeated measurements of the same parameter at the same location over several distinct sampling events. The Permittee shall note any procedures or variations that may affect the collection or analysis of representative samples and shall qualify the data accordingly;

2. Comparability -- To assure comparability of data, the Permittee shall implement standard collection and analytical procedures, and shall report analytical results in appropriate units for comparison with other data (e.g., past studies, comparable sites, screening levels, and cleanup standards). Any procedure or variation that may affect comparability shall be noted, and the data shall be qualified appropriately;

3. Completeness -- The Permittee shall evaluate all laboratory data for completeness with respect to data quality objectives. The degree of completeness shall be reported with the data in any reports in which the data are referenced;

4. Accuracy -- The Permittee shall evaluate all data for accuracy with respect to percent recovered of spiked samples. Results shall be reported for each analyte in any report in which the data are cited; and

5. Precision -- The Permittee shall evaluate all data for precision with respect to RPDs of duplicate samples. Results shall be reported for each analyte in any report in which the data are cited.

***12. Waste Management***

Waste management of investigation derived waste shall be in accordance with that set forth in Part 1 of this letter.

***13. Geophysical Logs***

Geophysical logging shall be conducted using induction (deep, medium), neutron, and gamma (large crystal) tools. Geophysical logging at cluster/nested well locations is required in only the well at each location that has the deepest screened interval.

Geophysical logs submitted to the NMED must show results of the induction logging (medium and deep) in millimhos per meter, neutron logging in American Petroleum Institute (API) neutron units, and gamma logging in API calibrated counts per second, the results of each method plotted versus depth from the surface to total depth of the borehole for which the log represents. The name of the borehole, location of the borehole, the date(s) that the borehole was completed, the drilling method, and the elevation of the top of the borehole shall also be noted on the boring log. The data must be provided to the NMED in hard copy and in digital format.

### *14. Field and Geologic Logs*

The physical characteristics of soil and rock samples, such as mineralogy and lithic content, ASTM soil classification, moisture content, texture, color, presence of stains or odors, field screening results, depth, location, method of sample collection, the presence of any water-bearing zones and any unusual or notable conditions encountered during drilling shall be recorded in a field log. Field logs shall be completed by a qualified geologist.

The Permittee shall prepare geologic logs for each borehole showing relative to borehole depth the rock types, thickness of rock units, and water bearing zones (including that at and below the water table). The name of the borehole, location of the borehole, the date(s) that the borehole was completed, the drilling method, and the elevation of the top of the borehole shall also be noted on the boring log. The data must be provided to the NMED in hard copy and in digital format.

### *15. Reporting*

Unless specified otherwise in this letter, the Permittee shall report to the NMED the information that is required by NMED's letter of June 4, 2010, and by the indicated schedules in that letter. Reporting for the additional SVE units required to be installed under Part 2 of this letter shall also be in accordance with NMED's letter of June 4, 2010.

## Final Direction

The Permittee shall meet the deadlines specified in the Compliance Schedule of Table 5 of this letter. The Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans must be completely revised and resubmitted. The Permittee shall submit to NMED by **September 7, 2010** (Table 5) revisions of the Vadose Zone, Interim Measures, and Groundwater Investigation Work Plans that correct the deficiencies noted herein and incorporate the requirements set forth in this letter. The Permittee shall also implement the interim measures and other actions as directed under Part 2 of this letter by the dates indicated and in accordance with the schedule in Table 5.

The investigation plans required under this letter shall include relevant maps and cross-sections that show concentration data for contaminants and other relevant information with supporting data posted on the maps and cross-sections in a legible manner, and clearly showing which borings/wells contributed data towards construction of the maps and cross-sections and which did not. Tables including all existing soil borings, soil-gas monitoring wells, and groundwater monitoring wells, listing their surveyed location, sampling points and maximum depth of exploration shall also be included in the reports and plans. For soil-gas monitoring wells, tables and graphs shall also be included providing trends of TPH concentrations versus time for the depths below ground surface of 25, 50, 150, 250, 350, and 450 feet.

To the extent any requirement of this letter requires access to property not owned or controlled by the Permittee, the Permittee shall use its best efforts to obtain access from the present owners of such property to conduct the required activities. In the event that access is not obtained when necessary, the Permittee shall immediately notify the NMED in writing regarding its best efforts and its failure to obtain such access.

**Table 5. Compliance Schedule.**

| **Revisions to Work Plans** | |
|---|---|
| Submittal | Due Date |
| Interim Measures Work Plan | September 7, 2010 |
| Vadose Zone Work Plan | September 7, 2010 |
| Groundwater Investigation Work Plan | September 7, 2010 |
| | |
| **Other Document Submittals** | |
| Indoor Air Quality Report | October 6, 2010 |
| | |
| **Interim Measures and other Actions** | |
| Install and operate SVE units at KAFB-3411, KAFB-10614, and KAFB-10624 | October 6, 2010 |
| Install and operate SVE units at soil boring/monitoring well locations #4, 5, 9, 10, 11, and 12 (see Table 1) | November 8, 2010 or 60 days after required access is granted, which ever is later |
| Install and operate SVE units at KAFB-10617 and KAFB-10618 | October 6, 2010 |
| Install and operate SVE units at soil boring/monitoring well location KAFB-10610 | November 8, 2010 or 60 days after required access is granted, which ever is later |
| Prepare for SVE operation at soil boring/monitoring well locations #3, 8, and 9 (see Table 2) | November 8, 2010 or 60 days after required access is granted, which ever is later |
| Operate SVE units at Fuel Offloading Rack and KAFB-1065, KAFB-1066, and KAFB-1068 | Immediately, except operation of SVE Unit at Fuel Offloading Rack may be temporarily suspended while excavating soil and removing remaining components of the Fuel Offloading Rack. |
| Maintain spare parts and spare engine for SVE units in inventory | September 7, 2010 |
| Report that spare parts and spare engine for SVE units is in inventory | October 6, 2010 |
| Begin excavation of contaminated soil and removing remaining components of the Fuel Offloading Rack. | October 6, 2010 |
| Complete excavation of contaminated soil and | October 6, 2011 |

| | |
|---|---|
| removing remaining components of the Fuel Offloading Rack. | |
| Report on completion of excavation of contaminated soil and removing remaining components of the Fuel Offloading Rack. | January 15, 2012 |
| Submit estimate of contaminant migration rate to NMED | September 7, 2010 |
| Complete A, B, and C sentry wells at location #28 (see Table 4) | November 8, 2010 or 90 days after required access is granted, which ever is later |
| Complete B and C sentry wells at KAFB-10613 and KAFB-1064 | November 8, 2010 or 90 days after required access is granted, which ever is later |
| Complete A, B, and C sentry wells at location #3 (see Table 4) | November 8, 2010 or 90 days after required access is granted, which ever is later |
| Complete A, B, and C sentry wells at location #1 (see Table 4) | November 8, 2010 or 90 days after required access is granted, which ever is later |
| Complete geologic logs of new wells at locations #1, 3, 28, KAFB-10613 and KAFB-1064 | During drilling of each well |
| Complete geophysical logs of new wells at locations #1, 3, 28, KAFB-10613 and KAFB-1064 | Within 30 days of well completion |
| Submit copies of geologic and geophysical logs for locations #1, 3, 28, KAFB-10613 and KAFB-1064 | In accordance with NMED letter of June 4, 2010 |
| Submit copies of geophysical logs of existing wells | October 6, 2010 |
| Submit critical data to NMED (Section A.7 of Part 2). | September 7, 2010 |
| Notification of sampling and other field activities (Section B.1 of Part 2) | No less than 15 days prior to implementation |
| Submit geologic and geophysical logs for sentry wells | In accordance with NMED letter of June 4, 2010 |
| Submit water quality data for WUA wells | In accordance with NMED letter of June 4, 2010 |
| Submit well completion reports | In accordance with NMED letter of June 4, 2010 |
| Submit report on all SVE units | In accordance with NMED letter of June 4, 2010 |
| Report to NMED if any SVE units will not receive an air emissions permit to operate | Immediately |
| Report to NMED down time of SVE units that will exceed a duration of 72 hours | Within 24 hours of discovery that repairs or maintenance will take more than 72 hours to complete |

The Permittee shall respond directly to my attention, with copy to Mr. Bill Olson of the NMED's Ground Water Quality Bureau, and Mr. William Moats (NMED HWB, 5500 San Antonio NE, Albuquerque, NM 87109), on all correspondence and required plans and reports related to the Bulk Fuels Facility Spill, unless otherwise directed by NMED. All submittals and correspondence must be submitted in hardcopy and electronic format.

If you have any questions regarding the technical aspects of this letter, please contact Mr. William Moats of my staff at (505) 222-9551. Any other questions should be directed to me at 505-476-6016.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

Enclosures: Figures 1-4

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
W. McDonald, NMED HWB
S. Brandwein, NMED HWB
B. Olsen, HWB GWQB
A. Puglisi, HWB GWQB
B. Swanson, HWB GWQB
L. Barnhart, NMED OGC
B. Gallegos, AEHD
B. Gastian, ABCWUA
L. King, EPA-Region 6 (6PD-N)
File: Reading and KAFB 2010

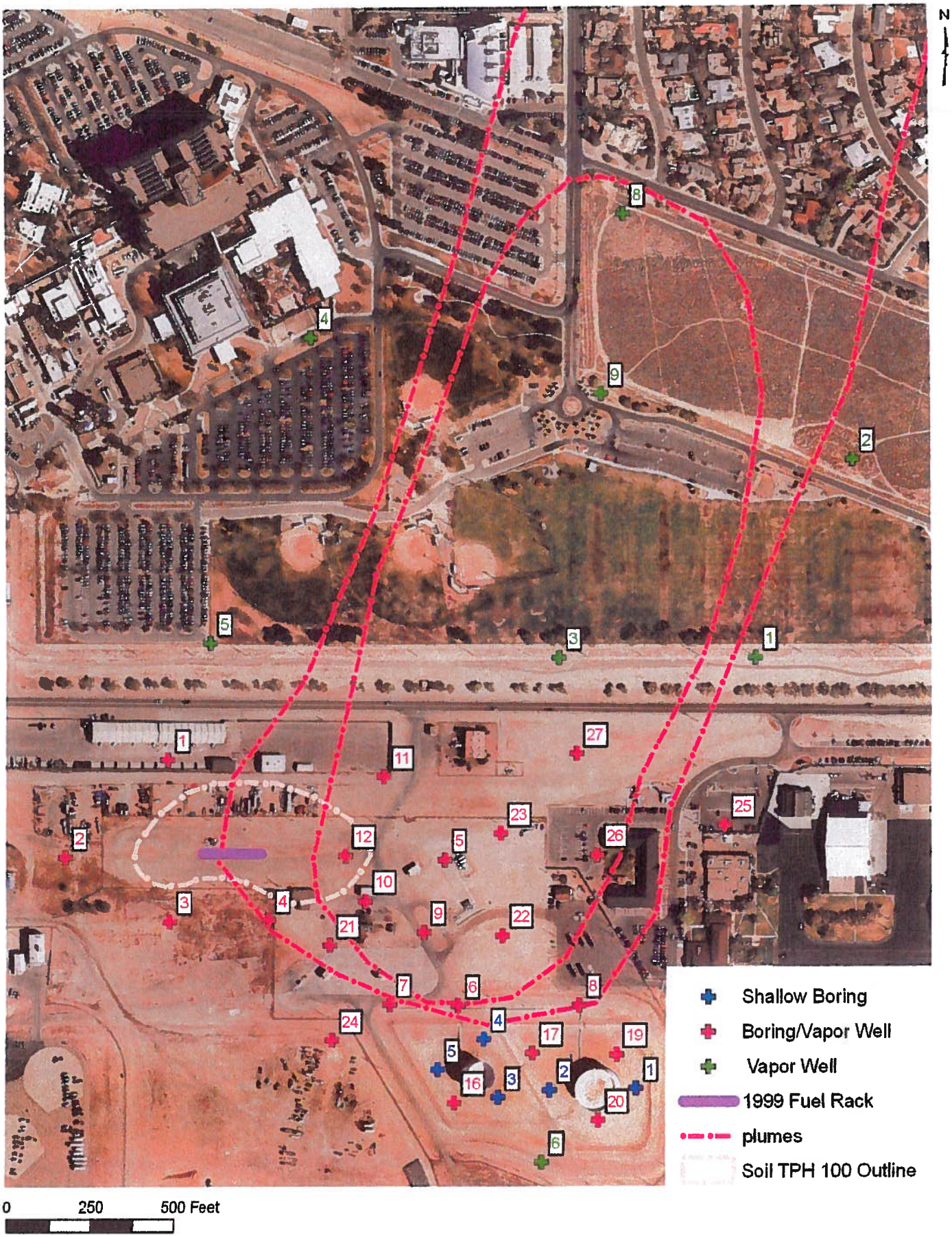


Figure 1. Soil Boring and
Soil-Vapor Monitoring Well Locations

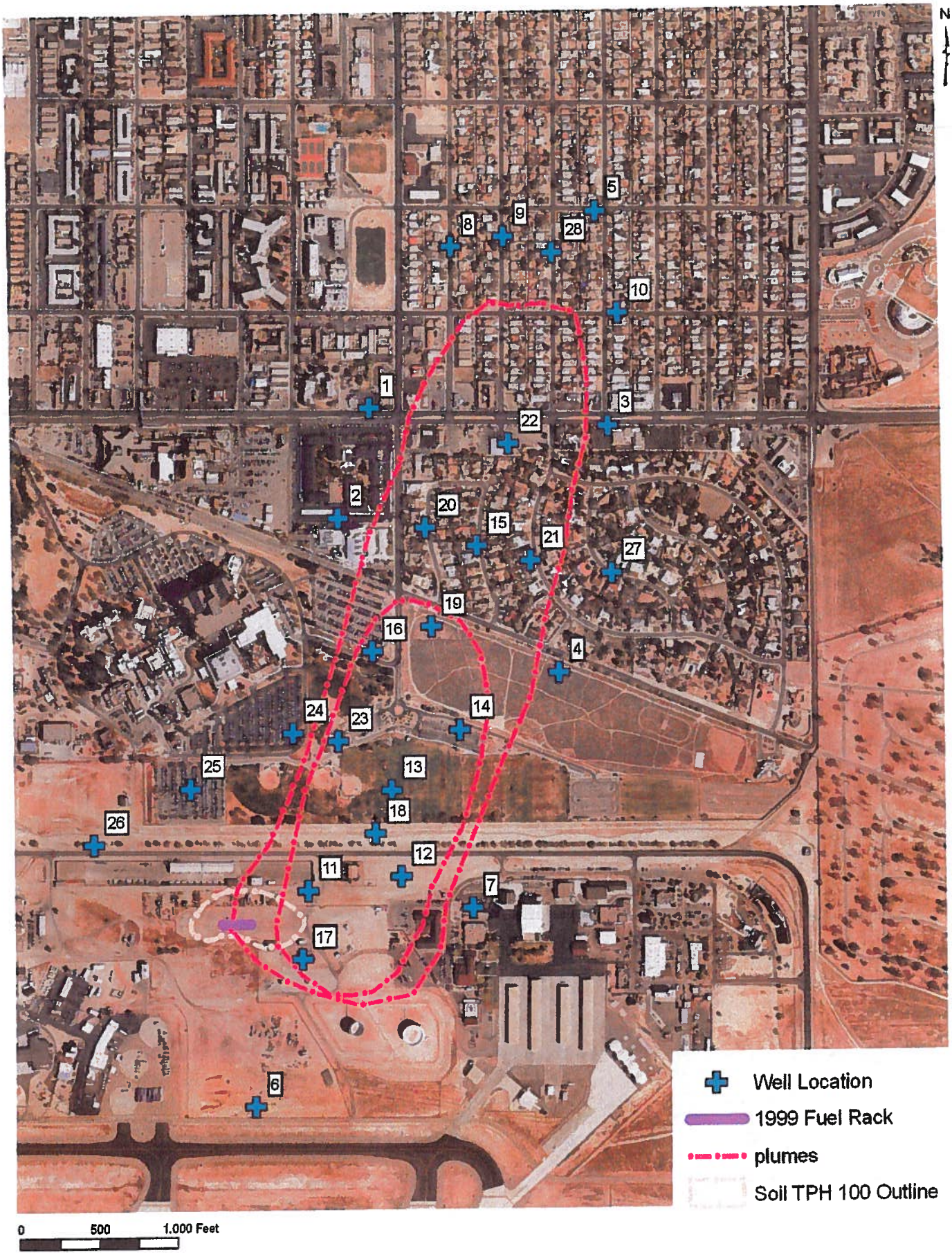


Figure 2. Groundwater Monitoring Well Locations

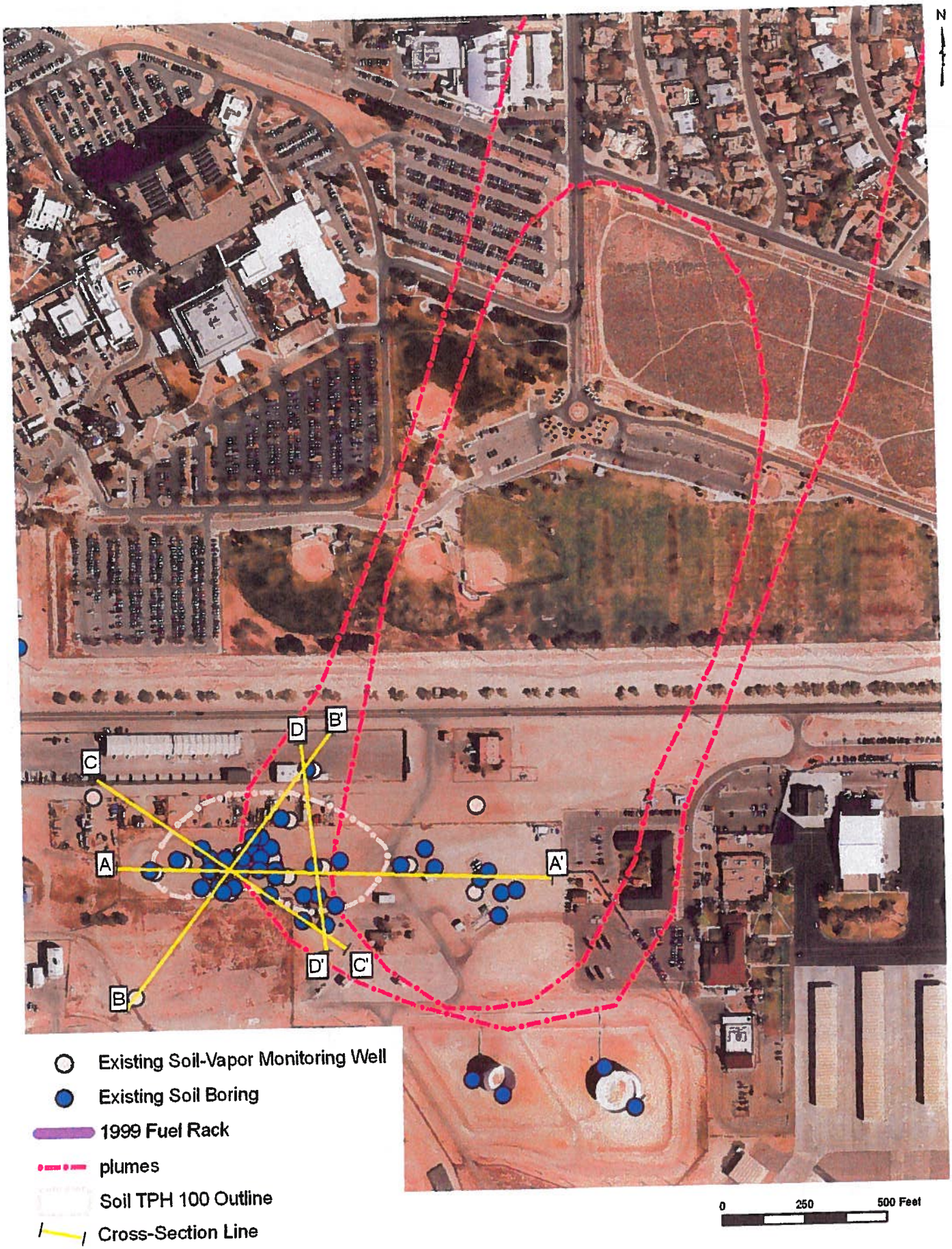


Figure 3 Existing Soil Boring, Soil-Vapor Monitoring Well and Cross-Section Locations

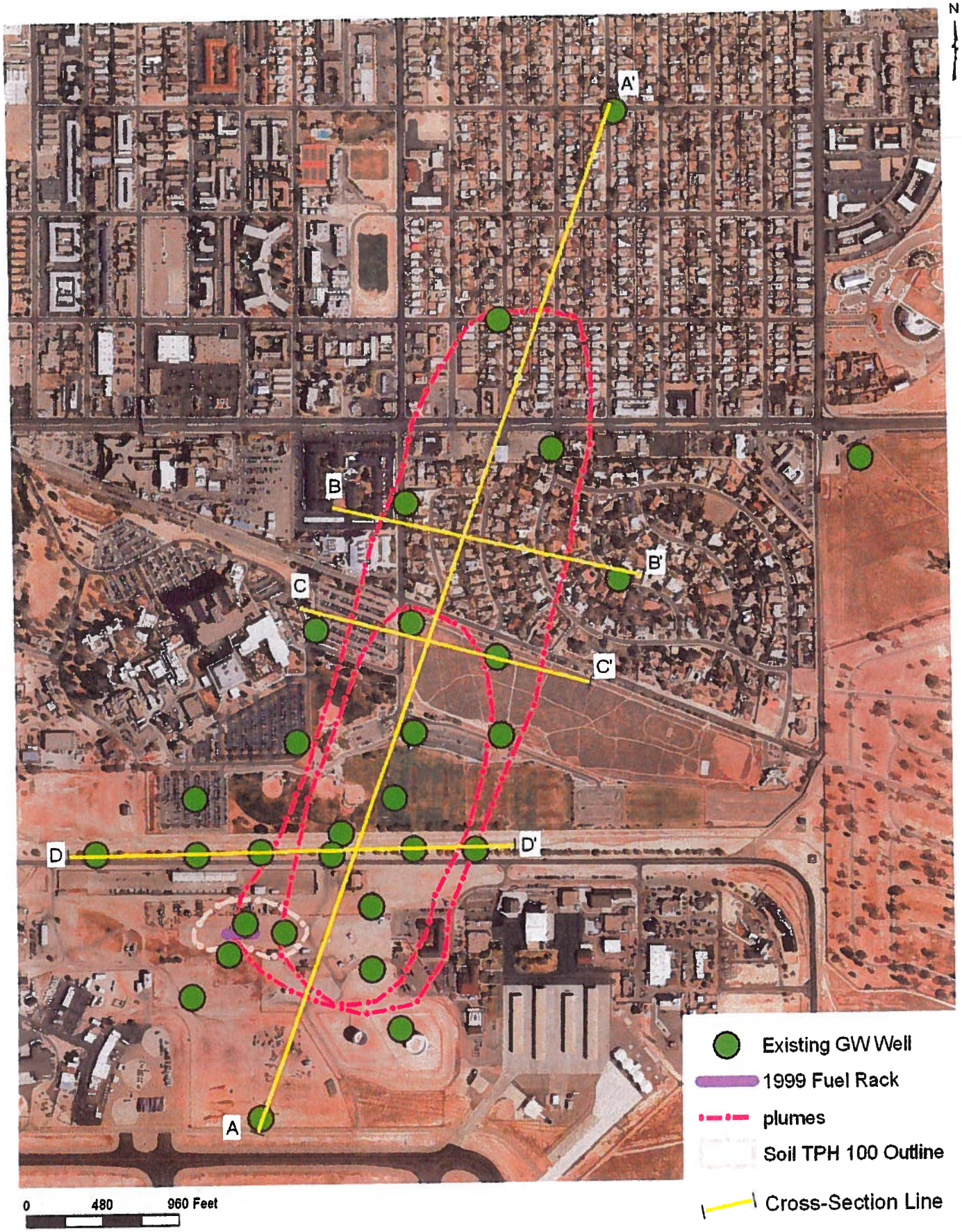


Figure 4. Existing Well and Cross-Section Locations

# ATTACHMENT 3

## June 4, 2010 Correspondence from the NMED HWB to Colonel Robert L. Maness, Base Commander, 377 ABW/CC and Mr. John Pike, Director, Environmental Management Section, 377 MSG/CEANR

## Re: Reporting, Sampling and Analysis Requirements, Solid Waste Management Units ST-I06 AND SS-111, Bulk Fuels Facility Spill, Kirtland AFB

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AR Doc # 3459

CEANR

# NEW MEXICO ENVIRONMENT DEPARTMENT

## *Hazardous Waste Bureau*


BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

**2905 Rodeo Park Drive East, Building 1**
**Santa Fe, New Mexico 87505-6303**
**Phone (505) 476-6000 Fax (505) 476-6030**
***www.nmenv.state.nm.us***

RON CURRY
Secretary

SARAH COTTRELL
Deputy Secretary


**CERTIFIED MAIL - RETURN RECEIPT REQUESTED**

June 4, 2010

Colonel Robert L. Maness
Base Commander
377 ABW/CC
2000 Wyoming Blvd. SE
Kirtland AFB, NM 87117-5606

Mr. John Pike
Director, Environmental Management Section
377 MSG/CEANR
2050 Wyoming Blvd., Suite 116
Kirtland AFB, NM 87117-5270

**RE: REPORTING, SAMPLING, AND ANALYSIS REQUIREMENTS SOLID WASTE MANAGEMENT UNITS ST-106 AND SS-111**
**BULK FUELS FACILITY SPILL**
**KIRTLAND AIR FORCE BASE, EPA ID# NM9570024423**
**HWB-KAFB-10-004**

Dear Colonel Maness and Mr. Pike:

This letter sets forth reporting, sampling, and analysis requirements related to the characterization and remediation of contaminated groundwater at the U. S. Air Force Kirtland Air Force Base ("Permittee") Solid Waste Management Units ST-106 and SS-111, collectively known as the Bulk Fuels Facility Spill. In the past, the Permittee has submitted semiannual reports concerning the Bulk Fuels Facility Spill to the New Mexico Environment Department (NMED) Groundwater Quality Bureau. However, due to the severity and urgency of this matter, NMED directs that reporting occur on a more frequent basis. This letter describes how the Permittee must submit reports to the NMED from this time forward. In addition, this letter also sets forth general sampling and analysis requirements to ensure that groundwater and soil-gas data are of high quality and representative of the conditions present in the field.

**Reporting Requirements**

All characterization and remediation activities and data concerning the Bulk Fuels Facility Spill that have been completed or acquired during the last semiannual reporting period (October 2009 through March 31, 2010) are to be reported to the NMED no later

than June 30, 2010.

After June 30, 2010, quarterly reports must be submitted by the Permittee to the NMED for its review and approval. Quarterly reporting shall continue until such time that corrective action is deemed complete for the Bulk Fuels Facility Spill by the NMED, or until NMED approves in writing a different schedule.

Quarterly periods for each year and the due dates for corresponding quarterly reports are summarized in the following table.

| **Quarter** | **Period** | **Due Date of Quarterly Report** |
|---|---|---|
| 1 | January 1 through March 31 | May 30 |
| 2 | April 1 through June 30 | August 29 |
| 3 | July 1 through September 30 | November 29 |
| 4 | October 1 through December 31 | February 28 of the following year |

Each quarterly report shall provide detailed information on all characterization and remediation activities that took place during the period covered by the report, including, but not limited to, as applicable for the reporting period, field and laboratory analytical results for groundwater, soil, and soil gas; graphs showing trends of major contaminants versus time, a table of surveyed well locations; descriptions of the installation of groundwater and soil-gas monitoring wells; measurements of light non-aqueous phase liquid (LNAPL); table of water levels; water-level map; plume contaminant maps and cross-sections; and geologic and geophysical logs of wells and boreholes. Each quarterly report shall also describe the operation, maintenance, and performance of the four soil-vapor extraction (SVE) systems. Each quarterly report shall also include all field and laboratory quality control data for the reporting period and a discussion of data quality as it relates to accuracy, precision, representativeness, and completeness for each analytical parameter that is to be reported.

In addition to the above reporting requirements, the NMED may require submission of data at any time. The Permittee will be notified in writing of any such required submissions and their associated submission due dates.

Also, pursuant to 20.4.1.900 NMAC (incorporating 40 C.F.R. § 270.11(d)(1)), all quarterly reports shall include a certification, signed by a chief or senior executive officer of the Facility, stating:

> 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 fine and imprisonment for knowing violations.

**General Sampling and Analysis Requirements**

Groundwater and soil-gas monitoring shall be conducted on a quarterly basis with all groundwater and soil-gas monitoring wells sampled each quarter. Sample collection and analysis must be conducted in manner that yields results of high quality and are representative of the conditions of their respective media in the field. Field quality control samples, including duplicates, field blanks, equipment rinsate blanks, and trip blanks shall be collected or prepared as appropriate and analyzed for quality control purposes. Chain-of-custody and proper shipping and handling procedures shall be followed to ensure the integrity of samples.

At a minimum, groundwater shall be sampled and analyzed in a laboratory for volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), lead, major ions (calcium, magnesium, potassium, sodium, sulfate, carbonate, bicarbonate, chloride), nitrate, ammonia, sulfide, dissolved iron, and dissolved manganese. Except for sample fractions taken for dissolved iron and manganese, groundwater samples shall not be filtered. Groundwater shall also be sampled and analyzed in the field for temperature, pH, specific conductance, alkalinity, turbidity, dissolved oxygen, and Eh.

Groundwater samples shall be obtained from a well only after temperature, pH, and specific conductance measurements have stabilized within ±10% for three consecutive measurements and after purging at least one well-bore volume of stagnant water. A well-bore volume is herein defined as the volume of water in the saturated filter pack plus the volume of all standing water within the well screen and casing, including the sump. Field measurements taken during purging, including purge volumes and the date and time of each measurement, and the type and serial number of each field instrument used shall be recorded in a log book. The thickness of LNAPL shall be measured and recorded for every well location where LNAPL is present.

The detection limit for each groundwater constituent shall not exceed 50% of the constituent's U. S. Environmental Protection Agency's Maximum Concentration Level or its New Mexico Water Quality Control Commission standard (20.6.2.3103 NMAC), whichever is more stringent. For naturally occurring groundwater constituents, the detection limit for a given constituent shall also not exceed the constituent's background concentration as approved by the NMED for the KAFB area.

Soil-gas samples shall be collected from all monitoring intervals (all depths) for each soil-gas monitoring well. At a minimum, soil gas shall be sampled and analyzed in a laboratory for VOCs. The Permittee shall continually monitor the concentrations of soil vapor with an appropriate field instrument (e.g., photoionization detector of appropriate lamp energy) while purging. The Permittee shall collect soil-gas samples only after field instrument readings have stabilized within ±10% for three consecutive measurements and after the sampling tubing and the soil-gas monitoring well have been purged to remove all stagnant vapor. Soil-gas measurements taken in the field during purging, the date and time of each measurement, and the type and serial number of field instrument used shall be recorded in a log book.

The reporting and sampling and analysis requirements set forth in this letter are in effect, until and unless superseded by subsequent direction in an approved work plan or implementation plan.

If you have any questions concerning the technical matters in this letter, you may contact William McDonald or Sid Brandwein of my staff at (505) 222-9582 and (505) 222-9504, respectively. If you have other questions, you may contact me directly at 505-476-6000.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: M. Leavitt, Director, NMED WWMD
J. Kieling, NMED HWB
W. Moats, NMED HWB
B. McDonald, NMED HWB
S. Brandwein, NMED HWB
B. Olsen, HWB GWQB
A. Puglisi, HWB GWQB
B. Swanson, HWB GWQB
L. Barnhart, NMED OGC
B. Gallegos, AEHD
B. Gastian, ABCWUA
L. King, EPA-Region 6
File: Reading and KAFB 2010
KAFB-10-004

# ATTACHMENT 4

## December 10, 2010 Correspondence from the NMED HWB to Colonel Robert L. Maness, Base Commander, 377 ABW/CC and Mr. John Pike, Director, Environmental Management Section, 377 MSG/CEANR

## Re: Bulk Fuels Facility Spill (SWMUS ST-106 and SS-111), Notice of Partial Approval with Modification and Notice of Disapproval, Interim Measures, Vadose Zone, and Groundwater Investigation Work Plans, HWB-KAFB-10-015, HWB-KAFB-10-016, HWB-KAFB-10-019

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# NEW MEXICO ENVIRONMENT DEPARTMENT

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Deputy Secretary


**CERTIFIED MAIL - RETURN RECEIPT REQUESTED**

December 10, 2010

Colonel Robert L. Maness
Base Commander
377 ABW/CC
2000 Wyoming Blvd. SE
Kirtland AFB, NM 87117-5606

Mr. John Pike
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377 MSG/CEANR
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**RE: BULK FUELS FACILITY SPILL (SWMUS ST-106 AND SS-111)**
**NOTICE OF PARTIAL APPROVAL WITH MODIFICATIONS AND NOTICE OF DISAPPROVAL**
**INTERIM MEASURES, VADOSE ZONE, AND GROUNDWATER INVESTIGATION WORK PLANS, NOVEMBER 2010**
**KIRTLAND AIR FORCE BASE, EPA ID# NM9570024423**
**HWB-KAFB-10-015, HWB-KAFB-10-016, HWB-KAFB-10-019**

Dear Col. Maness and Mr. Pike:

The New Mexico Environment Department (NMED) has reviewed the revised Interim Measures, Vadose Zone, and Groundwater Investigation Work Plans, concerning the Kirtland Air Force Base (KAFB) Bulk Fuels Facility Spill, Solid Waste Management Units (SWMUs) ST-106 and SS-111. The revised plans were submitted November 4, 2010, in response to the NMED's Notice of Disapproval (NOD) issued August 6, 2010.

NMED finds the plans to be deficient, and provides the following comments. However, NMED must also ensure that commencement of the vadose zone and groundwater investigations and interim measures not be further delayed. NMED is therefore partially approving with modifications the Work Plans in accordance with Permit Part 1.38 of the Permittee's Hazardous Waste Operating Permit (Permit), issued July 15, 2010. Those aspects of the Work Plans that are approved with modifications are addressed in Part 1 of this letter. Under Part 1 of this letter, the Permittee must conduct certain activities to

begin the investigation of the vadose zone and groundwater at the Bulk Fuels Facility immediately, and to conduct interim measures at the former Fuel Offloading Rack, prior to approval of the remainder of the Work Plans. These activities are to be conducted as described in this letter, and without delay. The work to be conducted under Part 1 must also be included in the revised Work Plans even if the Permittee believes that such work has been completed when it submits the revised Work Plans for approval. NMED reserves the right to require the Permittee to correct work completed under Part 1 that does not meet the corrective action requirements of Permit Part 6 or the modifications specified in this letter for such work.

Part 2 of this letter concerns those aspects of the Work Plans that are disapproved. The Permittee is further directed, in Part 2 of this letter, to make additional revisions to the three Work Plans, which are necessary before NMED can approve the plans.

## PART 1
## PARTIAL APPROVAL WITH MODIFICATIONS

The Permittee must begin immediate investigation of the vadose zone and groundwater in accordance with the corrective action requirements of Permit Part 6, and with the modifications to the three Work Plans that are specified in this letter. The Permittee shall also complete the removal of the former Fuel Offloading Rack and the excavation of contaminated soil exceeding NMED Soil Screening Levels (SSLs).

### A. Installation of New Groundwater Monitoring Wells

NMED approves the well installations as described in the revised Groundwater Investigation Work Plan submitted November 4, 2010 with the following modifications. The Permittee shall therefore immediately commence installation of the 78 groundwater monitoring wells provided for in Section 5.2.4 of the revised Groundwater Investigation Work Plan. The installation of the wells shall be completed by **April 28, 2011** (Appendix B of the Groundwater Investigation Work Plan).

Because steel well screens and casing would render most of the geophysical logs useless the Permittee must use polyvinyl chloride (PVC) screens and casing for the deep wells. The Permittee may substitute PVC screens and casing for the intermediate-depth wells, and may use PVC screens and casing for wells screened across the water table at locations where LNAPL is not present.

Section 5.2.4.1 of the Groundwater Investigation Work Plan, *Monitoring Well Installation Procedures*, item #6 states that three PVC centralizers would be used in well construction, one installed directly above and one below the well screen and one installed at the midpoint of the well. In lieu of a centralizer installed at the midpoint, the Permittees shall install PVC centralizers approximately every 100 feet between the top of screen and the ground surface.

The borehole of each well shall be logged in accordance with Permit Part 6.5.15 by a registered professional geologist.

Screen lengths for wells shall not exceed 15 feet, with the exception that wells screened across the water table shall have screens 20 feet long, with no more than 15 feet of screen length situated below the water table.

Each of the new wells shall be developed pursuant to Permit Part 6.5.17.10.6. Pursuant to Permit Part 6.5.17.3, initial groundwater samples shall be obtained from newly-installed monitoring wells within 30 days after completion of well development. Groundwater sampling and reporting requirements shall be conducted as directed in NMED's letter of June 4, 2010, and as specified in Permit Part 6.5.17.5.

## B. Development of Existing Wells

In NMED's letter of April 2, 2010, the Permittee was directed to develop all existing wells located within the LNAPL plume, and to make such wells available to sample groundwater below the floating LNAPL so that concentrations of dissolved-phase contaminants can be assessed in this area. This work was to be completed by July 6, 2010. The Permittee failed to complete this work. Furthermore, the revised Groundwater Investigation Work Plan does not contain any provisions for developing the existing wells within the LNAPL plume.

NMED is again directing the Permittee to develop all existing wells located within the LNAPL plume, and to make such wells available to sample groundwater. Well development shall be conducted in accordance with Permit Part 6.5.17.10.6. The work must be completed no later than **February 15, 2011**.

## C. Geophysical Logging of Existing Wells

In the August 6, 2010, NOD, the Permittee was directed to conduct borehole geophysical logging (medium and deep induction, gamma, and neutron) at all existing groundwater monitoring wells, and to submit copies of the geophysical logs to the NMED by October 6, 2010. The Permittee failed to complete this work on time, but provides for the geophysical logging of existing wells in the revised Groundwater Investigation Work Plan.

NMED approves the Permittee's proposal to conduct borehole geophysical logging (medium and deep induction, gamma, and neutron) at all existing groundwater monitoring wells. Copies of the logs must be submitted to the NMED by no later than **February 15, 2011**.

## D. Completion of Soil Borings

NMED approves the projects in Sections D and E of this letter as described in the revised Vadose Zone Investigation Work Plan submitted November 4, 2010 with the following modifications The Permittee shall immediately complete the 35 deep and 5 shallow soil borings provided for in Section 5.2.10 of the revised Vadose Zone Investigation Work Plan. The work shall be completed by **February 11, 2011**(Appendix B of the Vadose Zone Investigation Work Plan). Each deep boring at each location shall be drilled from the surface to the water table.

Soil samples from the deep borings shall be collected at a frequency of at least one sample every 10 feet for the first 50 feet, and at least one sample thereafter every 50 feet to total depth, and at least one sample at total depth in each boring. The soil samples shall be analyzed for TPH, VOCs, SVOCs, and lead.

Soil samples from shallow borings shall be collected at depths of 0, 5, 10, 15, and 20 feet and shall be analyzed for TPH, VOCs, SVOCs, and lead.

Each soil boring shall be logged in accordance with Permit Part 6.5.15 by a registered professional geologist.

## E. Installation of New Soil-Gas Monitoring Wells

The Permittee shall immediately install the 35 soil-gas monitoring wells provided for in Section 5.2.11 of the revised Vadose Zone Investigation Work Plan submitted November 4, 2010. The well installations shall be completed by **February 11, 2011** (Appendix B of the Vadose Zone Investigation Work Plan).

The soil-gas monitoring wells shall be capable of yielding discrete samples of soil gas recovered from depths of 25, 50, 150, 250, 350, and 450 feet below the ground surface.

The borehole of each well shall be logged in accordance with Permit Part 6.5.15 by a professional geologist.

Vapor sampling and reporting requirements shall be conducted as directed in NMED's letter of June 4, 2010.

## F. Geophysical Logging of New Groundwater and Soil-Vapor Wells

NMED approves the Permittee's proposal to conduct borehole geophysical logging (medium and deep induction, gamma, and neutron) at all new groundwater and soil-vapor monitoring wells. Copies of the logs must be submitted to the NMED by no later than **June 1, 2011**.

## G. Interim Measures at Former Fuel Offloading Rack

The NOD issued August 6, 2010, specified that the Permittee begin removal of the remaining components of the former Fuel Offloading Rack and excavation of contaminated soil exceeding NMED SSLs to 20 feet (SSLs shall be those based on residential land use) by October 6, 2010. The Permittee was also instructed that laboratory analysis of soil samples shall be conducted to determine the concentrations of hazardous constituents for the purpose of defining the final extent of excavation, for risk assessment, and for waste determination. NMED approves the Permittee's proposal for sample analysis, with the following modification: Soil samples shall be analyzed in the laboratory for TPH, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and lead, and collected on all sides and the bottom of the excavation at a spacing not to exceed 25 feet. Additionally, the excavation of soil and removal of the former Fuel Offloading Rack shall be completed by October 6, 2011, and a report on completion of the work submitted to the NMED by January 15, 2012.

NMED approves the Permittee's soil sampling plan except as modified below. Section 4.5.2 of the Interim Measures Work Plan, *FFOR Soil Investigation and Sampling*, indicates that the direct-push technology (DPT) samples are to be collected at the former Fuel Offloading Rack (FFOR) and along the remaining aboveground and underground piping on 25-ft centers. The Permittee does not adequately describe the locations of the samples nor are the locations individually depicted on Figure 4-2. No additional sampling is proposed for the known three locations of pipeline leaks, which occurred approximately 18 ft, 150 ft, and 200 ft from the west end of FFOR.

For underground piping from Building 1033 (Pump House) to its terminus at the west end of the FFOR, the Permittee shall instead collect soil samples on 10-ft centers along a line oriented directly over what was once the centerline of the now-excavated pipeline (hereafter referred to as the former pipe centerline). Soil samples shall also be collected at locations spaced no further than 10 ft apart along two lines oriented parallel to the former pipe centerline, with the two lines situated no further than 5 ft from and on opposite sides of the former pipe centerline. Sampling shall also be conducted directly beneath each of the three known leak locations.

At each of the three known leak locations, sampling shall be increased by collecting soil samples at 5 ft by 5 ft grid nodes.

At each sampling location, soil samples shall be collected at depths of 0, 5, 10, 15, and 20 feet.

If lead, VOCs, or SVOCs are detected in soil at concentrations exceeding the NMED SSLs at a given location, the soil at the location shall be excavated, removed from the site, and properly disposed of. The Permittee shall also increase the sampling grid at the location by using the same method as directed above for sampling the three known leak locations, and collect and analyze the additional samples. Expansion of sampling and the collection and analysis of additional samples shall continue until all soil containing VOCs, SVOCs, or lead at concentrations exceeding the NMED SSLs have been excavated.

Section 4.5.2.1, Bullet 4, of the Work Plan states "The field Geologist will collect samples for laboratory analysis that appear to contain the greatest degree of contamination based on visual observation and headspace VOC screening...", suggesting that not all samples will be submitted to the laboratory for analysis. Because headspace analysis will not detect lead and may not detect SVOCs, all soil samples must be submitted to the laboratory for analysis.

Confirmation samples are samples collected to verify that all contaminated soil with concentrations of hazardous constituents exceeding the NMED SSLs has been excavated and removed. In Section 4.5.3.6, *Confirmation Sampling*, the Interim Measures Work Plan indicates that confirmation samples will not be collected from the sidewalls of the excavation. In contrast, the Interim Measures Work Plan in Section 4.5.1 indicates that sidewalls will be sampled for confirmation.

Confirmation samples must be collected from the bottom and sides of all excavations at intervals not to exceed 25 feet. This includes any areas excavated to depths of 20 ft. The Permittee can collect sidewall conformation samples ahead of, behind, or through shoring via portholes cut through the shoring.

Excavation of contaminated soil at the former Fuel Offloading Rack must be completed by **October 6, 2011**.

## H. Piping From Building 1033 to Tanks

NMED approves the Permittee's soil sampling plan, except as modified below. The Permittee must excavate to a depth of up to 20 feet any contaminated soil exceeding NMED SSLs that occurs along the piping from Building 1033 to the jet-fuel fuel storage tanks. In lieu of what the Permittee proposed, for the underground and aboveground piping from Building 1033 to the jet-fuel storage tanks, the Permittee shall collect soil samples at locations spaced no further than 20 ft apart along two lines oriented parallel to the pipe centerline, with the two lines situated no further than 5 ft from and on opposite sides of the pipeline. Soil samples shall be collected at depths of 0, 5, 10, 15, and 20 feet and shall be analyzed in the laboratory for TPH, VOCs, SVOCs, and lead.

If lead, VOCs, or SVOCs are detected in soil at concentrations exceeding the NMED SSLs at a given location, the soil at the location shall be excavated and removed from the site for proper disposal. The Permittee shall also increase sampling at the location by using the same method as directed above for sampling the three known leak locations at the former Fuel Offloading Rack, and collect and analyze the additional samples. Expansion of the sampling and the collection and analysis of additional samples shall continue until all soil containing VOCs, SVOCs, or lead at concentrations exceeding the NMED SSLs are excavated and removed from the site for disposal.

Section 4.5.2.1, Bullet 4, of the Work Plan states "The field Geologist will collect samples for laboratory analysis that appear to contain the greatest degree of contamination based on visual

observation and headspace VOC screening...", suggesting that not all samples will be submitted to the laboratory for analysis. Because headspace analysis will not detect lead and may not detect SVOCs, all soil samples shall be submitted to the laboratory for analysis.

Confirmation samples must be collected from the bottom and sides of all excavations at intervals not to exceed 25 feet. This includes any areas excavated to depths of 20 ft. The Permittee can collect sidewall conformation samples ahead of, behind, or through shoring via portholes cut through the shoring.

Sampling along the pipeline from Building 1033 to the storage tanks shall be completed by **March 7, 2011**.

## I. Soil-Vapor Extraction

In the August 6, 2010, NOD, the Permittee was directed to install and operate additional SVE units, or prepare for SVE operations at the following 16 locations: existing groundwater monitoring wells KAFB-3411, KAFB-10614, KAFB-10624, KAFB-10617, KAFB-10618, and KAFB-10610, at soil boring/soil-vapor monitoring well locations # 4, 5, 9, 10, 11, 12, and 21 listed in Table 1 of the NOD, and soil-vapor monitoring well locations #3, 8 and 9 on Table 2 of the NOD. The Permittee did not accomplish this work, and did not propose any alterative work for NMED to consider. Furthermore, the Permittee has not done anything in the past four months to accelerate the reduction of the soil-vapor mass in the vadose zone at the Bulk Fuels Facility.

Nevertheless, NMED has reconsidered its earlier position to expand the number of SVE Units. Instead of expanding the number of operating SVE Units, the Permittee is directed to prepare the locations of existing groundwater monitoring wells KAFB-3411, KAFB-10614, KAFB-10624, KAFB-10617, KAFB-10618, and KAFB-10610 for conducting SVE by no later than **February 15, 2011**. The Permittee is also directed to prepare an SVE Optimization Plan for the four existing SVE Units, with the concept that the four SVE units will be moved periodically between the six aforementioned locations and the four locations where SVE is currently conducted to maximize the removal of contaminants (by mass) via vapor extraction. Furthermore, the Permittee must propose in the SVE Optimization Plan alternative technologies for the removal and treatment of soil-vapor contamination that do not rely on the use of internal combustion engines. The SVE Optimization Plan must be submitted to NMED by **March 31, 2011**.

## J. Special Tests under Interim Measures Work Plan

NMED approves the ROI, hydrocarbon baildown, and Pneulog tests. The Permittee shall conduct the Radius of Influence, the Hydrocarbon Baildown, and PneuLog tests by **April 6, 2011**; **March 2, 2011;** and **December 21, 2011**, respectively.

## K. Collection of LNAPL Sample

The Permittee shall collect a sample of LNAPL from one of the groundwater monitoring wells within the LNAPL plume and provide the sample to the Scientific Laboratory Division (SLD) of the New Mexico Department of Health by no later than **March 31, 2011**. The Permittee shall notify the NMED in writing of the delivery of the LNAPL sample to the SLD no later than **1 business day** following delivery of the sample.

The Permittee is directed to conduct all activities required in Part 1 of this letter in accordance with the terms described in each section of this letter and to resubmit the Work Plans with the required revisions along with the changes required by Part 2 of this letter. Any portion of a Work Plan that was not specifically approved and modified as described above is disapproved and must be corrected as described in Part 2.

# PART 2
# PORTIONS OF WORK PLANS THAT ARE DISAPPROVED

## A. Deficiencies Common to All Three Plans

1. Part 1, A.7 of the NOD issued on August 6, 2010, required that the Permittee list the data gaps that apply to each of the three plans, as appropriate for the topic of a plan. The Permittee was also instructed to revise the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans to include a description of at least the data gaps identified by the NMED and point specifically to where in each of the documents the data gaps are addressed.

This deficiency was not corrected in any of the revised Work Plans submitted on November 4, 2010. The NMED is directing the Permittee again to revise the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans to include a description of the data gaps identified by the NMED and point specifically to where the data gaps are addressed in each of the documents.

2. Part 1, A.9 of the NOD issued on August 6, 2010, required that the Permittee include a site conceptual model encompassing the source area(s), the fuel percolation area, the light non-aqueous phased liquid (LNAPL) plume floating on groundwater, and the dissolved-phase contaminant plume in groundwater in each of the plans. However, none of the revised Work Plans contains a site conceptual model. Instead, the issue was addressed under the Work Plans by stating that a model will be provided later by the Permittee.

The NMED is directing the Permittee again to revise the Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans to include a site conceptual model encompassing the source area(s), the fuel percolation area, the light non-aqueous phased liquid (LNAPL) plume floating on groundwater, and the dissolved-phase contaminant plume in groundwater in each of the plans. The model should be illustrated through the liberal use of detailed, accurate, and scaled geologic cross-sections, maps in plan view, and any other necessary graphical

representations to clearly and accurately show geologic and hydrologic features, and contaminant levels. NMED invites the Permittee to meet to discuss NMED's expectations with respect to the conceptual model and graphic representation of data.

3. Part 1, A.10 of the NOD issued on August 6, 2010, required that the Permittee meet Section E of the NMED's letter of April 2, 2010, which directed that investigation plans are to include relevant maps and cross-sections that show concentration data for contaminants and other relevant information with supporting data posted on the maps and cross-sections, and clearly show which borings/wells contributed data towards construction of the maps and cross-sections and which did not. Additionally, tables including all existing soil borings, soil-gas monitoring wells, and groundwater monitoring wells, listing their surveyed location, sampling points and maximum depth of exploration were also to be included in the plans. For soil-gas monitoring wells, tables and graphs were also to be included providing trends of TPH concentration versus time for the depths below ground surface of 25, 50, 150, 250, 350, and 450 feet.

The required maps, cross-sections, tables, and graphs were not included in the Work Plans submitted November 4, 2010. Revise the Work Plans accordingly.

4. Appendix E, Uniform *Federal Policy-Quality Assurance Project Plan* – This plan is incorporated into the Vadose Zone Investigation, Groundwater Investigation, and Interim Measures Work Plans. The plan, as written, appears to be a combination of many types of plans, such as project management, training, data validation, quality assurance, and sampling and analysis plans. Additionally, much of the information presented appears to be overly burdensome and not particularly useful in the present format. For example, a tabulated listing of field quality control samples to be collected for every quarter/year is unnecessary as the types and frequencies of such samples are not likely to change every quarter or even every year. Listings of quality control targets (in particular, limits for laboratory control samples) from three different entities are also not useful – instead only those that will actually be used for this particular project should be listed.

The Permittee must revise Appendix E into multiple appendices to separate the various types of plans (e.g. project management, training, data validation, quality assurance, and sampling and analysis). The various listings of laboratory analytes per media (QAPP Worksheet # 18a-c), field quality control samples (QAPP Worksheet # 20a-c), quality control targets (Appendix A of Appendix E) should be revised to simplify the information presented and contain only the necessary information to support the Bulk Fuels Facility Spill project. Some tables, such as QAPP Worksheets # 3, 4, 9, 16, 24c, 25, 28a-d, do not provide useful information to the NMED and should be deleted.

NMED is expecting a Quality Assurance (QA) Plan that contains specific quality assurance and quality control activities for the Bulk Fuels Facility Spill project. The QA plan is to integrate all technical and quality aspects of the project to ensure that the necessary type and quality of data are obtained to adequately characterize the release, the contaminated media, and for conducting and verifying clean up. NMED invites the Permittee to meet and discuss NMED's expectation

with respect to what should be in the QA Plan, as well as project management, training, data validation, and sampling and analysis plans.

## B. Groundwater Investigation Work Plan

1. The Permittee must describe in the first paragraph of Section 5.2.5 what geophysical logging has been previously conducted at existing wells.

2. The last paragraph on page 5-19, Section 5.2.5.1, states "The logs will be run from the groundwater table (approximately 500 ft bgs) to ground surface through the well casing." Correct the text to read "The logs will be run from the bottom of the well to the ground surface." Also, change all references to "groundwater table" in the Groundwater Investigation Work Plan to the correct term "water table".

3. The first sentence on page 5-20, Section 5.2.5.1, references a proposed seismic survey. Discuss the survey, or remove the reference to the seismic survey if such a survey will not be conducted.

4. Section 5.2.5.2, *Induction Logging*, on page 5-22, 3rd paragraph, 1st sentence states: "The borehole induction system can be used in boreholes that range from 2 to 8 inches diameter without significant borehole effects." Because the Permittee is proposing to drill boreholes with diameters of 9-5/8 and 11-3/4 inches, indicate whether the borehole induction system can be used properly in boreholes with diameters greater than 8 inches, or modify the plan to indicate that another, more appropriate tool will be used to log the boreholes.

5. Section 5.2.5.2, *Induction Logging*, page 5-22, the last sentence of the 3rd paragraph states; "The maximum depth of measurement for the most induction logging systems is 650 ft (200) meters)." Explain what this sentence means, as wells many thousands of feet deep are logged using induction logging. If the sentence is incorrect, correct the sentence or delete it from the Work Plan.

6. The last paragraph and bullets in Section 5.2.5.2, *Induction Logging*, discusses general procedures for all geophysical logging. This discussion needs to be moved to a more general section, such as Section 5.2.5 *Logging Requirements*. Also:

   a. Add total depth from the logger to the list of bullets.

   b. Add the same information to the list of bullets that is to be recorded in the first bullet of Section 5.2.3.2 of the Vadose Zone Investigation Work Plan (e.g., logging tool serial number, sensitivity range setting).

   c. The Permittee must include the measured deviation between the "zero point" of the tool at ground level at the start of the logging run and after completing the logging run.

7. Describe in Section 5.2.5.1 of the Work Plan if tools are to be run centralized, decentralized, or free in casing and describe where that information will be recorded.

8. Section 5.2.6.1, Logging System, p.5-25, last sentence, states "The logging system will be equipped with.... cable long enough to log 600-ft.depths." Because some of the groundwater monitoring wells may be 610-620 ft deep, the logging system must be capable of logging the full depth of all wells, even those in excess of 600 ft depth.

9. Table 4-1, Data Quality Objectives Summary Table, in the 3rd and 4th column in row 4, *Define the Study Boundary* states "Study boundaries are indicated on Figure 2-1". Many wells are outside the study boundary shown on the figure. Correct the statement or the figure as appropriate.

Revise Table 4-1 in accordance with the directives in this letter, or delete the table. Although the Permittee may use the EPA's DQO process to plan work, NMED prefers that Table 4-1 and Section 4 be deleted from the Work Plan, as they add little additional useful information. Items in the table should be included in the text of the Work Plan with additional details and as modified in accordance with the directives of this letter.

10. Table 4-1, Data Quality Objectives Summary Table, in the 3rd and 4th column in row 6, *Specify Limits on Decision Errors* states "Borehole geophysics measurements obtained is less than 1 ft." Explain what this sentence means, especially in light of the second sentence in Section 5.2.5.2 on page 5-22, which states "The intercoil spacing resolves conductivity layers 20 inches thick." See comment # 9 above about the deletion of Table 4-1 and Section 4.

11. Section 5.2.7, *Borehole Geophysics Equipment Decontamination* – Revise the Work Plan to indicate clearly that both the cable and probe will be decontaminated.

12. The 2nd paragraph, last sentence of the *Preface* states "Part II will consist of the evaluation of all existing and new data, and development of the risk assessment (including the conceptual site model), and the Groundwater Investigation Report (including cross sections and plan views)."

Revise the Work Plan to include a detailed description of what is to be included in the Part II Work Plan. NMED notes further that the inclusion of a "report" in a work plan is unusual and generally inappropriate. Information derived from newly completed work is normally submitted as a stand alone report, not as a section of a work plan.

Furthermore, the schedule in Appendix B lists the Part II Work Plans as being submitted by August 6, 2011. Because the contents of the Phase II plans are unknown to the NMED, the NMED can not agree to this submittal due date.

13. There are few details of reporting in the Work Plan, and most of those are aimed at the geophysical logging. Revise the Work Plan to include details for reporting on well installation, monitoring, and sampling results.

14. Section 3.5.3, *Identification of Contaminants of Potential Concern*, page 3-10 lists WQCC water quality standards from 20.6.2 NMAC. The cleanup levels for groundwater shall be the New Mexico Water Quality Control Commission (WQCC) water quality standards (20.6.2.3103 and 20.6.2.4103 NMAC) and the drinking water maximum contaminant levels (MCLs) adopted by EPA under the Federal Safe Drinking Water Act (42 U.S.C. §§ 300f to 300j-26). If both a WQCC standard and a MCL have been established for a contaminant, then the most stringent of the two levels shall be the cleanup level for that contaminant.

If a WQCC standard or MCL has not been established for a contaminant, the EPA Regional Screening Level (RSL) (EPA, 2009) for tap water shall be used as the cleanup level. If a RSL for tap water does not exist for a contaminant, and toxicological information is available, the Permittee shall propose a cleanup level based on a residential scenario, a total target human health excess cancer risk level of $10^{-5}$ and for non-carcinogenic contaminants a HQ of one (1.0). Revise the Work Plan accordingly.

See Permit Section 6.2.3.1.

15. Section 3.5.4, *Light Non-Aqueous Phase Liquid Distribution*, contains a list of wells where LNAPL has been detected. Add well KAFB-10628 to the list.

16. Section 5.2.3.1, page 5-6, 3rd bullet, discusses a scale of 1 inch =10 feet for drilling logs for wells shallower than 200 feet, but does not address a scale for wells greater than 200 feet. Because all wells are likely to be greater than 200 feet deep, identify the scale to be used.

17. Section 5.2.4, Groundwater Monitoring Wells, page 5-14, 2nd paragraph, last sentence states "A schematic showing a well construction detail is included in Appendix D, Forms 4, 5, 6, and 7." None of the four forms seems to fit the proposed construction details with a single cased, telescoped borehole, as shown on Figure 5-1. Revise the Work Plan to include appropriate well-construction field forms.

18. Section 5.2.4.3, *Well Development*, 2nd bullet discusses stabilization of groundwater field parameters during well development. Water stability indicators must be as described in the Permit, not as listed in this section, or as listed in Appendix D. Form 8, *Well Development Record and Water Quality Field Data Sheet (Continued 5 of 6)*.

19. Appendix D. Form 8, *Well Development Record and Water Quality Field Data Sheet (Continued 5 of 6)* lists conversion factors to determine the volume of well water to be purged for development and sampling based upon the height of the water column in the well. A distinction is made between a dedicated and non-dedicated system. NMED does not recognize such a

distinction and requires that all well development meet Permit Part 6.5.17.10.6 and that well purging be conducted as directed in NMED's letter of June 4, 2010, and Permit Part 6.5.17.4.

20. Appendix C, *Waste Management Plan*, Table 2 implies that the preferred method of disposal of non-hazardous waste water, a form of investigation-derived waste (IDW), is to discharge it to the ground surface. NMED encourages the Permittee to dispose such non-hazardous waste water into the City of Albuquerque's Publically-Owned Treatment Works (POTW) sewer system. Furthermore, all such water must be containerized and tested prior to disposal in accordance with 20.4.1.300 NMAC incorporating 40 CFR § 262.11. Waste water from one well can not be commingled with that from any other well or wells unless demonstrated not to be a hazardous waste.

21. The Permittee shall address the following concerning Appendix E, *Uniform Federal Policy-Quality Assurance Project Plan.*

a) Appendix E is shown as "(Pending Review)". This suggests that Appendix E is a draft document. Revise the Work Plan to contain only finished products, ready for NMED review.

b) Appendix E, page 77, Section 17.2, first paragraph, correct "April 2009" to the appropriate date.

c) Appendix E, page 77, Section 17.2 must clearly state quarterly groundwater monitoring will occur until a change is approved by NMED.

d) Describe what risk evaluation the Permittee is expecting to do and why.

e) List the data quality objectives that the QAPP must address.

f) Describe the Quality Assurance for geophysical logging.

g) Appendix E, Section 17.5 (and elsewhere) – Samples must be analyzed at an EPA-certified laboratory. Also, the Permittee must indicate whether the referenced Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) laboratory is EPA-certified. Revise the Work Plan accordingly.

h) Appendix E, Section 17.8, *Investigation-Derived Waste* –This section needs to clearly state that no IDW water from individual wells will be comingled before appropriate testing.

i) Appendix E, Section 17.9.4 states that no trip blanks will be collected for soil samples for VOC analysis. Revise the Work Plan to indicate that trip blanks are required for soil samples that are to be analyzed for VOCs.

j) Appendix E, Section 17.9 must include percent frequency of field quality control samples in each subsection. The sampling frequency must be as described in Permit 6.5.17.6.

k) Appendix E, Section 17.9.5, states field (ambient) blanks will be collected for groundwater only. Revise the Work Plan to include field blanks for soil sampling.

l) Appendix E mainly addresses sampling only for laboratory and field analyses. Other field activities, such as surveying and geophysical logging need to be addressed.

m) Appendix E, Section 17.2.2, *MNA Groundwater Monitoring*, states "30 groundwater monitoring wells will be installed for the monitored natural attenuation (MNA) investigation effort." Specify which wells these are and the purpose of this monitoring given that NMED has not made any decision concerning MNA as a remedy. Additionally, Section 11.2 of Appendix E, indicates that there are 35 wells to be included in the study. Specify which number of wells is correct.

22. Revise the Work Plan to provide for the collection and maintenance of representative soil samples encountered during well installations and to indicate that said samples will be made available for NMED inspection upon request by the NMED. Additionally, Section 11.2 of Appendix E indicates that there are 35 wells to be included in the study. Specify which number of wells is correct.

23. Revise the Work Plan to specify the frequency that soil samples will be tested for grain size via sieve analysis. Indicate the specific sieve screen sizes that will be utilized for the testing.

24. Table 6-2 lists only two soil samples each to be collected for grain size, residual LNAPL saturation, Water/LNAPL Drainage Capillary Pressure and Water LNAPL Relative Permeability and only one LNAPL sample each for testing for viscosity, fluid density and surface and interfacial tension. Revise the Work Plan to describe why these few numbers of samples are sufficient for the range of conditions at the site. Also, clarify in the table if the column titled "No. of Field Samples" is correct, and if the column "Total No. of Samples to Laboratory" is correct.

25. Saturated hydraulic conductivity and porosity are important variables in groundwater flow considerations. Specify field or laboratory tests that will be conducted to arrive at a range of site specific values. Revise the Work Plan to indicate how values for saturated hydraulic conductivity and porosity will be assessed.

## C. Vadose Zone Investigation Work Plan

1. Geophysics – Revise the Vadose Zone Investigation Work Plan in accordance with the above Comments 1-8 and 10-11 concerning Groundwater Investigation Work Plan.

2. Geophysical logging is proposed in soil-gas wells with 2-inch casing. Confirm that all tools fit in 2-inch casing, given the neutron probe is described as being 60 mm in diameter (2.36 inches, see page 5-24 of the Groundwater Investigation Work Plan, first paragraph, last sentence) or make an appropriate change in tool size or casing size.

3. For the soil vapor wells, describe where the 2-inch casing will be located in the borehole (e.g., in the center, closer to one side), and if so, how geophysical logging conducted in the 2-inch casing could be affected by the other soil-vapor monitoring points attached to 0.75-inch diameter casing in the same nested borehole.

4. The Work Plan does not include a detailed discussion of soil-vapor sampling. Revise the Vadose Zone Investigation Work Plan to include a section describing soil-vapor sampling in detail, with discussion of sampling methods, analytical methods, sampling frequency, laboratory and field quality control, handling, shipping and packaging, and reporting of results.

5. Section 5.2, top line on page 5-3 references Table 4 of the August 6, 2010, NOD for number, location, and depths of soil borings/soil-vapor wells. The table number is incorrect. The correct reference is Tables 1, 2 and 3.

6. Table 5-2 of the Work Plan does not show an exact correspondence to the August 6 letter. However, NMED will accept the locations as described in Table 5-2.

7. Section 5.2.10, *Soil Borings/Drilling*, page 5-18, last sentence, 1st paragraph, mentions "10 ¾" O.D. casing whereas Figure 5-2 shows "11 ¾" casing. Correct, as appropriate, the figure or the text.

8. Section 5.2.10, *Soil Borings/Drilling*, page 5-18, last sentence, 1st paragraph, mentions telescoping to a smaller diameter borehole at 200 feet, while Figure 5-2 shows telescoping to a smaller diameter borehole at 150 feet. Correct, as appropriate, the figure or the text.

9. Revise the Work Plan to add total depth from the logger to the first bullet of Section 5.2.3.2.

10. In the bullets of Section 5.2.3.2, define what "Assemble the downhole logging tool" means as a type of information recorded, or remove the bullet.

11. Section 6.1, *Soil Sampling*, Revise the Work Plan to indicate that additional samples will be collected and analyzed, beyond those obtained at the planned sampling intervals, if field evidence suggests contamination may be present as required in Permit Part 6.5.11.

12. Describe what will be submitted in Part 2 Vadose Zone Investigation Work Plan, indicate when the information will it be submitted, and explain why any of the information that was required by November 8, 2010, was not included in Part 1.

13. Appendix E, Section 17.3, *Pre-remedy Quarterly Monitoring Program – Soil Vapor*, discusses soil-vapor monitoring. Describe the risk evaluation the Permittee is proposing to conduct and the purpose of the evaluation. Revise the Work Plan to state that soil-gas

monitoring will be conducted quarterly until a change in frequency or termination of soil-gas monitoring is approved by the NMED.

14. Table 5-2 – Correct the date of the "August 8" letter to "August 6" in the title and last column heading.

15. Table 5-2 – Correct the locations listed in the last column under Shallow Borings. The same location is given for the five separate borings. Revise the Work Plan to correct the location numbers.

16. There are few details of reporting in the Work Plan, and most of those are aimed at the geophysical logging. Revise the Work Plan to include details for reporting on well installation, monitoring, and sampling results.

17. Section 5.2.11, Soil Vapor Monitoring Wells, p.5-27, 1st paragraph, discusses movement of the monitoring point by up to 20 feet if the point lies in a fine-grained layer. This is acceptable for the four deepest points (150, 250, 350, 450) but not for the two shallow points (25, 50). Movement of up to +/-5 feet for the shallow points will be acceptable. Screen depths can only be changed if the adjustment sets the screen in a more permeable geologic unit.

18. Section 5.2.11, Soil Vapor Monitoring Wells, p.5-27, 1st paragraph, states "If a large deviation is required, the NMED will be notified in writing of the deviation." All deviations must have prior written approval from NMED.

## D. Interim Measures Work Plan

1. Section 2. 4.5.3.2, Waste Profiling – The Work Plan states that soil will be characterized in place by sampling waste, but is unclear how sample locations will be selected and at what frequency that samples will be collected. Revise the Work Plan accordingly.

2. Section 4.6.11, Radius of Influence (ROI) Testing – The Work Plan does not indicate which existing wells will be used for the testing. Revise the Work Plan to list the wells to be used in the ROI tests.

3. Section 4.6.2.4 states that soil-gas wells will be constructed with 2-inch casing. Figure 4-4 indicates that the deepest monitoring point will be constructed using 3-inch casing. Revise the Work Plan to indicate the correct casing diameter. If 2-inch casing is correct, confirm that all geophysical tools will fit in 2-inch casing, given the neutron probe is described as being 60 mm in diameter (2.36 inches, see p.5-24 of the Groundwater Investigation Work Plan, first paragraph, last sentence) or make an appropriate change in tool size or casing size.

If 2-inch casing is correct, describe where the 2-inch casing will be located in the borehole (e.g., in the center, closer to one side), and if so, how geophysical logging conducted in the 2-inch

casing could be affected by the other soil-vapor monitoring points attached to 0.75-inch diameter casing in the same nested borehole.

## Final Direction

The Permittee must meet the deadlines specified in the Compliance Schedule at the end of this letter. The Interim Measures, Groundwater Investigation, and Vadose Zone Work Plans must be revised and resubmitted by the Permittee to the NMED for its review and approval by **March 31, 2011**. The revisions of the Vadose Zone, Interim Measures, and Groundwater Investigation Work Plans must address the comments noted herein and incorporate the requirements set forth in this letter. The Permittee shall also implement the interim measures and other actions as directed under Part 1 of this letter by the dates indicated and in accordance with the Compliance Schedule.

To the extent any requirement of this letter requires access to property not owned or controlled by the Permittee, the Permittee shall use its best efforts to obtain access from the present owners of such property to conduct the required activities. In the event that access is not obtained when necessary, the Permittee shall immediately notify the Department in writing regarding its best efforts and its failure to obtain such access.

The Permittee must document all field activities in accordance with Permit Part 6.5.2. All equipment that is not disposable must be decontaminated pursuant to Permit Part 6.5.3. All equipment that requires calibration must be calibrated as required under Permit Part 6.5.4. Sample handing, shipping, and custody procedures must comply with Permit Part 6.5.5. The collection and management of investigation-derived waste must conform to Permit Part 6.5.7. Well and boring locations must be surveyed in accordance with Permit Part 6.5.8. Field quality control samples must be collected and analyzed for all environmental media pursuant to Permit Parts 6.5.14 and 6.5.17.6. Laboratory analyses, including laboratory quality control samples, must be conducted as required under Permit Part 6.5.18. Field and laboratory quality control data must be reviewed and validated in accordance with Permit Part 6.5.18.3. Reporting of field activities, including sampling and analysis results, completion of soil borings, geologic and geophysical logging, and well installations, must be as directed by NMED's letter of June 4, 2010, for quarterly reporting.

The requirement under Permit Part 6.1.2 that the Permittee is to notify the NMED a minimum of 15 days in advance of field activities is waived for the work to be completed in the following sections of Part 1 of this letter: *A. Installation of New Groundwater Monitoring Wells, B. Development of Existing Wells, C. Geophysical Logging of Existing Wells, D. Completion of Soil Borings, Installation of New Soil-Gas Monitoring Wells, and I. Soil-Vapor Extraction.* The Permittee shall instead notify the NMED of these field activities by e-mail or letter by no later than the date that each of the activities begins.

## Compliance Schedule

| Revisions to Work Plans | |
|---|---|
| **Submittal** | **Due Date** |
| Interim Measures Work Plan | March 31, 2011 |
| Vadose Zone Work Plan | March 31, 2011 |
| Groundwater Investigation Work Plan | March 31, 2011 |
| **Well Installations, Soil Borings, Interim Measures, and other Actions** | |
| **Activity** | **Completion Due Date** |
| Complete installation of new groundwater monitoring wells | April 28, 2011 |
| Complete development of existing wells | February 15, 2011 |
| Complete geophysical logging of existing wells | February 15, 2011 |
| Complete soil borings | February 11, 2011 |
| Complete installation of new soil-gas monitoring wells | February 11, 2011 |
| Complete geophysical logging of new groundwater and soil-gas wells | June 1, 2011 |
| Complete excavation of soil at former Fuel Offloading Rack | October 6, 2011 |
| Complete investigation of piping from Building 1033 to storage tanks | March 7, 2011 |
| Complete preparation of locations for soil-vapor extraction | February 15, 2011 |
| Submit SVE Optimization Plan to NMED | March 31, 2011 |
| Complete Radius of Influence tests | April 6, 2011 |
| Complete Hydrocarbon Baildown tests | March 2, 2011 |
| Complete PneuLog tests | December 21, 2011 |
| Provide LNAPL sample to Scientific Laboratory Division of NM Department of Health | March 31, 2011 |
| Notify NMED that LNAPL sample has been delivered to Scientific Laboratory Division of NM Department of Health | No later than 1 business day following delivery of the sample. |

## LNAPL Plume

NMED's directives as expressed in its April 2, 2010, letter and the August 6, 2010, NOD required the Permittee to provide an Interim Measures Work Plan to conduct interim measures to remediate the LNAPL plume within five years. The revised Interim Measures Work Plan submitted November 4, 2010, does not contain such a plan. Rather than complying with NMED's direction to take immediate action to conduct LNAPL remediation, the Permittee proposes in the revised Interim Measures Work

Plan to conduct various tests. This same approach was proposed in the Permittee's June 18, 2010 version of the Work Plan, and was found unacceptable by NMED (*see* August 6, 2010 NOD).

On December 1, 2010, the Permittee submitted a separate plan to contain the LNAPL plume by proposing to pump and treat contaminated groundwater at the leading edge of the LNAPL plume. NMED will review this plan to determine whether it meets NMED's directives of April 2, 2010, and the NOD issued August 6, 2010, and otherwise proposes a sound technical approach. NMED's action on that plan will be provided under separate cover.

The Permittee must respond to this letter to my attention, with copy to Mr. Bill Olson of the NMED Ground Water Quality Bureau, and Mr. William Moats (NMED HWB, 5500 San Antonio NE, Albuquerque, NM 87109), on all correspondence and required plans and reports related to the Bulk Fuels Facility Spill, unless otherwise directed by NMED. All submittals and correspondence must be submitted in hardcopy and electronic format.

Please contact me directly at 505-476-6016 should you have any questions. Questions of a technical nature may also be directed to William Moats of my staff at (505) 222-9551.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

cc: J. Kieling, NMED HWB
W. Moats, NMED HWB
W. McDonald, NMED HWB
S. Brandwein, NMED HWB
B. Olson, NMED GWQB
B. Swanson, NMED GWQB
L. Barnhart, NMED OGC
B. Gallegos, AEHD
B. Gastian, ABCWUA
L. King, EPA-Region 6 (6PD-N)
T. Chapman, DOH SLD
File: Reading and KAFB 2010

# APPENDIX B

## Project Schedule

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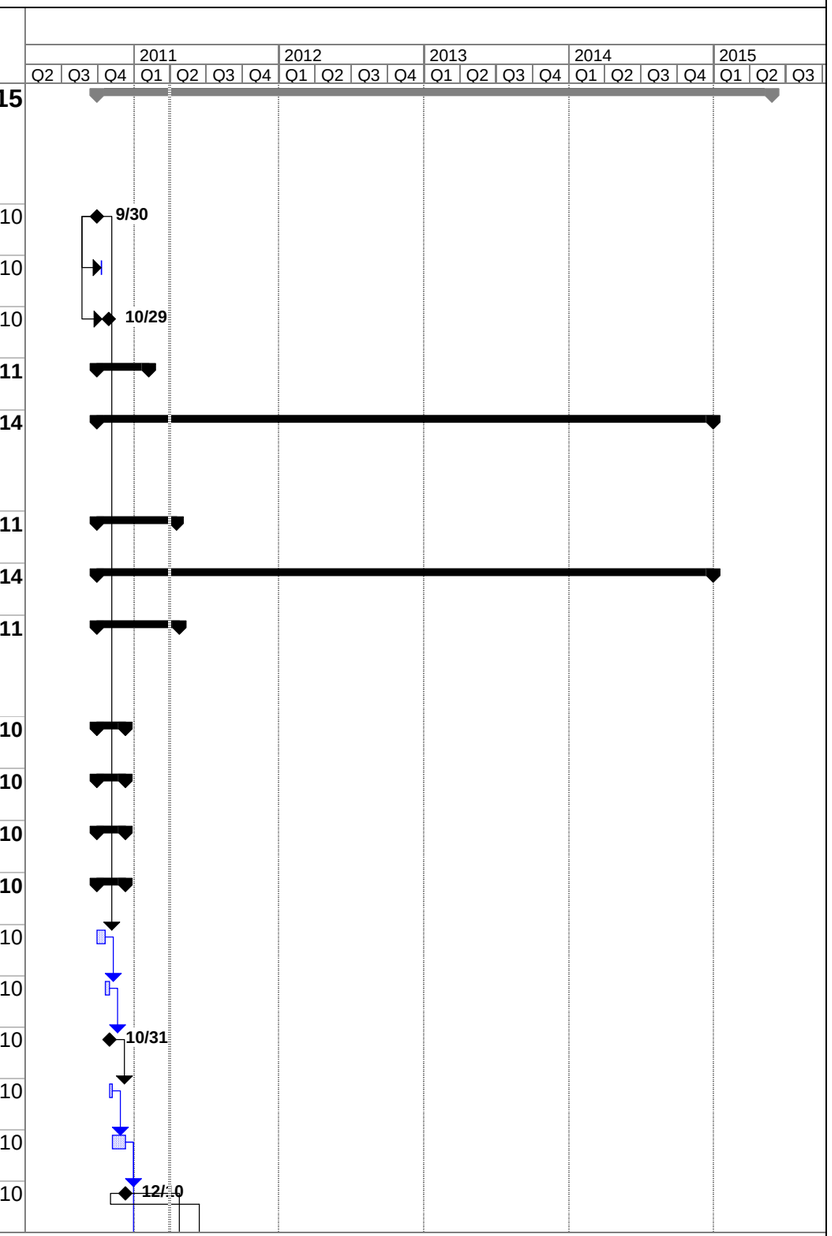
| Activity ID | QA PM | CLIN Sub-CLIN | Task Name | Duration | Start | Finish |
|---|---|---|---|---|---|---|
| 0 | | **2001** | **Kirtland Air Force Base Environmental Remediation Services at Bulk Fuels Facility (BFF)** | **1702 days** | **Thu 9/30/10** | **Thu 5/28/15** |
| 1 | | | Task Order Award/Notice to Proceed | 0 days | Thu 9/30/10 | Thu 9/30/10 |
| 2 | | | Project Kick-Off Meeting | 1 day | Mon 10/11/10 | Mon 10/11/10 |
| 3 | | | Submit Well Permit Application | 0 days | Fri 10/29/10 | Fri 10/29/10 |
| 4 | | **2001AA** | **Project Management Plan (PMP) and Quality Assurance Surveillance Plan (QASP)** | **131 days** | **Thu 9/30/10** | **Mon 2/7/11** |
| 12 | | **2001AB** | **Site Plans in Accordance w / Performance Work Statement (PWS) and Community Relations** | **1554 days** | **Thu 9/30/10** | **Wed 12/31/14** |
| 13 | | | **Community Relations Plan (CRP)** | **201 days** | **Thu 9/30/10** | **Mon 4/18/11** |
| 23 | | | **Community Relations** | **1554 days** | **Thu 9/30/10** | **Wed 12/31/14** |
| 99 | | | **Pre-Remedy Monitoring Work Plan, Health and Safety Plan (HASP), Quality Assurance Project Plan (QAPP)** | **208 days** | **Thu 9/30/10** | **Mon 4/25/11** |
| 110 | | | **Vadose Zone, Groundwater and Interim Measures Work Plans - Part I** | **72 days** | **Thu 9/30/10** | **Fri 12/10/10** |
| 111 | | | **Investigation Work Plan for the Vadose Zone at the BFF** | **72 days** | **Thu 9/30/10** | **Fri 12/10/10** |
| 119 | | | **Investigation Work Plan for Groundwater at the BFF** | **72 days** | **Thu 9/30/10** | **Fri 12/10/10** |
| 127 | | | **Interim Measures Work Plan** | **72 days** | **Thu 9/30/10** | **Fri 12/10/10** |
| 128 | | | Revise Existing Interim Measures Work Plan | 21 days | Thu 9/30/10 | Wed 10/20/10 |
| 129 | QA | | Army/Air Force Review | 11 days | Thu 10/21/10 | Sun 10/31/10 |
| 130 | PM | | Army/Air Force Approval of Draft | 0 days | Sun 10/31/10 | Sun 10/31/10 |
| 131 | | | Prepare Draft Final Interim Measures Work Plan | 7 days | Mon 11/1/10 | Sun 11/7/10 |
| 132 | QA | | Regulator/Stakeholder Review | 33 days | Mon 11/8/10 | Fri 12/10/10 |
| 133 | | | Conditional Notice to Proceed | 0 days | Fri 12/10/10 | Fri 12/10/10 |




Project: Kirtland Air Force Base Envir
Date: Wed 3/30/11

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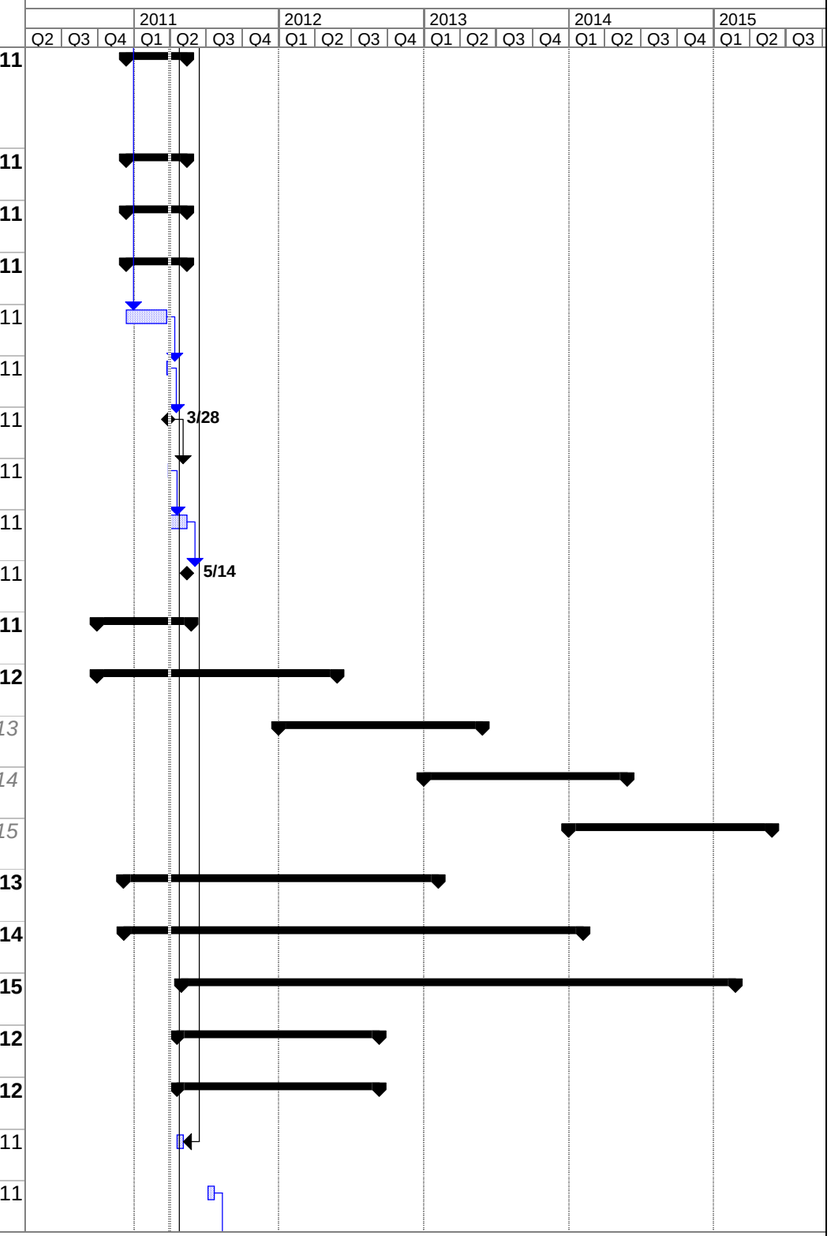
| Task | | Milestone | | Rolled Up Critical Task | | Split | | Group By Summary | |
| Critical Task | | Summary | | Rolled Up Milestone | | External Tasks | | Deadline | |
| Progress | | Rolled Up Task | | Rolled Up Progress | | Project Summary | | | |

| Activity ID | QA PM | CLIN Sub-CLIN | Task Name | Duration | Start | Finish |
|---|---|---|---|---|---|---|
| 134 | | | **Vadose Zone, Groundwater and Interim Measures Work Plans - Response to Comments (RTCs)** | **153 days** | **Mon 12/13/10** | **Sat 5/14/11** |
| 135 | | | **Investigation Work Plan for the Vadose Zone at the BFF** | **153 days** | **Mon 12/13/10** | **Sat 5/14/11** |
| 142 | | | **Investigation Work Plan for Groundwater at the BFF** | **153 days** | **Mon 12/13/10** | **Sat 5/14/11** |
| 149 | | | **Interim Measures Work Plan** | **153 days** | **Mon 12/13/10** | **Sat 5/14/11** |
| 150 | | | RTCs on Interim Measures Work Plan | 102 days | Mon 12/13/10 | Thu 3/24/11 |
| 151 | QA | | Army/Air Force Review | 4 days | Fri 3/25/11 | Mon 3/28/11 |
| 152 | PM | | Army/Air Force Approval | 0 days | Mon 3/28/11 | Mon 3/28/11 |
| 153 | | | Prepare Final Interim Measures Work Plan | 2 days | Tue 3/29/11 | Wed 3/30/11 |
| 154 | QA | | Regulator/Stakeholder Review | 45 days | Thu 3/31/11 | Sat 5/14/11 |
| 155 | PM | | Regulator/Stakeholder Approval | 0 days | Sat 5/14/11 | Sat 5/14/11 |
| 156 | | | **Light Non-Aqueous Phase Liquid (LNAPL) Containment Work Plan** | **238 days** | **Thu 9/30/10** | **Wed 5/25/11** |
| 168 | | **2001BA** | **Pre-Remedy Quarterly Monitoring and SVE Operation FY 2011** | **606 days** | **Thu 9/30/10** | **Sun 5/27/12** |
| 267 | | *2001BB* | *Pre-Remedy Quarterly Monitoring and SVE Operation FY 2012* | *514 days* | *Sun 1/1/12* | *Tue 5/28/13* |
| 379 | | *2001BC* | *Pre-Remedy Quarterly Monitoring and SVE Operation FY 2013* | *513 days* | *Tue 1/1/13* | *Wed 5/28/14* |
| 491 | | *2001BD* | *Pre-Remedy Quarterly Monitoring and SVE Operation FY 2014* | *513 days* | *Wed 1/1/14* | *Thu 5/28/15* |
| 603 | | **2001CA** | **Complete Investigation at BFF Vadose Zone** | **794 days** | **Mon 12/6/10** | **Wed 2/6/13** |
| 650 | | **2001CB** | **Complete Investigation for BFF Groundwater** | **1158 days** | **Tue 12/7/10** | **Thu 2/6/14** |
| 726 | | **2001DA** | **Installation of Interim Measure (IM) for Light Non-Aqueous Phase Liquid (LNAPL)** | **1397 days** | **Sat 4/30/11** | **Wed 2/25/15** |
| 874 | | **2001EA** | **Interim Measure (IM) for Vadose Deep / Shallow Zone** | **510 days** | **Wed 4/20/11** | **Mon 9/10/12** |
| 875 | | | **IM Vadose Zone Deep** | **510 days** | **Wed 4/20/11** | **Mon 9/10/12** |
| 876 | | | Bail Down Pilot Testing | 12 days | Wed 4/20/11 | Thu 5/5/11 |
| 877 | | | Radius of Influence Testing | 12 days | Thu 7/7/11 | Fri 7/22/11 |

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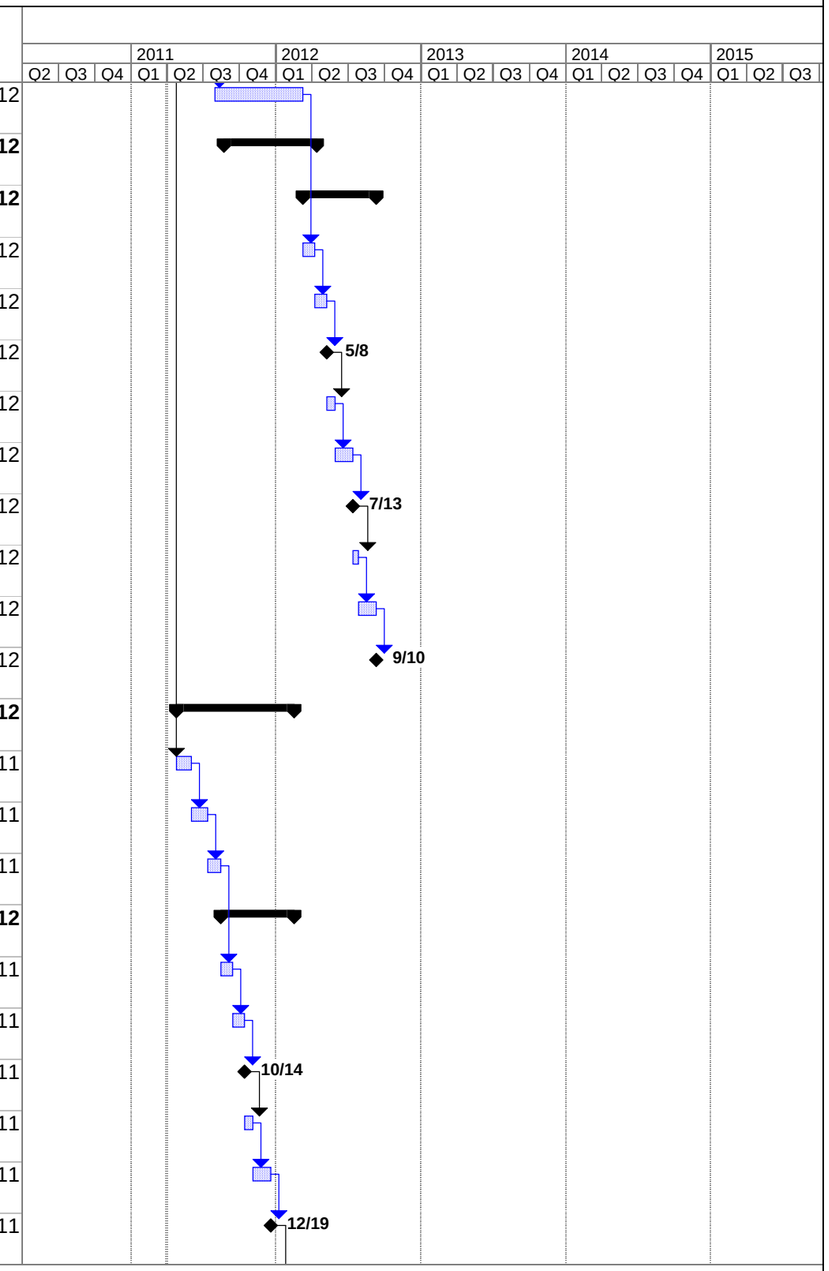
| Task | | Milestone | | Rolled Up Critical Task | | Split | | Group By Summary | |
| Critical Task | | Summary | | Rolled Up Milestone | | External Tasks | | Deadline | |
| Progress | | Rolled Up Task | | Rolled Up Progress | | Project Summary | | | |

| Activity ID | QA PM | CLIN Sub-CLIN | Task Name | Duration | Start | Finish |
|---|---|---|---|---|---|---|
| 878 | | | Well Installation/Pneu Log Testing | 160 days | Mon 8/1/11 | Fri 3/9/12 |
| 879 | | | **Well Completion/Pneu Log Reports** | **234 days** | **Wed 8/24/11** | **Fri 4/13/12** |
| 907 | | | **IM Evaluation and Design Report** | **185 days** | **Sat 3/10/12** | **Mon 9/10/12** |
| 908 | | | Prepare Draft IM Evaluation and Design Report | 30 days | Sat 3/10/12 | Sun 4/8/12 |
| 909 | QA | | Army/Air Force Review | 30 days | Mon 4/9/12 | Tue 5/8/12 |
| 910 | PM | | Army/Air Force Approval | 0 days | Tue 5/8/12 | Tue 5/8/12 |
| 911 | | | Prepare Draft Final IM Evaluation and Design Report | 21 days | Wed 5/9/12 | Tue 5/29/12 |
| 912 | QA | | Regulator/Stakeholder Review | 45 days | Wed 5/30/12 | Fri 7/13/12 |
| 913 | PM | | Receive Regulator/Stakeholder Comments | 0 days | Fri 7/13/12 | Fri 7/13/12 |
| 914 | | | Prepare Final IM Evaluation and Design Report | 14 days | Sat 7/14/12 | Fri 7/27/12 |
| 915 | QA | | Regulator/Stakeholder Review | 45 days | Sat 7/28/12 | Mon 9/10/12 |
| 916 | PM | | Regulator/Stakeholder Approval | 0 days | Mon 9/10/12 | Mon 9/10/12 |
| 917 | | | **IM Vadose Zone Shallow** | **297 days** | **Tue 4/26/11** | **Thu 2/16/12** |
| 918 | | | Fuel Off Loading Rack Soil Investigation (below ground pipeline) | 28 days | Tue 4/26/11 | Thu 6/2/11 |
| 919 | | | Fuel Off Loading Rack Soil Investigation (above ground pipeline) | 29 days | Fri 6/3/11 | Wed 7/13/11 |
| 920 | | | Soil Excavation / Disposal / Backfill | 23 days | Thu 7/14/11 | Mon 8/15/11 |
| 921 | | | **Fuel Off Loading Rack Soil Investigation Report** | **185 days** | **Tue 8/16/11** | **Thu 2/16/12** |
| 922 | | | Prepare Draft Fuel Off Loading Rack Soil Investigation Report | 30 days | Tue 8/16/11 | Wed 9/14/11 |
| 923 | QA | | Army/Air Force Review | 30 days | Thu 9/15/11 | Fri 10/14/11 |
| 924 | PM | | Army/Air Force Approval | 0 days | Fri 10/14/11 | Fri 10/14/11 |
| 925 | | | Prepare Draft Final Fuel Off Loading Rack Soil Investigation Report | 21 days | Sat 10/15/11 | Fri 11/4/11 |
| 926 | QA | | Regulator/Stakeholder Review | 45 days | Sat 11/5/11 | Mon 12/19/11 |
| 927 | PM | | Receive Regulator/Stakeholder Comments | 0 days | Mon 12/19/11 | Mon 12/19/11 |

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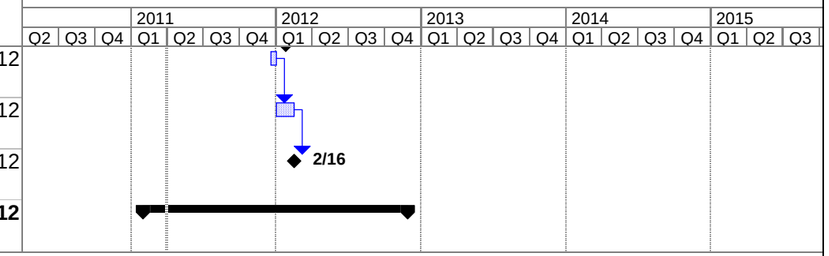
| Task | | Milestone | | Rolled Up Critical Task | | Split | | Group By Summary | |
| Critical Task | | Summary | | Rolled Up Milestone | ◇ | External Tasks | | Deadline | |
| Progress | | Rolled Up Task | | Rolled Up Progress | | Project Summary | | | |

| Activity ID | QA PM | CLIN Sub-CLIN | Task Name | Duration | Start | Finish |
|---|---|---|---|---|---|---|
| 928 | | | Prepare Final Fuel Off Loading Rack Investigation Report | 14 days | Tue 12/20/11 | Mon 1/2/12 |
| 929 | QA | | Regulator/Stakeholder Review | 45 days | Tue 1/3/12 | Thu 2/16/12 |
| 930 | PM | | Regulator/Stakeholder Approval | 0 days | Thu 2/16/12 | Thu 2/16/12 |
| 931 | | **2001GA** | **Groundwater IM** | **667 days** | **Tue 2/1/11** | **Wed 11/28/12** |

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| Critical Task | | Summary | | Rolled Up Milestone | | External Tasks | | Deadline | |
| Progress | | Rolled Up Task | | Rolled Up Progress | | Project Summary | | | |

# APPENDIX C

## Waste Management Plan

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**KIRTLAND AIR FORCE BASE**
**ALBUQUERQUE, NEW MEXICO**

# WASTE MANAGEMENT PLAN
# BULK FUELS FACILITY SPILL
# SOLID WASTE MANAGEMENT UNITS ST-106 AND SS-111

**March 2011**

***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

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ABCWUA | Albuquerque Bernalillo County Water Utility Authority |
| AFB | Air Force Base |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| CFR | Code of Federal Regulations |
| CHOX | chemical oxidation |
| CMBST | high-temperature organic destruction |
| DOT | U.S. Department of Transportation |
| EPA | U. S. Environmental Protection Agency |
| IDW | investigation-derived waste |
| INCIN | incineration |
| LF | landfill |
| mg/kg | milligrams per kilogram |
| NMAC | New Mexico Administrative Code |
| NMED | New Mexico Environment Department |
| PCB | polychlorinated biphenyl |
| PPE | personal protective equipment |
| RCRA | Resource Conservation and Recovery Act |
| STABL | stabilization |
| SVOC | semivolatile compound |
| TCLP | toxicity characteristic leaching procedure |
| TPH | total petroleum hydrocarbons |
| VOC | volatile organic compound |
| WMP | Waste Management Plan |
| WWT | wastewater treatment |

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# 1. INTRODUCTION

This document will serve as the Waste Management Plan (WMP) for environmental activities performed at Kirtland Air Force Base (AFB) in support of investigation of the BFF Spill, under U.S. Army Corps of Engineers contract W912DY-10-D-0014, Delivery Order 0002. The WMP governs the minimization, generation, management, storage, and transport and disposal of wastes that are routinely encountered during these environmental activities. The primary focus of this WMP is the management of investigation-derived waste (IDW). Wastes generated during the execution of remedial actions will be governed by this plan to the extent that they can be predicted and easily accommodated with the scope of this WMP.

## 1.1 Purpose

The purpose of waste management, particularly IDW management, is to leave the site in no worse condition after the implementation of activities than existed before the activities began, and to comply with federal and state waste management regulations and applicable or relevant and appropriate requirements to the extent practicable. These management procedures are directed toward waste minimization to reduce the quantity of waste that will require treatment, storage, or disposal.

## 1.2 Definitions

**Cross-contamination**—spread of chemicals from one item to another or from one location to another.

**Debris**—a solid material exceeding a 60 millimeters particle size that is intended for disposal that can be classified as a manufactured object, plant, or animal matter, or natural geologic material. The following materials are not debris—any material for which a specific treatment standard is provided in Resource Conservation and Recovery Act (RCRA) Subpart D, Part 268; process residuals such as smelter slag and residues from treatment of waste, wastewater sludges, or air emission residues; and intact containers of hazardous waste that are not ruptured and that retain at least 75 percent of their original volume.

**Decontamination Fluids**—fluids generated after decontamination of equipment. Fluids include soapy water, rinse water, solvents (e.g., isopropanol), and contaminated media removed from equipment during the decontamination process.

**Dewatering Fluids**—liquid waste generated from dewatering operations in excavations, retention ponds, and drainage channels.

**Disposable Equipment**—equipment that cannot be decontaminated at the conclusion of an environmental restoration activity and requires disposal. IDW disposable equipment includes bailers, coliwasas (samplers designed to permit representative sampling of multi-phase wastes from drums and other containerized wastes), jars and containers, plastic sheeting, foil, disposable laboratory equipment, etc. Disposable equipment from remedial activities includes small tools, barrier materials, decontamination pad equipment, hoses, chains, timber, survey stakes, etc.

**Free Liquids**—liquids that readily separate from the solid portion of a waste under ambient temperature and pressure.

**Hazardous Waste**—a solid waste is a hazardous waste if it is not excluded from regulation as a hazardous waste and exhibits any characteristic of hazardous waste identified in Subpart C and/or D of 40 Code of Federal Regulations (CFR) part 261.

**Mixed Waste**—radioactive waste that also contains a hazardous waste component regulated under RCRA (see definition of hazardous waste). Although not strictly a mixed waste, radioactive waste containing wastes regulated by the Toxic Substances Control Act (e.g., polychlorinated biphenyls [PCBs], asbestos) or naturally occurring radioactive materials are also considered to be a mixed waste under this plan.

**Personal Protective Equipment (PPE)**—coveralls, gloves, respirator cartridges, tape, boots, etc.

**Purge Water**—groundwater pumped from a borehole (monitoring well) prior to sampling.

**Radioactive Waste**—waste that contains higher than background levels of radioactivity, or is otherwise not releasable for use by the general public. Waste that can be disposed of without regard to its radioactivity is not considered radioactive waste.

**Remediation Waste**—any media or debris resulting from environmental restoration activities that meet the definition of solid waste in 40 CFR Part 261.

**Representative Sample**—a sample of a universe or whole (e.g., waste pile, lagoon, groundwater) that can be expected to exhibit the average properties of the universe or whole.

**Soil Cuttings**—excess soil removed by the direct-push and hollow-stem auger drilling techniques.

**Special Waste**—New Mexico defines "Special Waste" as the following types of solid wastes that have unique handling, transportation, or disposal requirements to ensure protection of the environment and public health and safety:

- Treated formerly characteristic hazardous wastes
- Packing house and killing plant offal
- Asbestos waste
- Ash
- Infectious waste
- Sludge
- Industrial process waste
- Residue from a spill of a chemical substance or commercial product (including contaminated soils)
- Dry chemicals, which when wetted, become characteristically hazardous

The New Mexico Environment Department (NMED) also defines petroleum-contaminated soil as "Special Waste" if the sum of benzene, toluene, ethylbenzene, and xylene (BTEX) isomer concentrations is greater than 500 milligrams per kilogram (mg/kg), with benzene individually greater than 10 mg/kg, and total petroleum hydrocarbon (TPH) concentration greater than 1,000 mg/kg.

## 1.3 IDW Minimization

A primary goal of the WMP is to minimize, to a practical extent, the volume of waste that will be generated, stored, and removed from the site for disposal. In order to minimize the volume of waste, the following general rules will be applied:

- Do not contaminate materials unnecessarily:
  - Plan work ahead, based on the work procedure to be used.

- Take only the material (i.e., chemicals) needed to perform the work activity. Additional material can be brought to the work location if it is found to be necessary. Materials can be stored in large containers but the smallest reasonable container will be used to transport the material to the location where it is needed.
- Maintain cleaning and extra sampling supplies outside any potentially contaminated area to keep them clean and to minimize additional waste generation.
- Maintain or construct prefabricated materials, barriers, support equipment, etc., outside potentially contaminated areas.
- Perform mixing of detergents or decontamination solutions outside potentially contaminated areas.
- Do not place media considered hazardous for different reasons together.
- Use drop cloths or other absorbent material to contain small spills or leaks.
- Avoid a bellows effect when double-bagging contaminated materials.
- Use containers to minimize the spread of contamination.
- Do not place contaminated materials with clean materials.
- Cover wooden pallets inside the exclusion zone with plastic. Decontaminate and re-use material and equipment when practical. Use volume reduction techniques when practicable.
- Verify that waste containers are solidly packed to minimize the number of containers.
- Use only the size of container to meet needs (i.e., do not use a drum or garbage can when a small polyethylene bag will do).
- Use less hazardous substances whenever possible (i.e., bring only the volume of standard solutions needed for testing, use minimal amounts of decontamination water and solvent rinses).
- Use direct-push, hydropunch, or any other waste minimizing sample acquisition techniques whenever possible.

## 1.4 Regulatory Context

NMED regulates environmental activities in the State of New Mexico. Environmental restoration work at Kirtland AFB is under the jurisdiction of both NMED and the U.S. Environmental Protection Agency (EPA), Region 6. Consequently, the following federal and state regulations form the regulatory context in from which waste management decision making at Kirtland AFB will derive:

- 40 CFR Parts 260 -299, EPA regulations for identification and management of hazardous waste
- 40 CFR Part 761, EPA regulations for management of PCBs
- 49 CFR Parts 100-178, U.S. Department of Transportation (DOT) rules for hazardous materials transport

- 20 New Mexico Administrative Code (NMAC) Chapter 9, New Mexico Solid Waste Management Regulations
- 20 NMAC Chapter 4, New Mexico Hazardous Waste Management Regulations
- 20 NMAC Chapter 5, New Mexico Underground Storage Tanks Regulations
- 20 NMAC Chapter 9, New Mexico Special Waste Requirements Regulations
- 20 NMAC Chapter 6, New Mexico Water Quality Control Commission Regulations

# 2. WASTE MANAGEMENT APPROACH

From the time that waste is generated through its ultimate disposal, waste will be managed in compliance with applicable regulatory requirements and in a manner that is protective of human health and the environment. All waste will be managed in compliance with applicable federal, state, local, and Kirtland AFB regulations. A regulatory expert will be actively involved in all planned activities to ensure that the appropriate characterization strategy will be used on a waste-to-waste basis. Furthermore, once characterization data are available, the regulatory expert will interpret the data and in combination with all other associated site history and project circumstance, provide a path forward for managing each waste generated in a timely and compliant manner.

## 2.1 Project-Specific Wastes

IDW anticipated to be generated during BFF Spill investigation and remediation field activities will consist of contaminated environmental media and associated waste materials from soil (excavation and sampling), drill/soil cuttings (from boreholes and well installation), monitoring well purge and development water, decontamination water, and water generated from pump tests. Waste material associated with these activities includes disposable PPE, disposable sampling equipment (e.g., scoops, bowls), and other inert materials (e.g., plastic, rope, tape, and paper).

## 2.2 Waste Accumulation and Storage Areas for Containers

Wastes governed by this plan shall be properly managed in an appropriate waste accumulation or storage area from the time it is generated until it is removed from the area (e.g., for disposal or further management). These areas will be, when practical, within the area of contamination at the point of generation. Otherwise waste containers will be staged at strategic and secure areas onsite until waste is properly disposed.

Waste accumulation and storage areas will be kept orderly and clear of non-waste-related items at all times. Minimum standards for the accumulation of waste in containers will be implemented at waste storage areas to ensure that waste is managed in a protective manner. Waste staging areas are not bound by specified time limits as are hazardous waste accumulation/storage areas. Inspections will be required weekly and will included visual confirmation of the following:

- Container is closed securely and/or locked.
- Container is in good condition (i.e., no excessive rust or dents that could compromise container integrity).
- All container labels are legible.
- Pertinent information is marked on drum/label (i.e., site of origin, waste contents, date of generation).
- Waste volume in container has not changed since the last inspection (only for containers where a visual assessment of volume is possible).

## 2.3 Container Management

IDW may be contained in drums, roll-off boxes, polyethylene tanks, or similar containers. IDW that is placed in a container (i.e., drum, roll-off box) will be managed in accordance with the following practices:

- Containers will be inspected upon receipt and/or before use to ensure the structural integrity of the containers.
- Only DOT-compliant containers will be used to accumulate, store, or transport waste generated at Kirtland AFB.
- Containers used for management of bulk IDW will be secured with a mechanism to prevent tampering. All access points to IDW containers (e.g., drum bungs, roll-off tarps) will be tightened with tools, as necessary, to prevent casual access.
- Once IDW is placed in the container, an appropriate label will be affixed to the container. The label must include the following basic waste identification information:
  - A unique container number
  - Accumulation start date
  - Site identification
  - Contents (e.g., soil, purge water)
  - Emergency contact information
- Drums will be positioned to allow for clear observation of labels and visual inspections for potential leaks. If an aisle is required in the drum storage area in order for a clear visual inspection of the drums, a minimum of three feet aisle space is recommended.
- Containers must always be closed, unless waste is being added to the container.
- Once the waste evaluator has fully characterized a particular waste stream, appropriate label(s) and markings will be placed on the container to reflect the characterization. Any previous labels or markings that were not accurate will be removed.
- Unless special circumstances warrant, IDW from different area of contaminations will not be mixed within a single container.

## 2.4 Additional Requirements for Hazardous Waste Containers

IDW that has been characterized as hazardous waste will be accumulated or stored in accordance with 40 CFR 262. The following requirements are applicable to only hazardous waste and are in addition to the general container management requirements.

- Containers of fully characterized hazardous waste accumulated in a generator 90-day area will have a hazardous waste label affixed to them and will be marked with the following information:
  - Generator information (name, address)
  - Kirtland EPA identification number
  - Applicable EPA waste number(s) (e.g., D008, F001)
  - Accumulation start date
  - Proper DOT shipping name
  - Appropriate DOT hazard class sticker(s)

In accordance with applicable state and federal hazardous waste and/or DOT regulations additional markings and/or labels may be required in preparation for transport of waste containers off-site.

## 2.5 Waste Staging Area for Stockpiles

Waste staging areas are defined strictly for the purposes of this plan, as areas within an area of contamination that will be used for the accumulation of stockpiling of soil or water, awaiting further management (e.g., treatment, disposal). Waste staging areas will be established within the boundaries of an area of contamination. Waste staging areas will be established and maintained by the contractor field team manager. For the purpose of the BFF spill remediation activities, centralized waste staging will be located at the BFF spill site location at Kirtland AFB.

## 2.6 Waste Characterization

IDW will be characterized using data obtained from the analysis of environmental samples collected during the investigation and quarterly monitoring activity that generated the waste, through analysis of samples collected directly from the waste, through knowledge of waste-generating process, or through a combination of these methods. A hazardous waste evaluation will occur for all waste generated at the site. If a particular waste meets the definition of a solid waste and is not excluded from regulation, it will then be determined if the waste meets the criteria of hazardous (characteristic and/or listed) or non-hazardous.

For the purpose of the BFF project, the Kirtland AFB active onsite landfill (LF-268) will be used for disposal of solid non-hazardous wastes. Kirtland AFB currently requires all waste being disposed at LF-268 to be analyzed for the following list of parameters for submittal in order to obtain approval for disposal at the landfill. The requirements include the following:

- Ignitability characteristic as defined in 40 CFR Part 261,
- Corrosivity characteristic as defined in 40 CFR Part 261,
- Reactivity characteristic as defined in 40 CFR Part 261, and
- Toxicity characteristic as defined by EPA Test Method 1311, toxicity characteristic leaching procedure (TCLP) for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), RCRA l metals, herbicides, and pesticides

Analysis for petroleum hydrocarbons is only required for wastes suspected of having petroleum-based contamination. The required petroleum hydrocarbon analyses include:

- TPH by EPA Test Method 8015B
- BTEX by EPA Test Method 8260B or 8021B

The following Table, Landfill-268 Waste Acceptance Criteria, summarizes acceptable levels that are applicable when utilizing the onsite landfill for waste disposal.

**Table 1 – Kirtland AFB Landfill-268 Waste Acceptance Criteria**

| Constituent | Regulatory Level* | Constituent | Regulatory Level* |
|---|---|---|---|
| Arsenic (D004) | 5.0 mg/L | Hexachlorobenzene (D032) | 0.13 mg/L |
| Barium (D005) | 100.0 mg/L | Hexachlorobutadiene (D033) | 0.5 mg/L |
| Benzene (D018) | 5.0 mg/L | Hexachloroethane (D034) | 3.0 mg/L |
| Cadmium (D006) | 1.0 mg/L | Lead (D008) | 5.0 mg/L |
| Carbon Tetrachloride (D019) | 0.5 mg/L | Lindane (D013) | 0.4 mg/L |
| Chlordane (D020) | 0.03 mg/L | Mercury (D009) | 0.2 mg/L |
| Chlorobenzene (D021) | 100.0 mg/L | Methoxychlor (D014) | 10.0 mg/L |
| Chloroform (D022) | 6.0 mg/L | Methyl ethyl Ketone (D035) | 200.0 mg/L |
| Chromium (D007) | 5.0 mg/L | Nitrobenzene (D036) | 2.0 mg/L |
| o-Cresol (D023) | 200.0 mg/L | Pentachlorophenol (D037) | 100.0 mg/L |
| m-Cresol (D024) | 200.0 mg/L | Pyridine (D038) | 5.0 mg/L |
| p-Cresol (D025) | 200.0 mg/L | Selenium (D010) | 1.0 mg/L |
| Cresol (D026) | 200.0 mg/L | Silver (D011) | 5.0 mg/L |
| 2,4-D (D016) | 10.0 mg/L | Tetrachloroethylene (D039) | 0.7 mg/L |
| 1,4-Dichlorobenzene (D027) | 7.5 mg/L | Toxaphene (D015) | 0.5 mg/L |
| 1,2-Dichloroethane (D028) | 0.5 mg/L | Trichloroethylene (D040) | 0.5 mg/L |
| 1,1-Dichloroethylene (D029) | 0.7 mg/L | 2,4,5-Trichlorophenol (D041) | 400.0 mg/L |
| 2,4-Dinitrotoluene (D030) | 0.13 mg/L | 2,4,6-Trichlorophenol (D042) | 2.0 mg/L |
| Endrin (D012) | 0.02 mg/L | 2,4,5-TP (Silvex) (D017) | 1.0 mg/L |
| Heptachlor (D031) | 0.008 mg/L | Vinyl Chloride (D043) | 0.2 mg/L |
| BTEX | 50 mg/kg | Benzene | 10 mg/kg |
| TPH | 100 mg/kg | | |

* 40 CFR 261.24, Table 1

In addition to the analytical thresholds, listed, the following LF-268 guidance to generators needs to be adhered to in considering the landfill as a disposal option for IDW.

1. The Kirtland AFB civil engineer and Kirtland AFB Landfill require that soil and/or debris from any restoration site or monitoring well installation have analytical documentation characterizing the waste prior to consideration for disposal. Analytical requirements will be based on the specific site knowledge of the Restoration project manager and/or site engineer.

2. Minimum analytical requirements necessary for soil and debris characterization derived from restoration site or monitoring well activities are defined above (See Table 1, Landfill-268 Waste Acceptance Criteria). For waste and debris that have been characterized during the completion of site

activities, analyses previously generated during the characterization process may be used in determination of suitability for disposal.

3. Soil or debris that has been analyzed for hazardous constituents and does not exceed any RCRA regulatory limits (40 CFR 261.24 Table 1) may be disposed of in the Kirtland AFB landfill. Soil and debris containing hazardous constituents exceeding regulatory limits and/or illustrating hazardous waste characteristics will be disposed of at a facility permitted to accept hazardous wastes following appropriate DOT procedures.

4. Petroleum-contaminated soil that has a total BTEX concentration greater than 50 mg/kg, or a benzene concentration greater than 10 mg/kg, or a TPH concentration greater than 100 mg/kg is considered a special waste. Special wastes will not be disposed of in the Kirtland AFB landfill but will be disposed of at a facility permitted to handle special wastes.

5. Kirtland AFB retains the right to reject all material for disposal into the Kirtland AFB Landfill on a case-by-case basis, even if the waste does not exceed regulatory limitations.

6. If a waste is approved for disposal at the Kirtland AFB landfill, a Kirtland AFB Landfill Pass will be issued to the requestor for the waste hauling vehicle. When using a government vehicle to haul waste to the Kirtland AFB landfill, a waste disposal authorization letter is required but a Kirtland AFB landfill pass is not.

The LF-268 specific waste characterization process and analytical requirements will be sufficient to make a general waste determination and allow for appropriate waste management onsite or off site. If the waste exceeds any of the levels listed in the Table 1, with the exception of the TPH and BTEX parameters, the waste will be considered a hazardous waste. That waste will then have to be profiled, treated, and disposed of offsite as a hazardous waste according to the level and type of contamination indicated in the waste characterization results.

In the event there are other reasons why the waste cannot be disposed of at the onsite landfill and all of the waste acceptance criteria are met, that waste will be managed as NMED special waste and shipped offsite accordingly.

The field team manager will stage IDW pending analysis (i.e., waste that is not fully characterized) at the site of origin pending the receipt of analytical data and subsequent characterization, unless otherwise directed by Kirtland AFB personnel. IDW that is generated outside of the Kirtland AFB installation boundary will not be staged at the site of origin. Such wastes will be staged at a waste staging area within the installation boundary at the BFF site.

## 2.7 Waste Management Implementation

If it is determined that the LF-268 analytical waste acceptance criteria are satisfied, the following information will be presented in a “waste profile” format that will be used consistently to represent each individual waste stream encountered and considered for onsite disposal.

- Submit a memorandum requesting authorization to dispose of investigative-derived debris to the appropriate Solid Waste program manager.
  - Kirtland AFB Activities: Mr. Steven C. Kitt, 377 MSG/CEANC at 846-9014 or Steven.kitt@kirtland.af.mil

- Include in the submittal the name and phone number of the point of contact overseeing the activity, the location from which the waste was generated/site identifier, waste analytical results, hauling companies to be used to transport the waste to the landfill, roll-off identification numbers, and license plate numbers of transport vehicles, if not using roll-offs for waste containment.

As stated, if for any reason waste is not accepted for onsite disposal, arrangements will be made to manage the waste offsite in a compliant manner. Licensed and/or permitted facilities will be used for the purpose of transportation and disposal of waste from Kirtland AFB, as deemed necessary. Waste profile documentation will be prepared for review and signature by Kirtland AFB before shipment offsite. Upon receipt of the signed profile packages waste removal will be coordinated to ensure proper management of all waste being offered for disposal.

In a letter received from the Albuquerque Bernalillo County Water Utility Authority (dated February 11, 2011), the ABCWUA states that non-hazardous water cannot be disposed of in the Albuquerque Publically Owned Treatment Works system. As a result, the decision tree provided by the NMED Groundwater Quality Bureau will be used for handling of non-hazardous waste water.

Table 2 lists the projected wastes to be generated during activities and the proposed analytical suite, the means of containerizing, probable waste status determinations and the two most likely methods of treatment and disposal.

**Table 2 – Management of Projected Waste Streams**

| Waste Description | Characterization | Containerization | Waste Status | Treatment/Disposal |
|---|---|---|---|---|
| IDW Soils | LF 268 Suite | -Roll-off<br>-Drum | Non-Hazardous | Direct Land Disposal<br>1.) LF268<br>2.) NMED permitted Subtitle D Landfill |
| IDW Soils | LF268 Suite | -Roll-off<br>-Drum | Hazardous<br>D004-D011<br>D018-D043 | STABL, CHOX, and Land Disposal<br>1.) WCS Hobbs, NM<br>2.) Clean Harbors Deer Trail, CO |
| IDW Water, well purge water, well development water | -LF268 (exclude BTEX, TPH)<br>-WWT specific parameters as needed | -Drum or bulk storage tank | Non-Hazardous | 1.) Discharge to ground surface per approval<br>2.) On-site WWT |
| Aviation Fuel | -Total Metals<br>-Total VOCs<br>-Flash Point<br>-pH<br>-PCB | -Drum | Hazardous<br>D018 | CMBST, INCIN<br>1.) Off-site Fuel Blending<br>2.) Off-site Incineration |
| Spent Carbon | -TCLP Metals<br>-Total VOCs<br>-Flash Point<br>-pH<br>-PCB | -Drum | Hazardous<br>D018 | CHOX, INCIN & Land Disposal<br>1.) Clean harbors<br>2.) Rhino Environmental |
| SVE Condensate | -TCLP Metals<br>-TCLP VOC's<br>-Total VOC's<br>-Flash Point<br>-pH | -Drum | Hazardous<br>D018 | CHOX, WWT<br><br>1.) Clean Harbors<br>2.) Safety Kleen<br>3.) Other off-site WWT |
| Used Oil | Generator Knowledge | -Drum | NA | Recycled |

Based on existing information, this table depicts an anticipated approach to waste streams generated in support of the BFF Spill field activities. However, if circumstances and/or analytical results deviate from the expected, necessary adjustments will be made to onsite waste handling and treatment and disposal selection. All procedures for handling and disposal of wastes, including necessary adjustments, will be in accordance with applicable federal and state regulations (see Section 1.4). Any significant adjustments to procedures will be transmitted to stakeholders during monthly status meetings, DQCRs, and other ad hoc meeting/conference calls as discussed in Section 5.1 of the work plan.

All documentation generated in managing each waste stream will be kept on file and provided to the appropriate Kirtland AFB environmental staff.

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# APPENDIX D

## Field Forms

**Form 1: Visual Classification of Soils Form**

**Form 2: Well Abandonment Form**

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# Visual Classification of Soils

Shaw Environmental & Infrastructure, Inc.

| | | |
|---|---|---|
| Project Number: | Project Name: | |
| Boring Number: | Coordinates: | Date: |
| Elevation: | GWL: Depth Date/Time: | Date Started: |
| Engineer/Geologist: | Depth Date/Time: | Date Completed: |
| Drilling Methods: | | Page: of |

| Depth ( ) | Sample Type & No. | Blows on Sampler per ( ) | Recovery ( ) | Description | USCS Symbol | Measured Consistency (TSF) | Well Construction | Remarks |
|---|---|---|---|---|---|---|---|---|
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Notes:

Drilling Contractor: ______________________

Drilling Equipment: ______________________

Driller: ______________________

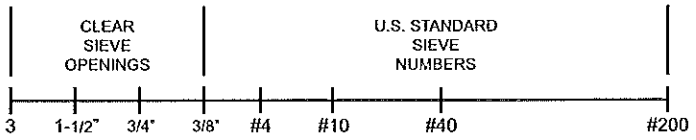
______________________

## Consistency of Cohesive Soils

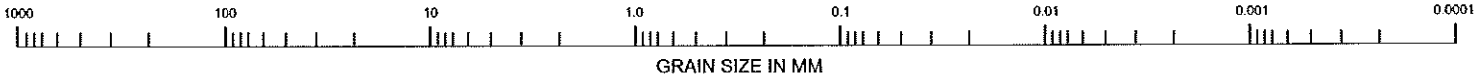
| Consistency | Unconfined Compressive Strength (Tons per Square Foot) |
|---|---|
| Very Soft | Less than 0.25 |
| Soft | 0.25 to 0.50 |
| Firm | 0.50 to 2.0 |
| Hard | 2.0 to 4.0 |
| Very Hard | More than 4.0 |

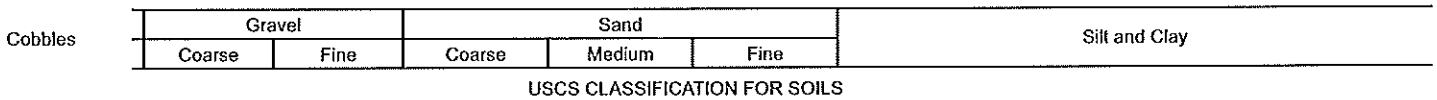
## Density of Granular Soils

| Density | Standard Penetration Resistance[1] |
|---|---|
| Very Loose | 0-4 |
| Loose | 5-10 |
| Medium Dense | 11-30 |
| Dense | 31-50 |
| Very Dense | Over 50 |




[1] Standard penetration resistance is the number of blows required to drive a 2-inch O.D. split barrel sampler 12 inches using a 1-pound hammer falling freely through 30 inches. The sampler is driven 18 inches and the number of blows recorded for each 6-inch interval. The summation of the final two intervals is the standard penetration resistance.




## Coarse-Grained Soils

| | | |
|---|---|---|
| Clean Gravels (little or no fines) | GW | Well-graded gravels, gravel-sand mixtures, little or no fines |
| | GP | Poorly-graded gravels, gravel-sand mixtures, little or no fines |
| Gravel with Fines (appreciable amount of fines) | GM | Silty gravels, gravel-sand-silt mixtures |
| | GC | Clayey gravels, gravel-sand-clay mixtures |
| Clean Sands (little or no fines) | SW | Well-graded sands, gravelly sands, little or no fines |
| | SP | Poorly-graded sands, gravelly sands, little or no fines |
| Sands with Fines (appreciable amount of fines) | SM | Silty sands, sand-silt mixtures |
| | SC | Clayey sands, sand-silt mixtures |

## Fine-Grained/Highly Organic Soils

| | | |
|---|---|---|
| Silts and Clays Liquid Limit (less than 50) | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity |
| | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| | OL | Organic silts and organic silty clays of low plasticity |
| Silts and Clays Liquid Limit (greater than 50) | MH | Inorganic silts, micaceous or diatomaceous; fine, sandy or silty soils |
| | CH | Inorganic clays or high plasticity, fat clays |
| | OH | Organic clays of medium to high plasticity, organic silts |
| Highly Organic Soils | PT | Peat, humus, swamp soils with high organic contents |

## Form 3. Well Abandonment Form

| Well Abandonment Form | Project Name | Borehole Number |
|---|---|---|
| | Location | Well Number |
| | Project Number | Page _____ of _____ |

| | | | |
|---|---|---|---|
| Logged By | Checked By | Reason For Abandonment | |
| Driller | | | |
| Drilling Method | | Measured Depth of Well | Depth to Water |
| Sampling Method | | Was Old Well Removed? Yes No Partial | |
| Start Date | End Date | Drilled Diameter | Quality of Backfill (Gal) |

| DEPTH (feet) | SAMPLE NUMBER | MATERIAL DESCRIPTION | BACKFILL DESCRIPTION | WELL CONSTRUCTION DETAILS | WELL SCHEMATIC |
|---|---|---|---|---|---|
| | | | | TOP OF SEAL | |
| | | | | TOP OF SAND | |
| | | | | TOP OF SCREEN | |
| | | | | WATER LEVEL | |
| | | | | DEPTH OF WELL | |
| | | | | DEPTH OF HOLE | |

## Form 3. Well Abandonment Form (concluded)

| Denver Federal Center Boring Log | Project Name<br>Contractor<br>Project Number | Boring Number<br>Page _____ of _____ |
|---|---|---|

| Depth (ft-bgs) | Blows/6" (recovery) | PID (ppm) | Graphic Log | MATERIAL DESCRIPTION | REMARKS |
|---|---|---|---|---|---|
| | | | | | |

# APPENDIX E

## BFF Spill Quality Assurance Project Plan (QAPjP)
## (submitted under separate cover)

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# APPENDIX F

## PneuLog Test Standard Operating Procedure

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# STANDARD OPERATING PROCEDURE - PNEULOG®

## 1. INTRODUCTION

This project will utilize a procedure combining site characterization and the collection of soil vapor extraction (SVE) data in vadose zone soils containing volatile organic compounds (VOCs). The procedure developed by PRAXIS Environmental Technologies, Inc. uses pneumatic well logging, known as PneuLog®, to measure the vertical air permeability and chemical concentration profiles in wells screened for SVE. The field procedures associated with PneuLog® are described in this attachment. All field activities will adhere to the procedures and specifications contained in the project Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) prepared as separate documents.

Pneumatic well logging is used to develop a detailed conceptual site model to aid in the design, optimization, or closure of SVE systems. The following data are collected in addition to lithologic logging and conventional sample analyses to build the conceptual site model:

- Flow and vacuum data from extraction wells,
- Vertical vapor concentration data from extraction wells, and
- Vertical air production profiles from extraction wells.

This attachment describes the PneuLog® technology and the collection of the data listed above.

## 2. TECHNOLOGY DESCRIPTION

This project will employ an expedited approach to vadose zone characterization with simultaneous collection of data for optimized SVE design and operation. For both vadose zone characterization and remedial design, Praxis has developed, field-tested and commercialized a pneumatic well logging process. Known as PneuLog®, the well logging is performed by simultaneously measuring the cumulative air flow and chemical vapor concentrations along the depth of an extraction well screen during active SVE. To make these measurements, a flow sensor is moved through the well during vapor extraction and soil gas samples are collected and analyzed continuously. Performing these measurements at a representative number of wells can yield a three-dimensional picture of the extent of chemicals in soils at a site as well as the soil permeability distribution. These measurements, in conjunction with traditional measurements, yield a thorough site evaluation.

The equipment for the pneumatic logging is illustrated in Figure 1. The Pneulog® instrumentation is attached to a cable, which passes through alignment pulleys and a vacuum-tight fitting at the wellhead. The instrumentation is raised or lowered by a motorized reel around which the cable is wound. The

logging proceeds at roughly eight feet per minute along the screen in the SVE well. Sensors in the pulley assembly indicate the depth of the measurement. Electrical leads connect the flow sensor to a data acquisition system located on the motorized reel. A vapor sampling tube connects the sample port on the instrument to a vacuum pump, also on the reel. The sampling pump draws a continuous stream of air through the sampling tube to the surface where it is analyzed for VOCs and other compounds of interest (e.g., oxygen and carbon dioxide). A photoionization detector (PID) is used to provide a continuous reading of total VOC concentration. Canister samples can be collected for off-site gas chromatographic and mass spectrometer analyses to determine compound-specific concentrations at discrete depths and to calibrate the PID readings. Supplemental vapor samples can be collected and analyzed on-site with a field gas chromatograph.

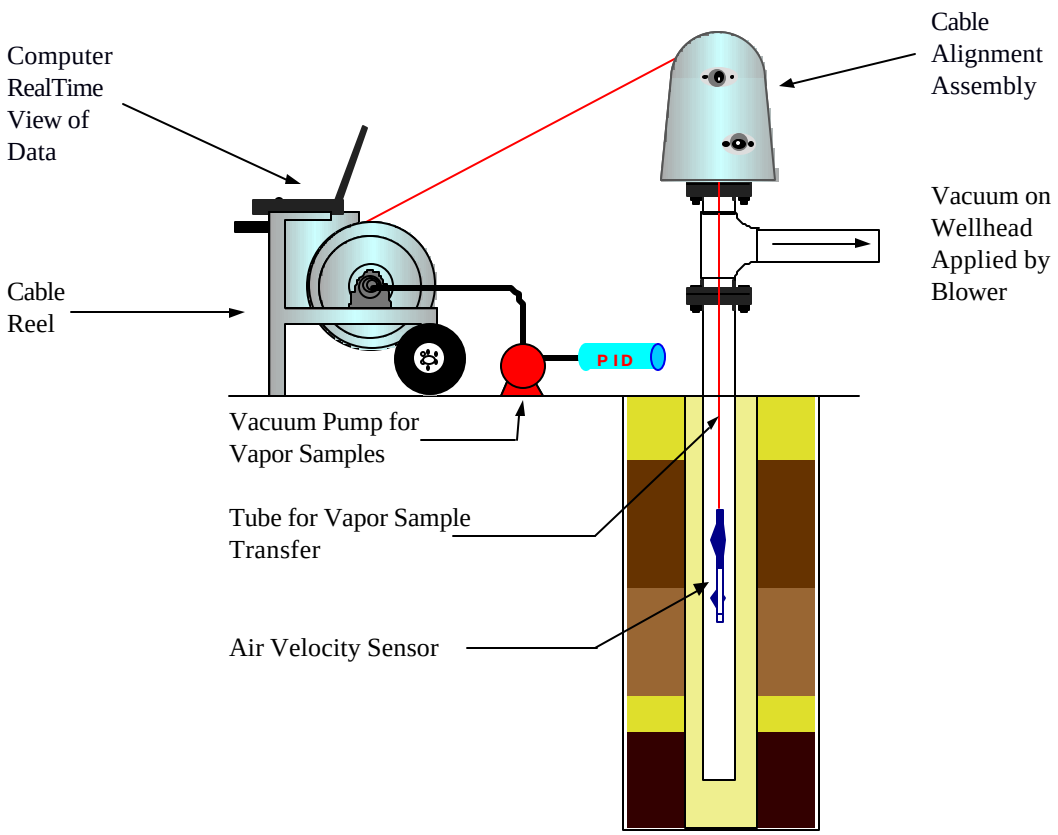


Figure 1. Schematic of Pneumatic Well Logging Equipment

The airflow from each soil layer is related to the cumulative airflow by a simple mass balance. To determine the airflow from a given soil layer, the cumulative airflow measured below the soil layer is subtracted from the cumulative airflow measured above the soil layer. The soil permeability of the interval is then determined from Darcy's law. The data and the analyses appear similar to output from borehole flowmeter testing in water wells (Molz et al., 1989). A typical cumulative airflow measurement

from PneuLog® is provided in Figure 2a. In this example, the well is screened from 12 to 32 feet below the ground surface (bgs). The screen interval is indicated by the green (dark) and yellow (light) blocks together. As shown, the airflow from the bottom half of the well is practically zero. The airflow increases steadily from 0 to 28 standard cubic feet per minute (scfm) between 23 and 16.5 feet bgs as the instrument is raised through the screen. The steady flow increase indicates this soil interval has a relatively uniform permeability to air. From 16.5 to 15 feet, only 2.5 scfm of soil gas are added. 15 scfm are then added in the next 1.5-foot interval up to 13.5 feet. The top 1.5 feet of the screen adds only one scfm to the total.

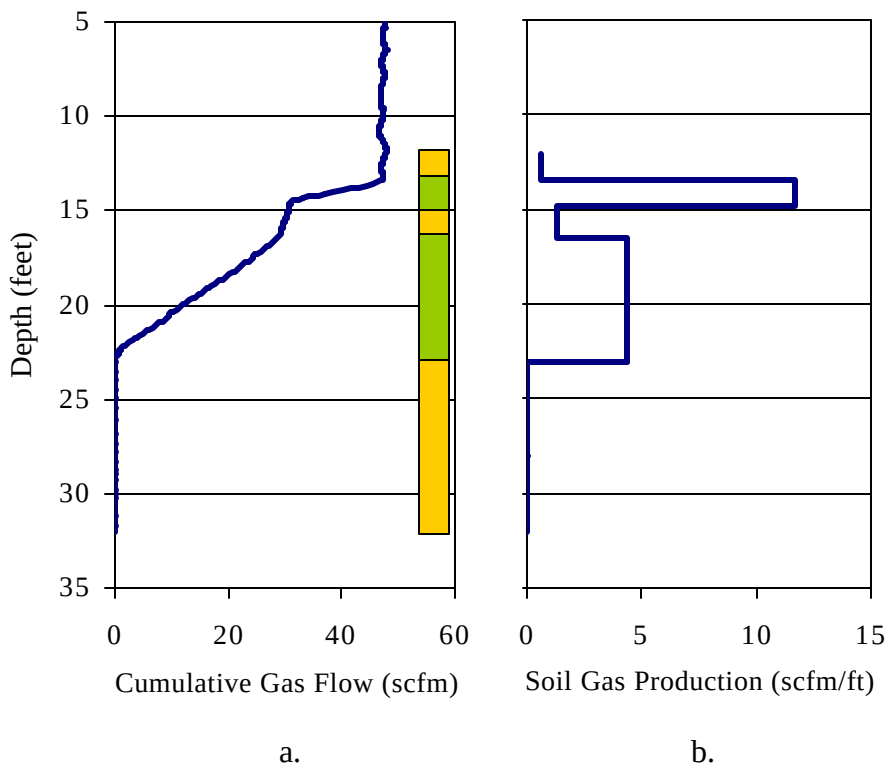


Figure 2. Example Pneumatic Well Logging Results for Soil Permeability to Air

Figure 2b presents an interpretation of the cumulative flow measurements as soil gas production. An effective air permeability profile can be generated using the soil gas production profile with multi-dimensional analytical or numerical airflow models. The permeability of an interval is proportional to the change in flow across the interval, its thickness, its depth below the surface and the well vacuum according to Darcy's law. Figure 2b reveals roughly five soil strata along the screen. The stratum intersected by the bottom half of the screen has a relatively low permeability since no measurable soil gas was produced. The geologist characterized the soils of this interval as silts. The soil intervals from

16.5 to 23 feet and 13.5 to 15 feet have air productions indicative of coarse sands. These two sand intervals are separated by a 1.5-foot-thick silt interval. The soil at the top of the screen would also be characterized as silt. This characterization of the physical properties is superior to a geological log and a typical air permeability test. The PneuLog® results were qualitatively consistent with the geological log; however, the geological log provided little indication of air permeability. Without the pneumatic logging data, the permeability determined by typical testing would be averaged over the screen interval and dominant features of the subsurface flow during SVE would not be quantified.

The characterizations of zones containing chemicals and soil gas concentrations result from the measurement of VOC concentrations along the well screen. An example concentration log, which was collected simultaneously with the previously discussed air flow log, is presented in Figure 3a. This concentration profile was obtained from a continuous PID reading which was calibrated to trichloroethylene (TCE) concentrations with on-site and off-site gas chromatographic analyses of vapor samples from discrete depths and the wellhead. The measured vapor concentration is lowest near the bottom of the screen and increases slightly up to a depth of about 28 feet. As the instrumentation is raised higher in the well, the concentration increases sharply to a maximum and remains relatively steady into the soil gas production interval starting at 23 feet. The concentration then decreases steadily from 22 to 15 feet bgs. Between 15 feet and the top of the screen, the concentration increases very slightly.

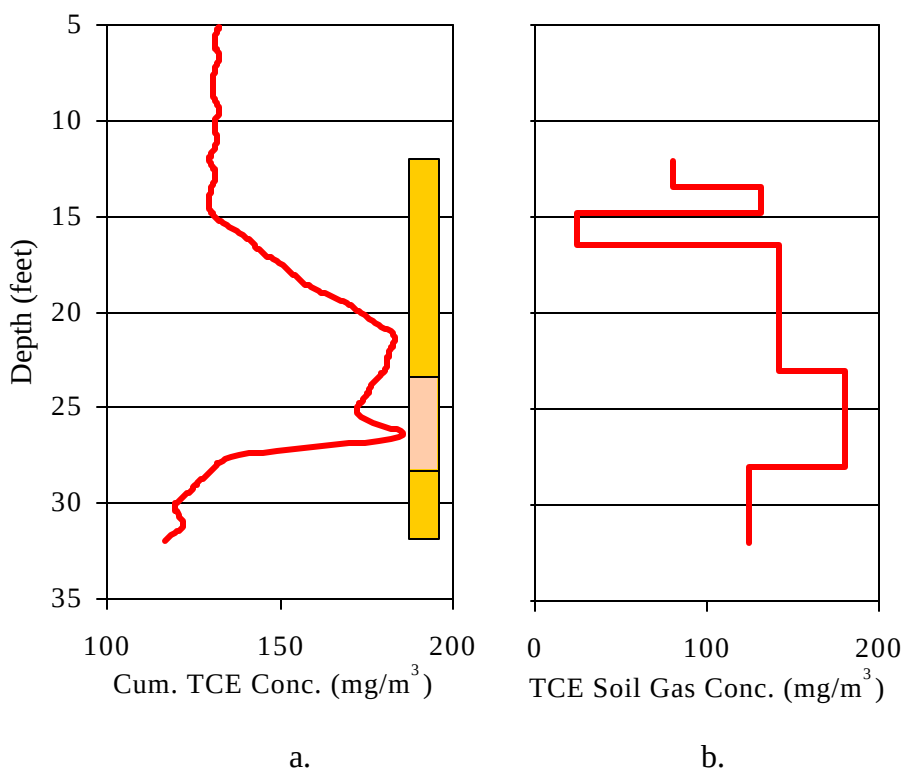


Figure 3. Sample Pneumatic Well Logging Results

The observed increases and decreases in concentration can be combined with the depth-specific air production in a mass balance to estimate depth-specific soil gas concentrations. The PneuLog® device simultaneously measures the flow rate and concentration versus depth. The change in the product of these two variables over a specified depth interval divided by the flow change is equal to the chemical vapor concentration in the soils of that depth interval. Application of this relationship to the data shown in Figures 2a and 3a yields the chemical vapor concentration profile presented in Figure 3b. The highest concentration occurs in the low permeability material underlying the deep sand interval. This high concentration indicates the low permeability interval creates a mass transfer constraint to SVE. Compounds must migrate slowly out of this interval into the flow interval above. The silt interval at 15 feet does not appear to be a barrier to chemical migration between the sands.

As illustrated by this example, pneumatic logging provides a more thorough and appropriate site characterization than traditional methods alone. Repeating the process in a representative number of wells can generate a three-dimensional description of the physical and chemical subsurface by correlating between locations. The technique also provides data to more effectively design and optimize an SVE system. Soil strata near or below cleanup goals are quickly identified and the extraction flow rate can be lowered or terminated from these layers. The operation can then be focused on strata remaining above cleanup goals. This optimization could lead to cost savings by accelerating cleanup and lowering operation & maintenance costs.

# 3. FIELD TASKS AND PROCEDURES

This section describes the field activities and procedures to collect data for site characterization and SVE design using PneuLog®. The activities adhere to the procedures and specifications contained in the project Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) prepared as separate documents. Site evaluation includes measurements of flow and vacuum in extraction and monitoring wells during pneumatic logging. Concentrations during the tests are monitored with a PID and two samples from each screen interval are collected and analyzed for VOCs. During the testing, vacuum responses are monitored in other available screens to aid in the calculation of permeabilities at the site. Vacuum responses depend on the soil properties and well spacing and may not be measurable in all monitored screen intervals.

The PneuLog® technique was described in detail in Section 2. During the pneumatic logging, a small flow of air is extracted through the Teflon® tubing attached to the flow instrument in the well. The total organic compound concentration in this air flow will be measured with a calibrated photoionization detector (PID) to yield the chemical concentration in soil gases extracted along the well screen depth. The pneumatic log will then be repeated and the instrument will be paused at a depth of major change in flow or concentration, generally at the maximum concentration. At this discrete depth, a sample of the soil gas may be collected in a canister or Tedlar® bag. A second canister or Tedlar® sample will be collected at the top of the well. Canisters will be packaged and shipped to a state-certified, off-site laboratory for analysis by GC/MS. The flow data from the pneumatic well log will immediately be

analyzed to yield an air production profile along the well screen and the concentration log will be analyzed to indicate the intervals with the highest chemical concentrations. In wells with lower concentrations, a meaningful maximum concentration along the screen may not be identified. In these screens, a vapor sample will be collected from the bottom of the screen.

Any point or non-point discharge to air generally requires review and permission from the local air board. This includes any process that volatilizes materials from the ground (e.g., soil vapor extraction) or uses volatilization as a means of disposal for unwanted materials or constituents. The SVE aspect of this fieldwork will require the extraction of contaminated air from the subsurface. The SVE discharge from each well will be treated with existing vapor abatement equipment on each site.

# 4. VAPOR SAMPLING AND ANALYSES

This section summarizes the procedures for collecting and analyzing vapor samples during the field tests. The equipment that will be used to collect vapor samples is also described. The sample locations, frequencies, and procedures presented are subject to change based on site-specific conditions.

Vapor concentrations will be monitored continuously during extraction periods with a calibrated PID as described in Section 3. Vapor samples will be collected in Summa® canisters for off-site analysis via method TO-14 (VOCs) or TO-15 (VOCs), and/or method TO-3 (total volatile petroleum hydrocarbons) at a state-certified laboratory or in Tedlar bags for on-site analyses of VOCs using a modified EPA Method 18. Approximately 2 samples will be collected during the pneumatic log of each screen in each well location. Samples will be collected through the pneumatic logging instrumentation and will provide depth-specific concentrations from inside the extraction wells. One sample will be collected from above the screen interval and one sample from the depth in the screen yielding the highest concentration or the bottom.

Depth-specific samples will be drawn by a small, oilless diaphragm pump through a Teflon® tube attached to the flow instrumentation for pneumatic logging. The vapor sample will be monitored by a PID on the surface and collected near the discharge of the Teflon® tube in a stainless steel SUMMA® canister or Tedlar® bag. The majority of samples collected in Tedlar bags will be analyzed on-site with a portable GC. Canisters will also be used to directly collect vapor samples at the wellhead to validate on-site analyses. The canisters will be submitted for offsite chemical analysis. Samples will be collected following the guidance offered in EPA's *"Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*," EPA 4-84-041-April 1984. The specific methods to be used are TO-14, "Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatography Analysis" or TO-15 and/or TO-3 for total volatile petroleum hydrocarbons. The canisters will be used and samples collected in the vacuum mode. The vacuum in the clean canister (near 30 inches Hg) will be sufficient to pull the sample out of the gas line. A slow flow rate into the canister will be controlled manually by slightly cracking open its valve.

The rate is checked by monitoring the canister vacuum gauge and comparing the value to the elapsed time and the wellhead vacuum. The final canister vacuum will be approximately equal to the vacuum in the vapor extraction line. The final vacuum will be recorded on the chain-of-custody and then measured at the laboratory after shipment and before analysis. The two recorded vacuums will be approximately equal if the canister has not leaked. Each canister will be cleaned in the laboratory before delivery.

The purpose of a field quality control program is to provide a measure of data quality. QA samples to be collected include field duplicates, equipment blanks, trip blanks, ambient condition blanks, and material for matrix spike/matrix spike duplicate (MS/MSD) analyses. Collection of the QA samples during the project is described in the project Work Plan. A summary of the quality control sampling for vapor sampling during PneuLog® is provided in Table 1. The sample handling, preservation and shipment procedures are described in the Work Plan along with sample custody and decontamination procedures.

**TABLE 1**
**QUALITY CONTROL SAMPLES**

| Sample Matrix Analysis | Analysis Level | Number of Samples | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Primary | Duplicate | Ambient Blank | Trip Blank | Equipment Blank | Matrix Spike /MSD | Total |
| **Soil Vapor** | | | | | | | | |
| VOCs (Offsite TO-14) | III | TBD[1] | 1 per 10 | 0 | 0 | 0 | 0 | TBD[1] |
| VOCs (Offsite TO-15) | III | TBD[1] | 1 per 10 | 0 | 0 | 0 | 0 | TBD[1] |
| VOCs (Onsite TO-18) | I | 2 per well | 1 per 10 | 1 per 10 | 0 | 1 per 10 | 0 | 13 per 5 wells |
| TVPH (Offsite TO-3) | III | TBD[1] | 1 per 10 | 0 | 0 | 0 | 0 | TBD[1] |

[1] TBD = To Be Determined

# 5. DATA MANAGEMENT

The data to be collected during PneuLog® include:

- Soil vapor concentrations,
- Extraction air flowrates,
- Wellhead vacuums,
- Vertical air flow profiles, and
- Vertical concentration profiles.

These data can be used to define the vertical and horizontal extent of chemicals at the various sites if a sufficient number of representative wells are logged. The data will also yield the disposition of the chemicals (e.g., found primarily in low permeability soil, found near the groundwater, suspected non-aqueous phase liquid present, etc.). The pneumatic logging data, combined with historical data can provide information on optimal SVE system operation and possibly the optimal locations for new SVE wells.

A general chronicle of field activities and personnel on site will be recorded daily. The following information shall be recorded for all field activities: (1) location, (2) date and time, and (3) identity of people performing activity. The information shall be recorded in a field notebook or on data logging sheets. These records shall be archived in an easily accessible form and made available to the Air Force upon request.

The collection of soil vapor samples will be documented in a field notebook or on appropriate data logging sheets. These records shall be archived in an easily accessible form and made available to the Air Force or its contractors upon request. The following additional information shall be recorded for all sampling activities: (1) sample type and sampling method, (2) the identity of each sample including location and depth(s), where applicable, from which it was collected, (3) the date and time of collection, (4) the amount of each sample or sample container volume, (5) sample description (e.g., color, odor, clarity), and (6) identification of conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged casing).

Field measurements will be recorded on data sheets specific to each measurement (e.g., air flow rates and wellhead vacuums). For each field instrument the following shall also be recorded: (1) the numerical value and units of each measurement, and (2) calibration results

# 6. HEALTH AND SAFETY

The health and safety plan for the fieldwork is prepared separately and is adhered to during all field activities.

# 7. MANAGEMENT AND STAFFING

Key staff from PRAXIS assigned to the project are shown in Table 2 with their responsibilities. Team members include:

Ms. Mary Scarpetti is the President of PRAXIS. She is responsible for the administrative, contractual and fiscal aspects of all PRAXIS projects. All significant changes in scope or cost must have her approval. Ms. Scarpetti received her law degree from the University of San Francisco in 1990 and is a member of the California Bar Association. Ms. Scarpetti has seven years of experience in the operations and financing of small firms and, in particular, government contracting and accounting. She worked in the securities industry prior to law school.

Dr. Lloyd "Bo" Stewart is the Principal Engineer for the pneumatic well logging and a Vice President of PRAXIS. Dr. Stewart has ten years of experience overseeing the development and implementation of innovative technologies for the remediation and characterization of hazardous waste sites. Dr. Stewart also develops and implements computer models for risk assessments and cleanup actions. Remedial technologies under development at Praxis include steam injection combined with vacuum extraction, dual-phase extraction, and hydraulic fracturing. Dr. Stewart received his Ph.D. in Mechanical Engineering from the University of California Berkeley in 1989.

Mr. Mike Chendorain in the Soil Hydrologist for the subsurface investigation, data analysis, and modeling. Mr. Chendorain received an MS in Soil and Environmental Sciences from the University of California at Riverside. He received a BS in Environmental Sciences from Virginia Institute of Technology. He has three years of experience in modeling the fate and transport of chemicals in the subsurface. While working on his MS, he also worked as a teaching assistant and as a research assistant.

**Table 2**
**PRAXIS Project Team Members**

| Responsibility | Team Member |
|---|---|
| Program Manager / Contracts | Mary Scarpetti |
| Project Manager / Principal Engineer | Bo Stewart |
| Subsurface Modeling/Data Analysis | Mike Chendorain |
| Equipment Installation & Maintenance | Steven Scarpetti |

# 8. REFERENCES

Molz, F.J., R. H. Morin, A. E. Hess, J. G. Melville, and O. Guven, 1989, "The Impeller Meter for Measuring Aquifer Permeability Variations: Evaluation and Comparison with Other Tests," *Water Resources Research*, Vol. 25, No. 7, pp. 1677-1683.