Closure Plan
Open Burn (OB) Treatment Unit and Open Detonation (OD) Treatment Unit

United States Air Force
Kirtland Air Force Base
EPA ID #NM9570024423

New Mexico Environment Department
Hazardous Waste Bureau

September 2018

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PERMIT ATTACHMENT H: CLOSURE PLAN

1.0 Introduction

This closure plan is intended to complete the requirements for Resource Conservation and Recovery Act (RCRA) closure of the Open Burn (OB) Treatment Unit and the Open Detonation (OD) Treatment Unit collocated within the Explosive Ordnance Disposal (EOD) Range at Kirtland Air Force Base (KAFB or Permittee). Figures H-1 and H-2 below show the location of the EOD Range and the co-located OB and OD Units.

The OB Unit consists of a stationary steel container located on a 30.5 foot (ft) by 10.5 ft concrete pad, surrounded by concrete walls on three sides. On the northwest side of the OB Unit is a soil berm, measuring approximately 15 ft high and 40 feet long, which protected the unit from shock waves resulting from detonations at the collocated OD Unit. Inside the unit is a 11 ft long by 5.25 ft high rectangular steel container constructed of heavy-duty steel. A heavy-duty steel door is located at one end of the container for the placement and removal of material after a controlled burn.

The OD Unit consists of a cleared circular area approximately 1,500 ft in diameter and surrounded and delineated by an approximately 2 ft high earthen berm. Detonations were conducted in pits measuring approximately 30 ft long, 15 wide and 12 ft deep.

The OB and OD units were used to treat (i.e., by open burning or open detonation) explosive and explosive-contaminated hazardous waste to remove the characteristics of reactivity (D003) and ignitability (D001). The wastes treated were explosives, propellants, and pyrotechnics in the form of pure substances, expired or unserviceable munitions, and explosive-contaminated waste items.

The OB Unit was permitted by the New Mexico Environment Department (NMED) on July 25, 1995 as RCRA Permit #NM9570024423-OB. A Permit renewal application was submitted on May 14, 2004. However, the Permittee discontinued the use of the OB Unit in September 2009 and subsequently withdrew the permit renewal application.

The OD Unit was permitted on December 20, 1994 as Permit #NM9570024423-OD. A Permit renewal application was submitted on May 14, 2004 and the renewed Permit was issued on July 15, 2010 as Permit# NM9570024423. The Permittee discontinued use of the OD Unit in August 2010.

In February 2010, the Permittee submitted a Class 3 permit modification request (PMR) to the Department (NMED) to amend and update the closure plans for the OB and OD Units. This modification was requested pursuant to the OB Unit permit issued in 1995, which remains in effect as the 2010 OD Unit Permit does not address the OB Unit. The Permittee provided the required public notice, held a public meeting, and provided an opportunity for public comment on the revised closure plans. After the NMED requested supplemental information, the

Permittee submitted a final revised closure plan for the PMR for the OB Unit on March 15, 2013 and a final revised closure plan for the OD Unit on May 19, 2015.

The OB and OD units are scheduled to undergo final closure activities simultaneously in accordance with this combined closure plan. If the OB and/or OD Units cannot be clean-closed, the Permittee shall prepare a post-closure care plan in accordance with Section 4.2 of the 2010 OD Unit Permit.

There is currently a perchlorate groundwater investigation occurring to the west of the EOD range at Schoolhouse Mesa. This investigation and its results are independent of this closure plan. Additionally, Solid Waste Management Unit (SWMU) 6-19 (KAFB site OT-29, Open Burn Pit), which is an old burn pit located approximately 20 feet northeast of the present OB structure, is listed as requiring corrective action under Attachment I, Table I-3 of the OD Unit Permit. Corrective action at SWMU 6-19 shall comply with the corrective action provisions of RCRA and is independent of this closure plan.

Until final closure of the unit is complete in accordance with the New Mexico Hazardous Waste Management Regulations and certification of closure has been approved by the NMED, this closure plan is part of the RCRA Hazardous Waste Treatment Facility Operating Permit and shall be maintained in the facility's Operating Record.

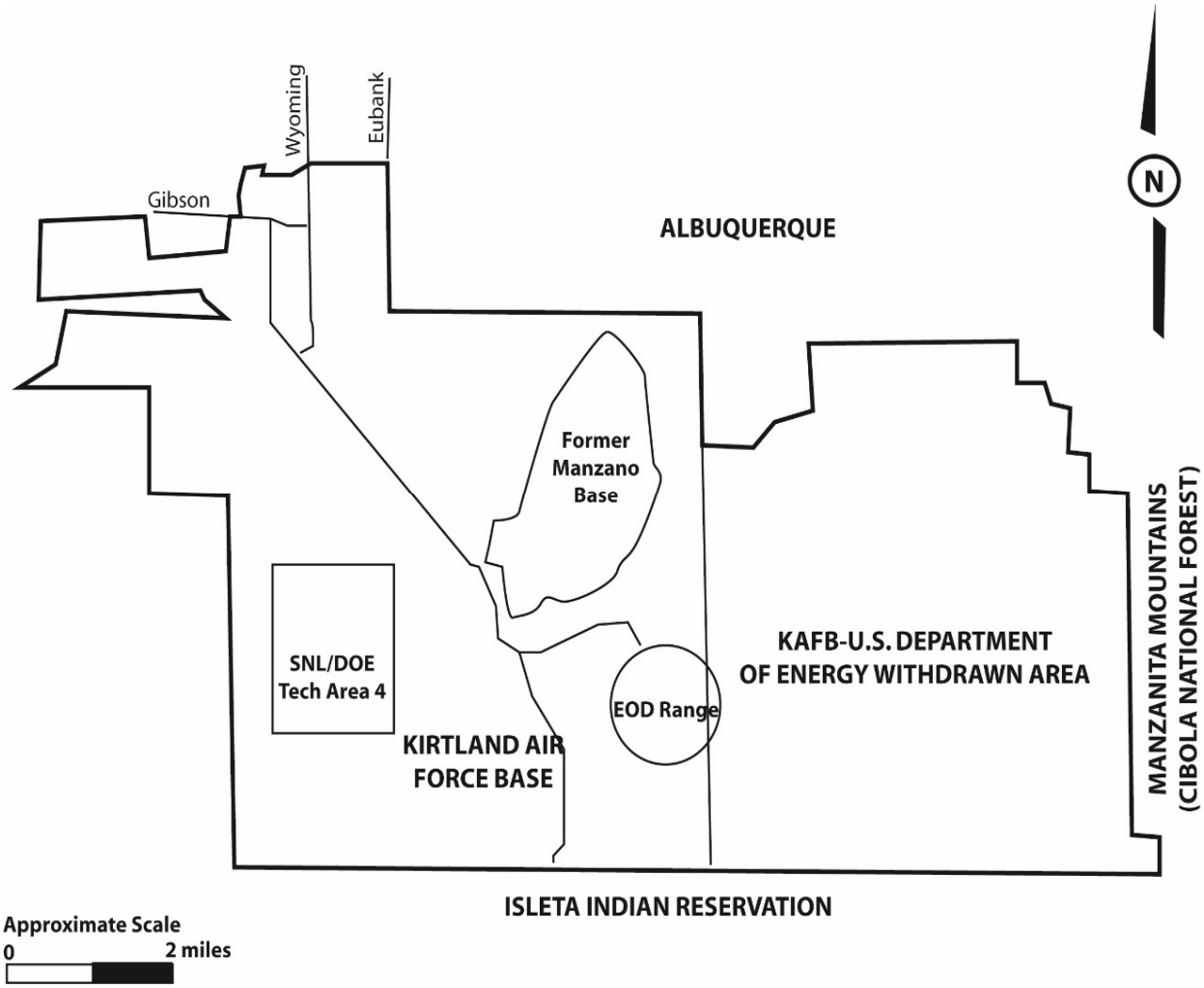


Figure H-1 – Location of EOD Range at Kirtland AFB

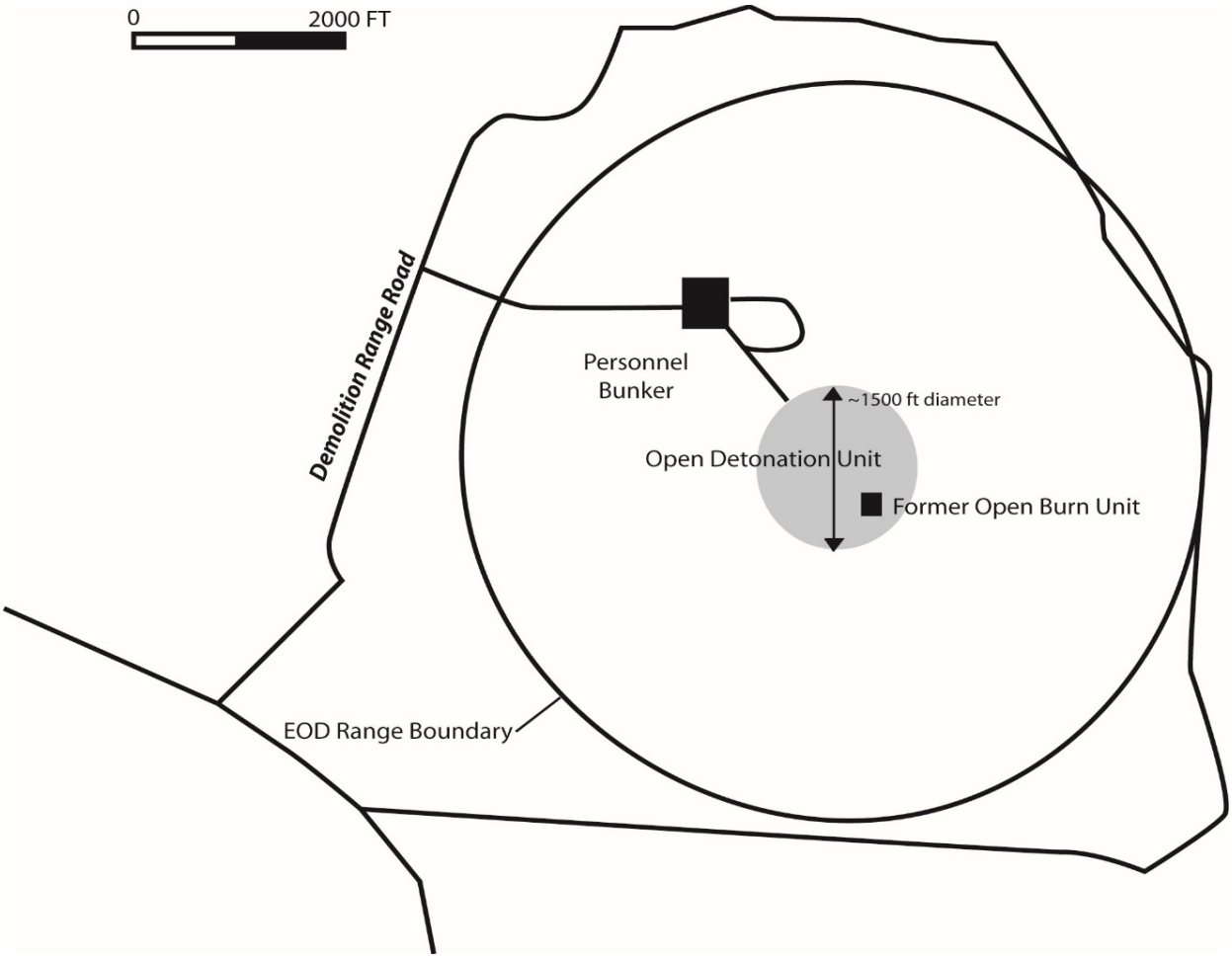


Figure H-2 – Location of Open Burn Unit and Open Detonation Unit at EOD Range

1.1 General Closure Information

This closure plan has been prepared in compliance with the requirements of RCRA (42 U.S.C. §§6901 et seq.) and 40 Code of Federal Regulations (CFR) Part 264 Subparts G and X and the New Mexico Hazardous Waste Act, (Chapter 74 Article 4 NMSA 1978) and the New Mexico Hazardous Waste Management Regulations(20.4.1.500 NMAC).

1.2 Closure Performance Standard

The OB and OD Units shall be closed to meet the following performance standards:

- Minimize the need for further maintenance;
- Control, minimize or eliminate, to the extent necessary to protect human health and the environment, the post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to ground water or surface waters or to the atmosphere; and
- Comply with the requirements of 40 CFR Part 264, Subpart G and 40 CFR §264.601.
- Ensure that residual contamination at the site meets the NMED-established risk and hazard levels for the residential (unrestricted) land use scenario.

1.3 Final Closure Activities

1.3.1 OB Unit

The last treatment event at the OB Unit occurred in May 2008. All treatment residues from this last treatment event have been removed from the unit. The Permittee ceased operation of the OB Unit on September 28, 2009 in accordance with the terms and conditions of Stipulated Final Order No. HWB-09-00(CO) and Settlement Agreement.

Final closure activities at the OB Unit shall include:

- Removal of the OB structure, secondary containment curbing and equipment used at the OB Unit for hazardous waste treatment.
- Sampling of the soil underneath the base of the former OB unit.
- Sifting of the soils beneath the OB Unit to a depth of one foot to remove scrap metal.
- Grading the area to create a level surface.
- Removing any soil or debris from the OB Unit that have contaminant concentrations which pose unacceptable risk to human health or the environment;
- Sending for treatment and disposal any solid and hazardous waste, including any treatment residues, to a permitted Treatment, Storage, or Disposal Facility (TSDF) in accordance with applicable regulatory requirements.

Final closure shall be complete when:

- All structures and equipment from the OB Unit have been removed;

- All solid and hazardous waste has been disposed of off-site as required by law;
- Sampling demonstrates that no unacceptable risk to human health or the environment exists in soil at the OB Unit;
- A Certification of Closure and Closure Report has been submitted to the NMED; and
- The NMED has approved the Certification of Closure and Closure Report.

1.3.2 OD Unit

The last treatment event at the OD Unit occurred in August 2010. The NMED was notified on August 13, 2010 that the Permittee had ceased all treatment activities at the OD Unit.

Final closure activities at the OD Unit shall consist of:

- Installation of four groundwater monitoring wells at the EOD range (one upgradient and three downgradient wells) and eight consecutive quarters of groundwater sampling to determine the presence or absence of groundwater contamination;
- Removing all waste military munitions and debris and all soils that contain contaminant concentrations which pose unacceptable risk to human health or the environment from the OD Unit;
- Sending for treatment and disposal any solid and hazardous waste, including any treatment residues, to a permitted facility for disposal in accordance with applicable regulatory requirements.

Final closure for the OD Unit shall be completed when:

- All solid and hazardous waste has been disposed of off-site as required by law;
- Sampling and analysis demonstrates that no unacceptable risk to human health or the environment originating from the OD Unit exists in soil or groundwater;
- A Certification of Closure and Closure Report has been submitted to the NMED; and
- The NMED has approved the Certification of Closure and Closure Report.

1.4 Maximum Extent of Operations and Maximum Waste Inventory

The OB Unit permit issued in July 1995 allowed 80,000 pounds Net Explosive Weight (NEW) of hazardous waste munitions per year to be treated annually. Small arms ammunition and spent flare casings were treated at the OB Unit. Based on the operating record, the total weight of material burned was approximately 60,466 pounds of NEW.

The OD Unit permit issued in December 1994 allowed 100,000 pounds of NEW to be treated annually. Rocket motors, large caliber munitions, explosive wastes and firearms were treated at the OD Unit. Based on the operating record, the maximum inventory treated at the OD Unit was approximately 316,012 pounds of NEW.

1.5 Schedule for Closure

Closure of the OB and OD Units shall proceed by the general schedule presented in **Table H-1**.

TABLE H-1
Closure Schedule

Activity	Time Required
Begin final closure activities	Day 0
Obtain analysis of soil samples	Day 45
Final closure activities completed	Day 130
Submit final report and closure certification to the Department	Day 180

Note: The schedule above indicates the calendar days on which activities shall start or be completed after commencing closure activities on day zero. Some activities may be conducted simultaneously or may require less time to complete.

1.6 Amendment of Closure Plan

All closure plan amendments, if necessary, shall be submitted in accordance with Section 4.1 of the 2010 OD Unit Permit. Written amendment requests shall include a copy of the amended plan for approval by the NMED.

1.7 Closure and Post-Closure Cost Estimate, Financial Assurance and Liability Requirements

Since KAFB is a federal facility, it is currently exempt from the requirement to provide closure and post-closure care estimates and the requirements to provide financial assurance and liability insurance for closure and post-closure activities pursuant to 40 CFR Part 264, Subpart H.

1.8 Closure Certification

The Permittee shall submit, via certified mail, a certification that the unit has been closed in accordance with the specifications of the approved closure plan no later than September 30, 2019. The certification shall be signed by the Installation Commander, the designated Responsible Official for Kirtland AFB and by an independent, professional engineer registered in the State of New Mexico. Documentation supporting the independent, registered professional engineer's certification shall be furnished to the Department with the certification.

1.9 Closure Report

A closure report shall be submitted to the NMED with the Certification of Closure no later than September 30, 2019. The report shall summarize the closure activities conducted and contain, at a minimum, the following information:

- A summary of the closure activities;
- Any significant variance from the approved closure plan and the reason for the variance;
- A summary of sampling data associated with closure, including analytical results for all field and laboratory quality control samples;
- A quality assurance statement on the adequacy of the analyses to support closure;

- The location of the file of supporting documentation (e.g., memos, logbooks, laboratory sample analysis data);
- Disposal location and quantities of all solid and hazardous wastes removed from the OB Unit; and,
- Certification of the accuracy of the report.

1.10 Survey Plat

Upon final closure of the OB and OD Units, a survey plat shall be prepared in accordance with 40 CFR §264.116 and certified by a professional land surveyor and submitted with the closure certification. The survey plat shall also be simultaneously filed with the local zoning authority.

2.0 Closure Procedures

The first phase of closure shall consist of a hazards survey of both units, which will include unexploded ordnance (UXO) safety personnel, and KAFB EOD personnel. The purpose of the survey will be to identify potential contamination concerns that may present hazards to workers during the closure activities and to specify any control measures necessary to reduce worker risk. This survey will provide the information necessary for health physics, UXO safety, and industrial hygiene personnel to identify worker qualifications, personal protective equipment (PPE), safety awareness, work permits, exposure control programs, and emergency coordination that will be required to perform closure. Any munitions and explosives of concern identified during the hazard survey will be reported to and handled by KAFB EOD staff personnel only. All workers involved in the closure activities shall be required to have training and medical monitoring as required by applicable regulations. Personnel performing closure activities shall be required to wear PPE as specified by health physics and industrial hygiene personnel.

Sufficient sampling and analysis of soil and groundwater shall be conducted to demonstrate that there are no contaminant concentrations which pose unacceptable risk to human health or the environment. Soil shall be characterized by sampling and analysis following the procedures described in Section 2.2.1. Groundwater shall be characterized as described in Section 2.2.2. If sampling and analysis of soil indicates the presence of inorganic constituents above approved background levels as shown in Table D-3 of Attachment D of the 2010 OD Permit, a risk assessment shall be conducted based on a residential land use scenario to determine whether the contaminants pose an unacceptable risk to human health or the environment using the procedures listed in the NMED's most current version of the *Risk Assessment Guidance for Site Investigations and Remediation* (RAGIR), provided the soil screening levels are based on a residential land use scenario. If the risk assessment demonstrates that the level of contamination is unacceptable, the contaminated soil exhibiting unacceptable risk shall be removed. The excavated soil and decontamination waste water shall be collected, transferred to containers, characterized and, if applicable, managed and disposed in accordance with all applicable regulations.

The Schoolhouse Mesa Well, a Department of Energy/National Nuclear Surety Administration (DOE/NNSA) well authorized under Kirtland AFB permit #PERM/0-K1-91-0010 was monitored for groundwater contamination as part of the July 1995 OB Unit's sampling and analysis plan.

This sampling has been discontinued and the wellhead is secure. The well will remain in place for possible future monitoring by DOE/NNSA.

2.1 Monitoring Wells

2.1.1 Installation of New Monitoring Wells

The OD Unit is subject to the environmental performance standards of 40 C.F.R. § 264.601. As such, groundwater monitoring shall be conducted as part of closure activities to demonstrate that operations did not impact groundwater. Four monitoring wells, one upgradient and three downgradient of the OD Unit, shall be installed. The locations of the monitoring wells are presented in **Figure H-3**.

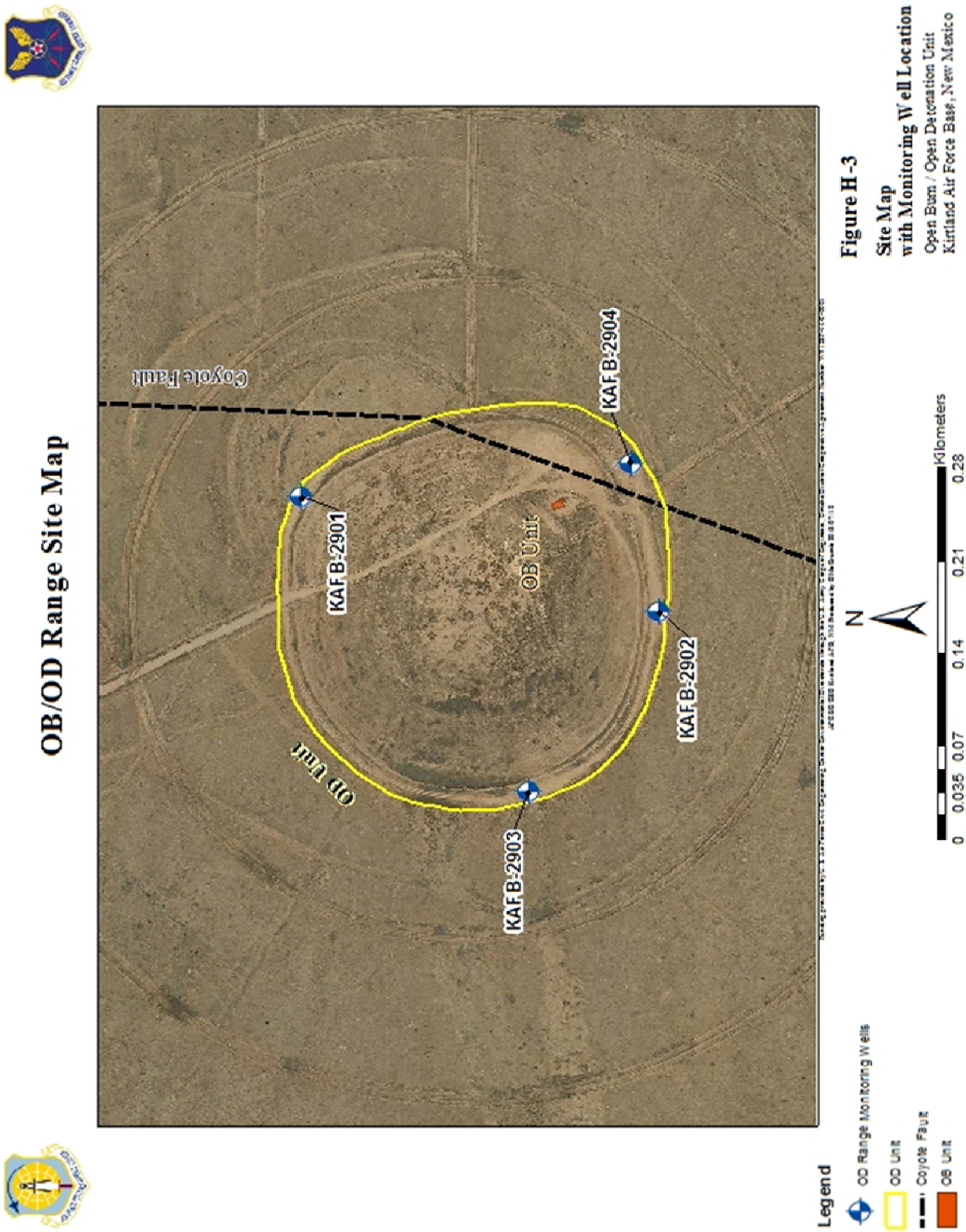
The wells installed at the OD Unit shall meet the groundwater monitoring requirements of 40 C.F.R. §§ 264.97(a)(2), (b), and (c). After completing well installation, the Permittee shall submit a well completion report to the NMED for review and approval.

If groundwater contamination is detected, these monitoring wells shall be maintained for implementing corrective action. The wells shall not be plugged or abandoned until the NMED has approved closure of the OD Unit after which time they shall be properly plugged and abandoned in accordance with applicable New Mexico statutes and regulations.

Activities for monitoring well installation are presented in the following paragraphs and include:

- Well locations,
- Drilling specifications,
- Well construction specifications,
- Well development procedures,
- A schedule for implementation and completion of the well installations;
- Preparation and submittal of a well completion report; and
- Groundwater sampling and analysis requirements for eight quarters.

Figure H-3 – Locations of Proposed Monitoring Wells



The primary project objective of the installation and sampling of the groundwater monitoring wells, is to evaluate the potential groundwater impacts from the operation of the OD unit. The new monitoring wells shall be installed near the OD Unit (**Figure H-3**). Installation of the monitoring wells shall facilitate groundwater sampling from the uppermost groundwater both up and downgradient of potential source areas associated with the OD unit. Based on data from nearby wells, groundwater at the proposed locations is expected to exist under confined conditions within the Paleozoic sedimentary rocks of the Madera Group or Sandia Formation or the underlying Precambrian granite. The depth to the uppermost water bearing zones at the proposed well locations is expected to range from approximately 100 ft to 200 ft below ground surface (bgs). Final well design shall be dependent on field conditions and the placement of the fourth well shall be performed in consultation with the Department.

2.1.1.1 Hydrogeologic Setting

The EOD Range is located within the Tijeras fault complex hydrogeologic region at KAFB (Sandia National Laboratories/New Mexico [SNL/NM], 2011a). The Sandia, Hubbel Springs, and Tijeras faults converge in this area and define the eastern edge of the Albuquerque Basin. Within the Tijeras fault complex, a thin layer of alluvium covers bedrock. The hydrogeology in this area is poorly understood due to the complex geology created by the fault systems. On the eastern side of the Tijeras fault complex, the depth to groundwater ranges from about 45 ft to 325 ft bgs. Most of the monitoring wells in this area are completed in fractured bedrock at relatively shallow depths and produce modest yields of groundwater.

The nearest existing wells to the proposed monitoring well locations include the Schoolhouse Mesa Well approximately 3,500 ft north-northwest of the OD unit; the EOD Hill Well approximately 4,300 ft west-northwest of the OD unit; three wells at Lake Christian (KAFB SWMU 6-22), roughly 5,500 ft southeast of the OD unit; and three monitoring wells installed at the Old Burn Site (SNL SWMU 68), approximately 7,000 ft south of the OD unit. Nearby former monitoring well locations include two wells at the Radium Dump/Slag Piles (KAFB SWMU RW-68); approximately 4,500 ft south-southeast of the OD unit; and one well at Lake Christian, roughly 5,500 ft southeast of the OD unit.

All of the nearby wells are completed in water bearing zones of the Paleozoic sedimentary rocks of the Madera Group or Sandia Formation or the underlying Precambrian granite. The available borehole logs and well completion diagrams from the surrounding wells and former well locations indicate that the uppermost groundwater occurs under confined conditions.

The groundwater flow direction near the EOD Range is not well defined and is assumed to mirror the topographic gradient of the land surface. There are several north-south trending faults mapped along the Sandia/Manzanita/Manzano Mountain range front. Near the OD unit, one normal fault crosses along the eastern edge of the EOD range, identified as the Coyote Fault in **Figure H-3**. This fault was encountered during drilling boreholes at the Old Burn Site, located south of the OD unit (SNL/NM, 2011b). This fault location is important to the OD unit investigation because it likely influences the groundwater flow across the site from east to west and may act as a hydraulic barrier. Comparison of water levels in the upgradient well and the downgradient wells

will likely provide data on the possible influence the fault has on local groundwater flow. The majority of the EOD Range is located west of the inferred location of the fault. The triangular configuration of the proposed downgradient monitoring wells and the measured groundwater elevations in the wells will be used to calculate the groundwater flow direction and hydraulic gradient in the uppermost groundwater aquifer across most of the site. The depth to the uppermost water bearing zones at the proposed well locations is expected to range from approximately 100 ft to 200 ft bgs.

2.1.1.2 Investigation Activities

Well installation activities shall be conducted in accordance with Part 6 of the Kirtland Air Force Base RCRA Permit and the *Kirtland Air Force Base, Base-Wide Plans for the Environmental Restoration Program*, *2004 Update* (USAF, 2004) and with the July 2010 OD Unit Permit. The procedures in Section 3.5 of the OD Permit, as well as procedures of the Base-Wide Plans, Standard Operating Procedure (SOP) B1.3: *Monitoring Well Installation*, shall be adhered to for this project, unless they are specifically modified by this closure plan.

Quarterly groundwater monitoring shall be conducted according to this closure plan. At the conclusion of the investigation and four quarters of monitoring activities, the Permittee shall provide a report with recommendations based on the data collected from the first four quarters of monitoring.

2.1.1.3 Mobilization

An exploratory well application permit for each well shall be filed with the New Mexico Office of the State Engineer (NMOSE) in accordance with the *Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells* (NMOSE, 2005). The Bernalillo County well installation regulations are not applicable to wells installed on KAFB. All well locations shall be cleared by UXO support personnel prior to mobilization of drilling activities. An environmental impact analysis shall be performed through the Base Civil Engineering and Natural Resources Request (AF Form 813). A utility clearance of the area shall be performed using Base Civil Engineering Clearance Requests (AF IMT 103), Base Civil Engineer Work Requests (AF IMT 332), and New Mexico One Call services. A surface disturbance permit shall not be required because the total disturbed area of the wells is less than 1 acre.

2.1.1.4 Drilling Method and Sequence

The boreholes shall be installed using air-rotary casing hammer (ARCH) drilling method. This method has been successfully used for the installation of nearby monitoring wells and should facilitate lithologic description of drill cuttings and allow for the observation of soil/bedrock moisture content for identification of groundwater zones. The ARCH drilling method shall be used to advance the boring through the unconsolidated soil zone and anchor the drive casing in the underlying bedrock.

The specific depths shall be determined in the field based on the observed lithology and presence of groundwater. The borings will be advanced approximately 25 ft into the uppermost water bearing unit.

During the ARCH drilling activities, the field staff shall monitor for the presence of groundwater by visually inspecting drill cuttings for moisture. If the cuttings become wet, the borehole shall be allowed to sit idle for approximately one hour. A water level probe shall then be lowered into the borehole to assess whether groundwater has accumulated and this information shall be documented on the field log.

Field screening of the soil cuttings for the presence of volatile organic compounds (VOCs) shall be conducted during the drilling process using a portable photo ionization detector (PID) as described in Base-Wide Plans, Appendix B, SOP B3.1: Photo-ionization Detectors and Organic Vapor Analyzers (USAF, 2004). As the boreholes are advanced, the field geologist shall continuously collect soil cuttings to aid in the preparation of lithologic logs. The monitoring well lithologic log shall be completed as described in Base-Wide Plans, Appendix B SOP B1.1: *Borehole and Sample Logging*. Drill cuttings from ARCH method drilling shall be stored at the well site on plastic sheeting or in roll-off containers and managed as investigation-derived waste (IDW).

Groundwater purged from the boring during borehole advancement and sampling shall be allowed to settle in roll-off bins then transferred to holding tank(s). These plastic holding tanks shall be managed as IDW along with decontamination and well development fluids.

Decontamination of the drill rig, drill tools, sampling equipment, and associated equipment shall be accomplished by steam cleaning prior to drilling each well. Decontamination activities shall be conducted at a central location with water obtained from an approved on-site source. Decontamination fluids shall be contained in polyethylene tanks and managed as IDW.

2.1.1.5 Subsurface Soil Sampling

Soil and rock sampling shall be performed for lithologic description. Subsurface soil laboratory analysis is not proposed as part of the groundwater investigation.

2.1.1.6 Monitoring Well Construction

Monitoring wells shall be designed and constructed based on the lithology and groundwater elevations encountered at each proposed well location. The well construction details may be subject to change based on the observed field conditions, but procedures and methods shall comply with Section 3.5 of the Permit and the OSE criteria. The proposed monitoring well design includes the use of 4-inch-inside diameter (ID), Schedule 80 polyvinyl chloride (PVC) casing with a 5-ft well sump, 20-ft of 0.020-inch slot size well screen, and approximately 2 ft to 3 ft of stickup at the surface. Centralizers shall be used to stabilize the well casing within the borehole at the top and bottom of the screen interval and at a minimum spacing of 40 ft on casing above the top of the well screen.

Wells shall be completed as follows:

- The sand filter pack type shall be determined based on field observations and shall extend from the bottom of the silt trap to 5 ft above the top of the screen. However, it is anticipated that a filter pack of 10-20 gradation Colorado Silica Sand shall be used in the construction of the monitoring wells. The filter pack sand shall be placed through a tremie pipe. Approximately 2 ft of barrier sand, 100 percent passing an American Society for Testing and Materials (ASTM) U.S. Standard Sieve No. 60, shall be placed above the filter pack to inhibit flow of grout into the filter pack.
- A minimum of 10 ft of bentonite chips or pellets shall be installed above the filter pack through a tremie pipe. The seal shall be hydrated with clean potable water in 6-inch lifts. Setup time for the bentonite shall be at the discretion of the field geologist.
- The annular space above the hydrated bentonite seal shall be backfilled with bentonite slurry. Bentonite slurries are effective in sealing off groundwater units above the screened and sand-packed intervals of a well and are less likely to damage the well casing than bentonite-cement grout. The bentonite slurry shall be installed through a tremie pipe. The bentonite slurry shall extend from the bentonite pellet seal to approximately 50 ft bgs.
- The remaining 50 ft of annular space shall be filled with bentonite-cement grout consisting of 94 pounds of Portland cement, 3 percent by weight sodium bentonite powder, and 7 gallons of contaminant-free water. The bentonite-cement grout shall be placed using a grout pump and tremie pipe to within 5 ft of the land surface. The grout shall be allowed to set for at least 24 hours before well development begins.
- The monitoring wells shall be completed at the surface in accordance with specifications as presented in SOP B1.3 of the Base-Wide Plans, Field Sampling Plan (FSP) (USAF, 2004). The surface completion shall consist of a 5-foot-long, 9-inch-diameter steel stand pipe with locking cap cemented into a 3-foot-square concrete well pad. Four concrete-filled steel bollards shall be installed at the corners of the well pad to protect the well from vehicle damage.
- The wells (KAFB-2901, KAFB-2902, KAFB-2903, and KAFB-2904) shall be properly abandoned in compliance with *Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells* (NMOSE, 2005) when no longer needed.

2.1.1.7 Well Development

The monitoring wells shall be developed using a variety of techniques including swabbing, surging, bailing, air lifting and pumping. Monitoring well development shall adhere to procedures outlined in Base-Wide Plans, Appendix B, SOP B1.4: Monitoring Well Development (USAF, 2004). Monitoring well development shall be performed within one week after well installation but no sooner than 24 hours after grout installation. Groundwater discharged from the wells shall be monitored for pH, temperature, specific conductance, dissolved oxygen, oxidation-reduction (redox) potential, and turbidity. Each monitoring well screen shall be developed until pH and specific conductance stabilize and the water appears substantially free of sediment. The development goal is to reduce the turbidity to less than 10 nephelometric turbidity units (NTUs) and a less than 10 percent variance in the other parameters observed in the final three readings. If the field parameters have not stabilized after 4 hours of continuous pumping, the well shall be allowed

to sit overnight and development shall continue the following day for a maximum of 2 hours. If the turbidity does not fall below 100 NTUs, the Permittee shall seek further direction from the NMED.

Proposed monitoring wells KAFB-2901, KAFB-2902, and KAFB-2903 shall be developed and surveyed after installation. A static groundwater elevation from each surveyed and developed well shall be measured and used to determine the groundwater gradient and flow direction across the OD Unit area. This information shall be used to determine the location and design of KAFB-2904.

2.1.1.8 Well Survey

A New Mexico licensed professional surveyor shall survey the horizontal well locations relative to New Mexico State Plane Coordinates and the vertical elevations to the nearest one-hundredth of 1 ft for the newly installed monitoring wells. Surveying shall be conducted in accordance with SOP B1.9 of the Base-Wide Plans FSP (USAF, 2004).

2.1.1.9 Groundwater Gradient Calculations

Depth to water measurements for static conditions shall be collected from monitoring wells KAFB-2901, KAFB-2902, and KAFB-2903 after well development. These measurements shall be converted to groundwater elevation data using well survey data. These elevations shall be mapped, and gradients shall be calculated perpendicular to the equipotential groundwater contours. The direction and magnitude of the groundwater gradient will provide information that shall be used to propose optimum location for monitoring well KAFB-2904. The Permittee shall consult with the NMED to determine the final location of KAFB-2904. Groundwater elevations may also be collected from comparable aquifer units from nearby monitoring wells to support the groundwater flow direction calculation. The previously installed wells surrounding the investigation area include KAFB-1901, KAFB-1902, KAFB-1904, EOD Hill Well, and Schoolhouse Mesa Well.

2.1.2 Groundwater Sampling and Analysis Plan

Groundwater monitoring shall be performed after well development on a quarterly basis for eight quarters. Groundwater elevations shall be measured in each well prior to sampling. Groundwater elevations shall be used to determine groundwater flow rate and gradient on a quarterly basis. Groundwater samples shall be analyzed for VOCs, semi-volatile organic compounds (SVOCs), explosives, perchlorate, white phosphorus, target analyte list (TAL) metals, dioxins, and furans, total dissolved solids, alkalinity, anions, cations, and total organic carbon (**Table H-2**). Data shall be of sufficient precision and quality to meet data quality objectives and to ensure that method detection limits are less than the applicable cleanup levels.

Table H-2
Analytical Methods, Sample Containers, Preservation Requirements and Holding Times for Soil and Groundwater Samples

Matrix	Analytical Group	Analytical and Preparation Method	Sample Volume	Containers	Preservation Requirements	Maximum Holding Time
Soil	TAL Metals (including mercury)	SW6010B/ SW6020A and SW7471A	1 gram	250-ml glass or polyethylene	4±2 degrees Celsius (ºC)	180 days metals; 28 days from collection to analysis for mercury
Soil	VOCs	SW8260B/ SW5035	3 different 5-gram aliquots	6 40-milliliters (ml) volatile organic analysis (VOA) vials	Per sample collection: 2 VOA vials with 10-ml water and 1 VOA vial with 10-ml methanol. All vials contain a stir bar. Or 3 VOA vials containing stir bars will have a 5-gram sample aliquot added, seals and frozen on site with dry ice. Samples must remain frozen in shipment and storage at the lab until analysis.	Freeze within 48 hours of arrival at the lab, analyze within 14 days from data of collection Analyze within 14 days from data of collection
Soil	SVOCs	SW8270C	30 grams	250-ml glass	4±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Soil	Perchlorate	SW6850	30 grams	250-ml glass	4±2ºC	28days
Soil	Explosives	SW8330B	10 grams	250-ml glass	4±2ºC	14 days from date of collection to extraction and 40 days from extraction to analysis
Soil	White Phosphorous	SW7580	40 grams	250-ml glass	4±2ºC	30 days
Soil	Dioxins/Furans	SW8290A	30 grams	250-ml glass	4±2ºC	30 days

Table H-2 cont.
Analytical Methods, Sample Containers, Preservation Requirements and Holding Times for Soil and Groundwater Samples

Matrix	Analytical Group	Analytical and Preparation Method	Sample Volume	Containers	Preservation Requirements	Maximum Holding Time
Groundwater	Dissolved metals (including mercury)	SW6010B/ 6020 and SW7470A	100-ml	1-liter polyethylene	pH < 2 with nitric acid; 4±2ºC	28 for Hg, 180 days for others
Groundwater	VOCs	SW8011/ SW8260B	3 40-ml vials	3 40-ml VOA vials	No headspace; 4±2ºC	7 days
Groundwater	SVOCs, PAHs, 1,4-Dioxane	SW8270C/ SW8270 SIM	1 liter	3 1-liter amber glass	4±2ºC	7 days
Groundwater	Explosives	SW8330B	1 liter	2 1-liter amber glass	4±2ºC	7 days
Groundwater	Perchlorate	SW6850	125 ml	2 125-ml Polyethylene bottle	4±2ºC	28 days
Groundwater	White Phosphorous	SW7580	500 ml	2 500 ml Polyethylene bottle	4±2ºC, kept in dark storage	5 days
Groundwater	Dioxins/Furans	SW8290A	1 liter	4 1-liter amber glass	4±2ºC	30 days

a. Holding time information from U.S. Environmental Protection Agency, 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*.
b. Volatile and semi-volatile organic compounds, metals, and high explosives are listed by respective test method numbers in U.S. Environmental Protection Agency, 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*.
c. HNO_3 = Nitric Acid
d. HCl = Hydrochloric Acid

2.1.2.1 Well Purging and Field Measurements

Each monitoring well shall be purged by removing groundwater prior to sampling to ensure that fresh formation water is sampled. Three or more well casing volumes shall be purged from each well prior to sampling. Purge water shall be contained in polyethylene tanks for subsequent characterization and management as IDW. The following groundwater field parameters shall be measured during well purging: pH, specific conductance, dissolved oxygen concentration, turbidity, redox potential, and temperature. The volume of groundwater purged, the field parameter readings obtained at each time interval, and the instruments used to measure the field parameters and their calibration procedures shall be recorded on the field monitoring log. Water samples shall be obtained from a well only after the measured values of purge water field parameters have stabilized to within 10 percent for three consecutive measurements or at least three well-casing volumes have been purged from the well.

Groundwater samples shall be collected using a submersible electronic pump, or a bailer within eight hours of the completion of well purging. Groundwater in monitoring wells with low recharge rates that purge dry shall be sampled when the water level in the well has recovered sufficiently to collect the required sample volume. Sampling handling, preservation, and storage shall comply with the requirements of **Table H-2**.

2.1.2.2 Laboratory Analysis and Quality Control/Quality Assurance Procedures

The proposed suite of parameters and analyses for the groundwater samples is presented in **Table H-2**. The contract laboratory must meet U.S. Environmental Protection Agency (EPA) certification requirements. To ensure that data is of sufficient precision, laboratory method detection limits shall be less than the New Mexico Water Quality Control Commission (WQCC) water quality standards or EPA maximum contaminant levels (MCL). To ensure that analytical data is of sufficient quality and that laboratory and field methods are assured of proper quality field quality control samples shall be collected in compliance with *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* EPA Method SW-846. All laboratory analyses shall be conducted in accordance with *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* EPA Method SW-846

The QC samples to be collected include: field duplicate samples, trip blanks, and rinsate blanks. Sample designations shall follow the guidelines as outlined in Section 4.2.1 of the Base-Wide Plans, FSP (USAF, 2004). The well identification numbers assigned to the four new wells for this investigation are: KAFB-2901, KAFB-2902, KAFB-2903, and KAFB-2904.

2.1.2.3 Groundwater Data Analysis

Groundwater laboratory analytical results shall be analyzed to determine if there is evidence of contamination in groundwater samples obtained from each groundwater monitoring well. If the

Permittee determines that there evidence of contamination at any monitoring well, the Permittee shall notify the NMED of this fact within 15 days of this discovery. The groundwater results shall be analyzed by comparison to established background concentrations and applicable groundwater standards.

Background groundwater quality at KAFB was evaluated in the mid-1990s by the NMEDDepartment of Energy Oversight Bureau and by Sandia National Laboratories (SNL), which is co-located within KAFB. The NMED established background concentrations for many inorganic compounds detected in groundwater in the area of the OD unit (NMED, 1995). In addition, the NMED-approved background concentrations for groundwater that were developed by SNL (NMED, 1997).

Inorganic compound analytical results for the OD unit groundwater monitoring wells shall be compared to the NMED-established background concentrations. If an analyte does not have a NMED-established background concentration, then the SNL background concentrations for groundwater shall be used for comparison. Inorganic analytes that exceed their established background concentrations for shall be reported to the NMED by the Permittee.

All analytes, both inorganic and organic, will be compared to the corresponding WQCC standards and MCL. Any analyte that exceeds a standard shall be reported to the NMED by the Permittee within 15 days of discovery. If a WQCC standard or MCL has not been established for a constituent, the New Mexico Tap Water screening level provided in the 2017 RAGIR shall be used for comparison. If a tap water screening level does not exist for a constituent, and toxicological information is available, the Permittee shall propose a screening standard based on a total target human health excess cancer risk level of 10^{-5}, and, for non-carcinogenic contaminants, a hazard quotient of one.

2.1.2.4 Investigation Derived Waste

Soil cuttings recovered during drilling operations are expected to be nonhazardous, native material. The cuttings shall be stockpiled on plastic sheet or in roll-off containers at each well site.

Upon completion of drilling activities, composite samples shall be collected from the cuttings and analyzed for the full suite of toxicity characteristic leachate procedure (TCLP) parameters. The full suite of TCLP parameters includes analyses for the compounds listed in 40 CFR 261.24. In addition, analysis shall be conducted for reactivity, ignitability, corrosivity, perchlorate, and explosive compounds. The cuttings shall be disposed in an appropriate landfill based on the laboratory analytical results.

Decontamination shall be conducted on a concrete pad constructed for that purpose (located near Pennsylvania Road, southeast of the Tijeras Arroyo Golf Course) or on plastic sheeting at the site. Wastewater from the equipment decontamination shall be stored in plastic holding tanks along with purge water from well development activities and groundwater sampling. The IDW water samples shall be collected from the tanks and analyzed for VOCs, SVOCs, and TAL metals. The sample analytical results shall be compared to the WQCC standards and the

Albuquerque Bernalillo County Water Utility Authority standards to determine the appropriate disposal option.

2.1.2.5 Site Safety and Health Plan

All environmental drilling and monitoring activities shall be conducted in accordance with the Accident Prevention Plan prepared for the OD closure activities.

2.1.2.6 Reporting

A well completion report shall be prepared to document the drilling and well installation activities. The well completion report shall be submitted to the NMED for review and approval within 30 days of the completion of well installation activities. The well installation report shall include the following information:

- Descriptions of the field program including the drilling, well installation, surveying, and IDW management activities;
- Field documentation including soil boring logs, well construction diagrams, well development logs, and survey data.

Groundwater monitoring shall be conducted for a minimum of eight quarters. A report summarizing the groundwater sample analytical data shall be submitted to the NMED within 90 days after the completion of field work each quarter.

Periodic groundwater monitoring reports shall be prepared to document quarterly groundwater monitoring results. All validated groundwater laboratory results shall be presented in periodic groundwater monitoring reports which comply with Section 6.2.4.4 of the OD Permit. Groundwater analytical results shall be compared to WQCC standards and MCLs to determine if contamination above standards is present in the groundwater monitoring wells. Each quarter of analytical data shall be evaluated for the presence of potential contaminants. Periodic Groundwater Monitoring Reports for the OD unit shall be prepared annually following four quarters of groundwater monitoring and submitted within 90 days after the completion of the last quarterly monitoring event.

2.1.2.7 Sampling, Decontamination Procedures, and PPE

This section describes procedures and methods for soil sampling applicable to closure activities. Sampling and chemical analyses will be conducted in accordance with procedures given in "*Samplers and Sampling Procedures for Hazardous Waste Steams*" (EPA 600/2-80-018) or SW-846, as appropriate.

The tools and equipment used during the sampling shall be scraped as necessary to remove any residue and cleaned with a nonphosphate detergent and rinsed with deionized water prior to use. The decontamination water will be collected and characterized for disposal. The wash water will be disposed of according to applicable regulations based on the results of waste characterization samples.

PPE worn by personnel performing closure activities will be disposable; therefore, all PPE shall be placed into containers and managed according to applicable regulations.

2.2 Soil Sampling

The OB Unit (i.e., concrete base, walls, and curbing; steel container, cover and framework; brass sorter) shall be dismantled and removed. Soils beneath the unit shall be sifted to separate scrap metal greater than ½ inch in diameter. The soils shall be sifted to a depth of one foot. The OB Unit area shall be graded after sifting activities are completed.

Once the OB Unit structure, curbing, and equipment are removed, three samples from beneath the unit shall be collected to a depth of zero to 6 inches. Additional, deeper soil sampling conducted during the closure of the OD unit shall also encompass the area of the OB Unit.

Soil samples from the OD Unit shall be collected on a 25-ft by 25-ft grid spacing from the surface to 15 ft below ground surface at five ft intervals (total of four samples per location). At a minimum, the grid shall encompass all portions of the OD Unit that have hosted or may have hosted a pit used for the treatment of hazardous waste.

Surface soil samples shall be collected approximately 25 ft from the OB Unit. Three samples shall be collected from each side of the OB for a total of 12 surface soil samples. These samples shall characterize potential contamination from the OB Unit that may have migrated onto the OD Unit.

Soil shall be analyzed for the parameters listed in **Table H-2**, which include all hazardous constituents of the hazardous wastes that were detonated at the OB and OD Units. Surface soil samples (zero to six inches depth) shall be collected with a wooden or Teflon™ trowel or scoop. Disposable sampling tools shall be used. A split barrel soil sampler, auger drill, direct push technology or other appropriate method shall be used to collect subsurface soil samples. Only discrete grab samples shall be collected; no samples shall be composited.

Clean sampling equipment shall be used to collect each sample. Reusable sampling equipment shall be decontaminated after each use by scraping to remove any loose material, washing with a nonphosphate detergent and water solution, rinsing several times with tap water and then rinsing with deionized water.

2.3 Appropriate Sample Containers and Preservatives

All samples shall be placed in laboratory-prepared, pre-cleaned containers approprieate for the intended analysis. The most recent version of SW-846 lists the proper container, preservative, and holding time for each chemical parameter. The EPA SW-846 procedures shall be followed for all samples collected during the closure process. **Table H-2** summarizes the sample containers, preservation techniques, and holding times for soil and liquid samples.

2.4 Sample Handling and Documentation

Each sample shall be labeled, sealed, and accompanied by a chain-of-custody and a request-for-analysis form. A chain-of-custody form shall be used to track samples from collection through analysis to ensure that the integrity of the samples is protected. The procedures followed during closure shall be in accordance with the most current version of EPA SW-846. A chain-of-custody form shall be prepared for all samples collected for laboratory analyses. The form includes:

- Sample identification number;
- Name and signature of sample collector;
- Date and time of sample collection;
- Location at which sample was collected;
- Type of waste (e.g., soil, liquid, etc.);
- Signatures of persons who have had samples in their possession;
- Dates and times of possession.

This form shall be initiated at the point of sample collection and shall then remain with the sample during transfer to the laboratory. The form shall be completed upon receipt at the laboratory and returned to Permittee for inclusion in facility operating record. The chain-of-custody form shall include a request-for analysis form that lists all analyses to be performed for the identified samples and all special instructions relating to sample management or analysis. Any potential hazards posed by the samples shall be listed on the request-for-analysis form. All chain-of-custody forms shall be included with the associated reports submitted to the NMED.

The sample containers shall be sealed in such a way that the seals must be broken to open the containers. The seals and sample labels must be completed with a waterproof pen. The sample labels are necessary to prevent misidentification of samples and shall include the following information: a unique sample number; name or initials of sample collector; sample collection date and time; sample location; and, sample type, depth, and description.

A closure sampling field log book shall be maintained and shall contain all information pertinent to field surveys and sampling. Sufficient information shall be recorded so that a person can reasonably reconstruct what occurred at a sampling event without relying on a collector's memory. The log book shall have bound and consecutively numbered pages in 8 by 11-inch format. Minimum entries shall include:

- Purpose of sample;
- Location of sampling;
- Name and business address of person making log entry;
- Number, type, and volume of sample;
- Description of each sampling methodology and equipment used;
- Date and time of sample collection;
- Sample destination and transporter's name (name of laboratory, UPS, etc.);
- Map or photograph of the sampling site;

- Field observations (ambient temperature, sky conditions, past 24-hour precipitation, etc.);
- Field measurements, if any (pH, flammability, conductivity, explosivity, etc.);
- Collector's sample identification number(s);
- Signature of person responsible for the log entry.

Documentation of sample acceptance at the laboratory shall be provided following sample screening and log-in. This documentation may consist of signed copies of the chain-of-custody, documentation or a letter detailing the field sample numbers accepted. Corresponding laboratory sample identification numbers shall be provided. The laboratory is required to have procedures for minimizing cross contamination of samples and securing sample custody within the laboratory.

2.5 Sample Shipping

Samples shall be packaged and shipped to the laboratory in accordance with Department of Transportation shipping requirements and in a manner to ensure that the integrity of the samples is protected. The sample containers shall be cushioned to protect against breakage or puncture.

2.6 Sample Analysis

Closure samples shall be analyzed by an EPA-certified contract laboratory. The analytical laboratory shall have procedures for minimizing cross-contamination of samples and securing sample custody within the laboratory. Test methods for analysis of all samples shall be performed according to procedures documented in the most current version of SW-846.

Minimum calibration, operation, and quality control (bias, precision, blank and matrix effects) requirements for laboratory analyses shall be performed as listed in the individual analytical methods of SW-846. All laboratory analyst notebooks, log sheets, instrument printouts, charts, and calculations relevant to analyses of these samples shall be identified and remain accessible. This information may be requested for independent review and validation. If requested by the NMED, this information shall be provided.

2.7 Quality Assurance/Quality Control Program

Because decisions about closure activities may be based, in part, on analyses of samples, a program to ensure reliability of analytical data is mandatory. Data reliability shall be ensured by documenting sample management so that analyses are traceable to specific areas of potential contamination and by following a quality assurance/quality control (QA/QC) program that mandates documentation of the precision and accuracy of laboratory analyses, as well as data completeness, representativeness, and comparability.

Sampling activities shall include collection of QC samples in addition to field documentation requirements. QC samples to be collected include: duplicate samples, trip blanks, and equipment blanks.

Blanks and duplicate samples shall be collected to determine potential errors introduced in the data from sample collection and handling activities. To determine the potential for cross contamination, equipment blanks consisting of rinsate from decontaminated grading equipment shall be collected and analyzed. At least one equipment blank shall be collected for every ten samples collected with non-dedicated sampling equipment. Duplicate samples shall be collected at a frequency of one duplicate sample for every ten field samples. In no case will less than one equipment blank or duplicate sample be collected for a sampling effort. These blank and duplicate samples shall be identified and treated as separate samples. Acceptance criteria for QA/QC sample analyses shall be compatible with the most recent version of SW-846 or other applicable EPA guidance.

The analytical laboratory shall operate under a QA program plan (QAPP) that meets the requirements of SW-846. QC procedures in the analytical laboratory are guided by the laboratory's QAPP. Laboratory QC samples are required to establish the accuracy and precision of analytical data to determine the quality of the data.

The analytical laboratory data shall be validated using the following criteria:

- Completeness of data deliverable;
- Collection, extraction, and analysis holding times;
- Blank data;
- Laboratory control sample results;
- Matrix spike/matrix spike duplicate results;
- Laboratory duplicate sample results; and
- Overall data assessment and usability.

3.0 Management of Waste from Closure Activities

Wastes that are expected to be generated during the closure activities include: concrete and steel from the removal of the OB Unit equipment; excess soil from sampling; decontamination water; brushes used to decontaminate equipment; PPE; scrap metal and excavated soils. Waste will be disposed of in accordance with all applicable environmental regulations.

3.1 Waste Management

Wastes associated with closure activities shall be managed as follows:

- Wastes shall be stored in appropriate containers that are compatible with the wastes and are in good condition.
- If analytical results indicate that the waste contains hazardous constituents, , Permittee shall manage the waste in accordance with all applicable regulations.
- Waste containers shall remain within the EOD unit boundary under the control of the personnel generating the waste until it is transported for treatment and disposal.
- Waste containers shall be segregated according to the compatibility and chemical waste type.

- Waste shall be stored in containers that remain closed, except when adding or removing wastes.
- Waste containers bearing free liquid shall be provided with secondary containment of sufficient volume to prevent spilled liquids from being released onto the ground.
- Waste containers shall be managed in such a manner as to prevent ruptures and leaks.
- Waste containers shall be labeled appropriately, pending receipt of analytical results. Labels shall be filled out appropriately and marked using permanent marker or pen.
- Label information shall include waste source, suspected contaminants, contents, depth (if appropriate), the date which accumulation began, and a contact name.

3.2 Waste Characterization

Characterization of the liquid waste and excavated soil generated during closure shall be based upon the results of sampling and analysis. Any decontamination water shall be analyzed for the constituents listed in **Table H-2**. PPE shall be managed according to applicable regulations.

4.0 References

EPA, 1980 and all approved updates, *Samplers and Sampling Procedures for Hazardous Waste Streams*, EPA-600/2-80-018, U.S. Environmental Protection Agency, Municipal Environmental Research Laboratory, Cincinnati, OH.

EPA, 1986 and all approved updates, *Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods*, SW-846, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, U.S. Government Printing Office, Washington, D.C.

EPA, 2017, *Regional Screening Level Summary Table*, U.S. Environmental Protection Agency, Washington, D.C. November.

IT Corporation, 1996, *Background Concentrations of Constituents of Concern to the Sandia National Laboratories/New Mexico Environmental Restoration Project and the Kirtland Air Force Base Installation Restoration Program*, prepared for Sandia National Laboratories/ New Mexico Environmental Restoration Department 7585, Albuquerque, NM.

NMED, 1995. *Background Ground-Water Quality of the Kirtland Air Force Base Area, Bernalillo County, New Mexico.* AIP/DOE Oversight Program, Hazardous and Radioactive Materials Bureau, Santa Fe, New Mexico. January.

NMED, 1997. *Approved Background Concentrations Sandia National Laboratories/Kirtland Air Force Base.* New Mexico Environment Department, Hazardous and Radioactive Materials Bureau, RCRA Permits Management Program, Santa Fe, New Mexico. September 24.

NMED, 2017, *Risk Assessment Guidance for Site Investigations and Remediation*, New Mexico Environment Department, Santa Fe, New Mexico. March.

NMOSE, 2005. *Rules and Regulations Governing Well Driller Licensing; Construction, Repair, and Plugging of Wells* New Mexico Office of the State Engineer. August.

SNL/NM, 2011a. *Annual Groundwater Monitoring Report, Calendar Year 2010, Sandia Report SAND2011-5781P*. Groundwater Protection Program, Sandia National Laboratories, Albuquerque, New Mexico. September.

SNL/NM, 2011b. *Groundwater Monitoring Well Installation Report for SWMU 8 (Open Dump Coyote Canyon Blast Area), SWMU 58 (Coyote Canyon Blast Area), and SWMU 68 (Open Burn Site).* Environmental Restoration Operations. Sandia National Laboratories/New Mexico. November.

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

USAF, 2007. *Long-Term Groundwater Monitoring Summary and Baseline Determination Report, Fiscal Year 2005*. U.S. Air Force, Kirtland Air Force Base, New Mexico. April.